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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INDEX.

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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.

THURSDAY, NOVEMBER 3, 1904.

APPLIED ELECTRICITY.

(1) *Wireless Telegraphy.* By C. H. Sewall. Pp. 229. (London: Crosby Lockwood and Son, 1903.) Price 10s. 6d. net.

(2) *Electricity in Agriculture and Horticulture.* By Prof. S. Lemström. Pp. iv+72. (London: The *Electrician* Printing and Publishing Co., Ltd., 1904.)

(3) *Modern Electric Practice.* Vol. iv. Edited by Magnus Maclean. Pp. viii+304. (London: The Gresham Publishing Co., 1904.)

(4) *The Theory of the Lead Accumulator.* By F. Dolezalek. Translated by C. L. von Ende. Pp. xii+241. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 10s. 6d. net.

(5) *Electric Motors.* By H. M. Hobart. Pp. x+458. (London: Whittaker and Co., 1904.) Price 12s. 6d. net.

(6) *Notices sur l'Électricité.* By A. Cornu. Pp. vii+274. (Paris: Gauthier-Villars, 1904.) Price 5 francs.

(7) *L'Année Technique* (1902–1903). By A. Da Cunha. Pp. 303. (Paris: Librairie Gauthier-Villars, 1903.) Price 3.50 francs.

(1) ALTHOUGH wireless telegraphy is of such recent development, it is apparently regarded by many as a legitimate subject for historical writing. The first volume before us is one of several which have appeared in the last three or four years in which the historical progress of wireless telegraphy is dealt with rather than its scientific principles. The book possesses to our mind the same faults which characterise all the other similar publications which we have read; there is a lack of discrimination in the selection of material which is likely to leave the untechnical reader in a state of considerable confusion. Wireless telegraphy as we know it to-day is wholly concerned with Hertzian wave telegraphy, and even if accounts of the experiments of Lindsay and others in telegraphy by earth or water conduction should be regarded as legitimate, we cannot see by what possible stretch of the imagination the achievements of, say, Marconi can be traced back to the prophecies of Galileo in 1632.

Mr. Sewall's method of compiling history appears to consist chiefly in making extracts from patents. Page after page of the book before us contains nothing more than reprints from the patents of Lodge, Marconi, Fessenden, and others, sometimes verbatim in inverted commas, at others with slightly altered context as original matter. We imagine it must be easier to write books in this way than it is interesting to read them. Mr. Sewall would have been much better advised, we think, to digest his material properly and present it to his readers in some more acceptable form. He could then have given a connected account of the remarkable developments that have followed the discoveries of Maxwell and Hertz which would have been of great practical use to students of the subject. At present we doubt if his book is intelligible to the amateur or useful to the expert.

(2) The late Prof. S. Lemström occupied himself for many years with experiments on the effect of electricity on growing plants, and this little book contains the results of his work. If the conclusions at which the author arrives are confirmed by the work of other investigators, the subject is one which merits the most careful consideration by all agriculturists. Practically only one type of experiment was tried; an influence machine was connected with one pole to earth and the other to a wire network over a field in which the crops were being grown. A discharge current could thus be passed either from the network to earth or *vice versâ* for any desired number of hours a day. The experiments were tried on a comparatively large scale in several different localities. The effect produced by this treatment was remarkable. There was an average excess of the crop of the experimental field over that of a control field of 45 per cent.; the excess varies considerably with the nature of the crop and the conditions, soil, weather, &c. Not only is this increase in quantity produced, but there is also often an improvement in quality and a diminution in the time taken for the plants to mature. This last is a factor often of great importance to the grower,

who can realise much higher prices by selling early in the season. Prof. Lemström calculated that in the case of wheat the outlay on a field of 25 acres will be repaid in two or three years, and that afterwards a net profit of 40*l*. a year or more can be realised. We cannot here enter into the details of the working, such as the best time of electrification, the effect of wet and dry weather, and so forth, but we should strongly advise those interested in the subject to study this book carefully; they will find it full of valuable suggestions, and the time spent in reading it will be amply repaid.

(3) We have already reviewed the first three volumes of this publication, so that it is only necessary here to refer briefly to the matter contained in the present volume. This is devoted to electric tramways, and is divided into seven chapters, dealing with overhead construction, feeders, surface contact systems, conduit systems, rolling stock, electric boats and motor cars, and electric traction on railways. The defects to which we alluded in our previous review are not so noticeable in this volume, which furnishes a good description of a very important branch of electrical engineering. The excellence of the illustrations is a characteristic of the whole production, and is a particularly valuable feature in the present instance, as the subjects are such that they cannot be effectually described without numerous photographs and diagrams.

(4) This exceedingly interesting monograph on the much debated theory of the chemical reactions taking place in the lead accumulator is probably already well known in the original German to those who have concerned themselves specially with this subject. Since the book first appeared the discussion has progressed a stage further, so that the English translation may be said to be out of date to a certain extent. This is, however, the penalty that the average English student has to pay for the neglect of his schoolmasters to teach him German, and he will probably therefore welcome the appearance of an English translation. Herr Dolezalek treats the subject from the standpoint of Nernst's osmotic theory, and shows that thermochemical considerations all point to the validity of the sulphate theory originally advanced by Gladstone and Tribe. Whether the author will succeed in satisfying others to the same extent as he has apparently satisfied himself may be regarded as open to question, but in any case the book is one which cannot be neglected by anyone wishing to study this complicated but fascinating problem.

(5) The design and construction of electric motors is becoming daily a matter of more importance to electrical engineers on account of the very rapid extension of the use of electricity for power purposes. When one considers the enormous number of tramcars, lifts, factories, &c., which are driven by electricity, it is easy to see not only how important the subject is, but also how very varied is the work which the electric motor is called upon to perform. If the development now is great, in a few years' time, when some of the numerous power schemes are more matured, it will be much greater still. The student of electrical engineering may find here ample scope for his abilities, and he cannot consult a better guide than the volume before us. The book is divided into two parts, the first dealing with continuous and the second with alternating current motors. The relative advantages of different types are considered in detail, and there are numerous calculations of motors of different types and capacities. In addition, there are a large number of curves, diagrams, and photographs.

(6) The essays which are comprised in M. Cornu's little book were written with a special and rather peculiar object, the author having been requested by some of his old pupils, who had been unable to keep touch with the rapid development of electrical engineering, to write for them something which would enable them to appreciate better the technical or semi-technical literature of to-day. These "Notices" are consequently of a somewhat elementary character, nor can the book be regarded in any sense as a text-book of electricity. But M. Cornu has succeeded in writing a book which should appeal to a very much larger audience than that for which it was originally intended; one cannot look through its pages without realising at every point that it is the work of a master, and such works repay study by all—the most advanced as well as the most elementary students. The beginner will find here ideas expressed clearly and concisely, and cannot fail to derive great benefit from the book as an introduction to more detailed treatises. The engineer will see well known facts expressed in new and suggestive language, and will doubtless have his own views enlarged in consequence. The subjects dealt with are the correlation of the phenomena of static and dynamic electricity, generators, transmission of power and polyphase currents, and we would strongly recommend anyone interested in any of these matters to spend a few hours reading M. Cornu's admirable booklet.

(7) We cannot help being conscious that the end of 1904 is rather late in the day to review a book which contains a *résumé* of the technical achievements of 1903. Still, as we gather that this publication is intended to appear annually, this notice may be of some service in directing readers' attention to the volume dealing with this year's progress, which we imagine will appear very soon; in addition, it may be pleaded that the lapse of time enables one to see matters more in the right perspective, and so to form a better estimate of the value of M. Da Cunha's work. The book ranges over a great variety of subjects. Thus we find at one place a mathematical calculation of the mechanical problems involved in "looping the loop," and in another a discussion of alcoholism and temperance worthy of the columns of a daily paper in the silly season. Between these extremes lie such subjects as the progress in wireless telegraphy, automobilism, aërial navigation, and the hundred and one other technical developments which are taking place in all branches of applied science. To the engineer the book can serve no other purpose than to while away an idle hour or so. The general reader who is interested in scientific and technical progress may read it with both profit and pleasure. He will find the descriptions clear, the style agreeable, and the illustrations and diagrams in many cases excellent.

M. S.

ADOLESCENCE.

Adolescence: its Psychology and its Relations to Physiology, Anthropology, Sociology, Sex, Crime, Religion. By G. Stanley Hall, Ph.D., LL.D., President of Clark University and Professor of Psychology and Pedagogy. Vol. i., pp. xx+589; vol. ii., pp. vi+784. (New York: D. Appleton and Co., 1904.) Price 31*s.* 6*d.* net.

THIS work is one of wide-reaching scope and interest. The subject of human growth has already been studied in relation to the earlier years and in its special features. The period intervening between childhood and adult life, which has been comparatively neglected, is the one to which Dr. Hall has directed his investigation. The work is thus of interest in focussing attention on an important section of human life; it is of value also in that the results of biology and anthropology are freely used in supplementing and interpreting the data which are gained from physiological and psychological investigation.

The first three chapters deal mainly with physical growth, taking up in order the increase in height and weight, the growth of parts and organs, and the growth in muscular power. The next two chapters deal with the physical and mental disorders of adolescence, and with juvenile faults and immorality. Sex is taken up in three chapters, one relating to boys and two to girls; of these two chapters one deals with the physiology of sex, the other with its bearing on education. Dr. Hall insists with great earnestness on the necessity of ceasing to mould woman's education on that of man, and of finding an education which shall be adapted to her nature, physical and mental. The volume closes with an account of adolescence in literature, biography, and history.

In the second volume, after a preliminary survey of changes in the senses and in voice, the emotional phenomena of adolescence are treated under the headings of adolescent love and adolescent feeling towards nature. Several chapters deal with social and historical relations; initiations in savage and classical times, confirmation as their correlative in modern religion, the social instincts and institutions of youth, ethnic psychology, and the treatment of uncivilised races, form the subject of successive discussions. In treating the subject of religious conversion, Dr. Hall points out that it is peculiarly a phenomenon of adolescence, and that it has close relations to the sexual life. "It is thus," he says, "no accidental synchronism of unrelated events that the age of religion and that of sexual maturity coincide." In the chapter on intellectual development and education there is a careful review of education in school and college, and a discussion of its value in the light of the results presented in preceding sections. Dr. Hall does not hesitate to condemn vigorously and comprehensively the studies and methods of schools for their aridity and want of vital relation to the developing individual, and though his criticisms are directed to American schools, they have a wider application.

It will thus be seen that we have in these volumes a text-book of adolescence in which scientific and practical interests are closely blended. Underlying the scientific treatment there may be said to be two leading principles. One principle is that of the intimate union, or rather the identity, of physiological and psychological processes.

"More summarily, then," he says, "the idea of soul we hold to is in its lower stages indistinguishable from that of life, and so far in a sense we revert to Aristotle, in holding that any truly scientific psychology must be first of all biological. . . . The first chapter of a scientific psychology, then, is metabolic and nutritive, and the first function of the soul is in food getting, assimilation, and dissimilation."

The other principle, of greater novelty and interest, is the application of the recapitulation theory to the mental as well as the bodily life of childhood and youth.

"Realising the limitations and qualifications of the recapitulation theory in the biologic field, I am now convinced that its psychogenetic applications have a method of their own, and although the time has not yet come when any formulation of these can have much value, I have done the best with each instance as it arose."

In his application of this theory Dr. Hall is undoubtedly original, but it is strange that among the many references to the literature of the subject there should be no mention of the work of Baldwin on "Mental Development in the Child and the Race," in which the same theory is applied in detail.

That the work took its origin in courses of lectures may perhaps explain in part the diffuseness and repetition which appear in these pages. There is an unnecessarily frequent use of strange words; one is at a loss to understand, for example, what is meant by the "solipsistic hopo" and by minds that are "rily." One meets with long lists of objects and with masses of facts which are not adequately correlated.

It is impossible to enter on a discussion of the many theoretical and practical questions which are raised. The treatment of the material, gathered from the most varied sources, is original and suggestive in a high degree; but among the wealth of new material and new conceptions one misses an exact discussion of the method by which the processes of psychogenesis are to be ascertained. Prominent among the data in the book are the results of the *questionnaires* which have been so much used by Dr. Hall and his pupils. We have, however, no presentation of the difficulties inherent in such a method of investigation, and of the precautions to be adopted in utilising its results. Apart from this special point there is the difficulty, which does not receive adequate attention, of distinguishing in any stage of adolescent development what is to be regarded as "palæopsychic," what is due to traditions and customs handed down from generation to generation of boys and girls, and lastly, what is conditioned primarily by the awakening mental and physical activity of the individual as he reacts on his experience. There is not sufficient treatment of the idea of individual growth in completeness and complexity, and of its relation to factors of development, the meaning of which is to be sought in past organic history; and one feels that some of the suggestions of racial influences are little more than interesting fancies. We may illustrate these points by reference to the author's interpretation of the child's attitude towards water. Human infants, we are told in one passage, have an untaught horror of water, and man must learn to swim. This is part of the evidence that there are "psychic vestiges in man which are suggestive of former arboreal life." Again, we learn that "children are phyletically older than women, and after the first shock and fright most of them take the greatest delight in water." This, among other phenomena, may be interpreted as a "pelagic vestige." Do we need arboreal or pelagic vestiges to account for the fact that, while some children dislike water at first and others delight in it, most of them in the end find it an excellent plaything? W. G. S.

A NATURALIST ON THE EAST COAST.

Notes of an East Coast Naturalist. By Arthur H. Patterson. Illustrated in colour by F. Southgate. Pp. xiv+304. (London: Methuen and Co., n.d.) Price 6*s*.

THE author of these notes, who has been in the habit of spending his spare time in a house-boat moored on Breydon Water and other East Anglian lagoons, has naturally enjoyed opportunities of making observations which are given to few people; for Breydon is a locality probably more famous than any other in the annals of British ornithology as a place where rare birds are in the habit of "dropping in." Moreover, as all field naturalists know, early morning and nightfall, ay, even night itself, are the times when the good things of their lives come to them. Hence the advantage of living on the field. In the latter part of the quarter of a century which these notes cover the author discarded the gun in favour of the field-glass, and could thus give undivided attention to observation without being distracted by the hopes and fears attendant on the wildfowler's efforts to obtain "a shot."

Breydon is a very carefully protected breeding area. A watcher has been stationed there for several years during the close season; but it will perhaps be disappointing (although we hope it may prove instructive) to ardent advocates of county council "orders" to find that Mr. Patterson writes, "I must, however, state that since stricter preservation has obtained, not nearly so many birds are to be seen on Breydon." It is impossible to deny the fact that no amount of preservation will bring back the *breeding* birds which left us with the spread of population and buildings, and the alterations in the system of agriculture. The spoonbills come and go in safety, but the late date at which they arrive shows that nesting is not the object of their visits. As a former east coast naturalist, remarkable for his common-sense views of such subjects, wrote years ago, "Unless England becomes dispeopled and uncultivated, nothing can ever bring back in numbers or variety the wealth of the ancient avifauna." But for all that the naturalist still "has his delights" on Breydon; as, for instance, on May 15, 1893, when the author, paddling up stream, saw on the "lumps" still uncovered by water "a congregation of no less than eighteen Black Terns, more than fifty Turnstones, several Common and Arctic Terns, a number of Dunlins, Grey Plovers, Whimbrel and Godwits, and not least worthy of a glance, three Spoonbills."

To one who is learned in the fishes of our seas, ready access to Yarmouth Market, and an extensive acquaintance among the fishermen have been a great advantage, and many a rare fish has the author rescued from oblivion and added to the east coast catalogue of fishes. Not the least valuable part of the book is that containing the fish notes, although the bulk of the volume deals with birds, their migrations and habits. Among the various interesting scraps of information here collected we find a record of the value of birds and the prices realised by the wildfowler and at the sales of noted collections; accounts of wildfowl brought into the market in hard winters, and incidents related by old-time wildfowlers, whose habits and customs, as well as their recollections of the hard winters and wildfowl of the "old days," are most amusing. Whales, crabs, lobsters, toads, insects, and rats all find a place in these very readable notes. Indeed, some of the most valuable paragraphs relate to the old English black rat, now extinct in most parts of the country, but so abundant in the malthouses and sail lofts of Yarmouth that Mr. Patterson can write of "a plague of Black Rats." This and many other of the records are well worth preserving as of permanent value, and the author is quite justified in thinking that some value may attach to these notes and observations "owing to their dealing with a period during which great changes have taken place in the habitat of the local fauna."

The twelve plates of bird-life reproduced in colours are among the most pleasing things of the kind we have seen, and these alone make the book one which all field naturalists will like to put on their shelves.

O. V. A.

CHEMICAL ANALYSIS FOR BEGINNERS.

Tables for Qualitative Chemical Analysis. By Prof. A. Liversidge, M.A., LL.D., F.R.S. (London: Macmillan and Co., Ltd., 1904.) Price 4*s*. 6*d*. net.

THE introductory chapter of Prof. Liversidge's book makes it clear that it is only when analytical methods are used intelligently that the time devoted to qualitative analysis is well spent, and to that end the student must have some preliminary training in other kinds of simple practical work (not described in the book), and be frequently supervised, lectured to, and examined as his work progresses.

All this is very right and proper, and quite as it should be, but leaving out the excellent counsel of perfection set forth in the introduction, the book is very much like other books on this subject. That is to say, it describes a series of qualitative tests in which inorganic and organic bases and acids, rare metals, and alkaloids are treated individually, and then collectively in tables after the old-established manner and with the old-established purpose.

It should be stated, however, that some attempt is made to introduce quantitative notions into the qualitative methods by using roughly weighed amounts of the substances; but the effect is somewhat discounted by the frequent omission of the quantity and strength of the reagents. I refer more particularly to the use of "drops," which may vary considerably in bulk, and to the omission of the strength of the acids.

Prof. Liversidge attaches great importance to the study of qualitative analysis as a means as well as an end of chemical education. It is an opinion very widely held, and is well worth discussing.

The fact is sometimes lost sight of that chemistry is a handicraft as well as a science, and that its science is as yet not exact.

Perhaps there is no branch of chemistry wherein the skill of the craftsman is in greater demand, or the inexactness of the science more clearly emphasised, than in chemical analysis.

A student may study intelligently the reactions for individual elements, and so learn their properties; but he finds that when they are mixed they behave differently, and the more observant and careful he is the more will these subtle influences, which conform to no equation, become apparent.

No substance is insoluble; mass action is a powerful factor; a precipitate will carry down a substance which should, for all he knows, remain in solution, and a substance will retain another in solution which, for equally occult reasons, should form a precipitate.

Tables for the analysis of mixtures, which are based on the behaviour of single substances by a process of simple logic, become artificial and illusory, and give a sense of false security which subsequent experience alone can dispel.

Is this a subject for extended study on the part of a beginner in chemistry? In the opinion of the writer the preparation of simple substances and a careful study of their properties, into which the general principles of qualitative and quantitative analysis are introduced, is his proper sphere of work. The host of reactions and elaborate tables of separations, and still more the countless precautions, *Kunstgriffe*, and manipulative details of practical analysis are a part of the handicraft of the specialist in chemistry. To thrust this work upon a beginner who is not to be a specialist is almost equivalent to expecting a student of mechanics, who is not to be an engineer, to work a lathe or use a planing machine.

The crux of the whole question lies in this, that qualitative analysis is a branch of practical work, calling itself chemistry, which can be easily adapted to the process of examination. Were the practical examination banished from the syllabus and replaced by notebooks supervised, signed and submitted by the responsible demonstrator or teacher of recognised standing, the mass of ill-digested analytical tests and tables would soon vanish from the curricula of schools and colleges, and its place supplied by a series of rational exercises. J. B. C.

OUR BOOK SHELF.

Les Lois naturelles. By Félix Le Dantec. Pp. xvi + 308. (Paris: Félix Alcan, 1904.) Price 6 francs.

JUST as "anyone can play the piano" with a piano-player, so anyone can write a book on the philosophy of science. The result gives satisfaction and pleasure to the performer in one case and to the writer in the other, but whether his particular interpretation is equally satisfying to an outsider is another question. The effects are, however, more lasting in the case of the author, for we are getting such an enormous accumulation of books on space, matter, force, the ether, and laws of nature that it is becoming a wonder who finds time to read them or even to cut their pages, if the publisher has failed to attend to his proper duties in this respect.

Let us examine how M. Le Dantec deals with thermodynamical considerations. In commencing he supposes bodies to have definite thermic masses, and he defines quantities of heat by the products of these masses into the changes of temperature. He also enunciates the principle of conservation of heat according to which the heat gained by one body is equal to that lost by another. But in the first place the quantities which he calls thermic masses are not constant for the same body between the same limits of temperature, but they also depend on whether the changes take place at constant pressure or constant volume; and, in the second place, his equation of conservation of heat is contrary to common experience of what happens when two rough bodies rub against each other. In the next chapter the author goes on a different tack, and speaks of the equivalence of quantities of work and quantities of heat, quite regardless (to all outside appearances) of the fact that the term "quantity of heat" is meaningless except in the case of passage of heat from one body to another. In the next chapter the author condemns the use of the term "quantity of heat" altogether. What ideas can a reader form of the nature of physical laws after perusing such a series of chapters as this?

Nature Teaching. By F. Watts and W. G. Freeman. Pp. xi + 193. (London: Murray, 1904.) Price 3*s.* 6*d.*

THIS little book forms a welcome change from the many appearing under similar titles in that it is avowedly based upon experiments, and treats of things about which the writers really know and have not merely read up. Dealing in the main with the life of the plant, it describes a simple series of experiments within the capacity of an elementary school or an evening continuation class, illustrating the function of seed, root, stem, leaf, &c., and amplifying the knowledge thus obtained with further examples drawn from the practice of the garden or the farm. A certain lack of definiteness in the description of experiments militates at times against the spirit in which the book has been conceived; in a subject where everything depends upon the cultivation of accurate observation and rigorous scientific method the authors should not allow themselves to fall into the slipshod generalised accounts of things which are the bane of so much of the current teaching of this nature. For instance, in their account of striking cuttings, the authors do not direct attention to the differences in the management of herbaceous and woody cuttings, the time of year at which they should be struck, and so forth, so that the teacher without experience would be apt to fumble over the matter at first, and would in real life be discouraged from trying any experiments in this particular direction unless he got hold of a gardener to give him some practical advice. However, with this slight drawback, the book is admirably designed for the teacher who wishes to work out an elementary course of instruction for a country school, either as an introduction to practical life or to a more special study of agriculture and horticulture.

I. *Clinical Lectures on Diseases of the Nervous System.* Pp. 279; price 7s. 6d. II. *Lectures on Diseases of the Nervous System.* Second series. Pp. 250; price 6s. net. By Sir William R. Gowers, M.D., F.R.C.P., F.R.S. (London: J. and A. Churchill, 1895 and 1904.)

IN these two volumes Sir William Gowers has collected in revised form a number of clinical lectures which have appeared in various medical journals. In the latter volume he has also printed the Bowman lecture on subjective visual sensations delivered to the Ophthalmological Society, and the Bradshaw lecture on the subjective sensations of sound. The clinical lectures deal with many subjects in neurology; some are mainly descriptive, some speculative. In reading them one not only appreciates the original and suggestive way in which the facts are presented, but also the finished literary style. In a short notice it is impossible to deal with them in detail. The two lectures on the subjective sensations of vision and hearing are perhaps of wider scientific interest than the clinical lectures. In the first the visual phenomena experienced by sufferers from migraine are described and figured, and there is an admirable *résumé* of physiological teaching with reference to vision. In the second lecture the phenomena of tinnitus, of auditory vertigo, and other labyrinthine sensations are discussed in a luminous and attractive way. Both neurologists and physiologists will find much in these volumes to assist and to stimulate them in researches into nervous phenomena.

Lectures Scientifiques. A French Reader for Science Students containing Extracts from Modern French Scientific works in Chemistry, Physics, Mathematics, Physiology and Botany, with a Glossary of Technical Terms. By W. G. Hartog, B.A. Pp. vii+371. (London: Rivingtons, 1904.) Price 5s.

THE University of London now insists that candidates for a degree in science shall be able to read and understand accounts in the original of French and German scientific work. In compiling this book Mr. Hartog has had the needs of such students in mind so far as French is concerned, and he has succeeded in bringing together a varied and representative collection of extracts from French scientific works and scientific periodicals. Among the latter the *Revue générale des Sciences* takes a very prominent position, contributing to Mr. Hartog's collection as many as fifteen extracts. The book should be of service not only to the undergraduates referred to, but also to students of science everywhere, for it is now more than ever necessary that the man of science should be able to acquaint himself at first hand with the results of fellow-workers abroad.

L'Industrie oléicole (Fabrication de l'Huile d'Olive). By J. Dugast. Pp. 176. (Paris: Gauthier-Villars and Masson et Cie., n.d.) Price 3 francs.

THIS little volume, which belongs to the Aide-Mémoire series, is a practical account of the manufacture of olive oil, and indicates several directions in which the results of scientific research have been utilised to improve technical processes. The formation and composition of olives are first explained, then the methods of extracting the oil are described and an account given of the appliances necessary for the purpose. The properties and methods of preservation of olive oil and the utilisation of the oil-cake are also considered.

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 Note on the Coloration of Spiders.

IT is well known that in a large number of animals, both vertebrate and invertebrate, the colour of the flanks and ventral side of the body differs from that of the dorsal. In the majority of cases the dorsal surface is most darkly tinted, the ventral palest, and the flanks intermediate in depth of tone between these two. This gradation of colouring has the effect of neutralising the shadows that are cast by the upper upon the lower portions of the body. Thus the animal does not stand out in prominent relief, but is, so to speak, artistically flattened, and thereby rendered less conspicuous.

To this general rule I have recently observed an interesting exception which affords strong evidence in favour of the truth of the above interpretation. The spiders belonging to the genus Linyphia are, almost without exception, darkly coloured upon the ventral surface; their flanks are variously slashed with oblique white bars and stripes, while their dorsal surface is yet more freely speckled with white or pale spots and lines. In these spiders, then, the scheme of coloration is the exact opposite to that which prevails elsewhere. Now the Linyphiidæ spin horizontal webs, in the centre of which they rest *inverted*, clinging to the lower side. Thus it is the ventral side of a Linyphia that is exposed to the strongest light, the dorsal side being in the deepest shadow. The inversion of attitude at once fully explains the inverted shading of the body.

OSWALD H. LATTER.

Charterhouse, Godalming, October 30.

Sir J. Eliot's Address at Cambridge.

AGAINST some of the main conclusions of Sir J. Eliot's opening address before Section A (subsection: cosmical physics) may be set the facts that south-east winds are rare on the south-east coast of South Africa, and that the rain of the greater part of the tableland and south-east coast comes mostly from some northerly direction.

My concern, however, is chiefly with the following remarks, reported in NATURE of August 25 last:—

"The chief features of the rainfall of the period 1895–1902, in the Indo-oceanic region were as follows:— . . . . There was a marked tendency in each year for late commencement and early withdrawal of the monsoon currents, and for deficient rainfall throughout the whole season over the greater part of India. These features were very pronounced in the years 1896, 1899, and 1901. The most remarkable feature of the period was that the region to the south of the equator, including South and East Africa, Mauritius, and Australia, was similarly affected. . . . Mr. Hutchins, Conservator of Forests, Cape Town, states that drought prevailed more or less persistently over the Karroo region in South Africa from 1896 to 1903, and that cattle and sheep perished by millions. He also states that the drought extended to British Central Africa from 1898 to 1903. The previous statements evidence the continuity, extension, and intensity of the drought. . . . The preceding statements have shown that variations of rainfall for prolonged periods similar in character have occurred, and may hence occur again, over the very large area including the Southern Asian peninsulas, East and South Africa, Australia, and perhaps the Indian Ocean. The abnormal actions or conditions giving rise to these large and prolonged variations must hence be persistent for long periods, and be effective over the whole of that extensive area."

Now the question is, what is a drought? From one point of view there is nothing but drought over a very large area of South Africa. But I gather from the table you print, showing the variation of the mean actual rainfall from the normal in India, that by drought is meant unusual and prolonged general dryness setting up marked economic results such as "large loss of cattle and great loss of capital," and so forth. If that interpretation is correct, then there has been no such drought in South Africa in the years stated.

This is proved by the accompanying table. It shows the average rainfall over each of the twenty rainfall districts of South Africa, during each year, in percentages of the means. These means have been computed for 160 stations having long records of twenty years, more or less, and are fully given and explained in my "Introduction to the Study of South African Rainfall." The information from which they are derived is open to all who take the trouble to look for it in the annual reports of the Cape Meteorological Commission.

The great mortality among cattle and stock can be explained without assuming that there has been a prolonged drought. In farming matters we live from hand to mouth. Farmers of the Karroo prefer to pray for rain rather than take the trouble to store it up when it comes. Therefore, if the rain is short in the late summer, and late in coming in the next spring, they have no reserve to fall back upon, and their cattle die. One year's drought kills off the stock almost as surely as fifty years' would. For instance, there was great loss of stock in 1897. Yet what were the facts of rainfall? At my station, where the annual mean is about 18·5 inches, the fall in December, 1896, was 8·42 inches; in the whole of 1897 it was 8·85 inches, and in January,

Percentages of Rainfall in the Various Districts of South Africa during the Years 1891 to 1902.

Sections	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902
I. Cape Peninsula	101	135	87	82	92	80	97	118	106	86	98	142
II. South-West	85	137	107	93	105	69	89	117	110	106	108	149
III. West Coast	97	139	103	94	86	57	84	122	128	122	99	122
IV. South Coast, W.	104	131	104	95	82	100	81	80	68	105	116	142
,, ,, E.	133	112	116	89	88	104	111	95	64	87	103	125
V. Southern Karroo, W.	98	104	(105)	110	78	99	80	79	80	118	123	144
,, ,, E.	138	103	116	85	74	101	86	65	55	93	104	130
VI. West-Central Karroo, W. ...	73	122	92	94	87	72	92	84	66	125	123	128
VI. West-Central Karroo, E. ...	135	112	114	147	98	101	82	86	87	131	93	87
VII. East-Central Karroo	134	97	115	99	95	97	74	91	64	105	103	97
VIII. Northern Karroo, W.	111	91	121	123	92	81	60	88	116	135	107	66
,, ,, E.	163	107	111	110	102	98	55	104	95	97	105	82
IX. Northern Border, W.	130	104	97	153	83	83	43	78	173	132	95	53
,, ,, E.	162	93	99	155	97	83	51	105	106	89	111	94
X. South-East	138	103	127	93	94	103	83	95	75	82	92	96
XI. North-East	162	112	128	99	94	105	55	110	98	88	97	82
XII. Kaffraria	136	108	150	98	99	107	80	107	72	69	91	94
XIII. Basutoland	125	104	127	92	104	106	68	107	98	83	105	101
XIV. Orange River Colony	143	111	108	101	108	83	70	105	104	94	92	87
XV. Natal...	114	96	153	98	120	107	90	119	87	74	112	97
Summary—												
Area of Winter Rains...	94	137	99	90	94	69	90	119	115	105	102	138
,, Spring and Autumn Rains ...	109	114	107	95	82	95	90	81	67	106	114	134
,, Summer Rains	138	103	121	114	99	96	68	100	98	98	100	86
South Africa	124	111	114	105	94	92	77	98	93	101	104	106

It is pretty plain that the area of winter rains, including the west coast and Cape Peninsula, was short of rain in 1896; that 1897 was a dry year over the area of summer rains, which comprises the greater part of South Africa; and that the south coast and adjacent districts, where the rainfall is fairly uniform throughout the year, had a dry year in 1899, and one not very wet in 1895. The area of summer rains, being so much greater than the rest, of course sets the tone of the mean rainfall of the whole country, making 1897 a dry year on the whole, and 1891 a very wet year.

There seem to be dry areas somewhere or other in pretty well every year. For example, the rainfall was short in the western part of the area of summer rains in 1902, although the fall was good enough further east. It was short over the east-central Karroo and south-east in 1899 in sympathy with the dryness of the south in that year. Even in 1891 there was a short fall over an extensive region.

I fancy that the impression of unusual dryness over South Africa in recent years arises from the misleading mean values used by the Meteorological Commission for comparative purposes. These are taken from Buchan's rather futile "Rainfall of South Africa," and average fully two inches (equal to perhaps 10 per cent.) too great. Buchan used only the rainfall of the ten years 1885–94 in constructing his results, and therefore got inflated averages in consequence of the heavy rainfall of 1891; whence the rainfalls of recent years are made to appear *minus* as compared with what is called the mean, whereas, as compared with the better means of longer periods, they would be often *plus*.

1898, it was 8·43 inches. Thus there was a drought during 1897, many cattle died, and there was much praying for rain. The year 1903 was probably almost the same as 1897, the fall at Kimberley being only some 65 per cent. of the mean, whereas the fall during the last half of 1902 was good, and during the first half of 1904 excellent. But with the exception of these years there has been nothing that can properly be called drought, in the sense of Sir J. Eliot's address, over any extended region of South Africa within the past fifteen years at least. Thus there is nothing to justify the statement that we have been under the same influence as that which set up the prolonged drought in Australia and the dry years in India.

J. R. SUTTON.

I TRUST to your courtesy to give my reply to Mr. Sutton's criticisms on certain portions of my address at the recent British Association meeting.

My address was in part based on an investigation I have had on hand for nearly two years, and which will be shortly published as a paper in the *Indian Meteorological Memoirs.* In that will be found a statement of the chief features of the meteorology of South Africa during the period 1892–1902. It is confessedly based upon very imperfect information—partly derived from newspaper reports, partly from data in certain meteorological reports received from Cape Town by the Calcutta Meteorological Office, and partly from data obtained from Mr. Hutchins, Conservator of Forests, Cape Colony, with whom I have been in correspondence for many years on the meteorology of South Africa and its relation to that of India. Mr. Hutchins was for some years in the Madras Forest Department before he went to the Cape some fifteen or twenty years ago. He has made a special study of the rainfall of South Africa, and is a careful and enthusiastic investigator in rainfall problems. He is, from his double experience in India and South Africa and his present official work and position, eminently qualified to form a judgment on the abnormal features of rainfall distribution in either area, and on their economic effect. It is hence, as I hope to show later, very satisfactory that Mr. Sutton's figures confirm the general inferences I made about South African rainfall, based chiefly on Mr. Hutchins's information, in my address.

Before discussing Mr. Sutton's data and inferences, perhaps I may be permitted to deal with two or three important issues raised in Mr. Sutton's letter.

The first is contained in the opening paragraph, in which he says "south-east winds are rare on the south-east coast of South Africa, and the rain of the greater part of the tableland and north-east coast comes mostly from some northerly direction." If these casual remarks have any point at all, I think I am correct in assuming that they imply that Mr. Sutton considers the rainfall in the areas mentioned is not due to humid currents from the Indian Ocean, but from the dry interior to the north of the tableland. I have examined the rainfall charts of South Africa given in Bartholomew's "Meteorological Atlas," and they certainly indicate to me that the aqueous vapour, the condensation of which gives rainfall in the eastern half of South Africa, is brought up by air movement from the Indian Ocean, and occurs as a summer precipitation. Hence, so far as I can reasonably judge, that area forms a part of what I have termed the Indo-oceanic region. I might add, in further reply, that rain in certain parts of India during the south-west monsoon chiefly occurs with easterly and north-easterly, and even with northerly winds. But these facts have not yet been utilised by anyone to prove that the rainfall is not brought up from the adjacent seas and oceans by the south-west monsoon circulation.

Mr. Sutton in a later paragraph says he fancies that "the impression of unusual dryness over South Africa in recent years arises from the misleading mean values used by the Meteorological Commission for comparative purposes which are taken from Buchan's rather futile 'Rainfall of South Africa,' and average fully two inches (equal to perhaps 10 per cent.) too great." There is an air of certainty about this statement which I am unable to share without further proof. Buchan's means are based on ten years' data, Mr. Sutton's on twenty years' data. It does not necessarily follow that twenty years' means are better representatives of normal or average conditions than ten years means. It depends entirely upon whether the ten years may or may not be accepted as representing the normal conditions, and whether the additional ten years' data are for an abnormal period or not. The fact that the two sets of means differ on the average of the whole area by 10 per cent. indicates to an outsider on South African meteorology like myself that it is quite as probable the ten years' additional data erred in defect as that the ten years' data employed by Dr. Buchan erred in excess. There hence appears to be (in the absence of any proof) an element of doubt in his means, just as he asserts to be the case in the "rather futile" means of Dr. Buchan.

Again, if I read Mr. Sutton's letter rightly, he considers that the question as to whether the crops have failed over large areas being due to drought is settled by a consideration of percentage variations. It is certainly not the case in India. A percentage variation gives no certain indication unless considered in relation to the normal fall, and also to its time-distribution. A deficiency of 25 per cent. is of absolutely no economic importance in such areas as Sind (with an average rainfall of about four inches) or such as Arakan (with an average of more than 200 inches). The former area depends solely on irrigation for cultivation, and the latter is so abundantly supplied for the rice crop that it bears a loss of fifty inches lightly. On the other hand, in the regions termed the dry zones in India, where the mean rainfall ranges between fifteen inches and thirty inches, a deficiency of 20 per cent. is usually a serious matter, more especially if it accompanies more irregular distribution than usual unsuited to the staple crops. Local knowledge of the agricultural and economic conditions is hence of the greatest importance in estimating the probable effect of a given variation of rainfall in any area. Mr. Hutchins, I have every reason to suppose, possesses such knowledge for South Africa, and hence I attach the highest value to his information on such matters.

The evidence I have collected, a small portion of which was given in my address, appears to me to have established that during the period 1895–1902 there was a marked tendency to more or less continuous deficiency of rainfall over the Indo-oceanic area, most pronounced in dry inland districts, and which in India intensified into severe droughts in the years 1896, 1899, and 1901, diminishing the crop returns over large areas to such an extent that it was necessary to resort to famine relief on a large scale during the twelve months succeeding each period of crop failure.

I was unable to make as precise statements for either Australia or South Africa, but the scanty facts and information at my disposal appeared to justify the statement that these areas were similarly affected. I also pointed out that this period stood in marked contrast to a preceding period of three years, 1892–4, when the precipitation was apparently in general excess over the same large area.

I give in the following table a comparison between the rainfall variations of India, and the area of spring, summer, and autumn rains in South Africa, which, so far as I can judge, is mainly dependent on the Indian Ocean supplies of aqueous vapour. I give, in the absence of the number of stations for each area, the arithmetic means of the second and third horizontal rows of figures in Mr. Sutton's summary of his data :—

Period of general excess of rain			Period of general deficiency of rain		
	Percentage variation			Percentage variation	
Year	India	S. Africa	Year	India	S. Africa
1892 ...	+12 ...	+ 8	1895 ...	− 5 ...	− 9
1893 ...	+22 ...	+14	1896 ...	−12 ...	− 5
1894 ...	+16 ...	+ 4	1897 ...	normal ...	−21
			1898 ...	+ 1 ...	− 9
			1899 ...	−27 ...	−18
			1900 ...	− 1 ...	+ 2
			1901 ...	−10 ...	+ 7
			1902 ...	− 5 ...	+10

These figures show that the eastern half of South Africa had heavier rain than usual during the same period (1892–4) as India, that it was steadily in defect during the first five years of the period of persistent deficiency of rain in India, and was especially deficient in the years 1897 and 1899, the former being the year and rainfall season following the first severe drought year of the period in India, and the latter the same year as that of the greatest drought experienced in India during the past 100 years at least. The parallelism between the two sets of figures is, indeed, more complete than I anticipated, and hence I consider not only that Mr. Sutton's conclusion to the effect that "there is nothing to justify the statement that South Africa has been under the same influence as that which set up the prolonged drought in Australia and the dry years in India" is neither in accordance with what I hold to be the general meteorological conditions and relations of the whole Indo-oceanic area nor even with the data which Mr. Sutton furnishes. The probability, so far as I can judge, is at least twenty to one that there is some relation such as I have suggested. The chief object of my address was, I may add, to urge the necessity for the coordination and intercomparison of the meteorological observations of the whole Indo-oceanic area and their discussion as a whole by an efficient scientific staff in London. The question at issue between Mr. Sutton and myself, for example, could be authoritatively settled by such an investigating office.

In conclusion, I hope that my remarks may not be interpreted as in any way depreciating the value of Mr. Sutton's work in collecting and discussing as a whole the rainfall data of South Africa, and in utilising the data to obtain normal means for purposes of comparison. His work will, I am confident, be appreciated by all interested in African meteorology from any point of view. JOHN ELIOT.

Bon Porto, Cavalaire, Var, France.

The Origin of Life.

Although to the evolutionist it must necessarily appear more than probable that at some time or other non-living matter has by evolution acquired the properties of life, and to him the only question is as to how this has come about, yet, for all that, he has been in the habit of admitting that the complete failure of all experiment in this direction makes the negative evidence very strong indeed. My present object is to suggest that the negative evidence, so far from being strong, is so weak that perhaps it can hardly be said to exist.

In the experiments the first step has always been, and, so far as one can see, must always be, to destroy all existing life and all existing germs of life. Suppose the agent to be heat. How does the experimenter know that the very means he employs to destroy in living matter the property of life are not equally efficacious in destroying the peculiar property or properties of matter that is just on the point of transmutation? For all that we certainly know to the contrary, dead matter may be changing into living every day in every pool, especially every warm pool, on the face of the earth. If so, the difference between the last state of the non-living and the first state of the living must, by the evolutionist's hypothesis, be extremely small; and it is probable—to my mind most probable—that both would be similarly affected by an unusual degree of heat, or whatever other agent is calculated to destroy life; the precaution eliminating life and its potentiality at one stroke. But the value of the negative evidence is precisely in inverse proportion to this probability. If the probability is thought great, the negative evidence will necessarily be thought small. I submit that the probability is very great indeed, and consequently that we are pretty much in the same position as to the possible evolution of life from non-living matter as we should have been if no experiments had been made. Certainly, so far as the logic of the matter is concerned, there is no need yet to consider the hypothesis of life having been imported here from another planet.

Birmingham, October 25. George Hookham.

Thinking Cats.

I have known three cats which behaved as if they thought. The first, a large, sleek tabby, belonged to a private family living in the City. Between 1846 and 1858 the owner, Mr. I. S., was surprised by his manservant coming to his office at the back of the house in business hours and asking, "Did you ring, sir?" "No, I have not been into the house," was his answer. This occurred repeatedly. At last the man watched, and observed that, the family being in other rooms, the dining room bell rang, and when he answered it the cat ran out of the door. He then purposely shut her into the room. A leather easy chair was so placed that by getting on the seat, and then standing on the arm, she could reach the knob with her front paw; and she continued to practise this accomplishment as often as she was shut up in the room.

The second cat, also a large tabby, lived at Blackheath. Her master often sat up late writing. The cook, a "good old servant," also now and then sat late, sewing or reading, in the kitchen. One night after twelve Mr. H. F. was interrupted by the cat running into the library (the door being open), mewing and clawing him, then running towards the door, and repeating these acts. He got up and followed the cat, which now ran into the kitchen. The cook was sitting asleep close to the fender, a piece of coal had fallen on her dress, and it was burning. No harm happened, thanks to the cat.

The third was a very small, slight cat, white and tabby, a good mouser and bird catcher, and not at all afraid of a rat. On one occasion the servant, exasperated by the trouble caused by the cat's selection of a birthplace for kittens, drowned them *all*, for which she was duly rebuked. The next family arrived in a suitable corner, but, when two or three days old, disappeared, as well as their mother. As the cat was never allowed to go upstairs, it was supposed that, like another cat once before, she had made a lair in the garden, where she spent most of her time. At dusk the mistress of the house went up to dress for dinner. As soon as she entered her room she heard something fall, and it struck her that the noise was like a cat's jump from a height. Procuring light she found the cat standing by the door. She then saw that the curtains, where folded on the bed, had been a little disturbed, put in her hand, and found three soft warm kittens! They were immediately put into a basket with flannel, and set by the kitchen fire; but as soon as the lady had gone downstairs she met the cat, with a kitten in her mouth, on her way back to the bedroom. Why did she select that room? She was not petted by the lady, nor friendly to her. The housemaid was safe, busy waiting at table.

Debarred from this resource, she hid the kittens again while the family were at dinner, and apparently felt so sure that they were safe, that she went and sat by the kitchen fire, awaiting the usual scraps. Of course a search was made in all likely hiding places and corners frequented by the young people, who were very fond of this cat, and thought she was fond of them. A piteous, faint squealing betrayed the poor little creatures on the floor behind the largest folios in the library. The space above the books was so small that it is difficult to think how the cat got in with a kitten in her mouth, or even without it. This was the one room into which the housemaid seldom came, especially in the evening, as the master sat there. He did not pet the cat at any time, and she took no notice of him.

But though securely hidden, the kittens could hardly have lived in that cold place; their mother seemed to have overlooked their need of warmth. After this failure she submitted to have them kept in the basket in the kitchen.

Y. N.

Fish-passes and Fish-ponds.

In your issue of August 18, in an article dealing with fish-passes and fish-ponds, the following statement is made:—

"Much of the information as to the construction of ponds and their inlets and overflows is, of course, ancient, and can be found in such books as the 'History of Howietoun'" (by the late Sir James Ramsay Gibson Maitland, Bart.).

The above statement may easily cause the incorrect inference that the information in Sir James Ramsay Gibson Maitland's work is now obsolete. Perhaps you may care to make it known that this is, of course, not the case, although no doubt with lapse of time improvements and modifications are introduced. Howietoun Fishery Co.

Howietoun Fishery, Stirling, N.B., October 24.

Average Number of Kinsfolk in each Degree.

I thank Dr. Galton for his explanation (p. 626), which only shows how easy it is to make mistakes in things which appear perfectly trivial. The discrepancy can be accounted for, however, more simply still by the fact that families containing boys only have to be left out of account, and therefore in the families which contain *at least one girl* there are on an average more girls than boys altogether.

G. H. Bryan.

Misuse of Words and Phrases.

It is quite true, as Mr. Basset says, that "in English considerable care is often required in the arrangement of a sentence, so as to avoid ambiguity"; but he seems to go too far when he says that "brevity ought always to be aimed at." Too much brevity will often, as we are warned by Horace, lead to obscurity: "*brevis esse laboro: obscurus fio*"; and the absence of inflections and genders renders it impossible to write English in the brief, epigrammatic style that is common in Latin.

To Mr. Basset's rules the following may be advantageously added: that new words of foreign origin should not be employed when English words will suit the purpose as well or better. For instance, *autotomic* and *anautotomic*, as applied to curves, are objectionable, because *self-cutting* and *non-self-cutting* express precisely the same ideas in simpler and more familiar words. I am at a loss to know on what ground Mr. Basset objects to the phrase "non-singular cubic curve"; does he think the epithet is "uncouth" or "inelegant" or "inaccurate"?

October 31. T. B. S.

FLOODS IN THE MISSISSIPPI.

WE have on previous occasions directed attention to the reports issued by the Department of Agriculture of the United States, and to the valuable information they afford to the officers engaged in the different departments. We have now been favoured with a copy of a report issued by the Weather Bureau on the floods in the Mississippi watershed in the spring of 1903,[1] which gives an interesting and detailed account of the most disastrous floods in this district of which there is any record.

FIG. 1.—Kansas City, Missouri. Scene in the freight yard of the St. Louis and San Francisco Railway after subsidence of the flood.

These floods are described as marking a new epoch in the economic history of the country. When previous floods occurred they ran harmlessly over unbroken forests, and bottoms tenanted only by the beasts of the field, except over a limited area where there were small farms tenanted by French colonists. The floods of 1903 descended upon fertile and highly cultivated fields, and upon rich valleys filled to overflowing with vast industries devoted with never ceasing energy to the fulfilment of the insatiable demands of commerce. The resulting ruin and desolation were beyond description. Along the lower Mississippi 6820 square miles of country were inundated. In Kansas City five square miles of territory were overflowed; large portions of the manufacturing towns of Venice and Madison were flooded to a considerable depth; more than 3000 square miles of territory, one-half of which was under cultivation, were overflowed and the crops ruined.

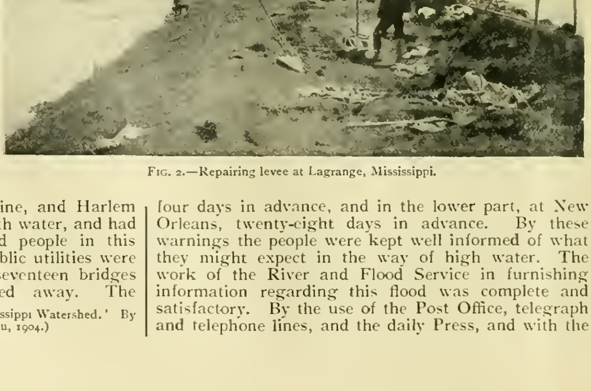


FIG. 2.—Repairing levee at Lagrange, Mississippi.

The towns of Armourdale, Argentine, and Harlem were covered from 8 feet to 12 feet with water, and had to be abandoned. Twenty thousand people in this district were made homeless. All public utilities were put out of service; sixteen out of seventeen bridges over the river Kaw were washed away. The Missouri and Kansas remained no longer rivers, but became merged into an inland sea. When the flood subsided there was revealed a condition of general ruin and desolation. Holes had been gouged in the streets some 30 feet deep; railroad tracks had been torn to pieces; an oil tank, 50 feet in diameter and 30 feet high, made of iron plates, had been torn from its foundations and tossed about like a frail shanty; freight cars had been broken up and carried away down the river; heavy locomotive engines had been rolled over and were discovered lying in mud banks; and mud from 2 feet to 4 feet deep covered everything. An approximate estimate of the loss in this district was put at $3\frac{1}{4}$ million pounds. In the vicinity of Kansas City the losses were placed at upwards of three million pounds, while the value of the bridges destroyed was more than 150,000*l*. In previous floods the losses have fallen principally on the agricultural districts, but this time the loss to the farmers was less than one-third of the total, and about the same proportion was borne by the railroads.

But great as the losses were, they would have been far greater but for the property saved owing to timely warnings issued by the Weather Bureau. Owing to the careful records kept of previous floods the department was enabled to forecast the time at which the flow would reach the various towns situated on the river, and the height to which it would probably rise, and so could send out timely warnings. In the lower district alone the value of the property saved by removal to places of safety was estimated at 5 million pounds. The forecasts as to the probable height of the flood were issued in the higher districts at least four days in advance, and in the lower part, at New Orleans, twenty-eight days in advance. By these warnings the people were kept well informed of what they might expect in the way of high water. The work of the River and Flood Service in furnishing information regarding this flood was complete and satisfactory. By the use of the Post Office, telegraph and telephone lines, and the daily Press, and with the

[1] "The Floods of the Spring of 1903 in the Mississippi Watershed." By H. C. Frankenfeld. (Washington: Weather Bureau, 1904.)

cooperation of the various railway companies, every intelligent person in the district was made aware of the impending danger in ample time to make such preparations as they were able.

The floods of 1903 owed their inception to a series of heavy rainfalls caused by a succession of storms of the south-western type, the best rain-producing quarter, coming on the top of the water derived from the melting of the snow on the mountains in the upper reaches.

In the February flood in the lower Mississippi the water rose in one long swell from Cairo to the Gulf of Mexico from 17·5 feet on the gauge on January 28, passing the danger point of 45 feet thirty-nine days later, and 50½ feet, or 5½ feet above the top of the banks, eight days afterwards. It remained above the danger line for another twelve days, and then began to fall. It will thus be seen that the water in the river during the flood rose 33 feet.

Although excessive rainfall was the original cause of these floods, the effect was greatly increased by works that had been carried out for the improvement of the river and for providing means of inland transport, necessitating the frequent crossing of the river by railway bridges. Formerly a certain amount of relief to the floods was afforded by the water flowing through the numerous crevasses or breaches of the banks that occurred, but during recent years the banks have been systematically raised and strengthened. For example, in the St. Francis system the levees have been extended and raised 2 feet over a length of 173 miles, and the area originally subject to being submerged reduced 4000 square miles. The same operations have been carried on in other districts, so that the flooded area which previous to 1897 extended over 30,000 square miles in 1903 barely reached 7000 square miles. The fight against this flood was also the most extensive and persistent ever attempted in the history of levee engineering. When a breach was likely to occur all the help and material available was concentrated at the point of greatest weakness. At one place a force of more than 1000 men was employed both day and night, in spite of which the bank gave way for more than a mile.

At another part of the river, about 36 miles below New Orleans, a crevasse occurred at a place where the river is 120 feet deep. The bank was all washed away, and where it formerly stood a hole was scoured out 60 feet deep. Owing to the precautions taken, due to the warnings of the Weather Bureau, provision had been made to meet such a catastrophe, and workmen were at once concentrated on the spot, and trainloads of material which had been provided in readiness for such an emergency were brought to the place. By this means the breach was successfully closed, and the flooding of some of the finest sugar plantations in Louisiana averted.

Other causes that contributed to the greater rise of the flood were the numerous railway bridges that had been carried across the river without leaving sufficient waterway for floods. In one place, where the natural width of the river is 900 feet, the waterway had been contracted to 400 feet by a railway bridge, the velocity of the water through which rose to twelve miles an hour.

Encroachments by reclamation have also materially interfered with the free flow of the river, the original width of the channel in some places having been reduced one-half.

The report of these floods contains numerous illustrations which give a very graphic idea of the ruin caused in the flooded areas, and also of the works carried on in repairing the levees. There is also a map of the watershed of the Mississippi and of the flooded areas, and of the rainfall in the different districts.

Two other volumes issued by the Geological Department relate to the floods of the river Passaic in 1902 and 1903, when the loss to the inhabitants of the district was estimated for the two floods at about 3 million pounds. These two volumes also contain numerous very telling illustrations of the flooded areas and of the damage done to houses and factories.[1]

WHAT IS BRANDY?

THIS question, which a few months ago greatly exercised analytical chemists in this country in consequence of the action of certain local authorities under the Sale of Food and Drugs Acts, has recently engaged the attention of the Technical Committee of Œnology, instituted by the French Minister of Commerce by decree of March 22, 1904, and the committee have adopted the conclusions of M. Rocques, the reporter of the subcommittee charged with the consideration of the matter, whose report is published *in extenso* in the *Moniteur Officiel du Commerce* of June 30. In view of the importance of the subject, it may be desirable to give a short summary of the facts and arguments which led the technical committee to adopt the conclusions of the special subcommittee.

In the first place the committee, for reasons which it is unnecessary to explain, object to the term *coefficient of impurities*, hitherto employed by French chemists, in conformity with a decree of the Minister of Commerce of May 26, 1903, to designate the aggregate proportion of the substances other than ethylic alcohol in brandy, and prefer to denote it by the term *coefficient non-alcohol*, or more simply *non-alcohol*, by which is to be understood the sum of the different volatile substances, other than ethylic alcohol, expressed in grams per hectolitre of absolute alcohol. These substances are the acids, aldehydes, ethers, the alcohols higher in the homologous series than ethyl alcohol, and the furfurol.

The causes which influence this coefficient are many, but in the main they may be said to depend upon (1) the nature of the wine, (2) the method of distillation, and (3) age.

As regards the first cause, it is found that the proportion, as well as the character, of the volatile matters vary according to the origin of the wine, the conditions under which its fermentation has been effected, the manner in which it has been kept, &c. The proportion of acids and ethers is considerably augmented if the wine becomes sour, and, speaking generally, the proportion of aldehydes is higher in white than in red wines.

But it is mainly in the method of distillation that we are to seek for the cause of the wide variations in this coefficient. This is readily understood if we examine the manner in which the various substances, which together constitute *non-alcohol*, behave during distillation. It is known that these substances pass over in very different proportion in the course of the distillation. Thus the aldehyde and the more volatile ethers are found mainly in the first runnings (*produits de tête*), whereas the taillings (*produits de queue*) contain in largest quantity the higher alcohols and the furfurol.

The separation of these various products—the *produits de tête*, the alcohol itself (*de coeur*), and the *produits de queue*—is effected in a manner more or less complete, depending upon the apparatus employed. In the larger distilleries this apparatus is of a very high order of perfection. But without further labour-

[1] The Passaic Flood of 1902, Water Supply and Irrigation Paper No. 88, and of 1903, Paper 92. (Washington: Government Printing Office.

ing this point, it is obvious that the aggregate amount and relative proportion of these products must depend very largely upon the means made use of, and hence perfectly genuine brandies must necessarily show wide differences in the *coefficient non-alcohol*.

In addition, it must be remembered that in the manufacture of brandy from wines of repute, the elimination of the substances constituting *non-alcohol* must be made with the greatest circumspection, since it is upon their bouquet that the value of these brandies depends, and this bouquet resides wholly in the *non-alcohol*.

On the other hand, if the brandy is being made from damaged wine the rectification must be most carefully conducted, and may have to be pushed to a point that the alcohol is obtained almost pure, that is to say, almost free from *non-alcohol*.

As regards the influence of age, it is observed that in those brandies which are found to improve on keeping there is an increase in *non-alcohol* due (1) to the formation of products of oxidation (acids and aldehydes), and (2) to *concentration* due to a loss of alcohol and water.

Brandies may be classified in the following manner:—

(1) The brandies of the two Charentes, which are habitually designated by the name of Cognac.

(2) The brandies of Armagnac.

(3) The brandies *de vin du Midi* and of Algeria (trois-six de Montpellier, &c.).

(4) Marc brandies.

The brandies of the Charentes are obtained by distillation of the wines of the district, and as the reputation of these brandies depends upon their bouquet they are submitted to a slight rectification only in order to preserve that bouquet.

The same may be said of the Armagnac brandies.

As to brandies made in other viticultural regions, and in particular in the middle of France, their nature is much more variable. These brandies require to be rectified in a manner, more or less complete, depending upon the nature of the wine or of the marc from which they are derived, and varying, too, with the quality of the brandy it is desired to produce. Certain wines require, in fact, to be most carefully rectified in order to produce merchantable brandy. Marc brandy is made in all viticultural regions, and that of Burgundy enjoys a special reputation.

As regards the value of the coefficient in different brandies, it is found that in those of Charente and Armagnac the coefficient is very high. Thus, as *minima*, a brandy of Clunis (1879, good, but not guaranteed) gave 259 (Girard and Cuniasse). A Cognac of 1892 gave 287 (Rocques). As *maxima* may be cited a Bois brandy of 1817, which gave 1174 (Lusson). This last number is exceptionally high. It may be said that, ordinarily, the value of the coefficient in Cognacs and *fine champagne* ranges between 275 and 450.

But little analytical evidence has been published respecting the Armagnac brandies, but, such as it is, it indicates that the coefficients in their case are less than are generally found in Cognacs.

The brandies obtained from the wines of the Midi and Algeria show much wider variations, ranging from 25 to 500.

Marc brandies have almost invariably a high coefficient. The numbers range from 555 to 1487, and it is interesting to note that the aldehydes frequently form a large proportion of the whole. Thus a Burgundy marc brandy was found to contain as much as 519 of aldehyde, and one from the Midi as high as 730 of aldehyde.

The question whether it is possible to fix minimum and maximum limits to this coefficient naturally received much consideration from the committee. The fixation of these presents a certain interest, and that from two different points of view. The fixation of a *minimum* limit has interest for the analyst, as guiding him in his inference as to the genuineness of the brandy or as to the amount of "silent" spirit with which it may have been mixed. The fixation of a *maximum* limit has an interest from the hygienic point of view, since it may become necessary if regulations are to be established in this sense.

The committee, however, are unable to recommend that any such limits should be fixed, owing mainly to the extremely variable character of brandy. Even in the case of brandies of a definite character, as, for example, Cognac, the non-alcohol coefficient is not the only element of value, and any conclusions as to character cannot be based solely upon it. Regard must be had to the proportions of the different volatile substances and their relations among themselves. Expert tasting (*dégustation*) must be considered as an indispensable complement of chemical analysis.

The hygienic point of view, involving the fixation of a maximum value for the non-alcohol coefficient, was brought to the notice of the International Congress of Chemistry in Paris in 1900, but the problem, as then stated, received no definite solution. To base conclusions on the value of the coefficient alone, with no regard to the factors which it comprises, seems illogical. For example, the acids, and in particular acetic acid, frequently make up a large proportion of this value, but it cannot be contended that these substances, at least in the proportion in which they are present in brandy, have any detrimental influence. Far more important are the aldehydes, ethers, the higher alcohols, and furfurol.

As regards the higher alcohols, the attempt has been made to establish a higher limit. Thus in Belgium, by a Royal decree of December 31, 1902, the sale is prohibited of spirituous liquors containing more than 1 gram of the higher alcohols and essences per litre of absolute alcohol when these liquors have an alcoholic content higher than 90°, and 3 grams when the alcoholic richness does not exceed 90°.

The committee remark that the effect of this regulation would be to exclude some of the most famous, and notably the oldest, brandies of the Charente, many of which exceed the maximum Belgian limit, which, expressed as a non-alcohol coefficient, is 300. Thus:—

	Higher alcohols per hectolitre of abs. alcohol
Bois Brandy, 1817 (Lusson)	... 612
Saintonge, Cazes, 1896 (Lusson) ...	... 372
Gemozac, or de Fesson, 1893 (Lusson)	... 345
Clunis, 1875 (Lusson)	... 345
Cognac, 1873 (Rocques)	... 304

From the hygienic point of view the ethers, furfurol, and especially the aldehydes, are undoubtedly of much greater importance than the higher alcohols, since admittedly the action of these substances on the organism is far more deleterious than that of the higher alcohols. From this point of view the attention of hygienists should be directed to the Marc brandies, which, as already stated, frequently contain considerable quantities of aldehydes.

Interesting and, no doubt, valuable as the report is, it is hardly calculated to facilitate the work of the unfortunate public analysts who may be called upon to express an opinion as to the genuineness of a sample of brandy. The question, What is brandy? analytically speaking, still awaits solution.

NOTES.

SPEAKING at St. George's Hospital Medical School on Friday last, Lord Kelvin remarked:—The modern medical man must be a scientific man, and, what is more, he must be a philosopher. The fundamental studies of medicine are of a strictly materialistic kind, but they belong to a different world from the world which constitutes their main subject —the world of life. Let it not be imagined that any hocus-pocus of electricity or viscous fluids will make a living cell. Splendid and interesting work has recently been done in what was formerly called organic chemistry, a great French chemist taking the lead. This is not the occasion for a lecture on the borderland between what is called organic and what is called inorganic; but it is interesting to know that materials belonging to the general class of foodstuffs, such as sugar, and what might be also called a foodstuff, alcohol, can be made out of the chemical elements. But let not youthful minds be dazzled by the imaginings of the daily newspapers that because Berthelot and others have thus made foodstuffs they can make living things, or that there is any prospect of a process being found in any laboratory for making a living thing, whether the minutest germ of bacteriology or anything smaller or greater. There is an absolute distinction between crystals and cells. Anything that crystallises may be made by the chemist. Nothing approaching to the cell of a living creature has ever yet been made. The general result of an enormous amount of exceedingly intricate and thorough-going investigation by Huxley and Hooker and others of the present age, and by some of their predecessors in both the nineteenth and eighteenth centuries, is that no artificial process whatever can make living matter out of dead. This is vastly beyond the subject of the chemical laboratory, vastly beyond my own subject of physics or of electricity—beyond it in depth of scientific significance and in human interest.

MR. H. H. JEFFCOTT has been appointed assistant in the metrological department of the National Physical Laboratory.

BY permission of His Majesty the King, the Sanitary Institute will henceforth be known as the Royal Sanitary Institute.

AN International Gas Exhibition will be held at Earl's Court from November 19 to December 17 inclusive, under the auspices of the Institution of Gas Engineers.

AN exhibition of water colours, photographs, and other articles of interest belonging to the National Antarctic Expedition will be opened at the Bruton Galleries, Bond Street, on Friday by Sir Clements Markham.

A SKETCH of some of the results of the public works policy in India during the last fifty years was given at the Institution of Civil Engineers on Tuesday, in the address of the president, Sir Guilford L. Molesworth, K.C.I.E. In the course of the address, it was pointed out that there are available in India millions of potential horse-power, in the form of water flowing from the mountain ranges, capable of being converted into electrical energy at generating stations in the hills, and conveyed, with slight loss in efficiency, to centres even at a distance, where it can be utilised for industrial purposes. A generating station has been erected at the Cauveri Falls, with a head of 380 feet. The turbines drive six generators, each of 1000 electrical horse-power, and the current is transmitted, at a pressure of 30,000 volts, for a distance of ninety-one miles, to the Kolar goldfields, with an efficiency of nearly 80 per cent. At the cordite factory, Wellington, in the Nilgiri Hills, an effective fall of 660 feet is employed to work a turbine and alternators, generating about 1000 horse-power at a pressure of 5000 volts. As to irrigation, the amount of land irrigated in British India is about 44 million acres. Of these 17 million are irrigated by canals, 8 million from tanks, and 19 million from wells and other sources. In conclusion, the president remarked that although much has been done, far more yet remains to be done—in opening up the country, in the prevention of famines, in the regulation of the water supply, in the installation of works and factories, in the transmission of power generated by the hill falls to those centres where it can be profitably utilised, and in the general development of the resources of the Empire.

THE three articles in the October number of the *Zoologist* deal exclusively with local bird-faunas, namely, those of Oxfordshire, Donegal, and Jersey. The capture of a white-beaked dolphin (*Lagenorhynchus albirostris*) off Aberdeen is recorded.

THE director (Captain S. S. Flower) of the Giza Zoological Gardens, Cairo, has sent us a copy of a list of rare animals recently received from the Sudan, among which reference may be made to a female of the Niam-niam race of the chimpanzee (*Anthropopithecus troglodytes schweinfurthi*).

"GAMMARUS," otherwise the freshwater-shrimp (a name which, by the way, appears to be omitted from the text), forms the subject of the twelfth number of the *L.M.B.C. Memoirs*. Miss M. Cussans, the author, seems to have treated her subject in the same thorough manner which has been the rule in the earlier issues of this excellent series, and the four plates, although diagrammatic, are all that can be desired from the point of view of the student.

THE greater bulk of parts i. and ii. of vol. xxv. of *Notes from the Leyden Museum* is taken up by an article on the beetles of the family Paussidæ by Mr. E. Wasmann. These beetles, which are now definitely known to live in companionship with ants, are regarded by the author as the most interesting of all living creatures, since they show better than any other group the interdependence of morphology and biology. They are remarkable for the enormous size of their antennæ, and are believed to be the descendants of pre-Tertiary Carabidæ.

THE first of three lectures on the fossil vertebrates of Egypt was delivered at University College, Gower Street, by Dr. C. W. Andrews, of the British Museum, at 4.30 on October 31. This lecture was devoted to the Proboscidea. On November 7, at the same hour, the lecturer will discourse on Arsinoitherium and the Hyracoidea, while on November 14 he will take into consideration the sirenians and reptiles. Free cards of admission to these lectures may be obtained on application to the registrar at University College.

ACCORDING to the report of the Government biologist for 1903, the Government of the Cape of Good Hope is making every effort to develop the local fisheries. During the year four large steam-trawlers arrived from Europe; two of these were unfortunately wrecked, but the others have been doing good work, as have also certain vessels belonging to private owners. A new fishing-ground, much nearer to Cape Town than any of the old ones, has been discovered, and has been the chief attraction for the new trawlers. The report contains reprints (without the plates) of various memoirs by specialists on different sections of the South African marine fauna.

"THE Animals of Africa" forms the title of an article by Mr. Lydekker in the October issue of the *Quarterly Review*. While admitting the African origin of the mastodons, the author does not consider that there are sufficient grounds for rejecting Huxley's theory that the bulk of the modern mammalian fauna of Africa came from the north. In an article on fatigue, Sir W. R. Gowers points out that the study it has received has been chiefly at the hands of Italians. The facts known relating to both muscular and brain fatigue are passed in review, and the methods of prevention are considered in turn. Mr. D. G. Hogarth describes the palace of Knossos, and his account of recent researches is accompanied by a large plan. Two other articles also are of special interest to men of science—one dealing with the Panama Canal and maritime commerce, the other summarising what has been accomplished in Wales in the provision of higher education. Referring to Sir Norman Lockyer's calculation, that to place the Welsh universities on a footing of equal efficiency with the best universities of Germany and America a capital sum of four millions is required, the writer says it is clear that Wales herself cannot raise a tithe of this large sum, and emphasises the fact that it is to the State that Wales must look for the bulk of the money needed.

IN a brief *Bulletin* issued by the Michigan State Agricultural Experiment Station (No. 218) Mr. Fred Edwards reviews in popular language our present knowledge of soil bacteria in their relation to agriculture.

THE October number of *Climate* contains articles on malaria by Dr. Harford, the climate of Uganda and of Lovaleland by Mr. Cook and Mr. Fisher respectively, and medical articles, notes, and reviews.

THE *Journal* of the Royal Statistical Society for September (vol. lxvii., part iii.) contains the second and third reports of the committee appointed to inquire into the production and consumption of meat and dairy products in the United Kingdom, with remarks thereon by Mr. Rew, from which it appears that we are well ahead of other European nations in meat consumption (122 lb. per head as against Germany's 99 lb.), but appreciably behind our American cousins (150 lb. per head), and much less carnivorous than our Australian kinsmen (262 lb. per head). Mr. Thompson contributes a paper on local expenditure and indebtedness in England and Wales, and Mr. Adam a newly calculated life-table for Scotland.

PROF. A. E. WRIGHT'S system of anti-typhoid inoculation, introduced by him in 1896, after being applied to the British Army in India was forbidden by an army order in consequence of certain objections raised against it. During the South African War the inoculation of troops proceeding there was officially sanctioned, and Prof. Wright and his assistants injected some 100,000 men without the slightest mishap. At the termination of the war the advisory board of the reorganised Army Medical Department recommended that the practice of anti-typhoid inoculation should be suspended. Prof. Wright demurred to this decision, and in consequence Mr. Brodrick referred the matter to the Royal Society, and at their suggestion a special committee of the Royal College of Physicians was appointed to examine and report. This committee was composed of Dr. Rose Bradford, Dr. Gee, Dr. Howard Tooth, Prof. Simpson, and Dr. Caiger, and reported unanimously that, "after careful scrutiny of the statistics from both official and private sources which have been made available, we are of opinion that not only is a lessened susceptibility to the disease brought about as a result of the inoculations, but the case mortality is largely reduced. We are further of opinion that with due care the process of inoculation is devoid of direct danger, but that under special circumstances there may possibly be some temporary increase of susceptibility to infection immediately following inoculation; and it is therefore desirable that the preparation of the vaccine and the inoculations should be carried out under specially skilled supervision." In spite of this favourable verdict the advisory board still maintained its opposition, and Mr. Arnold-Forster therefore appointed another committee to advise him, consisting of Colonel Bruce and Dr. James Galloway, of the advisory board, together with Dr. C. J. Martin and Dr. A. Macfadyen, Lister Institute, Dr. Bulloch, London Hospital, Dr. Bruce Low, Local Government Board, Major Leishman, R.A.M.C., and Prof. Wright. This committee has reported unanimously "that the anti-typhoid inoculation has resulted in a substantial diminution in the incidence and case mortality from typhoid fever, and recommend that the system introduced by Prof. Wright should be resumed in the Army." The Army Council has adopted this recommendation, and is proceeding to carry out inoculations and to conduct investigations, by the agency of Major Leishman, on volunteers from the 2nd Battalion of Royal Fusiliers now proceeding to India.

A LIST of fresh-water algæ, collected by Mr. A. Howard in Barbados, Dominica and Trinidad, and described by Mr. G. S. West, appears in the *Journal of Botany* (October). This contains species, some new, which are additional to those recorded in papers previously published by the same author. A species of Glœotænium, a green alga, is figured, which is distinguished by the presence of a peculiar opaque cruciform zone. Biographical notes culled from Sir M. Grant Duff's "Notes from a Diary" and other sources include references to Sir James Paget, Brodrick, and John Ball.

THE success obtained with Para rubber in Ceylon has led to the experimental plantation of the tree in other countries. In India planters are wisely hesitating before they embark upon a venture which yields no return for five years or longer. It is obviously the duty of the superintendents of experimental gardens to investigate the possibilities, and in the Tennasserim circle, Burma, the scheme instituted by Mr. Manson for developing a large Para rubber plantation at Mergui is progressing. Up to the present serious depredations have been caused by deer and pigs which attack the seedlings, but by planting out two-year-old plants it is hoped that this may be to a great extent obviated. The experiment, which was started in 1901, will be followed with considerable interest by planters.

THE annual report of the Royal Alfred Observatory, Mauritius, for the year 1903, states that the rainfall of the island for the year (mean of fifty-one stations) was 68·8 inches, the average being 77·3 inches. The greatest falls in twenty-four hours were 9 inches at Constance d'Arifat on April 23, and 8·5 inches at Britannia on January 14. The number of ships which visited the island was 274, against 686 in 1882. From the observations contained in their logs, daily synoptic weather charts were prepared and tracks of cyclones laid down. Photographs of the sun were taken daily when the weather permitted; 173 negatives were sent to the Solar Physics Committee. During the year 117 earthquakes were recorded, particulars of which will be published in the annual volume of observations. Mr. Claxton states that much damage has been done to the library by white ants, and that it has been necessary to remove the books to another position.

THE U.S. Weather Bureau has issued its meteorological chart of the Great Lakes for the winter of 1903–4. This was the coldest winter in the lake region that has been experienced since the beginning of the Weather Bureau observations in 1871. Freezing temperatures commenced about the middle of November. The climax was reached in February, when the mean monthly temperature ranged about 10° below the normal in all districts. On Lake Superior the ice-fields did not disappear from the eastern portion until the last week in May, 1904. Several interesting photographs are given of vessels and ferries forcing their way through apparently impassable masses of ice as soon as a thaw set in. When navigation is practicable storm warnings are displayed by day and night, and at almost all stations a chart is issued showing the weather conditions at 8h. a.m. daily (except Sunday); masters of vessels are invited to obtain these charts, or any other information in connection with the weather, at any of the Weather Bureau offices.

APPENDIX iii. of a report upon the basin of the Upper Nile, with proposals for the improvement of that river by Sir William Garstin, contains an interesting account of the variations of level of Lake Victoria Nyanza contributed by Captain H. G. Lyons, the director of the Survey Department of Egypt. This lake has a water surface of about 68,000 square kilometres, and is situated about 1129 metres above sea-level. It is believed to be of shallow depth, and lies for the most part of the year in the region of the equatorial rain and cloud belt, the excess water draining off at the Ripon Falls by the Victoria Nile. After reference to the geology and climate of the region, a brief historical summary is given of the early lake levels as observed by travellers and others visiting or residing by it; this is followed by a detailed study and discussion of the various gauges. Some of the results obtained are as follows:—The annual oscillation of the lake is from 0·30 metre to 0·90 metre. Between 1896 and 1902 there was a fall of 76 cm. in the average level, since followed by a rise of 56 cm. The epochs of high and low levels are given as:—1878, high level; 1880–90, falling level; 1892–95, temporary high level; 1896–1902, falling level; 1903, rising level.

WE have received from Mr. W. J. Brooks, 33 Fitzroy Street, W., some of his patent flexible curves and a parabolic curve. One of the former is a strip of celluloid with tags at intervals along its length; when placed on paper it can be bent to any desired curve, the fingers being placed on the tags to keep the strip in position; the strip does not yield under the pen. A second form (pattern B) has a steel strip and is self-clamping and reversible; this ingenious device maintains the steel strip in any position by means of stiff-hinged linkwork attached to metal tabs. The shape of any curve thus formed by this strip can be transferred from one drawing to another, a desirable advantage to many workers. A third and longer form (pattern C), also self-clamping and reversible, has been designed for such special purposes as are required by ship and boat builders, but it will have a much wider field of adaptation, such as, for instance, in the construction of interpolation curves for wave-lengths in spectroscopic work, &c. This pattern, which can be obtained from one foot up to any length, consists of light wooden cross-bars hinged to tabs fixed to a steel strip. The strips slide through brass spring-clamps, and are thus held tight against a stout wooden bar running the length of the curve. Several patterns and sizes for all the curves are obtainable, and they may be usefully employed for a great number of manipulations, such as curve drawing, transferring outlines of mouldings, &c. The parabola is of celluloid and is accurately cut, and its axis, focus and latus rectum neatly engraved on it. In addition to its use for draughtsmen, teachers of mathematics will find it serviceable for the study of that curve.

A NEW general theory of errors has been contributed to the *Proceedings* of the American Academy of Arts and Sciences, xl., 3 (August), by Mr. William Edward Story. The author's object has been to develop the theory in such a way as to avoid the usual assumptions, the legitimacy of which, as approximations, may be questioned. It is claimed that the present theory is based upon such simple principles as will be generally admitted to be necessary for the mathematical treatment of any theory. The fundamental assumptions are as follows:—Possible errors form a practically continuous sequence from a certain lower limit to a certain upper limit. The probability that the error of an observation lies between x and $x+dx$, where dx is infinitesimal, is $\phi(x)dx$, where $\phi(x)$ is an analytical function of x, developable by Taylor's theorem throughout the whole range of possible error. The probability that the error lies between given limits is independent of the unit of measurement.

ATTENTION has already been directed in these columns to the important innovation introduced into this country by the Drapers' Company in granting a sum of 1000*l.* to University College, London, for the furtherance of research in applied mathematics. No better testimony to the value of this grant could be adduced than is afforded by a reference to the pages of Nos. 1 and 2 of the technical series of the *Drapers' Company Research Memoirs*, edited by Prof. Karl Pearson. In the first of these Mr. E. S. Andrews discusses the stresses in crane and coupling hooks by means of the theory of elasticity, and describes experimental tests in verification of his theory. The present investigation shows not only that the existing theory is unsatisfactory, both theoretically and practically, but that improvements can well be made in existing types of hooks by following lines laid down in the paper. In the second paper Mr. L. W. Atcherley directs attention to certain very serious defects in the theory of masonry dams. It is shown that the stresses across vertical sections of a dam are far more important than those across horizontal sections, and that in many existing dams not only do shearing stresses exist in the vertical sections which are far in excess of any considered safe by engineers, but considerable tensile stresses also occur, which form a serious source of danger. These two papers are fitting illustrations of the many important practical problems now awaiting solution, which could be solved at a very small cost by the provision of further endowments for mathematical research.

THE third revised edition of "The Scope and Method of Political Economy," by Dr. J. N. Keynes, has been published by Messrs. Macmillan and Co., Ltd., at 7*s.* 6*d.* net.

MESSRS. ROUTLEDGE AND SONS, LTD., have added to their series of "Country Books" a profusely illustrated edition of Charles Kingsley's "Glaucus, or the Wonders of the Seashore." The volume is published at 3*s.* 6*d.*

SINCE the advent of the Nernst lamp, every physicist has recognised that it would ultimately be very serviceable for lantern purposes. Any lecturer interested in the matter may see a well designed lantern provided with Nernst filaments, in actual use, at Mr. R. W. Paul's, High Holborn.

MR. H. G. WELLS returns to the more serious side of his work in "A Modern Utopia," which is being published month by month in the *Fortnightly Review*. As in "Anticipations" and "Mankind in the Making," Mr. Wells concerns himself with sociological problems, and pictures the probable manners and customs of society in a Utopia, situated on a distant planet, which is the natural outcome of continued development on modern lines.

A REVISED edition of Mr. H. N. Chute's "Physical Laboratory Manual" has been published by Messrs. D. C. Heath and Co. In this edition sound and light have been made to follow mechanics, because, the author says, "there seems to be a consensus of opinion among teachers that . . . the grade is less steep than it is where these subjects follow electricity." A few of the problems of the first edition have been omitted, and new ones added.

THE first number of the *Journal of Agricultural Science*, edited by Messrs. T. H. Middleton, T. B. Wood, R. H. Biffen, and A. D. Hall, in consultation with other gentlemen, will be published in January next by the Cambridge University Press. The journal will publish only definitely scientific work in agricultural science, and will not include the results of the ordinary trials of manures and varieties for demonstration or commercial purposes. Papers for publication should be sent to Mr. T. B. Wood, University Department of Agriculture, Cambridge.

THE seventh edition of Dr. J. Frick's "Physikalische Technik," enlarged and completely revised by Prof. O. Lehmann, is in course of publication by Messrs. F. Vieweg and Son, Brunswick. The first half of vol. i. has been received, and the second half is promised shortly. The second volume will be published in a year or two, and will complete the work. In the part before us there are 629 pages and 2003 illustrations of lecture and laboratory apparatus for demonstrations and experiments in various branches of mechanics and physics.

A CHEAP edition (1s. net) of Mr. G. F. Chambers's "Astronomy for General Readers" has just been published by Messrs. Whittaker and Co. The book contains 268 pages and 134 illustrations, most of which represent the pictorial efforts of bygone days. As instances of the worst of these figures, reference may be made to Figs. 29, 104, 105, 106, 109, and 112. Before issuing this cheap edition an attempt should have been made to bring the text and the illustrations in line with the present position of astronomy, instead of leaving them as they were in the original volume.

THE *Journal of Anatomy and Physiology* for October (xxxix., part i.) contains a number of valuable papers, but of purely anatomical interest. The principal contribution is by Dr. Huntington on the derivation and significance of certain supernumerary muscles of the pectoral region, illustrated with fourteen excellent coloured plates.

THE new illustrated catalogue of physical apparatus just issued by Messrs. F. E. Becker and Co. (Messrs. W. and J. George, Ltd.) is likely to prove indispensable in the physical laboratories of all our schools and colleges. It runs to 628 large pages, and is strongly bound in cloth. Full particulars are provided, not only respecting the apparatus required in elementary and advanced physical teaching, but also concerning that necessary to the physicist in his research work. All branches of physics are included, and the instruments throughout are explained by excellent illustrations and concise descriptions, and, what is of prime importance, the figure and its appropriate text are close together.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN NOVEMBER :—

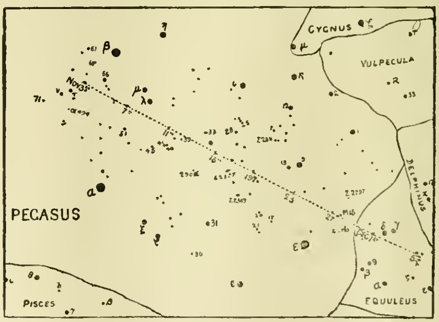
Nov. 5. Saturn. Outer major axis of outer ring = 39″·42.
,, ,, Outer minor axis of outer ring = 11″·01.
8. 11h. 50m. Minimum of Algol (β Persei).
9. 13h. 0m. Venus in conjunction with Moon (Venus, 6° 30′ S.).
11. 8h. 39m. Minimum of Algol (β Persei).
13. 21h. 0m. Juno in conjunction with Moon (Juno, 0° 8′ N.).
14. 0h. 0m. Saturn in conjunction with Moon (Saturn, 3° 53′ S.).
,, 5h. 28m. Minimum of Algol (β Persei).
,, 16h. Epoch of November meteors (Leonids, radiant 150° + 22°).
15. Venus. Illuminated portion of disc = 0·832, of Mars = 0·936.
16. 15h. Venus and Uranus in conjunction (Venus, 1° 28′ S.).
17. 5h. 5m. Transit of Jupiter's Sat. III. (Ganymede), egress.
19. 11h. Jupiter in conjunction with Moon (Jupiter, 1° 31′ N.).
20. 10h. 24m. to 11h. 44m. Moon occults ξ′ Ceti (mag. 4·5).
23. 5h. 20m. Near approach of Moon to α Tauri (mag. 1·1).
24. 6h. 39m. to 8h. 34m. Transit of Jupiter's Sat. III. (Ganymede).
25. Vesta in opposition to Sun (Vesta, mag. 6·5).

ENCKE'S COMET 1904 *b*.—In No. 3973 of the *Astronomische Nachrichten* M. M. Kaminsky gives a further ephemeris for Encke's comet, which he has corrected in accordance with the observation made at Heidelberg on September 11. The ephemeris gives the daily positions of the comet from October 14 to December 5, and the following is an abstract therefrom :—

Ephemeris 0h. (*M.T. Berlin*).

1904	α app. (h. m. s.)	δ app. (° ′)	log. r	log. Δ
Nov. 3	23 10 34	+24 9	0·1510	9·7380
,, 5	23 1 3	+23 21	0·1424	9·7305
,, 7	22 51 37	+22 29	0·1335	9·7237
,, 9	22 42 19	+21 33	0·1243	9·7178
,, 11	22 33 11	+20 36	0·1147	9·7125
,, 13	22 24 17	+19 35	0·1048	9·7080
,, 15	22 15 34	+18 33	0·0946	9·7040
,, 17	22 7 5	+17 29	0·0840	9·7008
,, 19	21 58 49	+16 24	0·0730	9·6978

The accompanying chart shows, approximately, the apparent path of the comet through the constellation Pegasus into Equuelus from now until December 5.



SIMULTANEOUS OCCURRENCE OF SOLAR AND MAGNETIC DISTURBANCES.—Writing in No. 3, vol. xx., of the *Astrophysical Journal*, Herr A. Nippoldt, of the Potsdam Magnetic Observatory, disagrees with Father Cortie's conclusion (published in *Astrophysical Journal*, pp. 287–293, vol. xviii., 1903) regarding the absence of any allied magnetic disturbances during the appearance of a vigorous sun-spot from May 19 to June 26, 1901.

Herr Nippoldt questions the advisability of introducing statistical gradations of the magnetic disturbances, and contends that the magnetic effect at any one place or at a number of places in approximately the same latitude is, possibly, not a measure of the solar cause. That is to say, an instrument near the poles might register a "great" when the Potsdam or Stonyhurst recorders only registered a "small" disturbance. Consequently, he would urge that when the magnetograph trace shows any marked divergence from the normal one might consider that a disturbance had taken place, and he shows, by a reproduction of the "horizontal-intensity" curve obtained at Potsdam on May 30–31, 1901, that a disturbance *did* take place during the time that the spot which Father Cortie especially discussed was on the sun.

Finally, he confirms M. Deslandres's opinion that in the future the solar observations should be continuous, and thereby become more strictly comparable with the magnetic records.

THE THIRD BAND OF THE AIR SPECTRUM.—In No. 16 (1904) of the *Comptes rendus* MM. H. Deslandres and A. Kannapell publish the results of a study of the third air band, which occurs in the more refrangible part of the ultra-violet end of the spectrum (λ 3000 to λ 2000), under a large dispersion.

The apparatus used consisted of a capillary vacuum tube closed with a plate of quartz under a pressure of less than 1 mm. of mercury, and a spectrograph containing two calcite prisms of 60° and two quartz lenses of 1·3 metres focal length. The latter produced a dispersion which, in the neighbourhood of N=42,189 (λ 2370), gave a separation of 0·005 mm. for a difference of 0·06 N.

The wave-lengths of the lines were obtained by reference to a spectrum of iron, using Kayser's fundamental values for the wave-lengths of the latter, and the authors state that in the individual values obtained for N the first six figures are correct.

In the results it is seen that, although the lines of the band may be separated into four series of doublets according to Deslandres's law, so that the difference of wave-lengths in each series advances in arithmetical progression, yet the variations from the computed values are greater than may be accounted for by errors of measurement, and, what is more remarkable, the sign of these variations for series i. and ii. is opposite to that obtained for series iii. and iv.

PRE-GLACIAL TOPOGRAPHY.[1]

THE beautifully illustrated memoir by Messrs. Wright and Muff, recently issued by the Royal Dublin Society, directs attention to an ancient rock-platform on which Glacial deposits were laid down in southern Ireland. The importance of such observations is clear when we consider the possibility of the preservation of a pre-Glacial, and perhaps Pliocene, fauna in favoured localities beneath the drift. At Courtmacsherry Bay, for example, south-west of Cork Harbour, a well marked rock-shelf occurs about 5 feet above high-water mark. On this rests a raised beach, with ferruginous sand and rows of pebbles, succeeded by the blown sand that accumulated when the uplift first occurred. Blocks from the adjacent cliff slipped down over the sand, and the series was then preserved by the Boulder-clay of the Glacial epoch. The wide stretch of coast, from Carnsore Point in co. Wexford to Baltimore in the west of co. Cork, over which this raised platform has been traced, affords ample opportunities for comparing the modern with the ancient features. The authors show that the pre-Glacial sea worked against a cliff about 100 feet in height, and consequently advanced slowly, leaving a denuded surface remarkably free from stacks and irregularities. This surface commonly lies about 12 feet above the modern beach. Unfortunately, no trace of fossils has yet appeared in the old beach-deposits, and the authors believe that even pebbles of limestone have been removed by percolating water. The Boulder-clay above contains the usual molluscs, including northern species.

The pre-Glacial beach is traced into the estuaries of the rivers of southern Ireland; consequently these inlets are still older. Since they have arisen from the submergence of river-valleys, the river-system and the submergence are of pre-Glacial age. This simple but important observation seems effectually to negative the views of the late Prof. Carvill Lewis and Mr. James Porter (*Irish Naturalist*, 1902, p. 153), who argued that deposits of glacial drift might have turned the lower portions of these rivers into their present north-and-south direction. We are thrown back,

FIG. 1.—Section in Courtmacsherry Bay, co. Cork, showing beach-gravel and sand resting on shore-platform, and overlain by Boulder-clay.

then, upon the view of Jukes in accounting for the courses of the Blackwater and the Lee, and may see, as the drift is slowly washed away, further and further developments of the pre-Glacial topography of Ireland. We have been apt to assume that the western fjords and rias originated when the glaciers retreated from them and the land sank upon the Atlantic side. It now becomes possible that the tongues of ice spread into pre-existing inlets, banking out the sea, and again admitting it in warmer times. Messrs. Wright and Muff even conclude, from British as well as Irish indications, that "a considerable portion of the coast-line of Southern Britain is of pre-glacial age. The approximation over so wide an area of the sea-level in pre-glacial times to that of the present day renders it very probable that Ireland was already insulated before the Glacial Period."

This only increases the difficulty of assuming an extinction of the fauna and flora of Ireland during the maximum extension of the ice. Many points of cheerful controversy lurk behind this straightforward and descriptive paper.

GRENVILLE A. J. COLE.

[1] "The Pre-Glacial Raised Beach of the South Coast of Ireland." By W. B. Wright and H. B. Muff. *Scientific Proceedings of the Royal Dublin Society*, vol. x. part ii. (Dublin: University Press, 1904.) Price 3s.

THE SALMON FISHERIES OF ENGLAND AND WALES.[1]

THIS report, although the first issued by the Board of Agriculture and Fisheries, is on the same lines as the forty-three previous annual reports of the Inspectors of Fisheries of England and Wales issued by the Board of Trade. It embodies the reports of the three Inspectors of Fisheries of England and Wales, Messrs. Archer and Fryer and Dr. Masterman. Besides these reports there are twelve appendices.

It is pleasing to learn from Mr. Archer's report that the salmon and trout season of 1903 was on the whole a good one. Mr. Archer refers to the long-standing difficulty of getting accurate statistics, and has made inquiries of the various boards of conservators as to the possible methods of obtaining them. The answers from these boards are not encouraging, and it is apparent that legislation is necessary in order to compel the recording of fish caught.

As usual, the want of funds by the boards of conservators, and the impossibility of their carrying out their proper work without such funds, is discussed. The present system by which the boards derive their revenue solely from the net and rod licences granted annually is obviously inadequate, and Mr. Archer quotes a resolution adopted unanimously by the Wye Board of Conservators, which is as follows:—

"That as the present system, by which the income of Fishery Boards in England and Wales depends entirely upon the amount realised from licences paid for nets and rods, has proved inadequate for the proper protection of the Fisheries, this Board is of opinion that legislation is urgently required to enable any Fishery Board, with the consent and subject to conditions formulated by the Board of Agriculture and Fisheries, to assess the annual value of all the Fisheries in its district and to levy a rate upon each Fishery for the purpose of providing the Board with a sufficient income for the proper protection and management of the Fisheries in the district under its charge."

We quote this, not because it is new, for the suggestion that some form of assessment of fisheries was probably unavoidable was made by the Salmon Fisheries Commission in their report in 1902, but because this move on the part of the Wye Board is worthy of commendation, and seems to us to be a move in the right direction. Too often our Royal Commissions make valuable reports which are pigeon-holed, and perhaps if the various boards of conservators pass similar resolutions to that passed by the Wye Board, and thus show some common agreement in the matter, it will go some way towards making those in authority take the matter up seriously. We have heard rumours of new salmon legislation, and let us hope that the financial side of the question will have full consideration.

Mr. Archer discusses further evidence brought forward by those who believe in the advantages of artificial propagation of salmon to show the success of the experiments upon the Weser in Germany, and he shows quite clearly that "not proven" must still be the verdict on the question of their success.

We are very glad to see from Mr. Fryer's report that salmon-marking experiments, which have now been carried on for some years in Scotland and Ireland and in Norway, have been undertaken in England. The percentage of returns of marked salmon is not very high, and the more the experiment is extended the better chance there is of gathering data which will throw some light upon the migratory habits of the species.

At last steps are being taken to alter the anomalous state of the law as to the English and Scottish sides of the Solway, as recommended by the Royal Commission on Tweed and Solway Fisheries, which sent in its report eight years ago.

There is a *résumé* of the various local questions with which Mr. Fryer has had to deal, and it is in reading this that one sees the futility of our present fishery laws. While inspectors or boards of conservators are corresponding with this manufacturer or that company or corporation as to the steps to be taken to mitigate some nuisance, the seasons slip by and nothing is done, often because there is insufficient power given under existing Acts to enforce those Acts being carried out.

Dr. Masterman, who was appointed only just before the end of the period with which the reports are required to deal, submits a short but interesting paper upon fish scales and upon the method of distinguishing the species of Salmonidæ. He refers to the work so far done upon fish scales as a means of recording the age of fishes, and in this connection we are glad to learn that the salmon scale is being studied at the present time by Mr. H. W. Johnston. The salmon scale is particularly interesting, as a number of rings—roughly about thirty—immediately surrounding the nucleus of the scale, and occupying roughly about 0·5 mm. or 0·6 mm., are much finer, and are situated much closer together, than the rings outside this area, perhaps representing the fresh-water life period of the individual.

We notice that the gross revenue returned during 1903 was 7504*l*., as against 6606*l*. in 1902. There were more rod licences issued than in any previous years since the commencement of the statistics, although the revenue therefrom, amounting to 3294*l*., was not equal to that realised in 1892, when it was 3386*l*. Revenue from nets was also slightly better than in 1902, being 3994*l*. as against 3905*l*., but in 1902 these licences realised less than in any year since 1867, the first year of the statistics, when only 3851*l*. was obtained.

Trout licences produced more in 1903 than in any previous year.

The report is published at His Majesty's Stationery Office, and is obtainable from Messrs. Eyre and Spottiswoode, or through any bookseller, price 8*d*.

FRANK BALFOUR BROWNE.

[1] Board of Agriculture and Fisheries. Annual Report of Proceedings under the Salmon and Freshwater Fisheries Acts, &c., for the Year 1903.

THE ANATOMY OF CORALS.[1]

THE classification of corals based upon the structure of the hard or skeletal parts alone, such as has been used by zoologists in general since the publication of Milne-Edwards and Haime's "Histoire Naturelle des Coralliaires" (1857–1860), is clearly not satisfactory. Some consideration in the system of the general anatomy of the soft tissues of the living coral polyps is clearly necessary if our classification is intended to indicate at all the natural grouping of the genera and species.

The startling discoveries made by Moseley during the voyage of the *Challenger*, that the coral Heliopora and the corals of the family Stylasteridæ do not belong even to the same order as the Madrepores, was an important, if not the principal, stimulus to the investigations of the anatomy of these zoophytes that have been published in recent years. Moseley himself, and his pupils Bourne, Fowler, and Sclater, and abroad von Heider and von Koch, contributed valuable memoirs on the anatomy of different species of Madreporaria, and slowly but without any further startling effects our knowledge grew. The result of these investigations was to confirm the belief in the close relationship of the Madrepores to the sea anemones, and to show that in the structure of the mesenteries, tentacles, and other organs there are differences between the genera of great systematic importance. But still our knowledge remained insufficient to suggest any permanent improvement on the Edwardsian system.

Some years ago Mr. Duerden, when stationed in the island of Jamaica, commenced a series of investigations upon the living corals of Kingston harbour and its neighbourhood. He took advantage of his opportunities for observing them alive on the reef and in his aquarium; he was equipped with a profound knowledge of the structure of the Actiniaria and of the modern methods of anatomical investigation. A series of papers and notes marked the period of his residence in Jamaica; but he reserved for this magnificent memoir of 200 quarto pages a general and detailed account of his work.

To say that the memoir is brilliant is to express an opinion, but to say that it is important is but to state a fact. Zoologists who are interested in the structure of corals must refer to this memoir as a great store of first-hand

[1] "West Indian Madreporarian Polyps." By J. E. Duerden. *Memoirs of the National Academy of Sciences*, vol. viii. (Washington, 1902.)

facts, and whoever attempts in the future to classify the Zoantharia must base his conclusions upon many of the anatomical details which are here for the first time adequately recorded.

No less than twenty-six species of corals, distributed among twenty genera, formed the materials of Mr. Duerden's investigations, and, although the descriptions are not exhaustive, there is a very full and interesting account of the general structure of all these forms.

The brilliancy of the colours of many corals in the living state has excited the interest and admiration of the naturalists and travellers who have visited coral reefs. These colours appear to be due to a variety of causes. In many cases the cavities of the polyps and the adjacent canals bear large numbers of the symbiotic algæ called Zooxanthellæ. The colour of these cells accounts for most of the prevailing brown and yellow-brown tints. In some few instances, such as *Astrangia solitaria* and *Phyllangia americana*, the Zooxanthellæ are nearly or wholly absent, and the polyps then are remarkably transparent and almost colourless. But there are in many cases definite pigment cells, both in the ectoderm and endoderm, which may add to or give the only colour effect of the expanded polyps. A third cause of colour is to be found in the boring filamentous red and bright green algæ with which many corals are infested.

The chapter dealing with the structure and arrangement of the tentacles is one of exceptional interest. To investigators in this country the tentacles have always offered difficulties and uncertainties. However carefully the

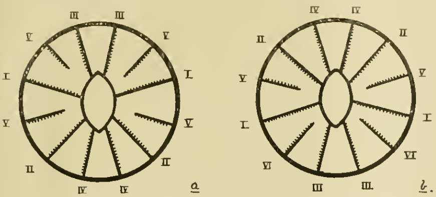


Fig. 1.—Diagrammatic figures showing the arrangement of the first six pairs of mesenteries in (*a*) Madrepora; (*b*) most other species of Madreporaria. The upper side of each is the side turned towards the axis (axial), and the lower is away from the axis (abaxial). The axial side of Madrepora is ventral, whereas in most other species it is dorsal. (The upper of the bilateral pairs marked v, v in *a* should have been vi, vi).

material they can obtain is preserved, it is impossible to prevent a great deal of retraction and shrinkage. Mr. Duerden's careful observations, therefore, of the fully expanded tentacles of his living corals form a particularly welcome addition to our knowledge.

The most elaborate, and perhaps we may say the most important, part of the author's work deals with the number and arrangement of the mesenteries. This is not the place to relate or to criticise details which are necessarily highly technical and somewhat intricate; but it may be said that it is upon the results of this part of his investigations that the suggestions he has to offer for the classification of the order very largely depend.

If we regard the Madreporaria as an order, we may divide it into two suborders:—(1) the Entocnemaria, (2) the Cyclocnemaria. In the former the mesenteries always arise in bilateral pairs, and beyond the protocnemic stage the increase takes place within one or both of the directive entocœles. In the latter the mesenteries, beyond the protocnemic stage, arise in isocnemic unilateral pairs within the primary exocœles. The Entocnemaria are represented only by the single section Perforata, the Cyclocnemaria by the two sections Aporosa and Fungacea. The arrangement of the families of the Aporosa into two groups, the Gemmantes and the Fissiparantes, based upon the method of asexual reproduction—by gemmation or by stomodæal fission—supported as it is by Mr. Duerden's later researches, can be regarded as only tentative and suggestive at present; but the facts upon which it is based are among the most interesting and important of his many results.

It is a matter for regret, which many will share with the reviewer, that in the introduction to the systematic part of the memoir Mr. Duerden has not given us his views as to the relation of the Actiniaria to the Madreporaria, a difficult matter upon which no one is more competent to express an opinion.

There are some points in the terminology employed by Mr. Duerden that appear to me to be open to some objection. "By universal acceptation," he says, "Cœnenchyme is the calcareous deposit originating from the cœnosarc." This is most unfortunate. The word was introduced by Milne-Edwards and Haime to signify the common tissue which precedes the existence of the polyps and plays a considerable part in their constitution. In a similar sense Kölliker uses the expression as the tissue that gives rise to the axis of the precious coral. It was for the soft, not the hard, parts of the "common tissue" that the word was introduced. But to say that by "universal acceptation" the word is used for the calcareous deposit is not accurate, for the writers on Alcyonarians invariably use the word to signify both hard and soft parts, other than the axis, which lie between the neighbouring zooids.

Again, the use of the word "gastro-cœlom" for the general body-cavity of the Cœlenterate, suggesting as it does a compromise with the old-fashioned gastro-vascular cavity, is to be regretted. Either of the words "enterocœl" or "cœlenteron" is preferable.

On the other hand, the discussion (pp. 443–4) on the use of terms referring to the aspects of the cœlenterate body is excellent. The aspect of the body towards which the faces bearing the musculature of the two complete bilateral pairs of mesenteries, i, ii, are turned was called by Haddon the "sulcar" aspect, and the opposite the "sulcular" aspect. This terminology was adopted by Bourne in his "Anthozoa" of Lankester's "Treatise on Zoology." Marshall, in writing upon certain Alcyonarians, had previously used the terms "abaxial" and "axial" respectively, and these terms were introduced to supersede the "ventral" and "dorsal" of Moseley, Kölliker, and others. It is quite clear now from Mr. Duerden's remarks that the use of the newer sets of terms can lead to nothing but confusion. Anything that can be called a "sulcus" occurs only in Alcyonaria and a few Zoantharia; the "sulculus" is a myth.

But of more importance is the fact that, as shown by Carlgren, the "sulcus" is dorsal in Cerianthus and ventral in the other forms where it occurs. The axial-abaxial relationship, moreover, is not constant. In the Alcyonaria and in the majority of Zoantharia the dorsal aspect of the polyp is turned towards the axis of the colony, and the ventral aspect away from the axis; but in Madrepora this arrangement is reversed. In the solitary Anthozoa the use of the terms "axial" and "abaxial" has no meaning.

The conclusion is then that, although they are open to some objections, the use of the terms "dorsal" and "ventral" for the two aspects of the bilateral anthozoon must be retained.

In conclusion, Mr. Duerden may be congratulated on the production of a really great work which marks an important step forward in the history of our knowledge of the Cœlenterata.

Sydney J. Hickson.

SEISMOLOGICAL NOTES.

In No. 10, vol. ix., of the *Boll. Soc. Sismol. Italiana*, Dr. Agamennone records the fact that his idea of taking photographs, at intervals, from fixed points, in regions suspected of bradiseismic movements, was independently suggested by F. Salmojraghi. The object is to detect slow or rapid changes of relative level in the interior of a continent, where there is no such convenient datum level as is afforded by the sea, and the paper is specially devoted to showing that the effects of refraction, being irregular, would not prevent the detection of a bradiseismic change of relative level in a regular series of photographic records.

No. 23 of the *Mittheilungen* of the Austrian Earthquake Commission is a paper by Prof. Láska on the application of earthquake observations to the investigation of the constitution of the interior of the earth. From a consideration of the observations of the Caraccas earthquake of

October 29, 1900, in Europe and Japan, he arrives at the conclusion that if the earth consists of a central core and an outer shell, each of uniform composition, the outer shell must have a thickness of not more than 500 km. This result would fall in with Milne's hypothesis, but as this is considered to be inconsistent with the facts of astronomy, he adopts the conclusion that there is a continuous increase in the rate of propagation from the surface to the centre of the earth, this increase being much more rapid near the surface than at greater depths; this condition would result in the wave motion being propagated along curvilinear paths, and give rise to a small apparent rate of propagation near the origin as compared with that found at greater distances. The value of Prof. Láska's conclusion is diminished by the fact that it is based on the consideration of only a single earthquake, the time of origin of which is not known by direct observation.

In the *Boll. dell Accademia Gioenia di Scienze Naturali in Catania* of February, 1904, Prof. Ricco returns to the consideration of the gravitational anomalies he has detected under Mount Etna, and shows that they are accompanied by corresponding irregularities in the course of the lines of equal magnetic force. Prof. Ricco merely records the fact of these magnetic irregularities, but the observation is important in its bearing on the explanation of the gravitational anomaly, which is equivalent to the removal of more than 1000 metres in thickness of rock, at sea level, from under the summit of the mountain. It is inconceivable that this can be due to the existence of huge cavities in the earth; more probably the effect is due to the existence of a "root" of the mountain, depressed into a denser magma, by the buoyancy of which the visible mountain is supported. There is independent geological evidence that Mount Etna lies over a region of special subsidence, the basis of sedimentary rock on which it was heaped up having been depressed during its formation, and if we suppose this depression to have caused the displacement of denser by less dense rocks to a considerable depth, we get an explanation of both gravitational and magnetic anomalies. A rough calculation shows that the buoyancy of the downward protuberance would, on the most favourable supposition, be inadequate to support the whole weight of the mountain, and it must be concluded that Mount Etna is not in a condition of complete isostacy, but partially supported by an upward force.

In No. 1 of the tenth volume of the *Bollettino* of the Italian Seismological Society Prof. Grablovitz discusses the vexed question of the nature of the wave motion in the third phase of the record of a distant earthquake. The occasion is the series of earthquakes which originated in the Balkan peninsula on April 4, 1904; as registered at Ischia, the great waves had a period of about 8 seconds, and, if the records of the horizontal pendula are interpreted as due to tilting, they indicate angular movements of as much as 100 seconds of arc, and this means a vertical movement of more than 2 metres; in the same earthquakes the instrument for recording the vertical component of the movement gave only negative results. From this Prof. Grablovitz concludes that the records obtained from the horizontal pendula and the *vasca sismica* are not due to tilting; he admits that there may have been a small amount of vertical movement which the instrument failed to record, but this must have been much smaller than that obtained by calculation in the ordinary way.

The same number contains a description, by Dr. Agamennone, of a new form of very delicate seismoscope, adapted for the detection of both near and distant earthquakes; and an account, by D. Vassalo, illustrated by a sketch plan, of the condition of Stromboli in June, 1904.

Dr. R. von Kövesligethy, of Budapest, has made an ingenious calculation of the work done by great earthquakes. Regarding the observed irregularities in the displacement of the poles as compounded of a regular epicycloid movement, and an irregular movement, which has been shown by Prof. Milne to vary with the frequency of great earthquakes, he calculates that each of the 200 great earthquakes registered during the eight years 1895–1902 caused an average displacement of the pole through $-0''.00275$; the negative sign is interesting, as showing that the tendency of great earthquakes is to diminish the departure of the instantaneous from the mean axis of revolution. The work done by this displacement is calculated as equivalent to that which would be required to raise a mass equal to that of the earth through 1.2 mm. at its surface (*Die Erdbebenwarte*, iii., 1904, pp. 196–202).

Prof. Omori contributes a note on the variations of sea level on the east coast of Japan to part xiii. of vol. ii. of the reports of the Tokio Physico-Mathematical Society. The curves of barometric pressure and sea level are very similar, and approximately reversed; the maximum sea level is in September and the minimum in February, while the minimum barometric pressure is in July and the maximum in November. The range of barometric pressure is 9·3 m., corresponding to 126 mm. of sea level, while the range of sea level amounts to 276 mm. at Misaki and 219 mm. at Ayukaua; these figures show that while the local variations of barometric pressure doubtless influence the level of the sea, this is also dependent on the variations of barometric pressure over the Pacific Ocean. The net result is that the variations of pressure on the bed of the sea are the opposite of those on the adjoining land, and Prof. Omori correlates this fact with the observed variations in frequency of earthquakes originating off the east coast of Japan.

The *Deutschen Rundschau*, vol. xxvii., part i., contains an interesting note, originally printed in the Honolulu *Evening Bulletin* of June 21, 1904, by Dr. Otto Kuntze on the present condition of Kilauea, which he describes as being now dormant or extinct. There are no longer any "lakes of fire"; the old lake of lava has cooled, and is covered by a sheet of rock, and though steam issues from some of the cracks in this, no molten, or even red-hot, rock is now visible. A remarkable statement in the note is that the lava lake, formerly visible, did not mark an active vent, but was merely a reservoir of slowly cooling lava, which had flowed from the crater of Halemaumau and accumulated in the lowest part of the caldera of Kilauea. There is no authentic record of this crater, which rises from the floor of the caldera, having been in eruption since June 24, 1897, and the paper contains some strongly worded comments on the mis-statements regarding the present condition of the crater, printed in the guide books issued by the tourist agencies, mis-statements which are unnecessary, as Kilauea, even in its existing condition, is nevertheless one of the most interesting sights in the world, of which Dr. Kuntz claims that few have seen more than himself.

In No. 17 of the *Publications* of the Earthquake Investigation Committee in Foreign Languages, Mr. S. Kusakabe continues his investigations of the modulus of elasticity of rocks, and publishes some interesting results. He finds that all rocks show a marked hysteresis, that is to say, when exposed to a stress they go on yielding, apparently to an indefinite extent, though after a while the effect is masked by that due to changes of temperature, and when released from the stress the recovery takes place at a continuously decreasing rate, but apparently is never complete. Rocks in a state of strain have a higher modulus of elasticity than in the unstrained condition, and if exposed to a series of alternating stresses, increasing and decreasing in opposite directions, the mean modulus for the whole cycle is distinctly greater than that obtained by the usual method of determination. The mean modulus of elasticity decreases with the increase in amplitude of the cycle, from which it is concluded that the rate of transmission of earthquake waves is a function of their amplitude, and is less for a larger than for a smaller amplitude. The modulus of elasticity was found to have a maximum value at about 9° C., and to decrease by about half per cent. of its value for each rise of one degree of temperature; from this it is inferred that there is a tendency towards a decrease in the rate of transmission as the depth of the wave path increases. On the other hand, the average rate of transmission is higher in Archæan and Palæozoic than in the newer rocks, and from these two considerations the deduction is drawn that there is a level of maximum velocity of transmission. We may point out that in arriving at this conclusion no account is taken of the increase in pressure with depth, and the consequent increase in compression of the rocks.

Prof. Imamura, in the Tokio *Sugaku-Butsurigakkwai* (Tokio Physico-Mathematical Society), vol. ii., No. 13, adopts the same notion that there is a level of maximum rate of propagation, and places this level at a depth of a few hundred kilometres. The estimate is based on the high rate of transmission, as much as 16 km. per second, obtained for near earthquakes by a calculation from the observed duration of the preliminary tremors, on the assumption that their rate of propagation is uniform. In another part of the paper he gives the results of direct calculation in the case of ten earthquakes the time of origin of which was known; for Tokio, at a mean epicentral distance of 665 km., the rates were 7·5 km. per second for the first, and 5·5 km. per second for the second, phase of the preliminary tremors, while Osaka, at a mean epicentral distance of 856 km., gave 8·2 km. and 5·8 km. per second respectively. These values may be accepted as more trustworthy than those obtained by the other method.

Globus of September 15 contains a note by Wilhelm Krebs on the distribution of submarine earthquakes, illustrated by a map of the world, on which all the recorded instances are plotted. Many of these are submarine volcanic eruptions, and their great concentration in the middle of the narrowest part of the Atlantic Ocean, between Africa and South America, is very striking. The utility of charts of this description would be much increased if they bore on their face indications of the principal trade routes of the oceans; as it is, some doubt may be felt as to whether the much greater frequency of recorded seismic phenomena in the Atlantic Ocean may not be due to a very large extent to the fact that this ocean is, proportionately, much more frequented than the Pacific. The other centres of activity, according to the map, are the West Indian islands, the west coast of South America, the south of the Bay of Bengal, the Malay Archipelago, the east coast of Japan, and the Mediterranean.

THE RACIAL ELEMENTS IN THE PRESENT POPULATION OF EUROPE.[1]

THE lecturer opened his discourse with a graceful acknowledgment of the honour conferred upon him by the Anthropological Institute, and paid a respectful tribute to the memory of Huxley, who was the first to make the two-fold division of the peoples of Europe into xanthochroid and melanochroid races. With the name of Huxley he coupled the names of Beddoe and Broca as pioneers in European ethnographical research. To the two races mentioned above a third was soon added—the Mediterranean race—and the lecturer himself had in 1897 made a further step by dividing the population of Europe into six main races. He then dealt with criticisms which had been passed upon his own theories, chiefly by the American ethnologist Ripley, and stated that the further researches upon which he had continually been engaged since that date, and of which he was about to lay the results before the audience, had confirmed him in his first opinion. During a considerable number of years he had been diligently collecting statistics concerning the stature, colour of eyes and hair, and head measurements of the various nationalities, and now, in spite of certain *lacunae,* some of which he regretted to observe occurred in Britain, he was able to say that he possessed data covering the whole of Europe.

In no part of the world does there exist such a blending of races, such an intermixture of somatic characters, as amongst the ethnic groups which constitute the present populations of Europe, even when we make abstraction of the "national" groupings, such as Austro-Hungarian monarchy, for instance, and consider only the properly called ethnic or linguistic groups, like Slavic, Roman, Germanic, &c.

In an anthropological study of the European populations it is impossible to proceed in the same way as in the case of the majority of the so-called uncivilised peoples, where the measurements of a small series of individuals (often twenty or fifty) suffices to give an idea of the whole population.

Another method is required for the study of complicated ethnic groups. It is the combination of the statistical and the cartographical methods, in which the observations taken on many thousands of individuals permit the investigator to exclude the influence of accidental variations, and to deduce one or several racial types in the population of a given region.

Such measurements concerning the principal racial characters, for instance, the stature, the colours of the hair and the eyes, the shape of the head (expressed principally by the cephalic index, *i.e.* the centesimal relation between the length and the breadth of the head), &c., have been made in nearly all the parts of Europe—especially by the examination of conscripts for the military service.

The only countries in which such measurements are now absent are Montenegro, some provinces of European Turkey and of Caucasus. Some other countries, and not of the least civilised, have not yet furnished sufficient information. For instance, there is no data concerning the cephalic index and the stature for Prussia and some other States of northern Germany; concerning cephalic index and pigmentation for Hungary, Roumania, and Servia; concerning the cephalic index for some parts of Switzerland, of Holland, of Russia, and, the lecturer regretted to have to mention that, for some parts of the United Kingdom.

The lecturer expressed then the hope that in a short time all these *lacunae* would disappear; considering this fact, that many serious efforts are made now for studying the populations in Germany, Roumania, Russia, and Great Britain. In every case this *lacunae* represent only a small part of Europe. For the rest, the details are sufficient, and furnish a basis for general deductions.

Taking the whole mass of these results (about 20,000, expressing the observations on more than 3,000,000 of individuals), and correcting them as to be comparable with each other, the lecturer explained how he put on the maps of Europe, of a comparatively large scale (1/10,000,000), district by district, this different data, and obtained in this way the distribution of every one of the principal somatic characters throughout the different regions of Europe.

Concerning the cephalic index, Europe can be divided into four regions:—

(1) A region of long-headed people with medium-headed areas in the north-west (Scandinavia, north of Germany, Holland, Great Britain).

(2) A region in the south-west (Portugal, Spain, south of Italy, east of Balkan Peninsula), characterised by even greater length of head.

(3) A very short-headed region in western Central Europe (south-eastern France, southern Germany, northern Italy, Switzerland) and in the immediate west of the Balkan Peninsula.

(4) A region comprising Russia and Poland subdivided into three, moderately long-headed in the centre, and medium-headed on the east and west.

After discussing these regions in detail, he proceeded to the subject of stature. He remarked that the great mass of his data was compiled from measurements taken on conscripts, and explained an ingenious method by which these measurements could be modified so that they represented fairly the typical stature of the full-grown male population. In Europe there are no people of very short stature according to the classification invented by Topinard (under 1,600 mm., or 63 inches); on the other hand, this continent is distinguished by the tallest race known, the Highlanders of Scotland. Hence, for the purpose of this lecture, he would speak of statures ranging between 1650 and 1675 mm. (65 inches to 66 inches) as *medium,* those below these measurements as *short,* and those above as *tall.* Tall statures are, with a very few exceptions, particularly well represented in the north-west; the rest of the population of Europe is, again with certain exceptions, chiefly in the Balkan Peninsula, of medium or short stature. People of medium stature are found grouped round the regions where the tall peoples occur, and connect the tall races of the north-west with those of the south-east. Short statures he divided into three groups, eastern (Russia), western (France), and southern (Spain and Italy), and showed how the eastern zone communicated by narrow "channels" with other centres of short stature.

In grouping the peoples of Europe with regard to colour of complexion, eyes and hair, he had taken as the basis of his classification the *brunette* type (eyes and hair *dark* brown or black), as the most easy of recognition. Those peoples among whom are found from 17 per cent. to 30 per cent. of brunettes may be called *intermediate.* Where less

[1] Summary of the Fifth Huxley Memorial Lecture, delivered before the Anthropological Institute of Great Britain and Ireland, on October 7, by Dr. J. Deniker, president of the Anthropological Society of Paris, to whom was presented the Huxley Memorial medal.

than 17 per cent. occur the population is termed *blond*, where more than 30 per cent. dark.

According to this grouping the two extremes are the Swedish (3 per cent. brunettes) and southern Italy (70 per cent.). From this point of view the map showed that north Europe was mainly blond, South Europe dark, and Central Europe intermediate. He traced the southern limit of the blond races through the various countries, showing that it nowhere reached below the 50th parallel in Central Europe, and below 55th parallel in Britain and Russia. The northern limit of the dark peoples is more irregular. In the intermediate zone blond areas are rare (one of these occur in south England, *i.e.* Berkshire, Oxfordshire, Hampshire, Sussex and Middlesex), dark areas fairly numerous, but individually very small. Intermediate areas in the blond zone are only found in the British Isles, but in the dark zone are fairly frequent in western Europe.

From these data and certain other considerations relating to shape of face and nose, character of hair, &c., Dr. Deniker had been confirmed in his theory that the present population of Europe is composed of six main races. These he proceeded to enumerate, giving their typical characteristics, tracing their positions throughout the map, and indicating the proportions in which they had intermingled to form the existing populations of the various countries. The following is an abbreviated sketch of his classification:—

(1) A race, blond, wavy-haired, long-headed, very tall, with long face, a straight prominent nose; the *northern race*, so called because its representatives are confined almost exclusively to North Europe. This is the *Cymric race* of Broca, the *Germanic* or *Reihengräber* race of German authors, the *Teutonic race* of Ripley, or the *Homo Europaeus* of Lapouge.

With this race is connected a subrace, blond or intermediate, straight-haired, medium-headed, of tall or medium stature, angular face, and *retroussé* nose, the *subnorthern race*, found in the neighbourhood of the *northern*.

(2) A race blond, straight-haired, moderately short-headed, and of short stature, broad square face, nose often *retroussé*; the *Eastern race*, so named since its principal home is in eastern Europe.

Connected with this is a subrace, blond or intermediate, medium-headed, of very short stature, named the *Vistulian race*, occurring in Poland, parts of Prussia, and probably Saxony and Silesia.

(3) A race dark, hair sometimes curly, long-headed, of very short stature, straight or *retroussé* nose; the *Ibero-insular race*. This is the *Mediterranean race*, or *Homo Mediterraniensis* of certain authors, found chiefly in the Iberian Peninsula and the islands of the western Mediterranean.

(4) A race dark, very short and round headed, of short stature, round face, broad nose, and thick-set body; the *Cevenole* or *western race*. This type occurs in its greatest purity in the extreme west of Europe, though found sporadically elsewhere. This is the race called variously by other authors *Celtic, Celto-Ligurian, Celto-Slavonic, Sarmatian, Rhetian, Ligurian*, or *Homo Alpinus*.

(5) A race very dark, moderately long-headed, and fairly tall; the *Littoral*, or *Atlanto-Mediterranean race*, situated on the coast of the Mediterranean, from Gibraltar to the Tiber, and in occasional groups on the Atlantic Littoral, but never more than 150 miles from the sea.

(6) A race dark, short-headed, tall, nose slender and straight or arched; the *Adriatic* or *Dinaric race*, which is found grouped round the northern Adriatic, particularly in Bosnia, Dalmatia, Croatia, and the centre of the Balkan Peninsula, but found also sporadically and with somewhat modified characteristics in Central Europe.

With the last two races are connected two secondary races, which are perhaps no more than types, produced by the admixture of the two former with each other or with the *northern, subnorthern*, and *western* races.

(*a*) The north-western, long- or medium-headed, situated between the *northern* and *Atlanto-Mediterranean* races, spread chiefly in Ireland.

(*b*) The sub-Adriatic, moderately short-headed, more rarely short-headed, of medium stature, found in many parts of Central Europe, probably the result of admixture between the *Adriatic* and *subnorthern* and *western* races.

REPORT OF THE SURVEY OF INDIA.

The Indian Survey report is a full record of useful work and widespread progress, but it lacks some of the interest which used to attach formerly to the very varied character of the work undertaken by the Survey department. The scientific section of the report is included within the limits of a few pages; and the narratives of individual surveyors (which always formed a most interesting chapter or two) have entirely disappeared.

The main work of the department, now, is the revision of old mapping in districts which have been sorely in need of such revision for many years. The plains of India, in fact, are being re-surveyed, and, on the whole, the work of the department is increasing, rather than diminishing, on purely utilitarian lines. It would almost seem as if the days of Indian geodetic triangulation, which once took such a strong lead amongst the scientific triangulations of the world, were numbered. Only one first-class series is in progress at present, and this is to connect the great meridional Mandalay series of Burma with a future extension following the Salwin valley. It is, however, satisfactory that the practice and training necessary for surveyors in this class of work is well maintained so far, for it is impossible to say what the future may demand in the way of similar extensions in Persia, Tibet, or even in China.

One subject of special interest dealt with in the report is the deflection of gravity. In 1901 a theory was advanced by Major Burrard that deflections of gravity in India could be classified by regions. Astronomical determinations of latitude have therefore been carried systematically through considerable arcs to prove whether this theory were sound. The results undoubtedly support Major Burrard's prediction, and it is expected that the substitution of this regional law for the old theory of local attraction will exercise a profound influence on future investigations.

The report on geographical or reconnaissance surveys (on the scale of 1/500,000) includes an out-turn of 38,000 square miles of survey of this class by one native assistant in western Tibet. This seems a remarkably large out-turn for one surveyor to secure during the progress of a "shooting expedition"; but it is only one instance amongst many of the remarkable capacity of well trained native explorers for work of this nature. In reasonably easy country there seems to be hardly any limit to their power of producing fairly accurate geographical maps so long as they have a few fixed points to work upon.

In this connection it is well to note the remarks of the Surveyor-General (Colonel St. G. Gore) on the difficulty that constantly faces him of finding qualified native assistants to meet the demands of military or political missions or geographical expeditions. He most justly observes that in the first place it is difficult to find the men who possess the necessary qualifications, and in the second that, having found them, it is impossible to train them efficiently in country which is unsuitable for instruction. It is due to a combination of natural aptitude with perfect educational environment that the native explorer of the Indian Survey becomes so extraordinarily efficient as a topographer. If these men are wanted (and they *are* wanted) for Imperial duty over half of the continents of Africa and Asia, it seems but fair that the Imperial Treasury should contribute something towards maintaining a sufficient staff to meet all demands.

T. H. H.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The State Medicine Syndicate reports that during the current year there were 57 candidates for the diploma in public health, of whom 34 were successful. For the diploma in tropical medicine and hygiene there were 12 candidates, of whom 8 were successful. The syndicate has resolved to hold two examinations for the latter diploma in 1905, the first beginning on January 10, the second on August 8.

Applications for the vacant readership in botany (annual stipend 300*l*.) are to be sent to the Vice-Chancellor by Tuesday, November 15.

Mr. R. H. Lock, late Frank Smart student in botany, has been elected to a Drosier fellowship at Gonville and

Caius College. Dr. A. C. Haddon, university lecturer in ethnology, has been elected to a senior fellowship at Christ's College.

A department of experimental psychology has been established, says *Science*, in the Western University of Pennsylvania, under the charge of Dr. Edmund B. Huey.

The new medical buildings of the University of Liverpool will be opened by the Chancellor, Lord Derby, on Saturday, November 12, and on the same day Lord Kelvin will formally open the new George Holt Physics Laboratory.

The council of the University of Liverpool has just appointed Dr. J. H. Grindley lecturer in engineering, Mr. A. Leitch assistant lecturer in engineering, and Mr. G. E. Piper demonstrator in applied mechanics and engineering design and drawing.

We regret to learn of the death of Prof. D. W. Fiske on September 17. The bulk of his estate, including the great book collections, has been left to Cornell University. It is stated in *Science* that the bequest amounts to between 100,000*l*. and 200,000*l*.

Dr. E. G. Coker, of the McGill University, Montreal, has been appointed to the professorship of mechanical engineering and applied mathematics at the City and Guilds Technical College, Finsbury, vacated by the appointment of Prof. Dalby to the professorship of engineering at the institute's Central Technical College.

Mr. Francis Galton, F.R.S., has endowed a research fellowship in the University of London for the promotion of the study of "national eugenics," defined as "the study of the agencies under social control that may improve or impair the racial qualities of future generations either physically or mentally." The fellowship is of the annual value of 250*l*., is tenable for one year in the first instance, and is renewable for two subsequent years. The person appointed to the fellowship will be required to devote the whole of his time to the study of the subject, and in particular to carry out investigations into the history of classes and families, and to deliver lectures and publish memoirs on the subject of his investigations.

The report on the work of the department of technology of the City and Guilds of London Institute for the session 1903–4 has now been published. The general introduction to the report points out that the encouragement now offered by the Board of Education to the teaching of technology is among the causes contributing to the increase in the number of students in the institute's registered classes. Compared with the figures given in last year's report, those for the past session show a decided improvement. In the different branches of technology, the number of students in November last attending classes in the United Kingdom was 41,089 as compared with 38,638 in the previous year, and the number of examinees was 20,051 as against 17,989. The closer connection of the work of the department with that of the Board of Education is shown, also, not only by the recognition of the City and Guilds of London Institute as an organisation for the inspection of classes in technology, manual training, and domestic economy, but also by the stamping by the Board of Education of full certificates granted by the institute to students who pass in technology and have "qualified in the cognate science or art subjects required by the institute." It is interesting to find that the question of arranging courses of instruction adapted to the requirements of operatives engaged in ship-building is under consideration; it is intended to extend the syllabus in ship carpentry and joinery so as to make it suitable for artisans engaged in other branches of the industry. Care is to be taken not to overlap the syllabus in naval architecture of the Board of Education, and it is expected that the new examination will appeal to a different class of candidates from those who have hitherto presented themselves for examination. It should be noted that the department of technology of the institute occupies an intermediate position between the central and local education authorities and the several trade societies. The latter bodies have shown a growing interest in technical instruction, and year by year the department has grown into more intimate relationship with these trade organisations.

SOCIETIES AND ACADEMIES.

London.

Entomological Society, October 19.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Dr. T. A. **Chapman** exhibited a series of *Lozopera deaurana*, Peyr., bred last spring at Hyères, a species regarded as lost, or mythical, until he re-discovered it three years ago at Ile Ste. Marguerite, Cannes. He also exhibited on behalf of Mr. Hugh Main a specimen of *Pieris brassicae*, the anterior and posterior wings of which had been symmetrically injured, probably by the girdle when in the pupal stage.—Mr. G. C. **Champion** exhibited specimens of *Nothorrhina muricata*, Dalm., from Las Navas, Spain, found trapped in the earthenware cups used to collect the exuding resin on the trunks of pines.—Mr. H. St. J. **Donisthorpe** exhibited specimens of the rare beetle, *Cis bilamellatus*, Wood, taken at Shirley on October 10 last.—Mr. W. J. **Lucas** exhibited a ♀ specimen of the rare dragonfly *Agrion armatum*. He said that a ♂ and a ♀ were taken in the Broads by Mr. F. B. Browne last year, and this year about ten more, probably all ♀♀, were taken in the same district. Besides these there are possibly no other examples in Britain. It is quite distinct from our other six blue Agrionines in form and colouring.—Mr. W. J. **Kaye** exhibited five specimens of *Dianthoecia luteago*, var. *ficklini*, from North Cornwall, taken during the first week of July, 1901, and remarked that while the typical *D. luteago* of the Continent was tolerably constant, wherever it occurred in Britain it assumed a special local form.—Prof. E. B. **Poulton,** F.R.S., exhibited a number of specimens of the genus Sphecodes, five species in all, and of *Ocyptera brevicornis*, a Tachinid, their mimetic fly, illustrative of Mr. Edward Saunders's recent paper on the aculeate Hymenoptera from the Balearic Islands and Spain.—Mr. C. A. J. **Rothney** sent for exhibition a series of the Indian ant *Myrmicaria fodiens*, from a colony established thirty-two years in the big banyan tree in Barrackpore Park; and specimens of *Monomorium salomonis*, Lin., and *Solenopsis geminata*, Fab., successfully encouraged in Madras as a protection against white ants—termites.—Mr. E. E. **Green** exhibited a spider from Ceylon mimetic of some coccinellid beetle, at present unidentified.—Colonel J. W. **Yerbury** exhibited specimens, and read notes upon, deer gadflies taken by him this year in Scotland.

Manchester.

Literary and Philosophical Society, October 18.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—Dr. W. A. **Bone** read a paper entitled "The Mode of Combustion of Hydrocarbons," in which he gave an account of researches carried out by Messrs. R. V. Wheeler and W. E. Stockings and himself, at the Owens College, on the slow combustion of hydrocarbons below their ignition points.—Dr. Charles H. **Lees** exhibited a modification of the U-tube used in electrolysis which he had devised, and which diminishes to about one-half the correction for pressure due to the column of liquid in the unsealed limb of the tube.

Paris.

Academy of Sciences, October 24.—M. Mascart in the chair.—Stereoscopy without a stereoscope: J. **Violle.** In a camera, furnished with two objectives, directly in front of the plate is placed a grating, ruled with 100 black lines to the inch. The negative from this contains the two sets of images, each crossed with a set of fine bands. When this is looked at through a similar ruled plate the picture appears in relief.—On the modifications of glycolysis in the capillaries caused by local modification of the temperature: R. **Lepine** and M. **Boulud.** The experiments were made on dogs. Relatively to the arterial blood, the venous blood of the warmer part always contains a little more sugar. In the case of the paw kept cool, this difference is increased to about double, and is in the same direction.—On integral functions of finite order: L. **Leau.**—On certain partial differential equations of the second order: S. **Bernstein.**—On the period of antennæ of different forms: C. **Tissot.** On account of the high value of the deadening, the rotating mirror method does not give accurate figures for the period, and the author describes another method which is free from this objection. It is shown that, independently of the principal period, the antennæ give rise to oscillations of a higher order, the laws for which have been experimentally worked out.—Study of the sea bottom of the North Atlantic; the Henderson and Chaucer Banks: M. **Thoulet.** The examination of the deposits obtained from the bed of the North Atlantic by the Prince of Monaco renders the existence of the Henderson and Chaucer Banks improbable. The proportion of lime found was remarkably uniform, whilst the amount of sand was very variable. It results that the usual method of classification by sand, although very useful near the coasts, is useless for the study of great depths.—Remarks on a recent series of calorimetric determinations: P. **Lemoult.** Some recent calorimetric determinations with the Krœker bomb by E. Fischer and F. Wrede are re-calculated to constant pressure, and the results compared with the original figures of Berthelot and some later unpublished ones of Landrieu. The numbers given by the formulæ of the author are also tabulated in parallel column.—The extraction of vanadium from the natural lead vanadate and the manufacture of some alloys of this metal: H. **Herrenschmidt.** The mineral is treated in a reverberatory furnace with carbonate of soda and carbon, and a slag obtained containing the vanadate, aluminate, and silicate of soda along with oxide of iron. This is again melted, and air blown through until the vanadium is completely oxidised, and the sodium vanadate lixiviated.—On a new anhydride of dulcite: P. **Carré.** The new anhydride is obtained by heating dulcite with phosphoric acid at 135° C. It is isomeric with mannide, and is named dulcide.—A new method for preparing organic derivatives of phosphorus: V. **Auger.** The solution obtained by dissolving granulated phosphorus in alcoholic soda is heated with an alkyl iodide or bromide. An alkylphosphine is formed, recognised after its oxidation to the corresponding alkylphosphinic acid.—The influence of the products of the breaking down of albuminoid materials on the saponification of oils by cytoplasma: Ed. **Urbain,** L. **Perruchon,** and J. **Lancon.**—On the tyrosinase of the fly: C. **Gessard.** In *Lucilia Caesar*, in both stages in the life of the insect, the coloration of the integument is due to the reaction of the tyrosinase.—On a parasite of *Audouinia tentaculata*, *Angeiocystis audouiniae*: Louis **Brasil.**—Oscillations of coast-line animals synchronous with the tide: Georges **Bohn.**—On the geology of the Lower Engadine: Pierre **Termier.**—On the toxicity of the chlorohydrate of amyleine: L. **Launoy.**

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 3.

CHEMICAL SOCIETY, at 8.—Note on the Action of Nitric Acid on the Ethers: J. B Cohen and J. Gatecliff.—The Condensation of Formaldehyde with Acetone (Preliminary Note): E. A. Werner.—Union of Hydrogen and Chlorine. Rate of Decay of Activity of Chlorine: J. W. Mellor.—The Action of Phthalic Anhydride on α-Naphthylmagnesium-bromide: S. S. Pickles and C. Weizmann.—The Constitution of Nitrogen Iodide: O. Silberrad.—The Available Plant Food in Soils: H. Ingle.—The Combustion of Ethylene: W. A. Bone and R. V. Wheeler.—The Decomposition of Methylurea: C. E. Fawsitt.—The Influence of Certain Salts and Organic Bodies on the Oxidation of Guaiacum: Miss E. G. Willcock.—The Influence of Potassium Persulphate on the Estimation of Hydrogen Peroxide: J. A. N. Friend.—The Dynamic Isomerism of α- and β-Crotonic Acids (Preliminary Note): R. S. Morrell and E. K. Hanson.—The Influence of Sunlight on the Dissolving of Gold in an Aqueous Solution of Potassium Cyanide: W. A. Caldecott: (1) The Fractional Hydrolysis of Amygdalinic Acid; (2) Isoamygdaline: H. D. Dakin.

RONTGEN SOCIETY, at 8.15.—The Presidential Address: C. Thurston Holland.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Presidential Address, The Effect of Patent Law on Modern Civilisation: C. T. Hanssen.

FRIDAY, NOVEMBER 4.

GEOLOGISTS' ASSOCIATION, at 8.—Conversazione.

MONDAY, NOVEMBER 7.

ROYAL GEOGRAPHICAL SOCIETY (Albert Hall), at 8.30—The Work of the National Antarctic Expedition: Captain R. F. Scott, R.N.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Trend of Invention in Chemical Industry: J. Fletcher Moulton, F.R.S.

TUESDAY, NOVEMBER 8.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Coast Erosion: A. E. Carey.—Erosion on the Holderness Coast of Yorkshire: E. R. Matthews.

WEDNESDAY, NOVEMBER 9.

GEOLOGICAL SOCIETY, at 8.—On the Occurrence of *Elephas meridionalis* at Dewlish, Dorset. No. II. Human Agency Suggested: Rev. Osmond Fisher.—Notes on Upper Jurassic Ammonites, with Special Reference to Specimens in the University Museum, Oxford. No. II.: Miss Maud Healey.—Sarsen-Stones in a Clay-Pit: Rev. E. C. Spicer.

THURSDAY, NOVEMBER 10.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The premiums awarded for papers read or published during the session 1903–4 will be presented, and the president, Mr. Alexander Siemens, will deliver his inaugural address.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—Presidential Address on the Theory of Waves on Liquids: Prof. H. Lamb.—Note on the Application of the Method of Images to Problems of Vibrations: Prof. V. Volterra.—On the Zeros of Certain Classes of Integral Taylor's Series: G. H. Hardy.—The Linear Difference Equation of the First Order: Rev. E. W. Barnes.—Curves on a Conicoid: H. Hilton.—Remarks on Alternants and Continuous Groups: Dr. H. F. Baker.—On the Expansion of the Elliptic and Zeta Functions of $\frac{1}{2}K$ in Powers of q: Dr. J. W. L. Glaisher.—Examples of Perpetuants: J. E. Wright.—Two Simple Results in the Attraction of Uniform Wires obtained by Quaternions, with, for comparison, their Verification by the Geometry of the Complex: Prof. R. W. Genese.—On the Reducibility of Covariants of Binary Quantics of Infinite Order: P. W. Wood.—On some Properties of Groups of Odd Order: Prof. W. Burnside.

FRIDAY, NOVEMBER 11.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—Descriptions of Three New Species of Opisthostoma from Borneo: E. A. Smith, I.S.O.—Two Apparently New Species of Planispira from the Islands of Java and Gisser: Rev. R. Ashington Bullen.—The Anatomy of *Siliqua patula*, Dixon: H. Howard Bloomer.—On the Genus Tomigerus, with Descriptions of New Species: H. von Ihering.—Notes on Some New Zealand Pleurotomidæ: Henry Suter.—Notes on Some Species of Chione from New Zealand: Henry Suter.

SOCIOLOGICAL SOCIETY, at 4.—Relation between Sociology and Ethics: Prof. Höffding.

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THURSDAY, NOVEMBER 10, 1904.

JUSTUS VON LIEBIG AND FRIEDRICH MOHR.

Monographieen aus der Geschichte der Chemie. Herausgegeben von Dr. Georg W. A. Kahlbaum. viii. Heft. Justus von Liebig und Friedrich Mohr in ihren Briefen von 1834–1870. Pp. viii+274. (Leipzig: Johann Ambrosius Barth, 1904.) Price 8 marks.

DR. KAHLBAUM continues to put those chemists who are interested in the personal history of their science under an obligation to him by reason of the care and assiduity which he devotes to the editing of the letters of the great leaders of chemical inquiry such as Berzelius, Liebig, Wöhler, and others, as these from time to time come into his keeping. The volume before us deals with the correspondence of Liebig and Friedrich Mohr.

Of Liebig it is unnecessary at this date to say anything. His name and personal characteristics are well known to all who are interested in science, and his position in the history of science is assured for all time. Whilst his correspondence with Mohr adds but little to our knowledge of him as a man, it throws many sidelights on incidents which occurred during the most interesting and active periods of his career. Thus, for example, we learn for the first time of the relative share of Liebig and Wöhler in the work which resulted in the classical memoir on bitter almond oil. Most of the experimental work was due to Wöhler; the interpretation of the facts and the compilation of the memoir was made by Liebig. It would appear, in fact, that Wöhler never saw the memoir until the proof of it was sent to him.

Indeed, the chief interest of the correspondence, so far as it relates to Liebig, is concerned with his work as editor of the famous periodical—the *Annalen der Chemie und Pharmacie*—which is now permanently associated with his name.

The name of Friedrich Mohr is much less familiar, at all events to the chemists of this generation; and yet the author of the "Titrier-methode"—the practical founder of the art of volumetric analysis—deserves to be had in remembrance. He was a representative of a type of man of which few examples, at least in this country, are left to-day, viz. that of the scientific apothecary. He was by instinct, training, and practice a man of science, and he brought his knowledge, experience, and aptitudes as a man of science to the exercise of his calling. In this respect he resembled many of those who laid the foundations of modern chemical science. In the early part of the last century the occupation of the apothecary was practically the only one open to the man who had his living to make, and who at the same time wished to exercise his passion for chemical inquiry. Teaching appointments were few, and even where chemistry was taught the opportunities for experimental work were very meagre.

Mohr was born in Coblenz at about the time that Dalton gave the New Philosophy to the world. His father, Karl Mohr, apothecary, town councillor and member of the Rhenish Medical College, was a person of some importance in the city, and it was probably in his house that the authors of this correspondence first made each other's acquaintance.

Coblenz, from its proximity to the French frontier, was the scene of many stirring episodes during the early years of the nineteenth century, and Mohr himself lived through the time of, and was personally witness to, the rise and collapse of French military power during the interval between Moscow and Sedan. As a little boy he might have seen the passage of the Rhine by the French troops on the occasion of Napoleon's invasion of Russia, and have spelled out the magniloquent inscription on the fountain before St. Castor which commemorates that event, as well as the caustic words which St. Priest, the Russian commander following on the heels of the retreating French, caused to be added:—"*Vu et approuvé par nous, Commandant Russe de la Ville de Coblence: Janvier 1er* 1814." As an old man he saw, after the *debâcle* of Sedan, the spectacle of a ruined and discredited War Minister skulking about in the twilight under the shade of the chestnuts in the Poppelsdorfer Allée in Bonn in just fear of the taunts and insults of the unfortunate soldiery whom he had betrayed.

In 1829 Mohr went to Heidelberg, where he came in contact with Leopold Gmelin. He had already acquired a considerable knowledge of operative chemistry and of pharmacology under his father's tuition. In those far-off days the laboratory of an apothecary was a reality, and those who practised the calling were not merely chemists by prescription, but were such in fact. They were for the most part well skilled in chemical processes, and actually made the greater number of the substances in which they dealt. The influence of this early training is to be seen in the character and scope of Mohr's subsequent work. He was essentially a *practical* chemist, and his services to the science consisted mainly in the improvements he effected in operative chemistry. Many of these humble but useful inventions were not calculated to bring their author much fame, but if his connection with them is well-nigh forgotten they at least secured for him the gratitude of his contemporaries. How many of the present generation of workers, it may be asked, associate his name with that commonest of laboratory appliances—the cork-borer?

Mohr remained at Heidelberg two years, and then repaired to Berlin to listen to Heinrich Rose's lectures. In 1832 he returned to Heidelberg and took his degree—*summa cum laude*. What a *summa cum laude* meant in 1832, so far as regards chemistry, may be inferred from the fact that the "hoch berühmten Führer," Gmelin, recorded that "the Herr Kandidat answered his questions on the chemical relations of iodine, the preparation of potassium iodide, the discovery of arsenic and on the preparation and composition of ether to his complete satisfaction." Creuzer found that he displayed considerable knowledge of what the old Greeks and Romans knew of botany and *materia medica*, and that he had a competent acquaintance with their languages; Muncke was satisfied with his answers concerning the balance, the pyrometer, and the electrical relations of bodies; Leonhard with those on mineralogy and geology; and Schweins recorded that the "Kandidat als Pharmazeut ungewöhnliche Kenntnisse in der Mathematik besitzt"—whatever that might imply.

The subjects in which Mohr took his degree continued to interest him to the end of his days. In chemistry he was no theorist; indeed, the speculative side of this science seemed to have little or no attractions for him; and this is the more remarkable when it is remembered that in other departments of human thought he let his imagination have the fullest play, as may be seen in his "History of the Earth." Further, Mohr has some claim to be regarded as an independent discoverer of the law of the conservation of energy, as his tombstone in the old "Friedhof" in Bonn testifies.

To the historian of chemistry these letters have a special interest. If, as has been said, they add little to our knowledge of Liebig as a man and as a leader in science, they nevertheless afford much valuable information concerning matters which agitated the chemical world during some of the most stirring periods of the last century. They have been most carefully annotated by the editor and his assistants, as the numerous foot-notes indicate. Many passages and allusions which might have been obscure have been elucidated by their patient research. We can heartily commend the book to all who are interested in the personal and biographical history of chemistry.

T. E. T.

THE BIONOMICS OF EXOTIC FLOWERS.

Handbuch der Blütenbiologie. Begründet von Dr. Paul Knuth. iii. Band. Die bisher in aussereuropäischen Gebieten gemachten blüten-biologischen Beobachtungen unter Mitwirkung von Dr. Otto Appel. Bearbeitet und herausgegeben von Dr. Ernst Loew. i. Theil. Cycadaceæ bis Cornaceæ. Pp. 570; mit 141 Abbildungen im Text. (Leipzig: Engelmann, 1904.) Price 17s. net.

THIS valuable summary of available information concerning the pollination of exotic flowers maintains the high standard of the preceding volumes, though it naturally deals with knowledge essentially fragmentary and only rarely founded on a statistical basis. The work does not limit itself to imparting information upon actual observations on pollination, but in some cases includes accounts of the forms and colours of flowers, the arrangement of their nectaries, and even the microscopical details of fertilisation. As examples of the various matters dealt with, the following may be cited:—Freycinetia and its suggested pollination by bats, the remarkable synchronous blossoming habits of *Dendrobium crumenatum*, parthenogenesis in Ficus, Kooders's work on tropical geocarpous plants, the fertilisation of Rhopalocnemis, the peculiar flowers of the commelinaceous Cochliostema and their morphology, species of Yucca and their relations with Pronuba.

Among the many interesting features of the work we may note that in bringing together in one work the scattered observations on ornithophilous pollination it renders possible a survey of existing knowledge concerning the inter-relations of birds and flowers. Yet the facts recorded show the rudimentary stage of our knowledge as to the significance of birds in the shaping of flowers. Scattered through the present work we find evidence of actual or possible ornithophilous flowers belonging to a considerable number of natural orders, including the Bromeliaceæ, Liliaceæ (Alöe), Scitamineæ, Orchidaceæ, Proteaceæ, Loranthaceæ, Ranunculaceæ (Aquilegia), Capparidaceæ, Rosaceæ (almond, peach, quince), Caricaceæ, Leguminosæ, Melianthaceæ, Balsaminaceæ (Impatiens), Malvaceæ, Cactaceæ, Rhizophoraceæ, Myrtaceæ, Marcgraviaceæ, and Passifloraceæ. Included among these are flowers, such as the peach and almond, obviously not originally ornithophilous, and others, such as Passifloraceæ and *Aquilegia canadensis*, the pollination of which by birds is dubious. Still others there are, such as *Carica Papaya*, the structure and creamy tint of the flowers of which scarcely suggest ornithophily. Other observations show that in different parts of the earth the same species of flower is visited by different animals. For example, the entomophilous Japanese *Eriobotrya japonica* is visited by humming-birds in South America, and by honey-birds in South Africa. On the other hand, certain natural orders, such as the Loranthaceæ and Mimosaceæ, markedly show pollination, or at least regular visitation, by honey-birds in the Old World and by humming-birds in the New World; and some flowers of remarkable structure, such as those of *Amherstia nobilis* and *Hibiscus schizopetalus*, visited by birds seem to demand correspondingly remarkable methods of pollination.

The fragmentary nature of our knowledge in regard to pollination is shown by the lack of published information in regard to some of the commonest plants. For instance, *Bombax malabaricum* is not mentioned in this work, yet it is very widely distributed, and even common in some regions; and in southern China I know that its large red flowers are visited by small birds. In some cases the omission of information is due to oversight on the part of the authors; for example, there is no reference to the Vallisneria-like pollination of the submarine Enhalus. The work also shows that additional observations are required in regard to some of the commonest tropical plants. As a case in point, it may be said that few of those who have scented *Pandanus odoratissimus* at distances of a quarter of a mile will accept without further examination the view that littoral species of Pandanus are anemophilous. Or, again, Knuth found that the flowers *Cassytha filiformis* were mostly cleistogamous on the coral islands of the Java Sea; but unpublished observations of my own on Dane's Island, near Canton (China), sufficiently showed that this is not the case everywhere.

In regard to the printing of the work, it must be confessed that misprints are too numerous, a brief examination showing the following:—Kleistoam, Magroglossa, Abitulon, Spahtiphyllum, and Bromeliaceenhlüten.

PERCY GROOM.

RECENT PHILOSOPHICAL WORKS.

(1) *A Primer of Philosophy.* By A. S. Rappoport, Ph.D. Pp. 118. (London: John Murray, 1904.) Price 1s. net.

(2) *Religion und Naturwissenschaft. Eine Antwort an Professor Ladenburg.* By Arthur Titius. Pp. 114. (Tübingen und Leipzig: J. C. B. Mohr (Paul Siebeck), 1904.) Price 1.80 marks.

(3) *Philosophische Propädeutik auf Naturwissenschaftlicher Grundlage.* By August Schulte-Tigges. Zweite verbesserte und vermehrte Auflage. Pp. xvi+221. (Berlin: Georg Reimer.) Price 3 marks.

(4) *Der Skeptizismus in der Philosophie.* By Raoul Richter. Erster Band. Pp. xxiv+364. (Leipzig: Dürr'sche Buchhandlung, 1904.) Price 6 marks.

(1) DR. RAPPOPORT'S book, which appears in Mr. Murray's new series of primers, is on the whole a very satisfactory introduction to the study of philosophy. The statement is always accurate, interesting and suggestive, and the terminology is carefully chosen. There are many interesting quotations; perhaps those from the German will not always be understood without a translation by the average reader of a primer. On p. 2 the statement "it was astonishment that first made man philosophize" is attributed to Aristotle. No doubt Aristotle said so, but Plato had the same idea before him. On p. 45 the term sociology is said to be derived from the Latin word *socius*, society (*sic*).

(2) "Religion und Naturwissenschaft" is a counterblast to a lecture given by Prof. Ladenburg of Breslau, on the influence of the natural sciences on the *Weltanschauung*. Prof. Ladenburg, as represented by the quotations from his work, appears to believe that experiment, observation, induction, are the key of all knowledge, and that all the progress of the last centuries has been caused chiefly by the enlightenment due to the natural sciences. This rather extreme position Prof. Titius assails with some success, and then proceeds to vindicate the spiritual life of man, individualisation, *Wertbestimmung*, Christianity, even miracles, on lines that are not altogether novel. But the author is no obscurantist, and the argument is probably as convincing as any popular discussion can make it.

(3) The third work on our list is intended to introduce pupils of the highest classes in *Realgymnasien* to the philosophic principles that underlie scientific method and the general scientific thought of our time. The first part deals with *Methodenlehre*, and discusses observation and experiment, induction, causal law and hypothesis, deduction. In the second part, entitled "The Mechanical View of the Universe, and the Limits of Knowledge," there is an adequate account of such things as atomism, teleology, the Darwinian theory, and the relations of psychical events and their physiological accompaniments. On this last head the author declares himself for a theory of parallelism, not as being the solution of the problem, but the problem itself. The book is excellent both in form and statement, and all the arguments both for and against a particular view are most fully and impartially stated. The quotations show a wide range of reading; but it would perhaps be well if the author's name and the title of the work in question were added in every case.

(4) The first volume of "Der Skeptizismus in der Philosophie" contains an account only of Greek scepticism, that is to say, of Pyrrhonism and of the scepticism of the Later Academy. But as many of the chief problems raised by scepticism in all ages are discussed here at considerable length, this first volume cannot safely be neglected even by those who are chiefly interested in Hume, the "partial" scepticism of Kant, or modern positivism. The author shows himself a most competent guide. He is always fair minded; even where it is most difficult to be patient with certain well-known quibbles of the Pyrrhonists he labours seriously to discover the grain of truth amid the heap of chaff. Almost a hundred pages are given to a discussion of "sensual scepticism," *i.e.* the scepticism which bases itself upon the contradictory perceptions of the same object experienced by different living creatures, by different human beings, by the same human being at different times, and the like. These arguments, according to this work, have weight only as against extreme realists, and both (extreme) idealism and moderate realism (*e.g.* the realism of Locke) are represented as able to face the situation. With which of the two last named the author's sympathies ultimately lie is not apparent from this first instalment; it will doubtless become evident in the second (and concluding) volume. It is to be hoped for every reason that so excellent a work will soon reach completion.

THE CHRISTIAN CENTURY IN JAPAN.

Geschichte des Christentums in Japan. By Dr. J. Haas. Band ii. Pp. xxvii+383. (Tokio: 1904.)

IN this second volume Dr. Haas—whom we congratulate on the well merited doctorate in theology recently conferred upon him by the University of Strassburg—pursues the history of the Christian missions in Japan from the departure of Xavier in 1549 to the year 1570 under the leadership of the Jesuit superior Cosmo de Torres, of Valencia. During that period, and, indeed, almost up to the close of the sixteenth century, the task of conversion lay entirely in the hands of the Jesuits, while the increasing trade with Japan was monopolised by the Portuguese. The sources of Dr. Haas's history are almost wholly European, and above all the famous letters of the Jesuit missionaries from Japan, of which the volume is largely a précis. These authorities are not, however, sufficient, and with the progress of the work it becomes more and more evident that the true history of the Christian century in Japan can only be written in the Peninsula, where, as Father Cros's great book on "St. François de Xavier" tells us, in the inexhaustible archives and libraries of Lisbon and Madrid, and in those of Simancas, Coimbra, Evora, and Ajuda, are to be found the original documents in vast numbers from which alone an adequate account of that most interesting chapter in the world's history can be gathered.

In the score of years covered by the present volume the faith was preached over the whole of Kiushiu and most of Central Japan, the northern and eastern Daimiates and the whole of the great island of Shikoku being untouched. This work was accomplished by eleven Jesuit fathers, assisted by four converts. In 1564 the Daimio of Ōmura, the first Christian Daimio, known as Sumitada, or Omura Risen (Risen was his Buddhist name), was baptised, and adhered to the faith until his death in 1587. It is of this convert that Crasset writes:—

"He went to the chase of the bonzes as to that of wild beasts, and made it his singular pleasure to exterminate them from his states" ("Murdoch," p. 238).

It would, however, be merely special pleading to take this language literally, otherwise than as expressing the worthy father's admiration of the vigour with which the newly made convert promulgated Christianity within his petty domain. Up to 1570, out of the fifteen or sixteen millions of Japanese, some twenty thousand had been baptised. This seems a small proportion, but the true measure would be the ratio of the baptised to the population of those parts of Japan where the gospel had been, with some adequacy, preached. As to the quality of their Christianity it is difficult to form a judgment. The steadfastness of large numbers under persecution is some guarantee of the reality of their belief; on the other hand many in becoming Christians followed the example or obeyed the commands of their feudal superiors.

Another much debated point, not easy to determine, is to what extent the native converts "provoked" the immense majority who still adhered to the Way of the Gods and the Way of Buddha. It is certain that the Buddhists were "provoked," but there is little evidence that they had any real cause of complaint during the period now considered—the provocation was of a passive, not of an aggressive character. On the whole, the fathers were far from unpopular with the common folk. They were looked upon as superior beings, and Froez says of his reception at Yokoseura:—

"All the Christian inhabitants came to meet us and were so delighted at our arrival that they would willingly have taken us on their shoulders and borne us off."

It was not until 1587 that persecution began, the result of a fit of policy of the cruel, crafty, but capable Taiko, Hideyoshi.

Dr. Haas writes lucidly, and his pages are full of interesting details; but the narrative is obscured by an over-abundance of matter that might well be relegated to notes or appendices. The Germans seem unable to distinguish between books and note-books.

F. VICTOR DICKINS.

OUR BOOK SHELF.

Lectures on the Diseases of Children. By Robert Hutchison, M.D., F.R.C.P. (London: Edward Arnold.) Price 8s. 6d. net.

IT is difficult to praise this little volume too highly. It deals with one of the most attractive and satisfactory subjects in medicine, the treatment of children's diseases; the style is excellent, and the illustrations, which, with one or two exceptions, are taken from photographs of the author's cases, are unusually good.

In some three hundred pages Dr. Hutchison describes aspects of some of the more common diseases of childhood which, as he says, "are not usually dealt with in systematic lectures." In the first instance, the lectures were given at the London Hospital; subsequently they were published serially in the *Clinical Journal*, while their present appearance in book form is in response to the request of a number of readers who wanted them in a convenient form for reference.

The early chapters deal with the problems of infant feeding, and the subject, which unfortunately is closely allied, of the various digestive disturbances which occur in hand-fed babies. Upon questions of diet Dr. Hutchison speaks with special authority, and his remarks on the difficult subject of artificial feeding are concise and practical.

In the space of a short lecture it is not possible or desirable to deal with all the conceivable methods by which children might be, or have been, fed, but it seems an omission not to mention "laboratory" milk, which, whatever its objections, certainly offers the physician a method of wonderful precision in prescribing the exact percentage of fat, proteid, and lactose which he requires for any individual patient. The establishment in London of the Walker Gordon Laboratory, at which this milk can be obtained, and the existence of a farm in connection with it at which every precaution is taken to procure germ-free milk with scientific accuracy, certainly deserve mention in any book which deals with the subject of substitute feeding. The expense of "laboratory" milk puts it beyond the reach of many babies, but it is less expensive than a wet nurse, and avoids all the disadvantages inseparable from employing one.

In succeeding chapters Dr. Hutchison deals with various common diseases of childhood. They are all delightful reading, full of common sense and helpful suggestion as to diagnosis and treatment. One would like to quote extensively, but the book is one that every student of the subject, whether he be qualified or not, should possess.

Special interest attaches to the lecture on mental deficiency in childhood, often a subject of great difficulty in practice, and one with which the ordinary text-book scarcely deals. The photographs illustrating this chapter are particularly good.

The concluding chapters are devoted to the diagnostic significance of some common symptoms, such as wasting, cough, fever, &c. It is impossible to do full justice to this delightful book in a short notice. The work forms a valuable adjunct to the good text-books already written on the subject, and it shows to the full the clinical knowledge and the literary ability of the author, whose reputation, already high, will no doubt be increased by it.

Elementary Manual for the Chemical Laboratory. By Louis Warner Riggs, Ph.D., Instructor in Chemistry in Cornell University. Pp. vi+138. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 5s. 6d. net.

THIS volume embodies the author's idea of what should be taught during a one-year course of chemistry, the time available being not less than a hundred and twenty hours for laboratory practice, and sixty for "recitation" work. It is arranged in short numbered paragraphs, each containing a direction to the student or an explanation of some point or process, and is intended to be used, under the guidance of an instructor, in conjunction with some general text-book of chemistry and physics.

About one-third of the work is devoted to preliminary experiments in general chemistry. The student is then introduced to simple volumetric analysis, the principles of which are very well explained

—this forming, perhaps, the best portion of the book. After three experiments in gravimetric work the learner passes on to systematic qualitative analysis, treated from the standpoint of electrolytic dissociation. The author recognises that, "logically," the quantitative work should follow rather than precede the qualitative; but after repeated trials he prefers the order indicated. In the present connection, however, the matter is more one of convenience than of logic.

Accepting the author's system, the experiments themselves are judiciously selected, and well fitted for their purpose. But there are educationists who would by no means agree that "theoretical explanations should be reserved for the recitation-room," and not given in the laboratory. Still less would they say that the students should "study thoroughly all the details of an experiment before attempting to perform it," and that "this should be done outside the laboratory." Whether such a system would tend to produce a hod-man or an architect would depend, as it seems to the writer, less upon its own merits than upon the personality of the instructor. C. S.

Die Einheit der Naturkrafte in der Thermodynamik. By Richard Wegner. Pp. viii + 132. (Leipzig: Von Veit and Co., 1904.)

As described in the secondary title, this pamphlet is an attempt to deduce from the kinetic energy of non-elastic atoms, corporeal and ethereal, all known physical forces, chemical, electrical, and mechanical, including gravity. Nothing Boschovichian is assumed; only the kinetic energy of moving atoms of different sizes. It is not easy to follow an argument which provisionally assumes that the atoms are held together to form molecules with regular vibration frequencies capable of propagating through the surrounding swarm of ether-atoms waves of condensation and rarefaction, by means of the reactions and interference of which (when there are two or more molecules) attractions are brought into being; and which then, in terms of this general outlook, gives reasons why the reaction of the ether atoms may be found sufficient to hold the corporeal atoms together. A necessary consequence of the investigation is that gravity is propagated in time, and should be a function of the temperature. The author has tested the latter point by experiment, and finds some evidence in favour of its truth. The source of the chemical elements is found in the different magnitudes of the atoms, with the corresponding differences in their energetic combinations. The temperature of a body is proportional to the mean molecular weight, multiplied by the square of the mean translational velocity of the molecule; divided by the relative number of molecules in unit volume; multiplied by the relative mean path of the molecule. Since, according to the theory elaborated, the kinetic energy of the elementary particles implies attraction, all bodies will be surrounded by a layer of condensed gas and ether particles. In the waves in the ether sheath is found the source of the electrical current. Electrostatic action, on the other hand, depends on chemical actions in the ether sheath. The applications to chemical and electrical phenomena are admittedly crude and imperfectly worked out; but the author claims to have proved the possibility of deducing all the recognised forces of nature from the kinetic energy of non-elastic Lucretian atoms.

The Science and Practice of Photography. By Chapman Jones, F.I.C., &c. Fourth edition. Pp. 569. (London: Iliffe and Co., Ltd., 1904.) Price 5s. net.

THIS volume, which is the fourth edition of the work, has been very greatly enlarged and rewritten since the appearance of the third edition, the number of chapters having been increased from fifty-five to sixty-eight. It may be considered as forming a most excellent guide to the practice of photography, and a perfect reference for those who so continually question one as to "the best book on photography, for a beginner, you know"; and it will doubtless prove useful as a reference book to many who have long passed the beginner stage. There is a decision of tone and clearness of exposition, combined with an intelligent anticipation of the many questions which arise at every step of the path, which render it especially suitable for this purpose.

At the same time, the scientific reader who hopes to gain from it some account of the work which has been done of late years, with a view to the clearing up in some measure of the chemical and physical problems in which photography abounds, will probably be greatly disappointed. The two most noteworthy features of this, as of almost all English works on photographic science, are found in the method in which contemporary German literature is ignored, and in which the whole of modern physical chemistry is disregarded. The fact, for instance, that development may be regarded as a reversible heterogeneous reaction occurring between ionised salts, in accordance with the mass law, seems to be entirely beyond the idea of this or any other book on the subject. Development with ferrous oxalate is here represented by the equation:—

$$3AgBr + 3FeC_2O_4 = FeBr_3 + Fe_2(C_2O_4)_3 + 3Ag,$$

which, involving as it does the existence of ferric ions in the developer after use, gives a sufficiently distorted view of the reaction. While we find the chemical theory of the book to be of this type, the information as to the progress of sensitometry is of the slightest, no mention whatever being made of the notable researches by Dr. Eder. A most original suggestion as to the nature of the developable condition is to be found at the close of the chapter devoted to that subject. In brief, this book is a most delightful manual of the practice of photography, but can scarcely claim to represent the scientific side of the subject in any sense whatever. C. E. KENNETH MEES.

Ants and Some Other Insects. An Inquiry into the Psychic Powers of these Animals. With an Appendix on the Peculiarities of their Olfactory Sense. By Dr. August Forel. Translated from the German by Prof. William Morton Wheeler. Pp. 49; figures. (Chicago, 1904.) Price 2s. 6d.

AN elaborate treatise on the senses of insects, especially ants, illustrated by numerous experiments. The book deserves the most serious attention of students of psychology and animal intelligence; but it would occupy too much space, nor would any useful object be gained, by attempting to epitomise either the body of the work or even the author's deductions. We may, however, quote the following conclusions:—

"Even to-day I am compelled to uphold the seventh thesis which I established in 1877 in my habilitation as *privat-docent* in the University of Munich:

"'All the properties of the human mind may be derived from the properties of the animal mind.'

"I would merely add to this:

"And all the mental attributes of higher animals may be derived from those of lower animals. In other words, the doctrine of evolution is quite as valid in the province of psychology as it is in all the other provinces of organic life. Notwithstanding all the differences presented by animal organisms and the conditions of their existence, the psychic functions of the nerve-elements seem nevertheless everywhere to be in accord with certain fundamental laws, even in the cases where this would be least expected on account of the magnitude of the differences."

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.*]

Archebiosis and Heterogenesis.

THE columns of the daily papers have during the last two weeks contained many references to the question of the origin of life. One of the most recent utterances has been that of Lord Kelvin, who has roundly declared himself an unbeliever in the natural origin of living matter either in the present or in the past. We must suppose, therefore, that in reference to this question he is content to believe in miracles.

Prof. Ray Lankester and Dr. Chalmers Mitchell, however, proclaim themselves, as followers of Huxley, believers in evolution generally, and in the natural origin of living matter in the past. They, like many others, refuse to believe that it takes place at the present time, because undoubted proof of its occurrence cannot be produced by laboratory experiments. The uniformity of natural phenomena would certainly lead us to believe, as Sir Oliver Lodge has intimated, that if such a process occurred in the past, it should have been continually occurring ever since—so long as there is no evidence to show cause for a break in the great law of Continuity. Certainly no such evidence has ever been produced, and if the origin of living matter takes place by the generation in suitable fluids of the minutest particles gradually appearing from the region of the invisible, such a process may be occurring everywhere in nature's laboratories, though altogether beyond the ken of man.

My point may be illustrated thus. Bacteriologists all over Europe and elsewhere have been working for the last thirty years by strict laboratory methods, and notwithstanding all that they have made out and the good that has thereby accrued to suffering humanity, they have apparently never yet seen the development from Zooglœa aggregates of Fungus-germs, of flagellate Monads, or of Amœbæ. If, however, they would only examine what goes on in nature's laboratory when a mixed bacterial scum forms on suitable fluids, they would have no difficulty in satisfying themselves as to the reality of these processes. I described such processes in your columns in 1870, more fully in the *Proceedings* of the Royal Society in 1872, and finally in my "Studies in Heterogenesis" (pp. 65–84, pls. vi. and vii., Figs. 53–71). Even during the last week I have again obtained photomicrographs demonstrating the origin of flagellate Monads from Zooglœa aggregates forming in a bacterial scum, and if you will admit an illustrated communication on this subject to your columns, proving by such a test case my position as to the reality of heterogenesis, I shall be happy to present it, and to show that something beyond the recognised strict laboratory methods of the day is needed if we are to fathom some of nature's deepest secrets.

The councils of the Royal and Linnean Societies are guided in the acceptance of papers by referees who are wedded, on biological questions, to laboratory methods. It is useless for me, therefore, again to attempt to submit such a communication to them. Their referees (probably not having worked at such subjects themselves) would not advise the acceptance of the paper, and my communication might simply be consigned to their archives. The Royal Society "for the Promotion of Natural Knowledge" on two occasions would not even allow me to submit my views to the consideration of, and discussion by, its fellows. In these circumstances, Sir, I appeal to you, in the interests of science, to allow me to send you an illustrated paper proving, so far as such proof can go, the heterogenetic origin of flagellate Monads and of Fungus-germs.

H. CHARLTON BASTIAN.

Manchester Square, October 31.

[IN reply to Dr. Bastian's appeal we will print his communication, and also any important replies from competent workers on the subject which may be sent to us.—ED.]

Average Number of Kinsfolk in each Degree.

I WAS glad to read the first paragraph of the reply by Prof. G. H. Bryan to my letter, in which he acknowledges his mistake, but I cannot allow the second paragraph to pass without protest, in which he says "the discrepancy can be accounted for more simply still" in a way he describes. I do not wholly understand his present view, but only enough of it to be assured that it is vitiated by some fundamental misconception. In these circumstances it is best to re-state my original argument in different words. We agree to start on the assumptions that boys and girls are on the average equally numerous, and that all other conditions are to be ignored. Then, if an individual be taken out of a family of $2d$ children, $2d-1$ children will be left, of whom $d-\frac{1}{2}$ will, *on the average of many experiences*, be girls and $d-\frac{1}{2}$ will be boys. The sex of the individual who was taken out in the first instance is quite unimportant; the result will be the same whether that individual be a boy or a girl.

Prof. G. H. Bryan thinks, if I understand him rightly, that the sex of the individual in question *is* of importance.

Some persecuting demon must have again caused my pen to write and my eye to overlook an absurdly erroneous figure in my last letter. The faulty passage runs ". . . is 80 ($=2\frac{1}{2}\times 16$, as it should be)"; the 16 ought to be replaced by 32. It is intended to be quoted from the right hand column of line (5) in the table which accompanies that letter.

FRANCIS GALTON.

Misuse of Words and Phrases.

IN the preface to my book on "Cubic and Quartic Curves" I have stated my views on the matters referred to in the last paragraph of T. B. S.'s letter. I am a strong advocate of the use and, if necessary, the invention of words of classical origin to express new ideas, and I consider the phrase *self-cutting* inelegant.

My objection to the phrase non-singular cubic or quartic curve is that no such curves exist, since Plücker has shown that all algebraic curves, except proper conics, possess a determinate number of singularities. Thus anautotomic quartics possess 52 simple singularities, viz. 28 double and 24 stationary tangents. It is also possible for such curves to possess compound singularities, formed by the union of one double and two stationary tangents.

With regard to the use of *an*, the rule is that before a word beginning with a vowel *an* is to be used instead of *a* for the sake of euphony, but when a word beginning with a vowel is pronounced as if it commenced with a consonant, *a* must be used instead of *an*. The phrases *such an one, an uniform rod, an wonderful sunset, an yew tree*, are all equally incorrect.

A. B. BASSET.

November 4.

The Coming Shower of Leonids.

THE pretty abundant shower of Leonids witnessed last year encourages the hope that a fairly rich return may be observed this year. There will be no moonlight to interfere with the brilliancy of the display should it occur, and the most probable time of its apparition will be before sunrise on November 15.

In 1903 the maximum occurred between 5 and 6 a.m. on November 16, and, allowing for leap year, the ensuing maximum should take place on November 15 at about noon. The shower seems likely to be observed to the best advantage at American stations, as in 1901, but it should be carefully watched everywhere, and with a special view to ascertain the hour of greatest abundance.

It is to be hoped that some further attempts will be made to determine the place of the radiant by photography. We have already a sufficient number of eye observations of the position, and the work of ordinary observers will be better directed to counting the number of meteors visible at regular intervals during the night, and registering the most brilliant objects. The meteors from other showers should also be noted, and especially any conspicuous Taurids that may appear. The latter by their slow long flights and yellow trains are readily to be distinguished from the swiftly moving Leonids with their green streaks.

W. F. DENNING.

OWING to the large numbers of shooting stars visible on the night of November 15, 1903, the expectation of witness-ing a meteoric spectacle on perhaps a more extensive scale will probably be revived on the near approach of the Leonid epoch of 1904. Reasons have already been given for supposing that last year's display was connected by the nineteen years' period with a very similar phenomenon observed on November 13, 1865, the interval between the two events representing two complete revolutions of the meteoric cycle. The present epoch, therefore, which is thus associated with the historic meteor shower of November 14, 1866, will be liable to reproduce its brilliant prototype, though only to a limited extent.

The anticipated shower, however, if it takes place, will not occur on the night of November 14, as it might naturally have been expected to do, owing to 1904 being a leap year. The meteor-swarm, according to calculations made by the present writer, has undergone considerable retardation since 1903, and as a result of this perturbation the Leonid meteor shower becomes due in 1904 on the night of November 15. It is on the latter night, therefore, that the maximum will take place, whether it culminate in a shower or not. There will occur, however, on November 14, 15h., an interesting miniature meteor display. The shower on the night of November 15, though not so intense, will be more extensive than that of 1866, as maxima fall due at 9h., 12h. to 15h., and 17h. 30m. G.M.T. JOHN R. HENRY.

The Definition of Entropy.

FROM time to time controversies have appeared in various journals regarding that most difficult of all physical conceptions—entropy. I have purposely avoided passing any opinions as to the merits of the views of different writers, as I have considered the question far too large a one to be dealt with satisfactorily by destructive criticism directed towards particular points. I have, however, now found a definition of entropy which certainly appears to meet most of the objections to the conventional treatment. That definition may be stated somewhat as follows:—

Let the available energy of any system at any instant relative to a refrigerator of temperature T_0 be defined by the condition that it is the maximum amount of energy that could be obtained from the system at that instant by reversible thermodynamic engines working between the system and the refrigerator T_0, the remaining portion of the energy being, of course, called non-available energy. Then in any change of the system the increase of entropy is the quantity obtained by dividing the increase of non-available energy by the temperature T_0 of the refrigerator.

I hope to publish a detailed treatment shortly, but in the meantime I would mention that this definition overcomes all the difficulties inherent in the conventional treatment of at least the more ordinary irreversible phenomena, such as friction, impact, gas rushing into a vacuum.

If we adopt the principle of degradation of energy as the fundamental second law of thermodynamics (as I suggested in the Boltzmann *Festschrift*), Clausius's statement that the entropy of the universe tends to a maximum now follows at once. So, too, do his inequalities. For every irreversible transformation in the interior of a system produces loss of available energy, and therefore (since it does not affect the total energy) increase of non-available energy, and therefore increase of entropy. We may say that entropy can be generated, but never destroyed. It follows that the total increase of entropy in the system is greater than the quantity of entropy entering from without. This is Clausius's inequality for an irreversible non-cyclic process. If the process is cyclic the total gain of entropy is zero, and therefore the entropy generated in the system must be exported during the cycle. This is Clausius's inequality for a cyclic process.

The introduction of the refrigerator presents no real difficulty. If non-available energy, instead of being given to the refrigerator T_0, is worked down reversibly to a refrigerator at a lower temperature T_1, its amount will be decreased in the ratio $T_1 : T_0$. G. H. BRYAN.

The Direction of the Spiral in the Petals of Selenipedium.

IN *Selenipedium grande*, *S. longifolium*, and *S. conchiferum*, the twisted petals are so arranged that the direction of the spiral is right-handed on each side.

They are not heteronymous, *i.e.* the right petal with a left twist and the left petal with a right twist, as in all antelopes' horns, nor are they arranged homonymously, as in most sheep's horns,[1] but the twisted petals have the same direction on each side, and in the cases above mentioned the right-handed spiral is always present. In trying to find a cause for the direction, I expected it to appear that before and during the unfolding of the flower the petals were twisted when lying together, and thus took the bias, which continued during growth. If two strips of paper be laid together and twisted into a pipe-lighter, each, when separated, would exhibit the same spiral twist.

Examination of the still-folded flower proves that this simple explanation is not the true one, and, at least in *S. grande*, the petals are straight when they show at first (two inches or more in length), and become afterwards spirally twisted during growth and elongation.

The necessary bias to determine the direction of the spiral evidently acts after the unfolding of the flower, and is a slight force acting continuously during growth, such as would be made by the circulation if there were a difference in the circulation of the sap in the two edges of each petal.

This difference would act alike in each, and would make each petal twist in the same way; but, of course, this is a mere conjectural suggestion. GEORGE WHERRY.

Cambridge, October 30.

Thinking Cats.

THE story of the cat that saved the cook, in your last issue, is certainly remarkable, but surely it is not unusual for cats to find out how to direct attention when they want to get into or out of a house, or for them to conceal their kittens in curious places.

Two instances of the former occur to me among many. A cat in my father's house used to rattle the letter-plate at the front door (it was in a window near the door) whenever it was shut out, and another, in my own house, would come to any *lighted* window, even on the top storey, and tap at the glass if it was shut out at night. In the same house a cat hid its kittens, after one family had been destroyed, under the boards of a lead flat, so that, as they grew, it could not get them out, and directed our attention to them by running backwards and forwards. They were released by taking up the boards.

From cats to birds seems a natural transition. I have a curious instance, at this moment, of a pair of robins mistaking their own importance. Last spring they built, and reared their family, in a hole in the wall of an old country mansion, which was being rebuilt under my supervision. The wall was inside the house, in the great hall, and the female sat on her nest, looking out at the workmen, amid all the noise and disturbance of building. They disappeared in the summer, but now that the house is finished and occupied, the pair have returned, and flit about the same hall and the adjoining drawing-room, evidently under the impression that the house was built for them.

R. LANGTON COLE.

Change in the Colour of Moss Agate.

A FRIEND of mine possesses a penholder the handle of which is made of moss agate. Originally the colour of the handle was bluish throughout, but recently the upper part of the handle has become very much lighter in colour and much more transparent.

I thought perhaps some of your readers could tell me whether it is usual for moss agates to undergo changes of this kind after having been cut and polished, and, if it is usual, to what agent or agents the change is ascribed.

W. A. WHITTON.

County School, Bridgend, November 7.

The Origin of Life.

MR. HOOKHAM ingeniously argues that experiments to evolve living out of non-living matter are inconclusive and must probably always fail because the sterilising agent used, which is commonly heat, "eliminates not only life, but its potentiality at one stroke."

Most of us believe that the earth was at one time an incandescent globe. Neither life nor the potentiality of life could have existed in such circumstances. How would Mr. Hookham, on the theory of evolution, explain their first introduction? GEOLOGIST.

[1] NATURE, December 12, 1901; *Lancet*, January 1, 1898.

ON THE OCCURRENCE OF WIDMANNSTÄTTEN'S FIGURES IN STEEL CASTINGS.

SOME little time ago, during his inspection of the metallurgical laboratories at the University College of Sheffield, Sir Norman Lockyer exhibited considerable interest in the fact then communicated to him that almost invariably small steel castings exhibited in the first stage of their manufacture the Widmannstätten figures, provided that the carbon was near the semi-saturation point of steel, namely, 0·45 per cent. The authors communicated the following brief note in the hope that it would be interesting to mineralogists and astronomers.

For many years an exhaustive research into the properties of steel castings has been proceeding at the Sheffield College. This research necessarily involves a close investigation of the influence of mass; hence the weight of the experimental castings varies from about 28 lb. to 2 tons. In such heavy castings as those last named the Widmannstätten figures are seldom found, the slow cooling of the mass exerting an influence similar to that of annealing, an operation which, as will presently be seen, causes a change in structure so profound as almost always to destroy the figures. The authors therefore selected for purposes of demonstration research casting No. 541, weighing about 30 lb. The mean analysis of drillings from this metal, taken from a portion of the casting $1\frac{3}{8}$ inches in diameter, registered the following figures:—

	Per cent.
Carbon	0·39
Silicon	0·08
Manganese	0·03
Sulphur	0·03
Phosphorus	0·02
Aluminium	0·03
Iron by difference	99·42

The structure of the metal as cast is shown in the upper half-section of Fig. 1. As usual, it exhibits two

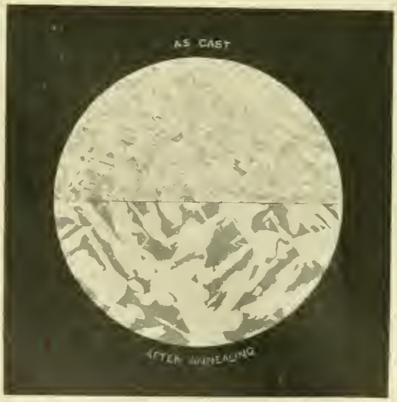


FIG. 1.—Research casting 541. Reduced from micrograph. Magnified 22 diameters.

constituents, the magnification being too low to reveal its third and fourth constituents, namely, the sulphides of manganese and iron also present in minute quantities. The dark etching constituent is pearlite $(21Fe + Fe_3C)$, its colour being due to the liberation during etching of an automatic stain composed of that dark, carbonaceous colouring matter upon which the well-known carbon colour test depends. The pale constituent is, of course, ferrite, in this case nearly pure iron, and has obviously assumed that crystalline structure characteristic of the Widmannstätten figures.

The lower half-section of Fig. 1 delineates the structure of the metal after the operation of annealing. The two stages of annealing were carried out as follows:—first, the steel, protected so far as possible

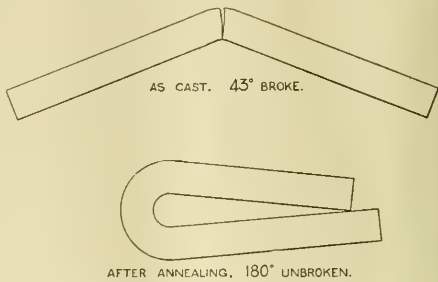


FIG. 2.—Dimensions of test-pieces:—$10'' \times \frac{3}{4}''$ diam.; bending radius, $\frac{3}{8}''$.

from the air, was maintained for about seventy hours at a temperature of about 950° C.; secondly, it was allowed to cool very slowly, occupying, perhaps, another seventy hours in falling to a temperature at which it could be comfortably handled. The result was a total re-arrangement of the pattern presented by the ferrite and pearlite, and a consequent elimination of the figures. This change in structure was accompanied by a profound change also in the mechanical properties of the steel.

Fig. 2 reproduces, before and after annealing, bending tests made on bars 10 inches long and $\frac{3}{4}$ inch in diameter. The metal as cast snapped sharply after bending through an angle of 43° over a radius of $\frac{3}{8}$ inch. The annealed steel bent through an angle of 180° without exhibiting any signs of fracture. At the request of Prof. Lewis, of Cambridge University, the authors have submitted to him duplicate sections of the steels figured in this paper. Prof. Lewis considers that an interesting point raised is as to whether the occurrence of the Widmannstätten figures in pieces of metallic iron dug out of the earth necessarily proves them to be of meteoric origin.

The authors have to thank their colleague Mr. J. H. Wreaks, demonstrator of metallography at the Sheffield College, for his patient and precise reproduction of the structures figured in this note.

J. O. ARNOLD.
A. MCWILLIAM.

FORESTRY IN THE UNITED STATES.

AMONG the professional papers of the United States Geological Survey we have already noticed the first six reports dealing with the various forest reserves in the States of Oregon, Washington, and California. The two latest reports, Nos. 7 and 8, now to hand, deal with the forest conditions in the San Francisco Mountains Forest Reserve and the Black Mesa Forest Reserve in the State of Arizona. The former report is by John B. Leiberg, Theodore F. Rickson, and Arthur Dodwell, with an introduction by F. G. Plummer; while the latter report was prepared by F. G. Plummer from notes by Theodore F. Rickson and Arthur Dodwell. Both forest reserves were first created by proclamation of President M'Kinley, dated August 17, 1898. The region in which the San Francisco Mountains Forest Reserve is situated forms a kind of plateau, traversed by numerous deep canons and dotted by several hundred

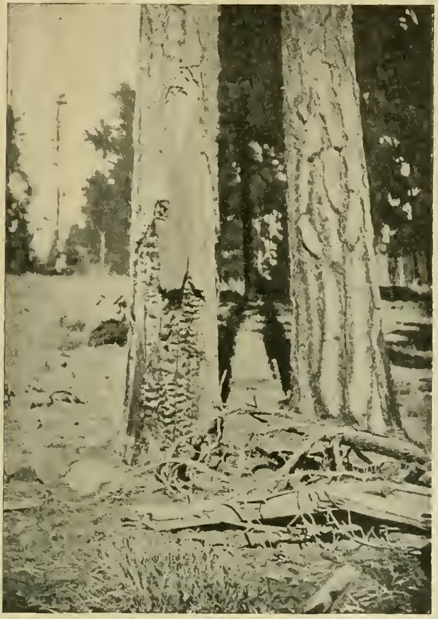


FIG. 1.—Fire Scars on Yellow Pine.

volcanic cones, which vary in height from 100 feet to 1000 feet. The soil is various, but gravelly loam is the prevailing type. On the slopes of the volcanic cones and ridges in their neighbourhood scoriaceous soils prevail. The water-retaining capacity of the latter class of soil is not very great. The loamy soils are best adapted for forest growth. As regards drainage, the visible run of permanent surface flow is small. Most of the precipitation sinks either within the reserve or in the desert or semi-desert tracks which border it.

Electric storms do considerable damage to the standing crop in the reserves, and it is estimated that in some places as many as 5 per cent. of the trees have been struck and killed by lightning. There are twelve coniferous species in the reserve, but the yellow pine predominates, producing more than 99 per cent. of the merchantable timber, and forming 90 per cent. of the total forest. About the same number of broad-leaved species occur, but a complete list of them is not available. All over the reserve the stands of yellow pine do not carry an average crop of more than 40 per cent. of the timber they are capable of producing. This unsatisfactory condition is attributable to the numerous fires which have occurred in this region within the last 200 years. In addition to the destruction caused by fire, careless cutting and grazing have done much damage in the reserve.

The reproductive capacity of the yellow pine in the reserve is extremely small there being a great deficit in seedling and sapling growth. There has apparently been a complete cessation of reproduction over large areas during the past twenty or twenty-five years. This low reproductive capacity is attributed to various causes—some depending on the operation of natural agencies, others on human intervention. The grazing value of the reserve was at one time very great. As the gramineous flora of the region is a rich one, there was formerly a luxuriant growth of grass, but owing to the persistent and excessive pasturing, especially by sheep, the turf-forming grasses were reduced in size and vegetative activity, which led to various changes in the character of the subsequent vegetation. What was formerly pasture land is now covered by exuberant growths of various low desert shrubs and herbaceous Compositæ, particularly species of sunflowers.

The agricultural value of the region is not great, there being only some 2500 acres under the plough, and these occur in the now dry beds of what were formerly Stone-man and Mormon lakes, or at the foot of ridges where local areas of seepage exist. The crops consist of oats, wheat, and potatoes. There is no fruit culture in this region. This reserve, like the others, is subdivided into townships and ranges, the detailed descriptions of which are included in the report. At the end we have a very useful summary, showing in tabular form a classification of lands in the reserve by townships. The maps and photographic illustrations are of the same high standard as those which accompany the other reports of this series.

The Black Mesa Forest Reserve comprises an area of 2786 square miles, made up as follows:—

	Square miles.		Square mil
Timbered area ...	2248·5	Burned area	5·5
Woodland	391	Logged area	1·0
Timberless area ...	140		

FIG. 2.—Large Growth of Alligator Juniper.

A very striking feature of the report is the decrease in the water supply due to successive seasons of drought, which have practically destroyed the value of the grazing and agricultural areas in the reserve. Three years ago the wheat crop yielded 5000 bushels. The following year it fell to 2500 bushels, and last season the yield was only 800 bushels. A cattle ranche in the range, which used to graze more than 100,000 head, will now support not more than 9000 head. As a remedy it is suggested to adopt stringent rules, regulating the number of stock and the areas on which they shall be grazed on each permit. Very little lumbering has been carried out within the reserve, which is apparently due to the difficulties and expense of transport. The timber species, coniferous and broad-leaved, number fifteen, the yellow pine being the principal timber tree. It is distributed uniformly throughout the extent of the reserve. In some ranges it forms a pure forest. Its average height is 125 feet, with 24 feet of clear trunk with a diameter of 18 inches at breast height. It varies in age from 125 to 150 years.

The Engelmann's spruce occupies the moister areas above an altitude of 9000 feet. It averages 70 feet in height and 10 inches in diameter. Its age varies from 50 to 75 years. Its growth is extremely rapid, but the tree is usually clothed with branches to the ground. A variety of the Engelmann's spruce, *Picea engelmannii*, var. *Franciscana*, known as the Arizona spruce, gives much better results, averaging 100 feet in height with 20 feet of clear trunk and a diameter of 18 inches. Red fir, white fir, western white pine, alligator juniper, and Arizona cypress also occur within the area. The deciduous trees are confined to the borders of streams and marshy areas. The reproductive capacity of the various species is exceptionally good, especially where the young growth is afforded shelter by the larger trees. The underbrush throughout the areas in which the yellow pine predominates is very small, and consequently this region has not suffered much injury from forest fires. The report also embodies detailed descriptions of the various subdivisions of the range, together with carefully prepared maps and beautiful photographic plates. Of the latter we have reproduced two as an example of the interesting way in which these papers are illustrated.

TECHNICAL EDUCATION IN LONDON.[1]

THE last report of the Technical Education Board of the London County Council, dealing with the year 1903–4, directs special attention to the progress made in the provision of technical, secondary, and higher education in London during the past eleven years. Under the recent Education Act (London), 1903, the administration of the whole of the education of London passed into the hands of the new Education Committee, and the Technical Education Board ceased to exist. The present report is consequently opportune, and serves to record the great services which have been rendered to education in London by the late Board.

The most striking features of the report are the evidences provided of the increase and rapid development of polytechnic institutions, the establishment and success of London County Council schools and technical institutes, and the improvement in the equipment and staffing of secondary schools. The extent of the advances made can be estimated satisfactorily by comparing the number of educational institutions providing good scientific and technical education at the time of the supersession of the Technical Board with the number in existence in 1893, when Mr. Llewellyn Smith reported on the provision made for technical instruction at that time. To take the case of the laboratory accommodation for the teaching of chemistry. In 1893 there appear to have been about fourteen chemical laboratories in London open in the evening for instruction; since that time well equipped departments for teaching practical chemistry have been opened in eleven new polytechnic institutions. The total volume of instruction in evening classes in chemistry in 1893 was only about 38,000 student-hours per session, and in polytechnics under 15,000 student-hours. In 1893, after omitting the attendances of students who did not attend for more than twenty hours during the session, the amount of time devoted to evening work in theoretical and practical chemistry amounted to 64,554 student-hours in the polytechnics alone.

The result obtained by comparing the advance made in the teaching of electricity and electrical technology is just as striking as in the case of chemistry. In 1893 there were five electrical laboratories open for evening instruction, while in 1903 there were twenty-three institutions giving evening instruction in electricity or electrical technology, or both. In practical electrical engineering there were only four centres in 1893 available for evening instruction, and only one applied for aid from the Board, and at this institution there were thirty-eight students. During the session 1902–3 there were, in polytechnics aided by the Board, a large and increasing number of students for electrical engineering, and the volume of instruction, omitting students who attended for less than twenty hours during the session, amounted to 43,909 student-hours. In addition to these, a large number attended classes in electricity and magnetism in the physics departments of the institutions. The volume of instruction here reached 32,872 student-hours.

Ten years ago there was scarcely any provision in London for pure technological teaching. From the list of evening classes for 1903 it appears that technological instruction is now available in a great variety of subjects, of which the most important are:—bricklaying and brick-cutting in twelve institutions, cabinet-making in nine, carpentry and joinery in twenty, furniture design in nine, masonry in nine, metal-plate work in eight, painting and decorating in twelve, photo-process work in four, plastering in nine, plumbing in fifteen, printing in four, smithing in six, tailors' cutting in seven, and upholstery in six. This rapid increase in the number of polytechnics and technical institutes in which adequate provision is made for practical instruction in trade subjects has had a remarkable effect in producing an interest in the scientific principles underlying the various trades concerned. As an example, the report quotes the case of the Northampton Institute in Clerkenwell, in which district there is a very large number of special trades. In order to meet the demands of the neighbourhood, classes were started in subjects in which no organised technical instruction had previously been given in London. Some of these have been remarkably successful, and in several cases it has been found necessary to increase the number of evenings of instruction in order to provide for the large number of students in attendance.

There has been also, says the report, a natural tendency during the past few years for sporadic classes in trade subjects to disappear in consequence of the increasing popularity of the polytechnics and larger technical institutes, in which are found thoroughly well equipped laboratories and workshops. The number of distinct trades in which practical instruction is provided, and also the number of centres where such courses of instruction can be obtained, have more than doubled during the past nine years,

[1] "Annual Report of the Technical Education Board of the London County Council, 1903–1904." (Westminster: P. S. King and Son, 1904.) Price 2s. 6d.

and the number of apprentices and young workmen attending them has increased four-fold.

The great success which the rapid growth of polytechnics in different parts of London, since the formation of the Technical Education Board in 1893, has had in the development of evening instruction has not, the report points out, been achieved at the expense of other institutions; it represents a new growth, not the transference of instruction from old to new institutions. Many changes have taken place in the older polytechnics to bring them more into touch with modern requirements, and this has been accompanied in nearly every case by an increase in the volume of instruction. Statistics have been compiled, with regard to the attendances which have been made, from 1893 for a period extending over eight years. It has been impossible to give particulars with regard to all the 4000 classes in the numerous subjects of instruction aided by the London County Council, but mechanical engineering, electrical engineering, carpentry and joinery, plumbing, other building trade classes, experimental physics, chemistry, and mathematics have been selected. The total volume of instruction in these subjects, taken together, shows an increase from 118,732 student-hours in 1893 to 454,363 student-hours for 1900–1. Since then the number of artisan students has been increasing steadily. The increase in the amount of work done by the students, speaking generally, appears to have been even greater than the growth in numbers. A growing proportion of the students are now, it is satisfactory to find, taking advantage of the systematic courses which have been arranged, involving attendance on several evenings a week; and it is not surprising to find the Board recording its belief that the educational value of the work done in polytechnics, especially as regards the young mechanic, has been in this way greatly increased.

As has been frequently pointed out, it was from the first the policy of the Board to avail itself of the opportunity of aiding the supply of technical instruction rather than of creating a direct supply, wherever public institutions have existed capable of responding to the Board's aid by such developments of efficient technical instruction as might be expected to meet the requirements of the district. It has been necessary, however, to provide two classes of institution, for the conduct of which the London County Council is wholly responsible, viz. :—

(*a*) Institutions which provide instruction of such a highly specialised character that it is necessary for them to draw their students from the whole of London; for it has been impossible for any institution with the ordinary sources of income to provide the equipment and the highly specialised teachers necessary.

(*b*) Local institutions, providing instruction of a more ordinary character in districts in which no public institutions under a responsible governing body existed which could be utilised for the Council's requirements.

There are many other subjects of interest included in the report, and some of them have already been dealt with from time to time in these columns. It must suffice here, by way of conclusion, to mention briefly the work the Board has accomplished in aiding and extending satisfactory instruction in science in the public secondary schools of London. Seventeen chemical laboratories have been equipped in new buildings, generally in wings added to existing school premises, and three rooms used for class purposes have been converted into chemical laboratories. Four large rooms have been fitted up for practical work in physics and chemistry. Sixteen physical laboratories have been equipped in new buildings, and ten large class-rooms have been adapted for practical work in physics, in addition to the four mentioned above, in which practical work in chemistry is also carried on. Thus fifty laboratories have been equipped in secondary schools for boys, with bench accommodation for more than 1200 pupils working simultaneously, or for 6000 pupils working one day a week. Twenty-five science lecture-rooms have been provided, sixteen of these being specially constructed for the purpose in new buildings. A large number of additional science masters have been appointed as a result of the Board's maintenance grants. In secondary schools for girls, laboratories have in some cases been provided for practical work in physics, chemistry, and botany, and some of those in existence have been equipped suitably to meet modern requirements. A. T. S.

NOTES.

THE list of appointments on the occasion of His Majesty's birthday includes the following honours conferred upon men of science :—Mr. W. H. M. Christie, C.B., F.R.S., has been promoted to the rank of Knight Commander of the Order of the Bath (K.C.B. Civil Division). Dr. J. W. Swan, F.R.S., has received the honour of Knighthood. The Hon. C. A. Parsons, F.R.S., has been appointed a Companion of the Order of the Bath (C.B.). Mr. Francis Watts, Director of Agriculture in the Island of Antigua, and analytical and agricultural chemist for the colony of the Leeward Islands, has been made a Companion of the Order of Saint Michael and Saint George (C.M.G.).

THE council of the Royal Society has made the following award of medals for this year :—The Copley medal to Sir William Crookes, F.R.S., for his long-continued researches in spectroscopic chemistry, on electrical and mechanical phenomena in highly rarefied gases, on radio-active phenomena, and other subjects. The Rumford medal to Prof. Ernest Rutherford, F.R.S., for his researches on radio-activity, particularly for his discovery of the existence and properties of the gaseous emanations from radio-active bodies. A Royal medal to Colonel David Bruce, R.A.M.C., F.R.S., for his researches in the pathology of Malta fever, nagana, and sleeping sickness, and especially for his discoveries as regards the exact causes of these diseases. A Royal medal to Prof. William Burnside, F.R.S., for his researches in mathematics, particularly in the theory of groups. The Davy medal to Prof. William Henry Perkin, jun., F.R.S., for his discoveries in organic chemistry. The Darwin medal to Mr. William Bateson, F.R.S., for his contribution to the theory of organic evolution by his researches on variation and heredity. The Sylvester medal to Prof. Georg Cantor for his researches in the theories of aggregates and of sets of points of the arithmetic continuum, of transfinite numbers, and Fourier's series. The Hughes medal to Dr. Joseph Wilson Swan for his invention of the electric incandescent lamp and various improvements in practical applications of electricity.

THE following is a list of fellows who have been recommended by the president and council of the Royal Society for election into the council for the year 1905, at the anniversary meeting to be held on November 30 :—president, Sir William Huggins, K.C.B., O.M.; treasurer, Mr. A. B. Kempe; secretaries, Prof. J. Larmor, Sir Archibald Geikie; foreign secretary, Mr. F. Darwin. Other members of the council :—Dr. Shelford Bidwell, Mr. G. A. Boulenger, Colonel D. Bruce, R.A.M.C., Mr. F. W. Dyson, Prof. Percy F. Frankland, Prof. F. Gotch, Dr. E. W. Hobson, Prof.

J. N. Langley, Mr. J. E. Marr, Sir William D. Niven, K.C.B., Prof. W. H. Perkin, jun., Prof. J. Perry, Mr. A. Sedgwick, Dr. W. N. Shaw, Prof. W. A. Tilden, Rear-Admiral Sir William Wharton, K.C.B.

WE announce with deep regret that Dr. Frank McClean, F.R.S., died at Brussels on Tuesday morning in his sixty-seventh year.

MR. JAMES COSMO MELVILL has presented his general herbarium to the Manchester Museum of the Victoria University. The herbarium has taken nearly forty years to collect, and it was formally opened in its new quarters by Sir W. T. Thiselton-Dyer, K.C.M.G., on October 31.

THE portraits of Prof. Osborne Reynolds and Prof. A. S. Wilkins, by the Hon. John Collier, will be formally presented to the Victoria University of Manchester on Friday, November 18. Dr. A. W. Ward, the master of Peterhouse, Cambridge, formerly principal of the Owens College, and Vice-Chancellor of the Victoria University, will make the presentation on behalf of the subscribers.

A CHRISTMAS course of lectures, adapted to a juvenile auditory, will be delivered by Mr. Henry Cunynghame, C.B., at the Royal Institution, on "Ancient and Modern Methods of Measuring Time."

AN inaugural dinner of Royal School of Mines men resident in South Africa was held at Johannesburg on Saturday, October 8. The chair was taken by Mr. A. R. Sawyer, president of the Geological Society of South Africa, and many old students of the school were present.

THE *Times* correspondent at Tokio reports that a serious earthquake occurred in Formosa at 4.30 a.m. on Sunday, November 6. The centre of the disturbance was at Kia-yih, where 150 houses were overthrown and 33 damaged, 78 persons killed, and 23 injured.

THE deaths are announced of Forstmeister Schering, formerly professor of mathematics and geodesy in the School of Forestry at Munich; Clemens Alexander Winkler, professor at Freiberg; and Dr. Francesco Chizzoni, professor of geometry at Modena.

THE Society of Arts will commence its fourth half-century on November 16, when Sir William Abney, as chairman of the society's council, will open the 151st session with an address. The subjects on which papers will be read at the meetings before Christmas include British trade, canals, the St. Louis Exhibition, patent law, Burma, and street architecture. There will also be a course of lectures on wind instruments, with musical illustrations.

THE *Times* correspondent at Copenhagen announces that Mr. Mylius-Erichsen's expedition returned there from Greenland on November 6, having been absent two years and a half. Mr. Mylius-Erichsen was accompanied by Mr. Knud Rasmussen and Count Harald de Moltke, a well known painter. The expedition travelled along the west coast, and drove round Melville Bay on sledges. During the whole time the explorers lived with the natives, learning their language, and studying their manners and customs of life.

IT was decided early last year, soon after the death of Mr. F. C. Penrose, to commemorate his work in Athens by building on to the Students' Hostel of the British School in Athens a library to bear his name. Mr. Penrose was the first director of the school in Athens, and was called on more than once by the Athenian authorities to advise as to the preservation of the Parthenon. The total cost of the building and fittings will be about 1150*l.*, and so far 400*l.* has been received in subscriptions toward this object. The school can, if necessary, afford out of its own resources the sum of 600*l.*, but no more, so it seems that at least 150*l.* should be raised by subscription if the building is to be opened free of debt during the archæological congress in Athens next spring. The committee will have, it is to be hoped, no difficulty in securing this further sum of money. Subscriptions may be sent to Mr. George Macmillan, St. Martin's Street, London, or may be paid into the account of the Penrose Memorial Fund at the London and County Banking Company, Ltd., Henrietta Street, Covent Garden, W.C.

MR. J. FLETCHER MOULTON, F.R.S., gave an address on the "Trend of Invention in Chemical Industry" before the Society of Chemical Industry on Monday. In the course of his remarks he said that there are two departments of great interest at the moment from the inventive development they are manifesting in their products. The first is that of pharmaceutical products. Physiologists are beginning to associate specific effects on the human organism with specific chemical groups. These groups appear in countless combinations, and their effect may be masked or hindered by the setting in which they are placed. It may thus be that many of the forms in which these effective groups have up to now been administered have influenced and distorted their normal action, and a line of genuine research and invention is now being pressed forward seeking practical solutions of the problem of the best way to use these operative groups. The second department concerns food-stuffs. A vast waste of nutritious matter is going on all round us. A substantial part of the ability now devoted to the practical solution of difficult chemical questions in existing industries could be usefully applied to the preservation of food-stuffs. The main trend of invention in chemical industry is rendering certain and complete in their action processes formerly unmanageable or unprofitable by reason of the uncertainty of the reactions that actually and locally took place. The realisation of the necessity of uniformity of conditions in order to obtain full yield manifests itself not only in the efforts to improve old processes, but also in the choice of new ones; that process is a good one which permits the necessary conditions to be secured at every point and at every moment.

A LIST of awards to exhibitors from Great Britain and Ireland at the St. Louis International Exhibition has been received from the secretary of the Royal Commission appointed for the exhibition. The number of grand prizes gained by Great Britain is 121, while 238 gold medals, 162 silver medals, and 132 bronze medals have been awarded to British exhibitors, making a total of 653. It is therefore only possible here to mention a few of the awards to men of science and scientific bodies. Among these awards are the following:—Department of Liberal Arts: photography, grand prize, Sir W. de W. Abney, K.C.B., F.R.S.; the Royal Observatory, Greenwich; the Royal Photographic Society; the Solar Physics Observatory; and Sir Benjamin Stone; gold medal, the Geological Photographs Committee of the British Association; the Cretan Exploration Fund; and the Survey of India. Maps and apparatus for geography, grand prize, Board of Agriculture and Fisheries; Ordnance Survey of Great Britain and Ireland; Royal Geographical Society; Admiralty (Hydrographical Department); the Survey of India; Palestine Exploration Fund. Chemical and pharmaceutical arts, grand prize, low temperature research exhibit of the British Royal Commission; Sir

William Ramsay, K.C.B., F.R.S.; gold medal, Dr. Ludwig Mond, F.R.S.; the Owens College; Royal College of Science, London. Awards to collaborators, gold medal, Prof. James Dewar, F.R.S. (low temperature research exhibit); Mr. T. Wilton, and Dr. A. R. Garrick. Various applications of electricity: awards to collaborators, grand prize, Lord Kelvin (for important contributions to electrical engineering); gold medal, Prof. Hugh Langbourne Callendar, F.R.S., Mr. W. du Bois Duddell. Theory of agriculture: grand prize, the Rothamsted Experimental Station (Lawes Agricultural Trust); gold medal, Board of Agriculture and Fisheries; Royal Agricultural Society. Department of Horticulture: appliances and methods of pomology, grand prize, Board of Agriculture and Fisheries; Royal Horticultural Society; the British Royal Commission; gold medal, Dr. Henry. Department of Forestry: appliances and processes used in forestry, gold medal, Forest Department, India; silver medal, the Royal Scottish Arboricultural Society. Department of Mines and Metallurgy: ores and minerals, grand prize, Home Office (Mining Department); Department of Agriculture and Technical Instruction for Ireland. Geological maps and plans of mines, grand prize, Geological Survey of India. Mining literature, grand prize, the Iron and Steel Institute; the Geological Survey of India; gold medal, the Institution of Mining Engineers. Fishing equipment and products: grand prize, Marine Biological Association of the United Kingdom, for an exhibit prepared at their Plymouth laboratory illustrating the life-history and the food of fishes, and a gold medal for publications. Department of Anthropology: ethnography, grand prize, Cretan Exploration Fund; Egypt Exploration Fund; Palestine Exploration Fund.

A CONFERENCE on the teaching of hygiene and temperance in relation to physical deterioration was held at Caxton Hall, Westminster, on November 2, under the auspices of the National Temperance League, Sir John Gorst presiding. The various speakers dealt with the evils of intemperance, and attention was directed to the petition prepared by the British Medical Association in which the medical profession urged that the teaching of the elements of the laws of health should be made compulsory in the elementary schools.

THE American Bar Association has passed a resolution in favour of establishing in the Department of Justice, Washington, a laboratory for the study of the criminal, pauper, and defective classes. In the Bureau of Education, Washington, Mr. MacDonald has for some years been carrying on work of this kind under many difficulties, and it is mainly owing to his initiative that the foregoing resolution was framed.

IN connection with the review on "Cancer Research" (NATURE, vol. lxx. p. 279), an American correspondent, Mr. Harbert Hamilton, has directed our attention to the reported occurrence of a tumour in an oyster. The original paper (Prof. J. A. Ryder in *Proc.* Acad. Nat. Sciences, Philadelphia, 1887, p. 25) records that the tumour was growing in the pericardial cavity; it consisted of alveoli containing numbers of round nucleated cells resembling the colourless blood and lymph cells of the oyster. The opinion is expressed that the growth was of mesodermal origin, and probably benign.

WITH regard to the note on anti-typhoid vaccination which appeared in these columns last week (p. 14), it may be of interest to direct attention to a statistical inquiry on the same subject contributed by Prof. Karl Pearson, F.R.S., to the *British Medical Journal* (November 5, p. 1243). Prof. Pearson analyses mathematically certain statistics submitted to him by Lieut.-Colonel Simpson, R.A.M.C., and concludes that while most of the correlations both for immunity and recovery are distinctly sensible, having regard to their probable errors, yet they are so irregular that little reliance can be placed upon them as representing any definite uniform effect. He considers that the data suggest that a more effective method of inoculation must be found before it should become a routine practice in the Army.

AT a special meeting of the Charity Organisation Society on October 31, Dr. Orme Dudfield, medical officer of health for Kensington, contributed a paper on the need for sanatoria for persons suffering from consumption. He pointed out that more than one-tenth of the total mortality from all causes was due to tuberculous diseases, and that consumption accounted for nearly three-quarters of the tuberculous mortality. He suggested that the Metropolitan Asylums Board, which, on an order by the Local Government Board, has the power to do so under the various Health Acts, should take the matter in hand and equip sanatoria, the present Gore Farm Asylum being a very suitable building and site. With regard to the expense of such institutions, Dr. Dudfield remarked that the loss caused to London by tuberculosis could not be less than $4\frac{1}{2}$ millions per annum, and he contended that the expense incurred would be amply recouped by the money saved to the community. On the motion of Sir W. Broadbent, it was resolved "That it be referred to the Administrative Committee to consider Dr. T. Orme Dudfield's paper and the discussion upon it, and to report to the Council of the Charity Organisation Society at some subsequent meeting."

DURING last week a demonstration was given at Stratford, in connection with the process invented by Mr. Powell for treating timber with a solution of sugar. The result is that all kinds of wood are made tougher, heavier, and more lasting, while the softer varieties become more useful and more ornamental when worked. Besides this it is possible to put fresh and unseasoned timber through the process without delay, and after treatment the "powellised" wood is ready for immediate use, as there is no danger of its shrinking or warping. The timber is placed in cages which are wheeled into a boiler, and after this has been closed, a solution of beet sugar is pumped in, though apparently an open tank can be utilised. The solution takes the place of the air in the timber, and is absorbed by the individual fibres, for microscopical examination fails to demonstrate the presence of sugar crystals between them. It is therefore difficult to remove the sugar, and wood blocks which have been treated are no longer porous, so that pavements made from them should be more sanitary than those in present use. After being taken from the receiver the wood is dried in ovens by artificial heat, the temperature varying with the kind of wood. When subjected to a breaking strain, "powellised" timber recovers itself to a greater extent than untreated wood, and is able, even when broken, to support a greater weight without collapsing. It is also claimed that timber so treated is not subject to "dry rot," and by the addition of some poison to the sugar it is hoped to make it withstand the attacks of termites in tropical countries.

ACCORDING to the report of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne for 1903–4, the "museum talks" given once a month in winter by the curator have been continued. They were fairly well attended, although most of the audience contented themselves with listening to the discourse, only a few taking the opportunity of inspecting the museum.

Some excellent photographs of rorquals "spouting" illustrate a paper on these cetaceans by Dr. G. M. Allen in the September issue of the *American Naturalist.* In height and volume the "spout" of all the species is much less than was supposed to be the case by the older observers, even that of the huge "sulphur-bottom" averaging only about 14 feet in height, although it may occasionally reach 20 feet. In the same number Dr. C. R. Eastman has an article on fossil plumage, in which it is pointed out how extremely seldom are birds' feathers preserved in marine deposits; indeed, the only formations of this nature from which they have been recorded appear to be the Solenhofen limestones, the Cretaceous of Kansas, and the Monte Bolca Eocene.

The practice of planting trees and shrubs by stockmen around their ranch-houses is advocated in a *Bulletin* of the New Mexico Experimental Station, in which the author, Mr. Wooton, describes the native ornamental plants. Poplars or cottonwood trees are recommended for shade, also the hackberry, and a maple known as box-elder. The indigenous flora contains many climbers, including species of Ipomœa, Maurandia, and clematis, while for the gardens on the Mesa native yuccas, the sotol, Dasylirion, and the ocotillo are suitable.

The latest number of the *West Indian Bulletin,* vol. v., No. 2, contains an article on the cold storage of fruit, in which it is pointed out that previous to storage it is necessary to have the fruit cool before and while it is being packed. Reference is made to the installation of Hall's system for cooling the fruit chambers on board the West Indian Royal Mail Steamers *Tagus* and *Trent.* A review of the cacao industry indicates that Trinidad and Grenada continue to show a satisfactory increase in their exports, and Trinidad stands fourth in the list of cacao-producing countries.

Continuing the "Materials for a Flora of the Malay Peninsula," Sir George King, F.R.S., with the cooperation of Mr. J. S. Gamble, F.R.S., has worked out in the latest part (No. 15) the uniovulate series of the Rubiaceæ. This coincides with the subdivision Coffeoideæ adopted by Schumann in Engler's "Pflanzenfamilien." The authors retain Cephælis as a generic name, and include under Webera only a portion of the genus as understood by Hooker in the "Flora of British India." The most important genera are Ixora and Lasianthus, for the latter of which no fewer than twenty-five new species are given. No species of the Indo-Malayan genus Myrmecodia is recorded, and only one species of Hydnophytum.

We have received from Messrs. J. R. Gregory and Co., of Kelso Place, London, W., the prospectus and first part of the "Twentieth Century Atlas of Microscopical Petrography." This elaborate work is intended to supply drawings, descriptions, and microscopic slides of typical rocks to its subscribers; while, for an additional guinea, chips of the same rocks, mounted by a smooth face on glass plates, are issued to complete the materials for study. There are many good points about the idea, and we do not know why so capable a draughtsman as the author should veil his identity under the not very attractive title of "a senior medallist and first-class honoursman in Natural Science of the University of Edinburgh." The subject is not treated systematically, and we note that, while the plates can be arranged in a portfolio according to the owner's taste, the text is paged continuously, and cannot be cut up. There are many students, especially those forced to work alone, who will welcome a book of this kind, accompanied as it is by the actual specimens that are described.

The Royal Society has published its second annual issue of that part of the "International Catalogue of Scientific Literature" dealing with meteorology, including terrestrial magnetism. Our readers generally will know that this catalogue is an outgrowth of the catalogue of scientific papers published by the Royal Society. This second issue comprises mainly the literature of 1902, but includes some works published in 1901. Not only the titles of papers appearing in periodicals or as independent works are given, but their subject-matter has been indexed. The referee of this valuable contribution is Mr. T. D. Bell (librarian of the Meteorological Office), which, we consider, is sufficient guarantee of the care that has been taken in the preparation of the work. We note that a very important addition has been made by including the contents of the *Meteorologische Zeitschrift* for 1902 as well as for 1901 which were omitted in the first issue. But we also note some important omissions which will probably be remedied in a future issue, *e.g.* the valuable papers which appear in the *U.S. Monthly Weather Review.* The Royal Society appears to receive notification of very few daily weather reports, as only those of four countries are included out of some twenty-five that are actually published.

Mr. John W. Butters, writing in the Edinburgh Mathematical Society's *Proceedings,* advocates a much more extensive use of the principle of *symmetry* in teaching geometry, a proposal with which many mathematicians will no doubt agree.

An amusing anecdote about *Linnea borealis* is told by M. V. Brandicourt in *Cosmos* for October 1. This rare plant was reported to have been discovered in 1810 by the Empress Josephine when on a visit to the Montanvert at Chamounix. But it transpired later that the specimens were planted there by a certain Bonjeau, who was pharmacist to Her Majesty, and the secret was let out by the man who planted them in a letter to her asking for help when he was incapacitated by an accident. As M. Brandicourt remarks, no one will ever again find *Linnea borealis* at the Montanvert or anywhere near—the Empress took them all!

In the *Proceedings* of the Royal Society of Edinburgh, xxv., 4, Dr. J. Erskine Murray describes a simple differentiating machine. In it the differential coefficient of a function the graph of which has been drawn is obtained by recording the slope of the tangent at each point, and to give this the machine is guided so that two near dots on a piece of celluloid shall at each instant lie along the curve, while a tracing point on a second sheet describes the required graph of the first derived function as thus obtained approximately. This method, rough as it sounds in description, is said to give valuable information in many statistical problems where existing methods would prove too laborious.

We have received parts i. to vii. of the *Rendiconto* of the Naples Academy (January to July), and in them notice obituary accounts of three members of the academy. Antonio de Martini studied medicine at Naples and Paris. In 1839 and 1840 he published with Salvatore Tommasi two papers on the organism of reptiles and one on the lamprey, and these were soon followed by many other papers. In 1847 he was appointed professor of anatomy and physiology at the veterinary college. The new morphology emanating from Germany at that period attracted Martini's attention, and he published a valuable work on embryology. About 1860 he was nominated professor of physiology, and two years later he was appointed to a newly founded chair of pathology. He was also appointed consulting physician to Princess Margherita, mother of the present King. Throughout his career he worked hand in hand with his colleague Tommasi. Gaetano Giorgio Gemmellaro was born at Catania in 1832. At the age of twenty he produced his first paper on certain volcanic minerals from Patagonia, and from then onwards published papers almost continuously for fifty years. The geological history of Sicily was almost made by him. He was professor of geology and mineralogy at Palermo, a member of the Accademia dei Lincei and of many other academies of different countries, one of the "Forty" of the Italian Society of Science, a Senator, and Knight of the Order of Savoy. Prof. Giustiniano Nicolucci was born in the island of Liri, and graduated in medicine at Naples in 1843. Under Stefano delle Chiaje he developed a taste for biological science, and in 1842 published his first paper on the structure and functions of the human cerebral nerves. During the political disturbances he left his country, and three years later returned to practise medicine. The various types of humanity with which he came in contact in his profession attracted his attention to the study of anthropology, which he continued to his last day. His researches dealt with both historic and prehistoric anthropology, his favourite theme being the prehistoric anthropology of Italy, and especially of southern Italy.

A NEW and revised edition of "Object Lessons in Elementary Science," by Mr. Vincent T. Murché, has been published by Messrs. Macmillan and Co., Ltd., in two parts at 2s. each.

THE "London University Guide and University Correspondence College Calendar" for 1905 contains in a convenient form the kind of information required by a private student desirous of taking a degree at the University of London.

MR. HEMMING's book entitled "Billiards Mathematically Treated" has reached a second edition, which has just been published by Messrs. Macmillan and Co., Ltd. In appendix iii. of the new edition Mr. Hemming institutes a comparison of strokes played through and fine, and of the margin of error in each case.

MESSRS. WHITTAKER AND CO. have published a third edition of "The Optics of Photography and Photographic Lenses," by the late Mr. J. Traill Taylor. The short chapter on lenses of Jena glass which was included in the last issue of the book has been omitted, and one on anastigmatic lenses, written by Mr. P. F. Everitt, inserted in its place.

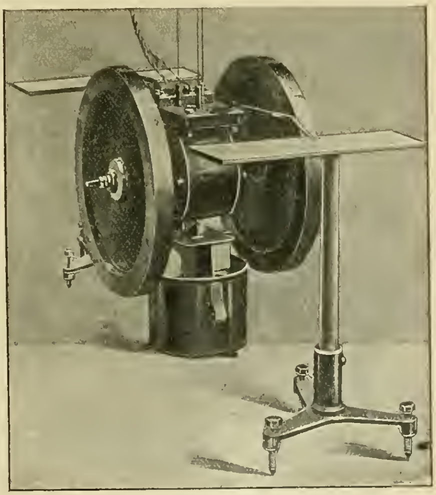
AN authorised translation, by Dr. M. Ernst, of the presidential address delivered by Mr. Balfour at the Cambridge meeting of the British Association has been published by Herr J. M. Barth, Leipzig, under the title "Unsere heutige Weltansschauung." Dr. Ernst has rendered the address into fluent German, and has added a few short descriptive notes—mainly of a biographical character—which will be of interest to readers unfamiliar with the names of Newton, Cavendish, Stokes, Maxwell, Kelvin, Rayleigh, and other natural philosophers to which reference is made. In the first note, on the foundation and objects of the British Association, the list of sections should have included the section of educational science.

THE "Notes on Shooting, with Instructions Concerning the Use of Nitro-Powders," written by "An Expert," and published by Messrs. Curtis's and Harvey, Ltd., has reached an eighth edition. This little volume of 83 pages has been completely re-written, and now contains a practical account of the results of recent researches in sporting gunnery. The actions of guns and gunpowder are based on the laws of physics and chemistry, and the results which have followed the application of the scientific method to the problems in connection with this branch of technology have been incorporated in the book. The volume provides evidence that manufacturers are coming to realise that substantial advantages in their work follow an acquaintance with results arrived at by the man of science. The six chapters into which the book is divided deal with smokeless powders and the methods of testing them, with patterns on the distribution of pellets on the target, with cartridge shooting, and aiming at moving objects.

OUR ASTRONOMICAL COLUMN.

APPARATUS FOR MEASURING THE VELOCITY OF THE EARTH'S ROTATION.—Prof. A. Föppl, of the Munich Technical High School, has devised a new gyroscopic apparatus for measuring the angular velocity of the earth's rotation.

As shown in the accompanying figure, the apparatus consists of a large top carrying at each end of a horizontal



spindle an iron wheel 50 cm. (19·7 inches) in diameter and 30 kilograms (66·1 lb.) in weight. This spindle is the axle of a small electro-motor which is capable of turning the wheels 2400 revolutions per minute. The whole framework is suspended by three fine, strong steel wires to the ceiling of the room in which the experiment is performed, and a cross piece immediately under the centre of the axle dips into a bath of oil, thereby deadening the subsidiary interfering oscillations. The angle through which the whole apparatus turns about its vertical axis is read off, on the two scales shown in the figure, to about the tenth of a degree.

To perform the experiment the current is disconnected from the motor, and the latter run as a generator for a short period, when a reading of a voltmeter placed in circuit enables the angular velocity of the revolving wheels to be found. Knowing this, one deduces the moments of inertia of the turning masses, and then by an equation which takes for its arguments the combined moment, the constant angular velocity of the wheels, the torsion of the trifilar suspension, &c., one may calculate from the observed readings, taken from the scales each minute of the quarter or half an hour that the wheels continue to revolve at a constant rate, the angular velocity of the earth's rotation.

For this quantity Prof. Föppl has obtained a value within 2 per cent. of that obtained from astronomical phenomena, and hopes, with the assistance of M. O. Schlick, the maker of the apparatus, to obtain a still more accordant value by further modifying and perfecting his device (*Revue générale des Sciences*, No. 19, October 15).

The Perseid Shower.—Mr. A. King sends an account of his observations of Perseid meteors during July and August. The observations were divided into two periods, namely, (1) July 12 to 18 inclusive at Sheffield, (2) August 3 to 18 inclusive at Leicester.

The total time spent in watching was twenty-one hours. Considerably more than 200 shooting stars were seen, of which nearly 130 were Perseids; 152 meteors were noted, about 80 being Perseids. The *maximum* of the shower seems to have occurred on August 11, or in the daylight hours of the morning of August 12. By August 14 the strength of the shower had much decreased, but on the following night there was a recrudescence of Perseid activity, for within the first fifteen minutes of a watch from 10h. to 11h. two beautiful Perseid fireballs, both nearly equalling Jupiter in brilliance, appeared, and altogether the hourly rate of Perseids was higher than on August 14. Mr. King considers that the display was scarcely so strong as of late years, but still was a fairly rich one. The following positions were obtained:—August 6, α 38, δ $+56\frac{1}{2}$ (10 meteors); August 11, α $45\frac{1}{2}$, δ $+57\frac{1}{2}$ (35 meteors); August 12, α $46\frac{1}{2}$, δ $+57\frac{1}{2}$ (13 meteors); August 14, α $50\frac{1}{2}$, δ $+58\frac{1}{2}$ (7 meteors).

The movement of the radiant is thus well shown. In conclusion, Mr. King says:—"All the brilliant Perseids had pear-shaped heads. Of 47 Perseids the colours of which were recorded 31 were yellow, a few of these having a greenish tinge. The tints of the streaks usually eluded observation, but the streak of a bright Perseid which appeared on August 13 was muddy."

The Dumb-bell Nebula.—From a special study of the various forms of nebulæ which he has photographed with the Meudon reflector, M. Louis Rabourdin has arrived at the conclusion that the dumb-bell nebula may be correctly classified as elliptical, and that the ring nebula in Lyra should also be placed in the same category.

On comparing a number of photographs of these two objects he found that they have the same elliptical form, and that the stars enclosed in each are, generally speaking, similarly arranged. Consequently, he believes them to be objects which started with the same primal form, but have arrived at different stages in the order of their evolution.

Several other well known objects are placed by him in the same class, and he suggests that the nebulæ generally may be of two general types only, viz. elliptical and spiral (*Bulletin de la Société astronomique de France*, October, 1903).

Harvard College Observatory.—In a small brochure published by the Harvard College authorities (Cambridge, Mass., 1904) the establishment, growth, and work of the college observatory is briefly recorded. The various stations and the instruments located in each are named and described, and the work already performed, the publications of the observatory, and the officers employed are mentioned in chronological order. Two reproductions of photographs show the stations at Cambridge and Arequipa respectively.

In a second similar publication Prof. E. C. Pickering outlines the second part of his "Plan for the Endowment of Astronomical Research," in which he suggests several methods of usefully spending the money he is seeking to raise for this purpose. Among other things he discusses solar eclipse expeditions, and states that the English method of organisation by means of a central permanent eclipse committee is one which might be usefully copied in other countries, where much money has been "wasted" by sending out a number of mutually independent expeditions, often in charge of incompetent persons, to attempt to obtain results which are but seldom adequately discussed or published.

IRON AND STEEL INSTITUTE.

The opening meeting of the Iron and Steel Institute was held on October 24 in New York under the presidency of Mr. Andrew Carnegie. Addresses of welcome were delivered by the Mayor, by Mr. John Fritz, chairman of the reception committee, and by Mr. James Gayley, president of the American Institute of Mining Engineers. On behalf of the council Sir James Kitson presented to Mr. Carnegie the Bessemer gold medal in recognition of his great services to the iron and steel industries of the world. On October 26 a selection of papers was read and discussed.

The first and most important read was that by Mr. James Gayley (New York) on the application of dry air blast to the manufacture of iron. The variable moisture in the atmosphere has long been recognised as a barrier to further progress in blast furnace practice. The problem of extracting the moisture has been solved by Mr. Gayley by the adoption of refrigeration by means of anhydrous ammonia. A plant was put in operation at the Isabella furnaces of the Carnegie Steel Company at Pittsburg on August 11, and remarkable results have been obtained. Prior to its adoption, the furnace from August 1 to August 11 produced on an average 358 tons of pig iron daily with a coke consumption of 2147 lb. Using dry air blast from August 25 to September 9 the daily production of pig iron averaged 447 tons with a coke consumption of 1726 lb. Similar advantages would doubtless be effected in the Bessemer converter, in the open-hearth steel process, in copper smelting, and in other processes where air in large quantities is used.

The next paper read was on the influence of carbon and phosphorus on the strength of iron and steel, by Mr. H. H. Campbell, of Steelton, Pennsylvania.

The paper by Mr. C. V. Bellamy, Director of Public Works, Lagos, was of great ethnological interest. He described the process of iron manufacture in the hinterland of the British colony of Lagos, within twenty days of London, where the methods are the same as those practised by the earliest workers in the metal. The smelting works are near Oyo, the capital of the Yoruba country, and it is only recently that they have been visited by a white man for the first time. Analyses given by Mr. F. W. Harbord, in an appendix to the paper, show that the metal is a pig iron partially decarburised by an oxidising flux. It is really a puddled steel, low in sulphur and phosphorus, its purity accounting for its good qualities.

Mr. J. M. Gledhill read a paper describing the development and rise of high-speed tool steel. Since the initiation of high-speed cutting at the Bethlehem Steel Works, great developments have been made, and results in cutting powers far beyond expectation have been attained. An analysis of one of the best qualities of rapid steels produced by Sir W. G. Armstrong, Whitworth and Co., Ltd., showed 0·55 per cent. of carbon, 3·5 per cent. of chromium, and 13·5 per cent. of tungsten.

The results of different analysts when operating on the same sample of iron or steel are far from concordant, and attempts have been made at various times to investigate the causes of difference. A further attempt has now been made to ascertain the most trustworthy methods for the determination of carbon and phosphorus in steel by a committee consisting of Mr. J. E. Stead, F.R.S., Baron H. von Jüptner (Austria), Mr. A. A. Blair (Philadelphia), and Mr. Gunnar Dillner (Stockholm), who presented an interim report covering fifty-two printed pages.

A paper on acid open-hearth manipulation was submitted by Mr. A. McWilliam and Mr. W. H. Hatfield (Sheffield), in which experimental results were recorded proving that, at about the temperatures occurring in Siemens steel-making practice, the chemical composition of the slag, particularly with regard to its acidity, is the factor which determines whether the percentage of silicon in the molten steel shall increase or decrease.

Mr. E. Demenge (Paris) submitted a paper on the utilisation of exhaust steam, from engines acting intermittently, by means of regenerative steam accumulators and of low-pressure turbines of the Rateau type. The process has been applied with conspicuous success at the Donetz Steel Works in Russia, at the Poensgen Steel Works at Düsseldorf, and at several French collieries.

The meeting concluded with the customary votes of thanks to the reception committee, proposed by Mr. E. Windsor Richards and seconded by the secretary, Mr. Bennett H. Brough. The meeting was attended by more than 300 members, and an attractive programme of visits to metallurgical works in various parts of America was arranged.

THE INTERNATIONAL ELECTRICAL CONGRESS AT ST. LOUIS.

SINCE the article on the proceedings of the International Electrical Congress at St. Louis appeared in our issue of October 27, we have received the subjoined report to the congress of the chamber of Government delegates referred to on p. 639.

It will be noticed that the resolutions ask for the appointment by Governments of one international commission, at first of a temporary character, but which, it is hoped, may become permanent, to deal with electric units.

Report of the Chamber of Delegates.

At the meeting on September 13, after discussion in the chamber, two subcommittees were appointed to deal with the questions of international electromagnetic units and of international standardisation respectively.

At the meeting on September 15 the following report of the committee on international electromagnetic units was accepted and unanimously adopted:—

Committee on International Electromagnetic Units.

The subcommittee appointed September 13 begs leave to suggest that the chamber of delegates should adopt the following report:—

It appears from papers laid before the International Electrical Congress and from the discussion that there are considerable discrepancies between the laws relating to electric units, or their interpretations, in the various countries represented, which, in the opinion of the chamber, require consideration with a view to securing practical uniformity.

Other questions bearing on nomenclature and the determination of units and standards have also been raised, on which, in the opinion of the chamber, it is desirable to have international agreement.

The chamber of delegates considers that these and similar questions could best be dealt with by an international commission representing the Governments concerned. Such a commission might in the first instance be appointed by those countries in which legislation on electric units has been adopted, and consist of (say) two members from each country.

Provision should be made for securing the adhesion of other countries prepared to adopt the conclusions of the commission.

The chamber of delegates approves such a plan, and requests its members to bring this report before their respective Governments.

It is hoped that if the recommendation of the chamber of delegates be adopted by the Governments represented, the commission may eventually become a permanent one.

The following report was also received and unanimously adopted from the committee on international standardisation:—

Committee of the Chamber of Delegates on International Standardisation.

The committee of the chamber of delegates on the standardisation of machinery begs to report as follows:—

That steps should be taken to secure the cooperation of the technical societies of the world by the appointment of a representative commission to consider the question of the standardisation of the nomenclature and ratings of electrical apparatus and machinery.

If the above recommendation meets the approval of the chamber of delegates, it is suggested by your committee that much of the work could be accomplished by correspondence in the first instance, and by the appointment of a general secretary to preserve the records and crystallise the points of disagreement, if any, which may arise between the methods in vogue in the different countries interested.

It is hoped that if the recommendation of the chamber of delegates be adopted, the commission may eventually become a permanent one.

At the meeting on September 16 the following resolutions were unanimously adopted:—

"That the delegates report the resolution of the chamber as to electrical units to their respective Governments, and that they be invited to communicate with Dr. S. W. Stratton (Bureau of Standards, Washington, D.C.) and Dr. R. T. Glazebrook (National Physical Laboratory, Bushy House, Teddington, Middlesex, England) as to the results of their report, or as to other questions arising out of the resolution."

"That the delegates report the resolution of the chamber as to the international standardisation to their respective technical societies, with the request that the societies take such action as they may deem best to give effect to the resolution, and that the delegates be requested to communicate the result of such action to Colonel R. E. B. Crompton, Chelmsford, England, and to the president of the American Institute of Electrical Engineers, New York City."

THE NATIONAL ANTARCTIC EXPEDITION.

THE narrative of the National Antarctic Expedition, related by Captain Scott to an audience of about seven thousand people at the Albert Hall on Monday, was the first account of the work of the expedition given to the Royal Geographical Society since the *Discovery* returned home. Captain Scott made a general statement of the work of the expedition, referring particularly to the various sledging journeys—nine of which were made in the first season and six in the second season—for exploration to the south, west, and east; but his remarks were chiefly of the nature of descriptions of a magnificent collection of photographs of scenes and incidents in the areas visited. These pictures themselves constitute a unique record of Antarctic conditions, and with the results of meteorological, magnetic, hydrographic, biological, and geological observations make the expedition most notable in the history of polar exploration. An exhibition of the photographs taken by Lieut. Skelton, water colour sketches and coloured drawings by Dr. E. A. Wilson, and other objects of interest connected with the voyage of the *Discovery*, is now open at the Bruton Galleries, 13 Bruton Street, Bond Street, W.

At the end of the lecture the chairman, Sir Clements Markham, K.C.B., on behalf of the Royal Geographical Society, presented a gold medal to Captain Scott and silver medals to the officers and men. The gold medal of the Geographical Society of Philadelphia for 1904 was presented to Captain Scott by the United States Ambassador in the name of that society. The medal bears on one side a medallion of Dr. Elisha Kane, their own discoverer, in whose honour the society was organised, and on the reverse this inscription:—"For eminent geographical research. *Per mare et terram.* The Philadelphia Geographical Society. Incorporated 1803. Awarded to Captain Scott in the year 1904."

As the scientific work of the expedition will be described at subsequent meetings of the Royal Geographical Society, Captain Scott only made incidental reference to it, and added little to what has already appeared in these columns (vol. lxix., p. 543, April 7). The following brief summary of the lecture is, however, of interest in showing some of the incidents and inquiries of the expedition.

The Antarctic area was divided into four quadrants, of which the Ross quadrant was allotted to the British expedition. It was there that Sir James Ross in 1840 discovered the sea that bore his name. But Sir James Ross was in a sailing ship, and only saw things dimly and in the distance. The geographical problem was therefore in brief to find out what lay to the east, to the west and to the south of what Ross had seen. In addition to the geographical problem, there were many scientific ones connected with a region so little known. The principal of these was magnetism, and the course taken by the *Discovery* was especially adapted for a magnetic survey.

Accompanied by two other members of the expedition, Captain Scott left the ship for a southern journey early in November, 1902, and on December 29 arrived at a point in latitude 80° 17′, when they were obliged to retrace their steps. Finally, the party returned safely to the ship, and found that the *Morning* relief ship had arrived in McMurdo Sound. Mr. Armitage made a journey to the westward with a large party. After one or two failures he found a good route to the main ice cap over the surface of a glacier of great length. He gradually rose in altitude until he arrived on the inland plateau at a height of 8900 feet, and was thus the first to penetrate into the interior of Victoria Land.

The expedition had hoped to accompany the *Morning* home, and it was not until the end of February, 1903, that this was seen to be impossible, because of the condition of the ice. They expected the ice in the bay in which they lay to break up, but unfortunately it got so late that there was only one thing for the *Morning* to do, and that was to return. She got home with a good deal of difficulty, but the *Discovery* was forced to remain a second winter.

Captain Scott next made a sledging expedition in a westerly direction, reaching his "furthest west" point on November 30, 1903. The party had reached the top of a mountain range some 7000 feet above the sea-level when a blizzard came on and prevented further movement for six days. The party then set out westward, rising another 1500 feet, and for another week advanced over a huge plain that extended as far as the eye could reach. The temperature was forty degrees below zero, and the lips, nostrils, and cheeks of the party were blistered by the incessant wind from the west. The rarefied air, too, had a great effect in reducing staying power. On this expedition they reached a very interesting spot—that at which the compass pointed south instead of north. They had reached for the first time the line of no variation lying between the South Pole and the south magnetic pole.

By the middle of December, 1903, all the sledging parties were ordered to be back, in order that an attempt might be made to free the *Discovery* from the ice by sawing out a channel. The attempt to clear a channel had to be abandoned, but on January 15 the *Morning* and the *Terra Nova* were sighted. They brought word that unless the *Discovery* could be freed it must be abandoned, and to obviate this hard necessity blasting operations were undertaken. But by the end of January the ice began to break up of its own accord, and by the middle of February there was a clear channel for the *Discovery*, which was then free to start on its return voyage.

MOUNT EVEREST: THE STORY OF A LONG CONTROVERSY.

THE highest mountain in the world is situated in a country from which Europeans have with few exceptions been jealously excluded; and the recent visit to the capital of Nepal of an experienced British surveyor, equipped with instruments and with full permission to use them, is an event of no small interest in the annals of Himalayan geography.[1] It is clear from Captain Wood's report that this event has been brought about by the personal intervention of Lord Curzon.

Surveyors have penetrated the Himalayas east and west of Nepal into Sikkim and Kumaon, and have from these points of view been enabled to observe a few of the Nepalese peaks; but from flanking stations the ranges of mountains are seen "end on," and the nearer peaks shut out the more distant from view. The knowledge that we possess of the heights and positions of the peaks of the Nepalese Himalayas has consequently been obtained from observations taken with theodolites at stations situated in the plains of Bengal and Oudh.

From maps of small areas we are able to estimate that the number of peaks existing in Himalayan regions, including Kashmir and Bhutan, probably exceeds 40,000, and that of these more than 10,000 are always clothed with snow. Such estimates, rough as they are, suffice to show that the problem which confronted the Indian Survey when it first undertook the determination of the positions and heights of the peaks of the Himalayas was not a simple one.

It is difficult now to discover how many of the 10,000 snow-peaks were known to the natives of India by name before the British commenced their survey. The number so named was certainly small, and possibly less than fifty. Not only were the two highest mountains of all without a name but many of the most conspicuous peaks throughout the whole length of the Himalayas were nameless. The few peaks that serve as landmarks to travellers on frequented thoroughfares have probably always had names, and the few that mark the sources of sacred rivers and indicate to weary pilgrims on distant plains the positions of the shrines that are their goals have for ages been recognised by names.

It is questionable whether some of the Hindu names now attaching to peaks were not given in the first instance by British surveyors; in the earlier days of the survey names were accepted from villagers more readily, perhaps, than would now be done. Even the celebrated name of Dhawlagiri, as attaching to a particular peak, is not altogether free from suspicion. The story of the controversy over Mount Everest shows how easy it is to find native names that have no existence in fact, and how hard it is to identify the precise peak even when a native name is current.

When 10,000 snow-peaks have to be fixed, and when but 50 of these have names, some system of classification has to be devised. The case is analogous to that of the stars; a few of the brighter stars have names of their own, the remainder are classified by constellations, and are designated by letters or numbers. The snow-peaks of the Himalayas are classified by areas, and are designated by Roman numerals or by letters with numbers attached; thus the highest mountain in the world is known in the official records as Peak XV, and the second highest is recorded as Peak K_2, both having been nameless at the time of their discovery.

The height of Peak XV, now better known as Mount Everest, is 29,002 feet, and that of K_2 is 28,250 feet. Sixty years ago Dhawlagiri, in Nepal, was considered the highest mountain in the world; Dhawlagiri is 26,795 feet high, and has since been found to be surpassed in height by six Himalayan peaks; of these K_2 is in Kashmir, and the other five, Everest (29,002), Kangchenjunga I (28,146), Kangchenjunga II (27,803), Makalu (27,790), and Peak T_{45} (27,000) are in or near Nepal.

The Discovery of Mount Everest.[1]—In 1848 trigonometrical surveyors commenced to build a line of survey stations along the plains of Oudh and Bengal from west to east, and to determine the positions of these stations in latitude and longitude by means of triangles observed with large theodolites. Sir George Everest had intended originally to carry the series along the mountains, but abandoned his design in consequence of the refusal of the Nepalese Government to allow the operations to enter their territories. Consequently, after crossing the hills of Kumaon, the stations were brought down into the plains near Bareilly, from which point they were carried for 800 miles through the deadly tracts which fringe the Himalayas. At almost every station the snowy range of Nepal was visible, and the northern horizon appeared broken by numbers of peaks. Just as some stars appear brighter to the eye than others, so do some snow-peaks against the sky-line appear loftier than others. The superior magnitude of certain stars may be due either to their greater diameter or their lesser distance, and the superior elevation of certain peaks may be due either to their greater height or their lesser distance. The most refined observations with the most perfect of instruments, if taken from a single station only, will furnish no clue as to whether a mountain-peak is conspicuous on account of its magnitude or on account of its nearness.

As the surveyors moved across Bengal from west to east they witnessed changes in the apparent positions of the peaks; the analogy of the stars no longer serves us, as owing to the great distances of the latter they appear to preserve their relative positions in the sky; but the case of mountain-peaks may be compared to what a traveller witnesses when he journeys by rail through a forest of pines—the nearer tree-trunks continually appear to pass between his eye and the more distant ones. As the surveyor moves across the plains parallel to the mountains he sees

[1] Report on the Identification and Nomenclature of Himalayan Peaks. By Capt. H. Wood, R.E., with a preface by Colonel Gore, C.S.I., R.E., late Surveyor General of India. (Published by Order of Colonel F. B. Longe, R.E., Surveyor General of India, 1904.)

[1] In order to appreciate the distance from which Mount Everest is visible, we have only to consider that if it stood in Snowdon's place, it would be seen from Land's End to Edinburgh and from Kent to Connaught.

innumerable peaks, many snow-clad, many bare, always seemingly changing their places and forms.

It is a mistaken idea that particular peaks can be identified from different points of view by their characteristic shapes. Such a course may sometimes be possible from near stations, but at distances greater than forty miles the form of a peak is its cross-section in outline against the sky, and this changes as one moves round it. The same peak is often found noted in the field records of the survey by a different letter or number at each station from which it was observed. Colonel Sir Andrew Waugh, of the Bengal Engineers, who was Surveyor-General of India from 1843 to 1861, realised from the outset the difficulties of identification. His orders were that every visible peak, great and small, was to be observed from every observing station, but that the identification of peaks, with the exception of the unmistakable few possessing native names, must be left to computers. In accordance with these orders the true direction of every visible peak and the angular elevation of every summit above the horizon were determined from every observing station.

The identification of the peaks as observed from different stations was then effected as follows:—

1st Step.—The stations of observation were carefully projected on a map, and from each were drawn lines representing the directions of all peaks observed from it.

2nd Step.—When direction-lines from three or more stations met in one point, it was tentatively assumed that the same peak had been observed on the three or more occasions.

3rd Step.—By trigonometrical formulæ the distance of this assumed peak from each of the observing stations was then calculated, and from these distances independent values of the latitude and longitude of the peak were obtained; if the several values were accordant the identification was proceeded with.

4th Step.—From the observed angle of elevation and from the calculated distance of the peak from each station the height of the peak was deduced; a separate value for the height of the peak was thus obtained from each observing station. If the several values of height were accordant the identification was finally accepted.

Numerous peaks were found to have been observed only once or twice, and could not be identified; many others failed to satisfy all the tests, and had to be rejected.

About 1852 the chief computer of the office at Calcutta informed Sir Andrew Waugh that a peak designated XV had been found to be higher than any other hitherto measured in the world. This peak was discovered by the computers to have been observed from six different stations; on no occasion had the observer suspected that he was viewing through his telescope the highest point of the earth.

The following table shows the several values of height that were obtained for Mount Everest:—

THE OBSERVED HEIGHT OF MOUNT EVEREST.

Extracted from the Records of the Great Trigonometrical Survey of India.

Observing station	Height of observing station	Distance of observing station from Mount Everest	Date of observation	Observer	Instrument	No. of observations	Observed angle of elevation	Height above mean sea level
	Feet	Miles					° ′ ″	Feet
Jirol ...	220	118·661	Nov. 27, 1849	Mr. J. O. Nicolson	24-inch theodolite	2	1 53 33·35	28991·6
Mirzapur	245	108·876	Dec. 5, 6, 1849			12	2 11 16·66	29005·3
Janjpati	255	108·362	Dec. 8, 9, 1849			4	2 12 9·31	29001·8
Ladnia ...	235	108·861	Dec. 12, 1849			4	2 11 25·52	28998·6
Harpur ...	219	111·523	Dec. 17, 18, 1849			8	2 6 24·98	29026·1
Minai ..	228	113·761	Jan. 17, 1850			8	2 2 16·61	28990·4
							Mean ...	29002·3

Sir Andrew Waugh had always adhered to the rule of assigning to every geographical object its true local or native name; but here was a mountain, the highest in the world, without any local or native name that he was able to discover. He determined, therefore, to name the great snow-peak after Sir George Everest, his former chief, the celebrated Indian geodesist. The name of "Mount Everest" has since become a household word, and no objection to it has ever been raised by natives of the country.

The Devadhunga Controversy.—When Sir Andrew Waugh announced that the peak was to be named Everest, Mr. Hodgson, who had been political officer in Nepal for many years, intimated to the Royal Geographical and Royal Asiatic Societies that Sir Andrew Waugh had been mistaken, and that the mountain had a local name, viz. Devadhunga. Sir Roderick Murchison, the president of the Royal Geographical Society, approved Waugh's action, but the Royal Asiatic Society supported Hodgson and repudiated the name of Everest. Seeing that the Survey officers had been debarred from entering Nepal, Mr. Hodgson was amply justified in raising the question he did; but he had made no scientific measurements, and it is known now beyond dispute that he was mistaken in his identification of Everest. He apparently assumed that the great peak, which he saw standing in the direction of Everest, and which was so conspicuous from Katmandu, where he resided, was the highest peak in Nepal;[1] but Nepal covers a large area, and Mount Everest is more than a hundred miles from Katmandu. Either Mr. Hodgson was unaware of the real distance of Mount Everest, or he failed to realise that even the highest mountain on earth will look small at so great a distance. It is probable that Mr. Hodgson never even saw Mount Everest; it is certain that if he did so he was unaware that he was looking at it.

All subsequent information goes to show that there is no peak in Nepal called Devadhunga. Mr. Hodgson's sincerity has never been doubted, and it is believed now that the name Devadhunga is a mythological term for the whole snowy range.

The Gaurisankar Controversy.—In 1854 three brothers, Hermann, Adolphe, and Robert de Schlagintweit, undertook a scientific mission to India and Central Asia at the instance of the King of Prussia, and with the concurrence of Lord Dalhousie and the court of directors. Their labours lasted until 1857, by which date they had succeeded in taking numerous astronomical, hypsometric, magnetic, and meteorological observations; they had also made geological, botanical, and zoological collections for the India House Museum; and they had explored the high mountains of India and Tibet, and had constructed many panoramic drawings of the snow-peaks of the Himalayas. Their mission unfortunately ended in the death of the second brother, Adolphe, who was killed at Kashgar.

In 1855 Hermann de Schlagintweit visited a hill in Nepal named Kaulia, near Katmandu, and from it took observations to the snow-peaks. He saw the mountain called Devadhunga by Hodgson, and he identified it as Mount Everest;[2] he, however, repudiated Hodgson's name of Devadhunga, and certified that the local native name for the peak was Gaurisankar.

Continental geographers, accepting Schlagintweit's views, have continued to this day to call the highest mountain in the world Gaurisankar; the Indian Survey, however, were unable to reconcile Schlagintweit's results with their own, and have declined to follow him.

The diagram in Fig. 1 illustrates the tour of Hermann de Schlagintweit, who visited the two stations of Kaulia and Falut, which are 175 miles apart. From Kaulia he saw a high peak to the north-east which the natives called Gaurisankar, and which he identified as Everest. From Falut he saw a high peak to the north-west, which he also identified as Everest.

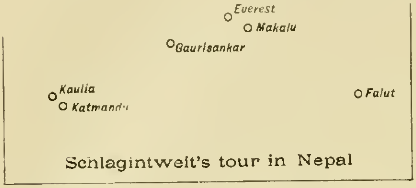
There is no doubt now that Schlagintweit was misled in his identification of Mount Everest. It is the common misfortune of all pioneers that posterity chiefly concerns itself with their mistakes. Indian geography owes much to Hermann de Schlagintweit, but she is more mindful now of his errors than of her debts. The mistakes of Schlagint-

[1] See *Proceedings* R.G.S., vol. viii., 1886, pp. 89 and 179.
[2] Schlagintweit's "India and High Asia," vol. iii. p. 193.

weit have formed the basis of controversy, and will continue to be remembered until controversy ceases.

In 1883 Colonel Tanner visited Falut, and found that Everest was barely visible from there, being almost shut out from view, and entirely surpassed in appearance by Makalu (height 27,790 feet), a lower though nearer peak; it was Makalu that Schlagintweit mistook for Everest, and it was Makalu that he drew as Everest, both in his panorama of the snows from Falut, and in his picture, which is preserved at the India Office.

In 1903 Captain Wood visited Kaulia by order of Lord Curzon; he found that Gaurisankar and Everest were



Schlagintweit's tour in Nepal

Heights in feet.		Distance from Mount Everest in miles.	
Everest	29,002		
Makalu	27,790	to Makalu	12
Gaurisankar	23,440	to Gaurisankar	36
Falut	11,815	to Falut	85
Kaulia	7,051	to Kaulia	109

FIG. 1.

different peaks thirty-six miles apart, and that Everest, far from being conspicuous, was almost obscured from view by intervening ranges. Captain Wood also discovered that an imposing peak of the snowy range, a peak long known in the records of the survey as Peak XX, height 23,440 feet, was the famous Gaurisankar of the Nepalese.

A comparison of the drawings of Schlagintweit and Wood tells us that the same peak was shown by the Nepalese to both observers as Gaurisankar. Schlagintweit was therefore right in giving the name of Gaurisankar to the great peak that is so conspicuous from Kaulia and Katmandu, but he has been proved to have been wrong in three particulars, namely, (1) in his identification of Everest from Kaulia, (2) in his identification of Everest from Falut, (3) in assuming that he had observed the same peak from Kaulia as he had done from Falut.

It is interesting to consider the magnitudes of the mistakes he made:—from Kaulia the direction of Gaurisankar differs from the true direction of Everest by two degrees; from Falut the direction of Makalu differs from the true direction of Everest by forty-two minutes.

From Kaulia the elevation of Gaurisankar differs from the true elevation of Everest by twenty-four minutes; from Falut the elevation of Makalu differs from the true elevation of Everest by fifteen minutes.

The two peaks Gaurisankar and Makalu, which Schlagintweit thought were the same, are forty-seven miles apart.

The supposed identity of Everest and Gaurisankar has rested only on Schlagintweit's evidence. It is true that successive British Residents at Katmandu have continued to regard Gaurisankar as Everest,[1] but their ideas have been based on the Schlagintweit tradition. It is also true that in a recent number of the *Geographical Journal*[2] the photographs of Dr. Boeck have been preferred as evidence to the observations of the Indian Survey; unfortunately Dr. Boeck made a mistake of thirty-two degrees in direction in his attempt at identifying Mount Everest,[3] and this initial slip led him to twist the whole area of Nepal round through a third of a right-angle.

Side Issues of the Controversy.—It is difficult to avoid the thought that this long controversy has of recent years been degenerating into a barren dispute over side issues.

(1) It has, for instance, been stated in the *Geographical*

[1] "In the Himalayas," by Waddell, 1899, p. 346.
[2] *Geographical Journal*, March, 1903.
[3] Colonel Gore's preface to Captain Wood's Report, 1904.

Journal that "the object of Captain Wood's visit to Nepal was to ascertain whether the mountain known as Mount Everest is visible from the heights in the neighbourhood of Katmandu, and forms part of the range known in Central Nepal as Gaurisankar."[1] But this statement is incorrect. The object of Captain Wood's visit to Nepal was to ascertain whether the peak known to the Nepalese as Gaurisankar was identical or not with the peak known to us as Mount Everest, and this main issue ought to be kept in view. It is also inaccurate to speak of a range in Central Nepal known as Gaurisankar: there is no range so known; Gaurisankar is a double peak.

(2) A side issue on which some argument has been expended is whether Mount Everest is visible from Kaulia or not. This point may be of interest to individuals, but it has no scientific importance; and I am surprised to see it asserted, as though some geographical issue were involved, that the Survey officers have generally held the view that Everest was not visible from Kaulia.[2]

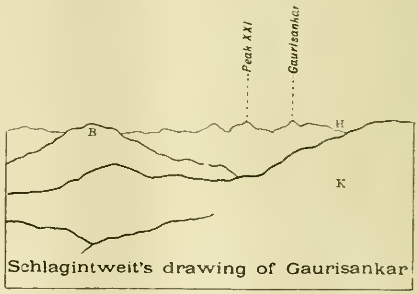
In a paper published in 1886, the late General Walker, R.E., gave some calculations of azimuth and elevation to show that the two peaks of Gaurisankar and Everest could not be identical; after proving his point in a convincing way, he added the following general remark:—"Obviously therefore Gaurisankar, the easternmost point of Schlagintweit's panorama of the snowy range, cannot have been Everest, and the great pinnacle must have lain hidden away from his view by intervening mountain masses."[3]

If we wish to discover whether a place A is visible from a place B, we have but two courses open to us: we can make calculations from contoured maps of the country, or we can send an observer to B to ascertain if A can be seen. If there are no maps, the second course alone is open.

Mount Everest is 109 miles from Kaulia; the intervening space is taken up by mountains and valleys, ridges and hollows, spurs and basins; this complicated area is unsurveyed, and questions of visibility are not mathematically arguable.

How came it, then, that an expert like General Walker expressed the opinion that Everest was not visible from Kaulia? General Walker was, of course, merely judging from Hermann Schlagintweit's recorded evidence. At Kaulia Schlagintweit made a careful drawing to scale of the snowy and nearer ranges; in Fig. 2 is given a copy of his drawing of Gaurisankar.

Schlagintweit wrote against the peak Gaurisankar on his drawing the words "Gaurisankar or Everest," but



Schlagintweit's drawing of Gaurisankar

FIG. 2.

General Walker showed by calculations that if Everest had been really visible it would have been seen by Schlagintweit as a low peak near the spot marked H. As Schlagintweit showed no low peak at this spot, General Walker concluded that it had been obscured from his view by one or another of the many unsurveyed intervening ranges.

[1] *Geographical Journal*, January, 1904, p. 89.
[2] *Geographical Journal*, March, 1903, and January, 1904.
[3] *Proceedings* R.G.S., vol. viii., 1886, where it will be seen that Schlagintweit described Everest as the easternmost point of his panorama.

When Captain Wood visited Kaulia in 1903 he was unable to discover the place from which Schlagintweit had made his drawing; he selected another spot, and made a careful drawing to scale of the snowy and nearer ranges. In Fig. 3 is given a copy of his drawing of Gaurisankar.

On the advice of the Prime Minister of Nepal, Captain Wood recorded on his drawing against the lower peak of the Gaurisankar double the name Gauri, and against its loftier companion the name Sankar.

If we compare Wood's drawing with Schlagintweit's, we see that the nearer range B appears higher in Schlagintweit's picture than in Wood's. This same peculiarity is visible throughout the panoramas of the two observers; the near ranges appear in Schlagintweit's drawing higher always with regard to the distant ranges than they do in Wood's. The inference is that Schlagintweit drew his panorama from a considerably lower point than Wood did; this may account for the fact that Schlagintweit shows no signs of Everest.

Again, in Schlagintweit's drawing the near range K cuts off laterally more of the snowy range than it does in Wood's, and obscures the shoulder of Gaurisankar just at the point where Everest should have been visible.

In Wood's drawing Mount Everest appears as a low peak at the spot where General Walker calculated that it would appear.

The omission of Everest from Schlagintweit's panorama led General Walker to believe that it was not visible from

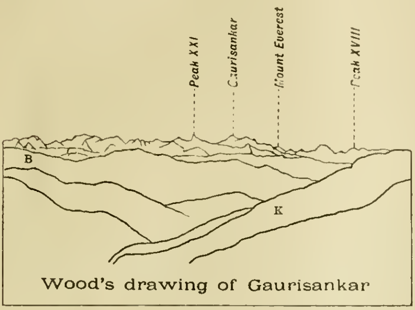


FIG. 3.

Schlagintweit's station at Kaulia. Whether it was visible or not was, I am sure, in General Walker's opinion not a question of moment.

(3) Now that Gaurisankar and Everest have been proved to be different peaks, a suggestion has been put forward [1] that they belong after all to the same "group" of peaks, and that "according to Alpine usage and precedent there is nothing to prevent the name Gaurisankar being applied to the loftiest peak of the group."

It is clear from this passage that the author is desirous of getting rid of the name of Everest, but it is not clear how his object is to be attained, whether by transferring the name Gaurisankar from the one peak to the other, or by giving the name Gaurisankar to both peaks. To displace the native name from the mountain which the natives know, and to attach it to a remote peak which they do not know, would be a course that would not commend itself to anyone interested in the preservation of local geographical names. To give the same name to both peaks would be to introduce a needless confusion.

Gaurisankar and Mount Everest, we are here told, belong to the same group; but what is a group? Controversialists give to the term different meanings to suit their own requirements. It is true that in some instances the same name has been given to different Himalayan peaks; Kangchenjunga I and Kangchenjunga II are the official designations of the two pinnacles which cap the lofty mass of Kangchenjunga; the eight peaks of a cluster in Kumaon are named Badrinath I, Badrinath II, &c.; but these peaks are slight prominences crowning the snow-clad pyramid of Badrinath, like turrets on a castle. Everest and Gaurisankar are separated by a wide interval and a deep valley, and are not spires of a single pile.

The extent to which we are justified in giving the same name to different peaks is, however, not altogether a question of intervening distance and depth; geographical significance has also to be considered. The peaks of the Badrinath cluster have a common, but no individual, significance; they are notable only as the several pinnacles of the sacred pile of Badrinath, and can therefore be classified without disadvantage under one general apellation. But the case of Gaurisankar and Everest is different: the former is remarkable in Nepal for the pre-eminence of its grandeur; the latter, screened from the gaze of man, is known only as the highest point of the earth. Would it not, then, be a mistake to include under one name two mountains the claims of which to celebrity are so different?

Before we blindly follow Alpine precedents in the settlement of Himalayan problems, we must consider well whether the conditions are identical. "It is no exaggeration to say," writes a great Himalayan authority, "that along the entire range of the Himalayas valleys are to be found among the higher mountains, into which the whole Alps might be cast, without producing any result that would be discernible at a distance of ten or fifteen miles." [1]

The Discovery of a Supposed Tibetan Name.—Colonel Waddell's book,[2] "Among the Himalayas," gives a good description of the Nepalese mountains with many interesting profiles · the author's investigations have enabled him to authenticate a Tibetan name for a high peak which he believes to be Mount Everest. This name is Jamokangkar, sometimes spelt Chamokankar.

Now let us suppose for one moment that it will be proved by future evidence—not at present forthcoming—that the mountain called Jamokangkar by Tibetans is identical with our Mount Everest. What then? Will it be incumbent upon us to abandon the name of Everest and to adopt that of Jamokangkar? I think not.

When the Gaurisankar controversy opened, the name of Everest was an interloper upon the map of Asia; but its trespass has long since been condoned. Time and usage have secured for it a right not less sacred than the right of origin; for what, after all, is the right of origin but that conferred by time and usage? To displace now this name from its lofty position in geography would seem to many of us an outrage.

It will, I think, be lamentable if former advocates of the name Gaurisankar, seeing that their cause is doomed, continue the struggle under this new flag of Jamokangkar. Already, to our regret, has Mr. Freshfield, a life-long defender of the claims of Gaurisankar, declared in favour of the Tibetan name.[3]

The old dispute has been settled; the names Gaurisankar and Everest have been proved to belong to different peaks; and it is to be hoped that Continental geographers, who have hitherto attached the name of Gaurisankar to the famous peak that we call Everest, will, in the interests of scientific harmony, now accept the name that has always been accepted by India. But before we can look for Continental acquiescence we must endeavour to show agreement at home. Few Continental geographers see the official reports of the Indian Government; the majority draw their conclusions from articles in our geographical Press.

In March, 1903, Mr. Freshfield, the late secretary of the Royal Geographical Society, wrote in the *Geographical Journal* as follows:—"The reason, for which the surveyors argued so strenuously forty-five years ago, that the 29,002 feet peak cannot be the Gaurisankar of Nepal was, of course, that their chief's proceeding in giving the mountain an English name was excused, or justified, at the time by the assertion that it had no local or native name."

The surveyors whose motives Mr. Freshfield has impugned were formed into a committee forty-five years

[1] *Geographical Journal*, March, 1904, p. 362.

[1] See the article on Himálaya by General Sir R. Strachey, R.E., in "Encyclop. Brit.," 9th edition.
[2] Published 1899.
[3] *Geographical Journal*, March, 1904, p. 363.

ago to consider the question whether the peak which Mr. Hodgson called Devadhunga was identical with the peak which Sir A. Waugh called Mount Everest; from the geographical evidence available they concluded that the two peaks were not identical, and their conclusion has been found correct.[1] In those early days there had arisen no such subtle questions as whether Mount Everest formed part of a certain range, or whether it belonged to a certain group of peaks, or whether it was just visible to those who knew where to search for it. To the clear minds of our predecessors, to Hodgson and Waugh and Schlagintweit and Walker, there was but one question at issue, namely, the identity of Hodgson's and Schlagintweit's peak with the Mount Everest of the Survey.

This question has now been answered, and after fifty years of discussion the Hindu and Nepalese names have been proved to be inapplicable; let us, then, close a controversy that has fulfilled its purpose, and let us suffer the English name to rest on our maps in peace.

S. G. Burrard.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—The Vice-Chancellor has appointed Prof. Ray Lankester, hon. fellow of Exeter College, to be Romanes lecturer for 1905.

Sir John Burdon Sanderson, Bart., hon. fellow of Magdalen College, late regius professor of medicine, has been constituted a perpetual delegate of the university museum.

Mr. Walter J. Barton, scholar of New College, has been elected to the geographical scholarship for 1904–5.

The executive committee of the Oxford division of the British Medical Association has had the electric light permanently installed in the Pitt-Rivers Museum as a mark of their appreciation of the generosity of the university in allowing the association to make use of their various buildings and of the help the university gave them in other ways during the meeting of the association in Oxford in July last. The cordial thanks of the university have been conveyed to the Oxford division of the association for their most acceptable gift, and the curators of the university chest have been empowered to erect a suitable record of the occasion in the Pitt-Rivers Museum.

Cambridge.—Mr. J. C. Willis, of Gonville and Caius College, director of the botanic garden at Peradeniya, Ceylon, has been approved for the degree of doctor of science.

Prof. G. H. Darwin, F.R.S., and Mr. A. E. Shipley, F.R.S., have been elected members of the council of the Senate.

Mr. A. Young, tenth wrangler in 1895, lecturer in mathematics at Selwyn College, has been elected a fellow of Clare College.

Mr. R. P. Gregory, demonstrator of botany, and Mr. E. Cunningham, senior wrangler 1902, have been elected fellows of St. John's College.

Prof. Marshall Ward, F.R.S., has been elected president, and Prof. Thomson, F.R.S., Prof. Liveing, F.R.S., and Dr. Hobson, F.R.S., vice-presidents of the Cambridge Philosophical Society.

We learn from *Science* that the will of Mr. James Callanan, of Des Moines, makes bequests amounting to 27,000*l*. for educational institutions. Of this sum 20,000*l*. goes to Talladega College, Alabama.

The chair of chemistry applied to the dyeing industry at the Paris Conservatoire des Arts et Métiers, rendered vacant by the death of M. Victor de Luynes, has been given, states the *Athenaeum*, to M. Maurice Prudhomme, who acted as reporter of the section devoted to textile industries and dyeing at the Exposition Universelle of 1900.

The following deans of faculties of the University of London have been elected for the two years 1904–6:—medicine, Dr. J. K. Fowler; science, Dr. A. D. Waller, F.R.S.; engineering, Prof. J. D. Cormack; economics, Mr. G. Armitage-Smith.

[1] *Vide Proceedings* R.G.S., 1858

Mr. Andrew Carnegie, who has been Rector of the University of St. Andrews for the past term of three years, was re-elected to that office on November 4.

An open competitive examination for not fewer than twenty situations as assistant examiner in the Patent Office will be held by the Civil Service Commissioners in January next. The examination will commence on January 2, 1905, and forms of application for admission to it are now ready for issue, and may be obtained on request addressed by letter to the secretary, Civil Service Commission, Burlington Gardens, London, W.

Dr. C. Kassner has been appointed professor of meteorology at the Berlin Technical College; Dr. Maurer physicist to the German Navy; Dr. O. Lummer, from Charlottenburg, to succeed Prof. O. E. Meyer as professor of physics at Breslau; Prof. London, of Breslau, to succeed Prof. Heffter as professor of mathematics at Bonn. Dr. Augustin, of Prague, has been raised to the rank of ordinary professor of meteorology, and Dr. Karl Exner has retired from the chair of physics at Innsbruck with the title of Hofrat.

In view of the importance of German to students of science, the University College of North Wales founded a lectureship in German, to which was attached the duty of conducting a beginner's class in that language, with especial reference to the needs of students qualifying for science degrees, and Mr. Rea, of Belfast, was appointed lecturer. The experiment bids fair to be a complete success, about thirty students having joined in the first year of the new venture. The institution of classes of this kind in our university colleges will, it is hoped, remove an anomaly which, in the natural order of events, has grown up in Britain, viz. the turning out of graduates in science who are debarred from efficiently engaging in post-graduate work by their inability to assimilate readily the subject-matter of Continental scientific literature.

SOCIETIES AND ACADEMIES.

London.

Royal Society, June 2.—"Studies on Enzyme Action: The Effect of 'Poisons' on the Rate of Decomposition of Hydrogen Peroxide by Hæmase." By George **Senter**, Ph.D., B.Sc. (Lond.). Communicated by Prof. E. H. Starling, F.R.S.

In a former paper (*Zeit. physikal. Chemie*, xliv., p. 257, 1903) the author investigated the relation of the reaction velocity to peroxide concentration and amount of enzyme present, as well as the acceleration caused by rise of temperature; the results correspond almost exactly with those obtained by Bredig in his experiments on the decomposition of hydrogen peroxide by colloidal platinum. In the present paper, assuming that hæmase is also a colloid in solution, it is suggested that the velocity of reaction between the catalysor and hydrogen peroxide is great in comparison with the rate of diffusion of the peroxide to the colloidal particles, so that what is measured is really a diffusion-velocity. This would account for the analogous results obtained with platinum and hæmase, since the nature of the catalysor would be of secondary importance.

The hæmase catalysis of hydrogen peroxide, like the platinum catalysis, is retarded by small quantities of many substances, more especially by those which act as poisons towards the living organism. Thus mercuric chloride, sulphuretted hydrogen, and hydrocyanic acid, in the concentration of 1 gram-molecule to 1 million litres, reduce the reaction-velocity to half its value; they are just the substances which have the greatest retarding effect on the platinum catalysis. Iodine, mercuric cyanide, and aniline have a much smaller effect. Arsenious acid, sodium fluoride, and formaldehyde do not greatly retard the catalysis; although powerful antiseptics, they have little effect on enzyme actions in general. Carbon monoxide, although an active poison for the platinum catalysis, does not affect hæmase. Hæmase, like other enzymes, but unlike platinum, is very sensitive even to minute quantities of acids and alkalis. The retarding effect of acids is, in most cases, proportional to the concentration of hydrogen ions, in other words, to the strength of the acid. The ways in which poisons may act are discussed in the paper, and it is suggested that in many cases they enter into chemical combination with the enzyme.

Royal Microscopical Society, October 19.—Dr. Dukinfield H. Scott, F.R.S., president, in the chair.—A communication from Mr. W. D. **Colver** described the antennæ of *Pulex irritans*, on the terminal joint of which Mr. Wm. Jenkinson, of Sheffield, had discovered a lamellated structure that he believed to have an olfactory function. Mr. Jenkinson had found similar structures in several other members of the family Pulicidæ. A slide showing the entire antenna, and another showing the terminal joint, were exhibited under microscopes, and photographs of the latter slide were exhibited in the room and on the screen.—Part xvii., being the concluding part, of Mr. **Millett's** report on the recent Foraminifera of the Malay Archipelago was taken as read.—The **President** then gave a demonstration on the reconstruction of a fossil plant. The plant selected was *Lyginodendron Oldhamium*. The growth of our knowledge of its construction was illustrated by a number of actual sections and lantern slides shown on the screen. The identification of the stem of a Pinites, the fern-like petiole of *Rachiopteris aspera*, and the foliage of *Sphenopteris Höninghausi* as being corresponding parts of Lyginodendron was demonstrated. It was discovered that the stem was frequently branched, and certain fossil seeds are now, on structural evidence and association, considered to be the fruit of this plant. The reconstruction of the plant is, however, still incomplete, for the male organs have not yet been identified with certainty. The position of Lyginodendron as a seed-bearing plant allied at once to cycads and ferns was now established. A picture of the reconstructed plant was shown on the screen, and models of the seed lent by Prof. F. W. Oliver were exhibited.

Physical Society, October 28.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—An interference apparatus for the calibration of extensometers: J. **Morrow** and E. L. **Watkin.** The paper describes an apparatus for calibrating extensometers and similar instruments by comparison with the wave-length of sodium light. The apparatus is self-contained and easily made ready for use. It consists essentially of two metal cylinders of equal diameter, with their axes in the same straight line, but with a small gap between their adjacent ends. The gap is increased or decreased by the movement of a lever actuating a screw, and the alteration in its amount is measured by the interference rings produced in an optical system situated inside the gap.—A sensitive hygrometer: Dr. W. M. **Thornton.** The instrument is made by enclosing the cooled surface of a Regnault's hygrometer in a glass globe so that only the mass of vapour contained in the vessel is available for condensation. The cooled surface is made much smaller than usual—about 1 sq. cm. The surface-density of the deposited moisture depends on the total quantity of water-vapour present. If this is more than a minimum to be determined later, it will be visible either by the loss of brightness by scattering, or by observing, as in the Dines hygrometer, the scattered light itself. Little is known as to the manner in which moisture is deposited on smooth cold surfaces. Dr. Park has shown that the thickness of the deposit is of the same order as that of the black spot in interference films. The reflection of light from such a clear layer of uniform thickness backed by a bright surface is considered in the paper, and it is shown that the loss of light due to the thinnest possible films can be perceived. The opposite case to that of a smooth layer is that of clear spherical particles resting on the surface. This is also considered, and the surface-density to give a visible deposit is calculated. In connection with this an interesting note was received from Lord Rayleigh in reply to an inquiry, in which he shows that the maximum brightness of a cloud is about 4×10^{-5} that of the sun. Comparing all values, it is taken that 10^{-8} grams per sq. cm. can be detected by unaided vision with diffused light. The time taken for moisture to diffuse from a state of uniform distribution throughout the globe towards the centre is then calculated, and found to be less than ten minutes for a sphere of 20 cm. diameter. The paper is an attempt to make the somewhat neglected Regnault hygrometer an instrument of precision in the detection of small quantities of moisture.—Note on a property of lenses: Dr. G. E. **Allan.** A well known method of testing the concavity or convexity of a lens consists in holding the lens at arm's length and, while looking through it, moving it from side to side or up and down, when the image in the convex lens is found to move in the opposite direction to that of the lens, whilst in the case of the concave lens it moves in the same direction. The above facts hold if, instead of the naked eye, we employ a microscope.

PARIS.

Academy of Sciences, October 31.—M. Mascart in the chair.—Presentation of vol. xi. of the "Annales de l'Observatoire de Bordeaux": M. **Lœwy.**—Trypanosomiasis in French West Africa: A. **Laveran.** The sleeping sickness is endemic in several regions of Senegal; an examination of six specimens of biting flies from this district showed that they were all *Glossina palpalis*, the fly which, according to the researches of Dr. Bruce, propagates human trypanosomiasis. In the blood of horses from French Guinea, in two cases numerous trypanosomes were encountered. In the flies from this region, *Glossina palpalis* predominated. On the Ivory Coast, sporadic cases of human trypanosomiasis are common; here one specimen of *G. palpalis* was found, together with several *G. morsitans*. Round Lake Tchad numerous trypanosomes, having the characteristics of *Trypan. Brucei*, were found in the blood from infected horses; *G. tachinoides* here appears to be the characteristic tsetse fly.—On a case of long phosphorescence emitted by the wood of a cherry tree: M. **Clos.**—The rotation of Venus: P. **Lowell.** The results of spectroscopic observations show a velocity of about 0·005 kilometre a second, which favours a long period of rotation. For a twenty-four hour period, the velocity would be 0·450 kilometre a second.—The rotation of Mars: P. **Lowell.** The spectroscopic measurements give a velocity of 0·228 kilometre per second, as against 0·241 kilometre calculated from the previous eye observations.—On a new micrometer. History of the question: G. **Millochau.** An account of previous applications of the use of parallel glass plates as a micrometer.—On a new safety arrangement for electrical mains at high tension: L. **Neu.** Each line is furnished at its source with an interrupter which works automatically in the case of a wire breaking, of a bad insulation, or in the event of an accidental contact between the high tension wire and a telegraph or telephone wire.—On the atomic weight of aluminium: M. **Kohn-Abrest.** Aluminium, the impurities in which had been determined by analysis, was treated with acid, and the evolved hydrogen burnt to water. The mean of seven experiments gave 99·15 parts of water from 100 parts of the pure metal, corresponding to an atomic weight for the aluminium of 27·05 (oxygen, 15·88).—The action of halogen derivatives of the metalloids on halogen alkyl compounds: V. **Auger.** The alkyl iodides, bromides, and chlorides react with phosphorus iodide, giving alkylphosphinic acids. No reaction occurs with the chloride of arsenic; chloride of bismuth simply gives rise to an exchange of halogens, whilst with chloride of antimony the quantity of antimony-alkyl was too small to separate.—The tetrahydride and decahydride of naphthalene: Henri **Leroux.** These addition products were obtained from naphthalene by means of the Sabatier and Senderens reaction. Their properties and those of some halogen derivatives are described.—The action of the chlorides of phosphorus on the organomagnesium compounds of the aromatic series: R. **Sauvage.** The action of phosphorus oxychloride upon organomagnesium compounds of the aromatic series leads to the production of compounds of the type $R_3 \vdots P:O$ and $R_2=POCl$, the latter, after treatment with water, giving acids $R_2=PO.OH$. The tetraoxy-cyclohexane-rosanilines: Jules **Schmidlin.** The author quotes some experiments of Lambrecht and Weil as affording a new confirmation of his views on the quinonic structure of these compounds, and also as showing that the benzene ring of the carbinol passes through the hexahydrobenzene ring before forming the quinone ring.—The density of nitrous oxide and the atomic weight of nitrogen: Philippe A. **Guye** and Alexandre **Pintza.** The nitrous oxide used in these experiments was prepared from sodium nitrite and hydroxylamine sulphate. After weighing the flask full of the gas, the latter was condensed by connecting the flask with a side tube, well cooled, and containing charcoal. The effect of some of the impurities in the gas was thus eliminated. The atomic weight deduced for nitrogen from these experiments is 14·013. Previous values obtained in the author's laboratory by different methods are, from the limiting density of nitrogen, 14·004; by weighing nitrous oxide, 14·007; by the volume analysis of the same gas, 14·019. The mean of the four methods gives 14·011.—On the oxidation of ethyl and methyl alcohols at the temperature of their boiling points: René **Duchemin** and Jacques **Dourlen**. The rapid deterioration of some alcohol lamps had been attributed to the presence of some acid impurities in the alcohol used. It is now shown that these alcohols are rapidly oxidised at their boiling points in the presence of copper, and the effects noticed are possibly due to this action.—On the anatomy of some fishes of the genus Orestias: Jacques **Pellegrin**. The difference in the pharyngeal apparatus in these fishes is caused by a special adaptation due to the special food, small molluscs with very hard shells.—Contribution to the study of resorption of the vitellus during the embryonic development: H. **Dubuisson**.—On the coincidence between the geosynclinals and the great circles of maximum seismicity: de Montessus **de Ballore**.—On the continuity of the tectonic phenomena between the Ortler and the Hohe Tauern: Pierre **Termier**.—On the pit of Trou-de-Souci, Côte-d'Or: E. A. **Martel**.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 10

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The premiums awarded for papers read or published during the session 1903–4 will be presented, and the president, Mr. Alexander Siemens, will deliver his inaugural address.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—Presidential Address on the Theory of Waves on Liquids: Prof. H. Lamb.—Note on the Application of the Method of Images to Problems of Vibrations: Prof. V. Volterra.—On the Zeros of Certain Classes of Integral Taylor's Series: G. H. Hardy.—The Linear Difference Equation of the First Order: Rev. E. W. Barnes.—Curves on a Conicoid: H. Hilton.—Remarks on Alternants and Continuous Groups: Dr. H. F. Baker.—On the Expansion of the Elliptic and Zeta Functions of $\frac{1}{2}K$ in Powers of q: Dr. J. W. L. Glaisher.—Examples of Perpetuants: J. E. Wright.—Two Simple Results in the Attraction of Uniform Wires obtained by Quaternions, with, for comparison, their Verification by the Geometry of the Complex: Prof. R. W. Genese.—On the Reducibility of Covariants of Binary Quantics of Infinite Order: P. W. Wood.—On some Properties of Groups of Odd Order: Prof. W. Burnside.

FRIDAY, NOVEMBER 11.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Note on the Variation of η Aurigæ: Col. E. E. Markwick.—On a very Sensitive Method of Determining the Irregularities of a Pivot; on the Pivot Errors of the Radcliffe Transit Circle, and their Effects on the Right Ascensions of the Radcliffe Catalogue for 1890: A. A. Rambaut.—The Determination of Selenographic Positions and the Measurement of Lunar Photographs: Third Paper—Results of the Measurement of Four Paris Negatives: S. A. Saunder.—Discussion of the Long-Period Terms in the Moon's Longitude: P. H. Cowell.—A Determination of the Apex of the Solar Motion and the Constant of Precession from a Comparison of Groombridge's Catalogue (1810) with Modern Greenwich Observations: F. W. Dyson and W. G. Thackeray.—Magnetic Disturbances 1882 to 1893, as Recorded at the Royal Observatory, Greenwich, and their Association with Sun-spots: E. W. Maunder.—Ephemeris for Physical Observations of the Moon, 1905: A. C. D. Crommelin.

MALACOLOGICAL SOCIETY, at 8.—Descriptions of Three New Species of Opisthostoma from Borneo: E. A. Smith, I.S.O.—Two Apparently New Species of Planispira from the Islands of Java and Gisser: Rev. R. Ashington Bullen.—The Anatomy of *Siliqua patula*, Dixon: H. Howard Bloomer.—On the Genus Tomigerus, with Descriptions of New Species: H. von Ihering.—Notes on Some New Zealand Pleurotomidæ: Henry Suter.—Notes on Some Species of Chione from New Zealand: Henry Suter.

SOCIOLOGICAL SOCIETY, at 4.—Relation between Sociology and Ethics: Prof. Höffding.

PHYSICAL SOCIETY, at 8.—Investigation of the Variations of Magnetic Hysteresis with Frequency: Prof. T. R. Lyle.—The Determination of the Mean Spherical Candle Power of Incandescent and Arc Lamps: G. B. Dyke.—Exhibition of Physical Apparatus: Robert Paul.

TUESDAY, NOVEMBER 15.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Discussion of Papers—Coast Erosion: A. E. Carey, and Erosion on the Holderness Coast of Yorkshire: E. R. Matthews.—*Succeeding Paper*:—Distribution of Electrical Energy: J. F. C. Snell.

ZOOLOGICAL SOCIETY, at 8.30.—(1) On Mammals from the Island of Fernando Po, collected by Mr. E. Seimund; (2) On Hylochœrus, the Forest-pig of Central Africa: Oldfield Thomas, F.R.S.—On the Species of Crowned Cranes: Dr. P. Chalmers Mitchell.—On the Mouse-hares of the Genus Ochotona: J. Lewis Bonhote.

MINERALOGICAL SOCIETY, at 8.—Anniversary Meeting.—New Localities for Gyrolite and Tobermorite: J. Currie.—Occurrence of Brookite with Anatase in the Cleveland Ironstone: C. R. Lindsey.—(1) Some Applications of the Gnomonic Projection to Crystallography; (2) The Construction of Crystallographic Projections: H. Hilton.—Some New Forms of Quartz-wedge and their Uses: J. W. Evans.—(1) On Three New Minerals from the Binnenthal; (2) On some Curious Crystals of Blende: R. H. Solly.

WEDNESDAY, NOVEMBER 16.

CHEMICAL SOCIETY, at 5.30.—The Isomerism of the Amidines of the Naphthalene Series: R. Meldola and J. H. Lane.—Theory of the Production of Mercurous Nitrite and of its Conversion into various Mercury Nitrates: P. C. Ray.—Amide Chloroiodides: G. D. Lander.—A New Synthesis of Isocaprolactone and some Derivatives: D. T. Jones and G. Tattersall.—The Influence of Substitution in the Nucleus on the Rate of Oxidation of the Side-chain, II. Oxidation of the Halogen Derivatives of Toluene: J. B. Cohen and J. Miller.—The Halogen Derivatives of Naphthacenequinone: S. S. Pickles and C. Weizmann. Constitution of Pyrazolidone Derivatives: B. Prentice.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Theories of Microscopic Vision (a Vindication of the Abbe Theory): A. E. Conrady.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Meteorological Observing in the Antarctic: Lieut. Charles Royds, R.N.—Decrease of Fog in London during recent Years: F. J. Brodie.—Hurricane in Fiji, January 21–22, 1904: R. L. Holmes.

SOCIETY OF ARTS, at 8.—Inaugural Address by Sir William Abney, K.C.B.

THURSDAY, NOVEMBER 17.

ROYAL SOCIETY, at 4.30.

LINNEAN SOCIETY, at 8.—On the Structure of the Stems of Plants: Lord Avebury, F.R.S.—Observations on Undescribed or Little Known Species of Membracidæ: G. B. Buckton, F.R.S.

FRIDAY, NOVEMBER 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Impact Tests on the Wrought Steels of Commerce: A. E. Seaton and A. Jude.

CONTENTS.

THURSDAY, NOVEMBER 17, 1904.

THE THEORY OF CONTINUOUS GROUPS.

Introductory Treatise on Lie's Theory of Finite Continuous Transformation Groups. By John Edward Campbell, M.A., Fellow and Tutor of Hertford College, Oxford, and Mathematical Lecturer at University College, Oxford. Pp. xx+416. (Oxford: Clarendon Press, 1903.) Price 14*s*. net.

THE theory of continuous groups should appeal to all who are interested in mathematics; it is based on the fundamental ideas involved in cases of change of the algebraic notation, and as such is an illuminating synthesis of a large number of our elementary operations; and the principal notions of the theory, once laid bare, are so simple and admit of so many familiar applications that these should form an integral part of elementary teaching, particularly in analytical geometry and differential equations. As to its philosophical import, the theory is of the greatest value in the analysis of our geometrical conceptions, being an indispensable part of that algebraic scheme which, at present running parallel with these, may modify them still more than hitherto before the parallelism is recognised again as an identity.

Lie himself, though directing attention to the fact that he heard as a student, in 1863, lectures from Sylow on Galois's theory of discontinuous groups, and acknowledging his indebtedness to several writers on partial differential equations, would seem to have been interested, above all other things, in the transformations of analytical geometry; and while the precise propositions of his theory of groups must be primarily attributed to his study of systems of linear partial differential equations, his bias was at first, and largely throughout, to arrive at his conclusions by the help of geometrical intuition. Thus, though he has succeeded so extraordinarily in what he tells us was one of his objects, drawing again into organic union branches of mathematics which threatened to pursue solitary developments, there is, some may think, a certain underlying vagueness of definition as to the character of the functions to which his theories apply. This even has, perhaps, some advantages.

Of these various points of view the book now under notice gives the English student an excellent means of judging. With roughly the same purpose as the simplified German account of Lie's theory (Scheffers, 1893, 800 pages), it is briefer, and yet quite clear in statement; it contains more of the application of Lie's theory to the solution of partial differential equations, and it offers alternative proofs, due to its writer, of the fundamental theorems of the subject. Like the German book, it largely leaves aside the developments subsequent to Lie, such as the intricate theory of the structure of groups, and the application to the transformation group of systems of differential equations initiated by Picard, and leaves wholly aside Lie's criticism of the axioms of geometry, while it accepts Lie's function theory throughout; but it abounds in apt examples, chosen mainly from differential equations and geometry, so that almost any mathematical student may find something to interest him, and, with such limitations as noticed above, it is extraordinarily full and complete. Altogether a book which should be widely read.

So much so that it is both difficult and uncongenial to offer any criticisms, were only a review complete without some. To us it seems that some account of *systems* of equations which in the aggregate define a finite continuous group forms the most natural introduction to the theory; though Lie's account of them comes near the end of his third volume he is there revising his fundamental principles, and the ideas involved are very simple. Reference to Schlesinger's "Treatise on Linear Differential Equations" (Bd. ii., Teil i., p. 23) shows how this suggestion works out in detail. It seems right that the student should early learn, for instance, how far the linear transformations which leave x^2+y^2 unaltered fall under Lie's terminology. Perhaps, again, fuller references to anticipations of the ideas which Lie has coordinated into one system would have helped the student. Such may be found widely scattered in all the early masters; two that are handy to us are in Sylvester's writings. In 1852, when Lie was ten years old, Sylvester ("Collected Works," vol. i., pp. 326, 353), while ascribing the notion partly to others, writes of *continuous* or *infinitesimal* variation, and that "concomitance cannot exist for infinitesimal variations without, by necessary implication, existing for finite variations also." Or, again, the deduction, so interesting when we first came across it, of the equations for the infinitesimal motion of a rigid body, from the invariance of the expression $dx^2+dy^2+dz^2$, is in a paper of Sylvester's of 1839 (*ib.*, p. 34). Again, it appears to us, though recognising the value of Mr. Campbell's proofs of the fundamental theorems, that much would have been gained in directness, without appreciable increase of the necessarily analytical character of much of the subject, by a frank recognition of Schur's forms for the first parameter group in terms of the constants of structure; of this we are, perhaps, not impartial judges (see *Proc.* Lond. Math. Soc., vol. xxxiv. p. 91), as equally not of Mr. Campbell's use of the word *united* in his exposition of Lie's definition of an integral of a partial differential equation, having ventured elsewhere to introduce the words *connected* and *connectivity,* which latter seems better than the mere symbol M_n which Mr. Campbell adopts from Lie (see "Encyc. Brit.," vol. xxvii. p. 452). But we have a more serious contention with Mr. Campbell about a matter in which opinions will be widely divided; no doubt it is proper that a beginner's course in the theory of groups should insist primarily on the group property, and not confuse this by complicated considerations in regard to the properties of functions; but in our opinion no account can be regarded as modern which does not face the difficulties; it seems to us misleading, without careful explanations, to use language about functions in general which applies in the first instance only to the simplest algebraic functions. On p. 11 we read: "b_k can in general be expressed . . . in order that (2) may remain an analytic function of its arguments." In what way is the student to imagine the function defined after it has ceased to be an analytic function of its arguments? or does the word *analytic* mean *regular*? and what is the meaning of *expressed*? Again, on p. 98: "This transformation of the variables has only involved algebraic processes." The processes in question consist in reverting certain power series; now a power series is an entirely symbolic thing unless we have very simple rules for the law of its coefficients; how can the reversion of a power series in general be regarded as a practicable process likely to aid the effective determination of the integrals of a differential equation? and at any rate it does not seem fair to describe it as an algebraic process. Moreover, apart from such indefiniteness, and passing over such phrases as (p. 24) "where t is a constant so small that its square may be neglected," there is the question, apparently unconsidered in this book, of how far Lie's propositions can be proved for functions which are not analytic, in regard to which various investigations are already forthcoming.

But we gladly turn from such criticisms to remark again on the merits of the book, choosing two random examples, one of the practical spirit in which it is written, the other of the author's eye for a neat result. On p. 256 the author frankly uses the known theorems as to forces in three dimensions to abbreviate the reduction of the equation of a linear complex. On p. 243 the author arrives at the theorem that Ampère's partial differential equation of the second order is reducible by a contact transformation either to $s=0$ or to $rt-s^2=0$, according as it possesses two distinct systems of intermediary integrals or only two coincident systems. In conclusion, we would express our admiration for the form and printing of the volume.

H. F. B.

TECHNOLOGICAL CHEMISTRY.

The Industrial and Artistic Technology of Paint and Varnish. By A. H. Sabin, M.S. Pp. vi+372. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 12*s*. 6*d*. net.

Food Inspection and Analysis. By Albert E. Leach, S.B., Analyst of the Massachusetts State Board of Health. Pp. xiv+787. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 31*s*. 6*d*. net.

(1) THIS is a gossipy, pleasantly discursive volume, the style of which will be indicated when we remark that the book is prefaced by an extract from Quintilian, and closes with a poetical quotation. It treats, generally in untechnical and even colloquial language, of varnishes and paints, their history, fabrication, and uses. Principles, not formulæ, are usually given by the author; the book is in no sense a collection of recipes.

If there is not much of strictly scientific value in the treatise, there is a good deal which is of practical interest. The chapter upon the protection of metals against corrosion, for instance, may be recommended to the notice of engineers, and also that on the coating of water-pipes. As regards this latter question, the author points out that the essential feature of the "Angus Smith process" has been misapprehended in modern practice. Dr. Smith's treatment resulted in a varnish or "enamel" of linseed oil and coal-tar pitch being baked on to the cleaned surface of the pipe, the oil oxidising more or less completely during the operation. The modern substitute for this is, too often, a mere dipping of the pipe in crude tar, or in tar diluted with "dead oil." From the wording of the original patent this process may, on a technicality, pass under Angus Smith's name; but our author has no doubt that if the inventor were living he would condemn the whole thing from beginning to end. It is "adulterating his invention and stealing his reputation."

Mr. Sabin describes a process of his own, which has, he tells us, been successfully applied to large pipelines in America, and is in use in the United States Navy for the protection of heavy copper mains. It is evidently based upon a study of the Angus Smith process. It consists in applying to the pipes a thin coating of a mixture of linseed oil and asphaltum, and afterwards heating the pipe to 400° F. until the oil is completely oxidised. The product is said to be a hard, elastic enamel. One result is that, whereas the aforesaid copper mains had formerly an average "life" of about six months, they have now lasted three or four years, and their ultimate durability is not yet determined.

There is some curious lore in the author's historical summary. The connection between electricity and "Berenice with the golden hair," between varnish and the Queen of Cyrene, is a good example of etymological ramifications. One quaint recipe of 1520 is worth quoting:—

"A most excellent varnish for varnishing arquebuses, crossbows, and iron armour: Take of linseed oil two pounds, sandarac one pound, Greek pitch two ounces. Boil the oil, then dissolve in it the other ingredients, and strain through a much-worn linen cloth; and when you wish to use the varnish, scrape and polish the work and heat it in a hot oven, because that is the best place to heat it . . . then lay it on thinly with an instrument of wood, so that you may not burn your fingers, and it will make a beautiful changing colour.

"And if you supplied the place of Greek pitch with naval pitch, I think it would make the work black when you varnished it."

The treatise can be read with profit either by the manufacturer who knows little of chemistry, or by the chemist who wishes to know something of paint and varnish technology.

(2) There is a Madras story of a native woman, who, charged with possessing illicit salt, would offer no defence; wherefore she was about to be mulcted in the sum of one rupee. Before closing the case, however, the magistrate thought he might just as well satisfy himself that the substance really was salt, and forthwith proceeded to taste it. Thereupon the lady raised her voice in a very effective interjection: "Not only," said she, "not only does the sahib fine me one rupee, but lo! he eats the ashes of my dead husband."

Fortunately for magistrates, such appeals to the palate are rarely either necessary or sufficient, nowadays, for disposing of legal cases relating to the identity and purity of foodstuffs. Much more cumbrous machinery has had to be devised. To summarise and explain this machinery is the aim of the work under notice. In the main it is intended for the food analyst, and the author's idea has been to give this official some information, not only on the subject of food-analysis, but also on various collateral matters with which he is brought into contact. Thus there are sections discussing the equipment of the laboratory, the storage of samples, legal precautions, the duties of the food inspector, and certain processes of food manufacture.

All the ordinary foodstuffs are dealt with, a chapter being allotted to each group of allied products, such as cereals, spices, alcoholic beverages, and so on. The descriptions are written clearly; an excellent selection of the salient facts and the best methods of examination has been made; and to each division an extensive bibliography is appended. Microscope work is a special feature, and the volume is enriched by a series of forty plates, containing about four times as many photomicrographs of the principal vegetable and animal structures met with in the examination of foods.

The chief criticism to offer on the book is that the treatment of so much material in one volume—even one of eight hundred pages—must necessarily be in the nature of a summary. Hence in many instances the information, though sufficient for routine work, is not full enough to be of much value when cases of real difficulty arise.

One notes several examples of careless transcription in looking through the work. On p. 441 the so-called "Koettstorfer's equivalent" for butter-fat is given a maximum value of 241 and a minimum of 253. It might be guessed that these two numbers have been transposed; but on the next page the value of the constant in question is given as 224. The author has, in fact, failed to distinguish between the "equivalent" and the "value" of the saponification experiment. In the table on p. 441 the values of the insoluble acids for oleomargarine are transposed; the specific gravity has no temperature of reference; and a faulty arrangement of the table makes it appear that butter-fat and margarine possess, somehow, a maximum and a minimum temperature; whilst in the data for edible oils and fats on p. 380 the limiting values are again transposed.

Nevertheless, it would be unfair to judge the book by these slips. It contains a large amount of information and, though written more particularly from the American point of view, will be found a useful conspectus of the whole field of food control.

C. SIMMONDS.

THE TRANSPIRATION OF PLANTS.

Die Transpiration der Pflanzen. Eine Physiologische Monographie von Dr. Alfred Burgerstein, A. O. Universitätsprofessor in Wien. Pp. x+283. (Jena: Gustav Fischer, 1904.) Price 7.50 marks.

THIS book is a classified analysis of the published work on transpiration from the time of Hales onward, with a running criticism by the author, who is well known to have attended to the subject for many years.

The amount of contradictory evidence is remarkable. In the case of the earlier experimenters, with more or less faulty methods, this is not surprising; but the same thing strikes one in many modern instances. The question of the amount of transpiration in moist tropical regions, as compared with Europe, is a case in point. Another instance is what the author describes as a "seven years' war" (1884–1891) between Wille and Lundström as to the absorption of water by the aërial parts of plants. Other disputed points are the effect of salt solutions supplied to the transpiring plants, and the influence of varying amounts of CO_2 in the atmosphere; and many other cases might be cited.

The relation of plants to water, though a subject of primary importance, is still to a great extent in the elementary stage of inquiry. A large number of the statements quoted by Burgerstein are little more than disconnected facts, and, in spite of the interesting book he has made of them, they still seem to us to await a somewhat different treatment.

The subject-matter of the book falls into two classes:—(1) the loss of water-vapour considered as physical phenomenon; (2) the biological inquiry into the adaptation of plants to the distribution of water considered as environment. From both points of view transpiration should be considered side by side with assimilation and respiration, and this manner of looking at the subject has not, in our judgment, been kept sufficiently in mind by the author. The point is that the same organs—the stomata—serve for gaseous exchange and for the evaporation of water. Burgerstein discusses at the end of his book the question whether, as some have supposed, transpiration is a necessary evil. This might have been discussed from a broader standpoint, and would have been in place in an earlier chapter. It does not seem necessary to treat the view referred to as entirely false. Plants undoubtedly have to strike a balance between the possession of a free stomatal connection with the atmosphere and the consequent danger of evaporating more water than they can take up from the soil. This compromise includes also the value of the transpiration-stream in supplying minerals to the aërial parts, on which Burgerstein rightly lays stress. All we suggest is that the whole problem, being of a fundamental character, might well have been dealt with more liberally, and been given a place preliminary to the details of transpiration.

A fault in Burgerstein's treatment of transpiration, though a fault difficult to avoid, is that he does not keep before the reader the fact that the condition of the stomata—whether open, half open, or shut—is far and away more important than all the other internal conditions put together. Like the rest of the world, he is well aware of this, but we doubt whether the uninstructed reader would here learn to think of the problem in this way. To take an example, he describes (p. 62) how, when part of the foliage is removed, the remaining leaves transpire more actively than before. Here we want a discussion of the possible effects, direct or indirect, of the operation on the stomata of the remaining leaves. The same thing is true of the discussion (p. 81) on the transpiration of flowers as compared with leaves, where the reader is left in ignorance of how far the facts are explicable by reference to the stomata.

But it is not merely in relation to isolated problems that we feel the want of more information with regard to the stomata. We should expect to find a full general discussion of their importance in regard to transpiration. This would have included a reference to Horace Brown's work on the static diffusion of gas through these openings, and a consideration of the question how far evaporation can be checked by the closure of the stomata. Again, we should have liked a discussion of the trustworthiness and general value of the microscopic measurements of the stomata in living plants. Burgerstein gives an interesting account of the methods depending on the yield of water-vapour, such as Stahl's cobalt test, &c., by which it can be roughly determined that the stomata are "widely open" or "nearly shut." But if we are to distinguish the stomatal factor from other factors in experiments on transpiration, numerical statements as to the condition of the stomata are wanted, and the question whether such data are available might well have been discussed. With regard to method, Burgerstein seems to us a little hard on the various "potometer" methods, by which a general idea of the transpiration curve is obtained by measuring the intake of water. He is justified in saying that these methods do not estimate transpiration but absorption; but we think he undervalues the fact that, with cut branches and for not too extended periods of time, the intake so closely corresponds to transpiration that the method cannot be neglected, and is certainly of great value for purposes of demonstration.

Though we have criticised "Die Transpiration der Pflanzen," we are far from meaning to condemn it; we have, indeed, read it with interest and profit. Anyone intending to make a study of the subject cannot do better than read it with care. He will thus be made aware of many pitfalls, and will have a guide to the chief points which need fresh investigation.

F. D.

OUR BOOK SHELF.

House, Garden, and Field; a Collection of Short Nature Studies. By L. C. Miall. Pp. x+316; illustrated. (London: E. Arnold, 1904.) Price 6*s*.

THIS admirable little work appears to be by far the best aid to the proper teaching of nature-study that has hitherto come under our notice, the author having very wisely refrained from furnishing the teacher with a manual which would do away with all necessity for original study and observation on his part, and enable him to read the various lessons to his pupils without effort or thought. The object of the writer is, indeed, as much to educate the teacher as to enable the latter to teach his pupils. For example, in the article on bananas, Prof. Miall, when he asks the reason for the peculiar shape of that popular fruit, under the guise of leaving the reply to the pupil is really testing the powers of observation and reasoning possessed by the teacher himself.

As the author observes in his introduction, teachers seem to expect a series of ready-made lessons on a variety of nature subjects, basing their demand on the ground that they have no time (or is it that they have no inclination?) to make the necessary studies for themselves. If this course were adopted, it would lead to two evils. First, all the observations (if they could be so called) would come from the teacher and not from the pupils; and, secondly, knowledge thus acquired by the teacher could not possibly raise the delights of genuine nature-study in the minds of his scholars. Prof. Miall has therefore preferred to make an effort to instil and encourage the habit of observation and inquiry in a few teachers (who will necessarily be the best of their kind) by showing them what may be learnt by careful observation of the common natural objects to be met with among their daily surroundings, rather than by pandering to the popular clamour for cut and dried lessons—which are really not nature-study at all. How he has succeeded remains to be seen. If we may venture to predict, it will be the clever and inquiring teachers who will praise and take advantage of his efforts, and the dullards and plodders who will condemn them and say that they are unsuited to their purpose.

Although the author modestly says that he gives only a few lessons, his articles or essays are no less than fifty-four in number, and cover a very wide range of subjects, including cheese-grubs, glow-worms, water-lilies, London pride, the human face and hand, and museums and their teachings. As an example of the large amount of information Prof. Miall manages to give in a very small compass, we may refer to the exceedingly interesting account of the ancestry and evolution of insects in the chapter on the "cheese-hopper." An excellent work which should be in the hands of all teachers is our verdict. R. L.

Ideals of Science and Faith. Essays by Various Authors, edited by the Rev. J. E. Hand. Pp. xix+333. (London: George Allen, 1904.) Price 5*s*. net.

"ON all sides" (to quote the preface) "is a growing recognition that the ideals common to both Religion and Science are not only numerous but are indeed the very ideals for which the nobler spirits on both sides care most." Necessarily the treatment is varied, perhaps too varied, but the editor gently deprecates criticism of this feature. Prof. Patrick Geddes has room to discourse on the excellence of teaching boys to make boxes; and the theologians, under "A Presbyterian Approach," "A Church of England Approach," and the like, hardly give one a definite view of "A Christian Approach."

In the papers of the men of science and philosophers the general position is that science does not deal with the whole of life, and that it can no longer meet the claims of faith with a "*certainly not.*" Sir Oliver Lodge defends the idea of continuous guidance on the part of the Deity, seeks to reconcile Pantheism and the belief in a personal God, and complains that religious people seem to be losing some of their faith in prayer. Prof. J. Arthur Thomson and Prof. Patrick Geddes lay stress on the altruistic side of the struggle for existence. Prof. Muirhead maintains that we must limit causation and the conservation of energy to the material world, and must look for some other conception when we come to the action of the mind itself. "We use a saw to make a fiddle; we throw it (*sic*) aside when we come to play upon it (*sic*)." The Hon. Bertrand Russell's paper—"An Ethical Approach"—is the most eloquent; much of it is Lucretius, Book iii., rewritten (could one be more complimentary?), with the difference that Mr. Russell recognises more definitely the need for religion and worship, albeit the worship of a God who is not Force but "created by our own love of the good."

Die orientalische Christenheit der Mittelmeerlände. By Dr. Karl Beth. Pp. xvi+427. (Berlin: Schwetschke, 1902.)

THE author spent five months in 1901 in the eastern Mediterranean, investigating at first hand, and at close quarters, the institutions, and the practical working of the Greek, Armenian, and Coptic Churches, and of such other fragments of Christian communions as survive in those parts. He is evidently a good observer and quick worker, and was able to elicit much interesting information, meeting everywhere, as he did, with cordial receptions and assistance. The result is a valuable handbook of an ill-explored section of ecclesiology, full of queer side-lights upon mediæval and modern history, and no less upon the workings of the religious instinct under the peculiarly unfavourable conditions which have prevailed in the Levant for so long. The author's personal knowledge of the working of these curious institutions enables him to supply a number of corrections to Kattenbusch's "Lehrbuch," and to confirm and expand the observations of Gelzer, von der Goltz, von Soden, and other recent travellers.

Tales of Sutton Town and Chase, with other Tales and some Sketches. Collected by "Tau." Pp. 86. (Birmingham: Hudson and Son, 1904.) Price 2s. 6d. net.

TWO of the narrative poems in this delightful little collection are of more than local interest. One ballad —"The Alchemist of New Hall"—refers to the moated stone mansion of New Hall, where the celebrated Dr. Sacheverell lived at one time. Another poem deals amusingly with a meeting of the Lunar Society, which met in the district in the latter portion of the eighteenth century, and included among its members Erasmus Darwin, Galton, James Watt, Priestley, Wedgwood and Baskerville. To persons familiar with Sutton Coldfield and the neighbourhood, this collection of verses describing in appropriate words and metre some of the stories of "oldest inhabitants" will be read with keen interest; and many others will find pleasure in the quaint ideas contained in this dainty little volume.

The Glamour of the Earth. By George A. B. Dewar. Pp. ix+255; with illustrations by R. W. A. Rouse. (London: George Allen, 1904.) Price 6s. net.

THE true lover of the country will enjoy this book. The author is not addressing the mere seeker after information; and such a reader will regard the volume as diffuse and unsatisfactory. But men who are weary with work and have gone to the country quietly to come into contact with nature, and so secure refreshment and recreation, will follow Mr. Dewar's notes and leisurely observations with sympathy and appreciation. The beautiful pictures by Mr. Rouse add much to the attractiveness of the volume.

Jahrbuch der Radioaktivität und Elektronik. Herausgegeben von J. Stark in Göttingen. Erster Band. 1 Heft. (Leipzig: S. Hirzel, 1904.)

THIS new magazine or "year-book," devoted to radio-activity and the electric discharge, is promised to appear in four parts yearly. The first part, now under consideration, contains two original contributions, six short summaries of recent work on special branches, and a fairly complete list of the original papers on radio-activity, &c., which had appeared in 1904 up to the date of going to press. The short summaries referred to are preceded by bibliographies, and should prove useful to specialists.

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.*]

What is Brandy?

WITH regard to the interesting article in your issue of November 3 upon this subject, I trust that I may be allowed to pass a few comments.

There can be no doubt that the word "brandy" originally connoted burnt or distilled wine; its derivation is thus stated in the "Oxford Dictionary" of Dr. Murray as from the Dutch word "brandewijn," old English "brandy wine."

Thus so late as 1719 one D'Urfey, "Pills," v. 23, wrote:—

"I was entertained, with Kisses fine and Brandy wine."

Certain spirits were introduced long before the outbreak of the phylloxera in France under the name of British brandy, still included in certain legal documents under the designation of British compounds, though, as a matter of fact, made more without than within this country. Herein a difficulty arises for those who may have to advise county or borough councils in the administration of the Sale of Foods and Drugs (Amendment) Act, as now interpreted, or those, like myself, who have to deal with cases under the Merchandise Marks Act. For on the one hand an astute chemist could make up a liquid, wholly innocent of grape juice, so that the results, obtained on analysis, were identical with those of a genuine grape-spirit, and on the other, a sample of the latter might, as pointed out in your article, if carelessly distilled be condemned, though innocent.

Again, if a genuine grape spirit, distilled not far from Cognac, were mixed with — per cent. of a spirit, not silent (I omit particular details on the ground of expediency), mere analytical results would be of little avail; such a problem (*credite experto*) requires prolonged research, and the application of methods not wholly chemical.

It is clear that professional tasting, especially by certain specially gifted persons, is a very valuable aid to analytical results and methods of research, yet, as a matter of evidence, it can be regarded only as a question of opinion, based on long experience, rather than as a definite proof.

A Government inquiry would elicit important evidence, and possibly some kind of standard might be arrived at which would not only exclude clever and fraudulent imitations, but also bring the present chaos or *impasse* to a conclusion. V. H. VELEY.

Oxford, November 5.

YOUR article published under the above heading in NATURE of November 3 raises some interesting points. The writer clearly fails to appreciate any difference between brandy and alcohol, for he says, "if the brandy is being made from damaged wine the rectification must be most carefully conducted, and may have to be pushed to a point that the alcohol is obtained almost pure, that is to say, almost free from *non-alcohol*." Now if brandy is merely alcohol, as is here plainly implied, why produce it from grapes or wine at all? Similarly, why produce whisky from malted barley, or rum from cane sugar? The fact is that the genuine article is, and has always been in history, the product of the pot still. The pot still produces alcohol plus "*non-alcohol*," the patent still pure alcohol. It is true that brandy, whisky, and rum contain alcohol, but the alcohol of the patent still or rectifying still is not whisky, brandy, or rum. Pot still spirit from "damaged" or sick wines would be nauseous and undrinkable, but pot still spirit from wines of repute possesses the qualities which distinguish genuine brandy chemically and physiologically from rectified spirit. It is well known that the effects of pure alcohol on the blood pressure and lymph circulation are modified very considerably by the presence of other constituents in spirits. These other constituents are the "*non-alcohol*" which you describe. To call rectified spirit or patent still spirit brandy is about as reasonable as calling skimmed milk milk. In England the word brandy ought to be confined to a pot still spirit produced from the wine of grapes, and should never be applied to alcohol distilled in a patent still from "damaged wine" or from likely enough worse material. Such a definition, if adopted, would be "calculated to facilitate the work of the unfortunate public analysts who may be called upon to express an opinion as to the genuineness of a sample of brandy," and the question, what is brandy? analytically speaking, would no longer "await solution." Recent analyses to which you refer have at any rate reduced a large section of the brandy trade to the confession that much of the stuff they sold never had its origin in the grape at all. The public house trade now posts notices in the bars that it cannot guarantee the brandy sold to be genuine grape spirit.

The attitude of the French committee is not difficult to understand, and there can be no objection to it so long as the trade, in the interests of which it has undertaken the inquiry, determines on issuing an honest label setting forth that either the spirit is a pot still spirit from grape wine or it is not. S. ARCH. VASEY.

Bromley, Kent, November 8.

The Origin of Life.

ALTHOUGH there are good reasons for believing that the life of our world is the product of its own physical conditions, and distinct from the life of other members of the solar system, it is hardly probable that living substance can be produced otherwise than by the same conditions that produced it in the past, and one of these conditions is a vast period of time.

We are not acquainted with any life apart from "cells." But the cell is a very complex organism, and between inorganic substance and the cell there may have been as long a course of evolution as between the cell and the highest existing animal or vegetable. Probably most biologists nowadays regard life not as an entity (*e.g.* not as a "vital force"), but rather as a coordination of many physical processes which have become more numerous and better coordinated in the course of evolution. It is not to be supposed that the *total* functions of life would be developed in not-living substances under the restricted conditions of human experiment; nevertheless, some of the *individual* functions might be brought into action, at least in a primitive form.

One of these functions, which I believe to be the most fundamental, is the deoxidation of a compound containing the elements N, O, C, H, &c., by the action of light, moderate heat, or slight electrical disturbance. This is the foundation of biosynthesis—a small beginning which in the course of ages develops mechanisms so perfect as the photosynthesis in chlorophyll-bearing cells. We ought by research to discover the conditions on which such deoxidation depends, and imitate it in our laboratories; we might even apply it to important economic purposes.

This deoxidation is probably a perfectly natural process, as natural as the opposite process of oxidation, only it must not be sought in the behaviour of mere oxides, as CO_2, but rather in that of compounds containing N, O, C, H, &c., as above suggested. In fact, it may be expected to be nearly a reversal of the process of vital oxidation, which has been more successfully investigated. Vital oxidation seems to take place in two stages, as follows:—(1) the O is taken into combination with the N in a complex molecule, (2) it is transferred from the N to a more oxidisable element. Whether complete linking occurs between O and N, as $O{=}N{=}$, we cannot say; but the linkings $\equiv C{-}O{-}N\equiv$ and $H{-}O{-}N\equiv$ are probable. The oxygen-carrying function of N seems to be assisted in many (if not all) cases by Fe.

First attempts at life may be occurring continually around us, but if any synthetic substances be formed they are sure to be seized and assimilated by the already developed organisms. F. J. ALLEN.

Cambridge, November 12.

Change in the Colour of Moss Agates.

IN connection with Mr. Whitton's inquiry (NATURE, November 10, p. 31), the following note may be of interest.

On the top of the West Cliff at Bournemouth the road is laid with material which includes a number of flint pebbles. These are, as a rule, rounded or subangular, and of a yellow or whitish-yellow colour as regards their general surface. But where exposed to the air the colour has changed to deep blue, violet, or purple, and so much so that in places the whole surface of the road has a marked blue shimmer. Or perhaps it should rather be said that this was the case last autumn; I have not seen it since.

As will be seen from the enclosed specimen, the contrast between the imbedded and the exposed portion of the pebbles is very striking.

Without giving any special study to the matter, I was inclined at the time to attribute the phenomenon either to a further oxidation and hydration of the iron which is, no doubt, present in the flints, or, possibly, to a molecular rearrangement of the silica. At some points the blue colour passes almost into black; this suggests that it may indicate a transition stage between yellow and black flints.

Possibly some mineralogist has examined the matter more thoroughly. C. SIMMONDS.

Northcroft, Deronda Road, Herne Hill, November 14.

Chemical Analysis for Beginners

IN a review on this subject (this vol., p. 5) "J. B. C." directs attention once again to the unsuitability of an extended study of analysis for a beginner. His opinions not only claim respect, but must be largely shared by all teachers of chemistry.

There is, however, a side to the question which somehow seems rather to be overlooked. The average elementary student will work patiently for hours over qualitative analysis, well taught, badly taught, or not taught at all—he is interested, and though none too willing to use brains as well as tables, he is ready under guidance to do his best. But in any logical system of elementary quantitative and preparation work calculated to build up a firm foundation in the principles of chemistry he appears to take no *natural* interest, when it comes to actual work. Possibly "J. B. C." will not agree that this is so; and it may be right that the student should be compelled (if it can be done) to think logically from the first. But it seems not unimportant to interest him in practice as well as "on paper."

I do not refer to the embryo professional chemist who soon gets through the introductory work and is nearly always interested, but to that enormous crowd of text-book consumers who spend, possibly, three hours per week in the chemical laboratory as part of their scheme of study. Does not the marked change of attitude in such students when qualitative analysis is touched upon indicate that there is still room for fundamental improvement in the method of presenting first steps in practical chemistry?

F. SOUTHERDEN.

Royal Albert Memorial College, Exeter.

Misuse of Words and Phrases.

IN Mr. Basset's book, to which he refers in NATURE of November 10 (p. 30), he speaks of the advantage of having "a concise and pointed mode of expression, which saves a great deal of circumlocution and verbosity." He thinks that this object is best gained by coining a new word from the Greek, for instance, *autotomic*, whereas I hold that the same object is better gained by adopting a word of English derivation, *self-cutting*. Mr. Basset now says that he considers this word "inelegant," and, in the absence of any standard of elegance, I can only reply that this is a matter of individual taste. Perhaps it would be better still to call a curve that has double points a "nodal curve," and one that has none a "nodeless curve." The word *binodal* is already in use.

As regards the phrase "non-singular cubic," it is clearly inaccurate if, with Plücker, we speak of "singular lines" as well as "singular points," and include all these under the term singularities; but I rather think that in English books the term singularity was formerly not applied to double tangents, or even to points of inflection.

November 14. T. B. S.

Reason in Dogs.

APROPOS of "thinking cats," perhaps the following story of a practical joke played by a dog will interest your readers.

A friend of mine, Mr. W., owns a Manchester terrier of which he is very fond, and for that reason receives rather more than doggy attention. The dog passes most of his time in the library, where a basket and rug are provided for him, but he prefers, when it is possible, to take possession of his master's easy chair. A short time ago I had occasion to call on Mr. W., and the dog was, as usual, occupying the chair, from which he was removed to his basket. He showed his resentment of this disturbance of his slumbers by becoming very restless. Presently he trotted over to the door, which he rattled by pushing with his nose, his usual method of attracting attention when he wished to go out. His master immediately rose and opened the door, but instead of the dog going out he rushed back and jumped into the chair his master had just vacated! The rapid wagging of his tail and the expression on his face showed the dog to be very pleased with the result of his ruse. The dog has repeated the same joke once or twice since, with much evident delight to himself. ARTHUR J. HAWKES.

Bournemouth.

Occurrence of a Tropical Form of Stick-Insect in Devonshire.

A FEW weeks ago I obtained through the kindness of a lady in Paignton a living specimen of a stick-insect, one of several individuals which had appeared in her garden. My example was met with on the plaster outside a window, and owing to the tenacity with which it adhered to its position required some force to dislodge it. I preserved it in captivity for about a fortnight, at the close of which period it died, having refused to feed on the foliage of any of the plants with which it was supplied.

It is an apterous female, and is, I think, referable to *Cladoxerus phyllinus*, Gray. I have not been able to obtain any clue as to the cause of its occurrence.

ROBERT O. CUNNINGHAM.

A Probable Variable of the Algol Type.

ON the evening of October 29, while examining the Pleiades with a binocular at about 9 p.m., G.M.T., I noticed that the star Atlas (27 Tauri) was slightly *fainter* than Pleione (28 Tauri), a little to the north of it. I did not remember at the time what the relative brightness of the stars was, and on looking them up in the Harvard Catalogues I was surprised to find that Atlas was measured 3·80 magnitude, and Pleione 5·19. I find that all the estimates for the last 300 years agree in making Atlas considerably brighter than Pleione. The nights following October 29 were cloudy, but on the evening of November 9 I found Atlas of its usual brilliancy, and more than 1 magnitude brighter than Pleione. The observed variation was therefore about $1\frac{1}{2}$ magnitude. As Atlas is not a long period variable, it seems probable that it is a variable of the Algol type. The star should be watched, and observations for variable radial velocity would be very desirable.

J. E. GORE.

THE PREVIOUS EXAMINATION AT CAMBRIDGE.

THE first report of the studies and examinations syndicate, issued on November 11, deals with the previous examination. This is the first public test imposed on candidates for degrees at the university, and since 1822 has included a compulsory examination in both Latin and Greek. In response to a demand for reform sent up by teachers, parents, professional men, and men of science in the direction of making Greek, at least for some students, an optional subject—a demand supported by a large majority of head-masters and assistant masters in the secondary schools—the syndicate proposes a new scheme for the examination in which this demand is recognised.

Briefly, the scheme provides that for *all* candidates the "previous" shall consist of three parts, to be taken together or separately at the convenience of the student. Part i. includes Latin, Greek, French, and German, the papers in each to require unprepared translation and composition. "Set books" are abolished. A candidate may take Latin *and* Greek, or either Latin *or* Greek together with French or German. In other words, he must take *two* languages, of which one at least is an ancient classical language. Part ii. includes arithmetic, algebra, and geometry as heretofore. The paper on "Paley's Evidences" is abolished; it is not a school subject, and it is got up largely by an effort of memory from a bare abstract or analysis. Part iii. includes English composition as a compulsory subject, and two of the following alternatives: (1) English history; (2) scripture knowledge (a Gospel and Acts in English); (3) elementary organic chemistry; (4) experimental mechanics and other parts of elementary physics. Natural science, in the shape of physics and chemistry, is thus introduced for the first time. The syndicate was urged by weighty authorities to require from all candidates some knowledge of science; but, after full consideration, it is unable to recommend more than the inclusion of science among the alternative subjects. Probably, in view of the imperfect organisation of science teaching in many public schools of the classical type, to make science compulsory at this stage would have involved the adoption of a standard so low as in effect to discredit the subject.

For the benefit of certain students, among whom students of science may certainly be reckoned, to whom the power to read French and German is more important than a special knowledge of one only of these, it is provided that the translation papers in each of the two languages may be substituted for the translation and composition papers in one alone.

For a boy from a modern school or technical institute, therefore, the examination provided might thus include, for example, Latin, French, and German translation, mathematics, English composition, elementary chemistry, and elementary physics. On the other hand, a boy from a purely classical school might take the following combination: Latin and Greek, mathematics, English composition, scripture, and English history. For him the examination would be an improvement on the old "previous" examination, not only by reason of the higher standard proposed to be required, but also on account of the wider range of literary subjects to be included.

The report represents a serious attempt to recognise and to provide for the changes which are in progress in modern English education. By asking from every aspirant evidence that he has seriously studied *one*, at least, of the classical languages, it safeguards the traditional virtue ascribed to that form of intellectual training. By admitting that modern languages (including English) and physical science are possible components of a liberal education in the twentieth century, it indicates a certain widening of academic aims and ideals that may lead to better things hereafter. There is little doubt that the report will meet with strenuous opposition from those who, in the supposed interest of ancient learning, dare not make any concession to modern knowledge. It will not escape criticism from reformers of the more advanced type, who would sweep away Latin as well as Greek. But the proposals at least remedy a genuine grievance in a practical manner, and they make for progress along the lines of a sounder and broader education than the older universities have yet sought to foster.

THE EXPLORATION OF THE TRANSVAAL.[1]

IN this first report, drawn up by Mr. H. Kynaston and his colleagues, we see the prospect of healthy rivalry between the geologists of Cape Colony and of the newly acquired territories to the north. No time has been lost in issuing one of those small folio

[1] "Geological Survey of the Transvaal. Report for the Year 1903." Pp. ii+48; with 24 plates, folding maps, and sections. (Pretoria: Printed at the Government Printing Office, 1904.)

volumes, the form of which, however unsuited to our bookshelves, probably recalls to the Government printers the blue-books of the old home-country. No time has been lost, moreover, in the prosecution of researches which furnish something worthy to record,

FIG. 1.—Waterberg sandstones near Balmoral, containing fragments of Pretoria quartzite.

and the results have here been illustrated on an excellent and liberal scale. Topographic work has been undertaken where existing surveys are deficient, and it seems probable that the geologists will run ahead, for some years to come, of the accurate mapping of the country. The beds dealt with are, firstly, the Pretoria series of quartzites and shales, which must have a high antiquity; secondly, the Waterberg sandstones and grits, which are now for the first time proved to be distinctly unconformable on the Pretoria series; and thirdly, the Karroo system, or rather systems, which opened under Glacial conditions, and were laid down on the denuded surface of the folded Waterberg series.

The two earlier series are thus clearly pre-Carboniferous. The Pretoria series is in places enormously swollen by the intrusion of diabase, which has worked its way along the bedding-planes with remarkable regularity. Where it breaks across the beds, it becomes slightly modified and charged with fragments from the quartzites. The Waterberg series near Balmoral has been invaded laccolitically by a granite, which is correlated with the red granite of the northern Transvaal. On its upper surface, which follows the planes of stratification of the overlying beds, it passes into a platy rock of the compact quartz-porphyry type.

Mr. E. T. Mellor regards the Waterberg series, with its coarse breccias and conglomerates, as deposited in waters swayed by powerful currents, torrents from the land being responsible for the earlier beds. Fragments of the Pretoria quartzites are found in these, affording additional proof of the unconformity (Fig. 1).

The Karroo beds similarly contain boulders of the rocks that preceded them, including the granite that rose beneath the Waterberg series. These boulders occur in the Glacial beds at the base of the system, corresponding with the Dwyka conglomerate of Cape Colony. These beds were laid down in a region already traversed by large streams, and it is very interesting to note that the modern Elands River, Bronkhorst Spruit, and Wilge River have cleared the Glacial beds out of the ancient channels, and have followed in the course of valleys that were long fossilised and lost to view.

As in Cape Colony, the Lower Karroo beds lie on handsomely glaciated surfaces. Dr. Molengraaff directed attention to these in 1898, and Mr. Mellor has described numerous new and admirable instances (Fig. 2). The uniform direction of the striæ from one exposure to another points to an ice-sheet, and not to local glaciers. The fact that the movement was from north to south, speaking in general terms, both in the Transvaal and in Cape Colony, only adds zest to the search for an explanation of this old Glacial epoch in the southern hemisphere. It is satisfactory to find that Dr. Molengraaff now concludes that even in the Vryheid district the ice-movement was from N.W. to S.E., *i.e.*, contrary to his previous suggestion.

Mr. A. L. Hall found in the area allotted to him an interesting series of igneous rocks, including a norite which, near Onderstepoort, has given rise to considerable masses of magnetite by a process of segregation.

FIG. 2.—Glaciated surface (Permo-Carboniferous glaciation), north of Douglas Colliery, near Balmoral.

It is not so clear, however, that similar internal processes, taking place during cooling, will account for the passage of the norite into red granite, described as occurring near the farm of Doornpoort. The facts noted, particularly the mottling of the granite near its margin, where it contains augite and decomposed hornblende, seem to point rather to the formation of a composite rock along an intrusive junction.

Messrs. Kynaston and Hall conclude this important report with an account of what they style "diamondiferous" pipes and alluvial deposits. It is suggested that the diamond-bearing vents were connected with the great uplift that followed the close of the Karroo period in South Africa.

Some of Mr. Mellor's results, now detailed in the official memoir, were communicated earlier in 1904 to the Geological Society of South Africa, and have been incorporated in Dr. Molengraaff's "Geology of the Transvaal."[1] This handy work, the publisher of which is not named, now replaces the well known paper in the *Bulletin de la Société géologique de France* for 1901. It is accompanied by a coloured sketch map on the scale of 1 : 500,000.

GRENVILLE A. J. COLE.

OUR MUSEUMS.[2]

THE object of the association, of which the manifold spheres of activity are chronicled in the *Museums' Journal*, is the promotion of the better and more systematic working of museums. That museums are destined to play a very important function in the future education of our race every curator is fully convinced. Yet anyone perusing the pages of the *Museums' Journal* will be struck by the apparent want of unanimity among those into whose charge such institutions have been placed as to the best methods to be adopted in conveying to the public the educational advantages offered. A learned German museum official thought that if artistic skill were more cultivated the public would show increased appreciation for museums. He insists that the greater the knowledge of drawing in a community, the greater the value of a museum as an educational institution for a nation. Dr. Hecht, a French museum authority, advocates placing among natural history specimens a number of attractive and pleasing exhibits so as to lead the mind of the visitor to larger ideas, and to show him by well chosen illustrations in how many ways animal life is connected with human civilisation. Another gentleman argues that the doctrine of evolution should be the key-note of museum work, while Mr. Pycraft directs attention to a real defect in many of our museums in the manner in which our animals are mounted. He gives as an instance how the train of the peacock, commonly called its "tail," is often placed as if it arose from the hinder end of the body, while in reality when erect it stands in front of the wings, as shown in the accompanying illustration reproduced from Mr. Pycraft's paper.

"Would it not be well," remarks Dr. Bather very aptly in his excellent presidential address at the Aberdeen conference of the Museums' Association, "for each of us Museum curators occasionally to ask himself the question: What exactly is the object of my Museum?" While laying stress on inspiration as one of the principal functions of a museum, by which Dr. Bather understands the selection and display of material so as to attract members of the general public, he does not, however, touch upon the really vital point to the museum curator—how can we best induce the community to enter the doors of our institutions?

FIG. 1.—Side view of the Peacock in display showing that, when erect, the train stands in *front* of the wings, and not behind them. From the *Museums' Journal*.

The scope of museums is extended from year to year, and everything is done to widen the sphere of their usefulness. A museum is no longer a place for exhibition only, but a place for research and investigation, and for the encouragement of those who desire to devote their time to such. Yet no one like the museum curator is more impressed with the fact that, in spite of all his efforts to make his collections appeal to the public, in spite of his heartfelt desire to teach both old and young, he only succeeds in attracting within the walls of the institution a comparatively small percentage of the community. What is really wanted, it seems to us, is that schools and museums

[1] "Geology of the Transvaal." By Dr. G. A. F. Molengraaff. Translated by J. H. Ronaldson, M.E. With Additions and Alterations by the Author. Pp. viii+90. (Edinburgh and Johannesburg, 1904.)

[2] *The Museums' Journal*. Edited by E. Howarth. Vol. iii. (July, 1903, to June, 1904). Pp. x+436 and 73–142. (London: Dulau and Co., 1904.) Price 12s. net.

should work hand in hand to aid one another in the supreme object of education. A beginning in that direction has been made in the United States and in some towns in England, where the young are taught in the lecture theatre and are then conducted by the teacher to the section of the museum dealing with the subject of the discourse. In this way the young are familiarised with the objects and uses of museums, to which they will surely more readily return in after life, and in the development of which they will take a keener interest than they do at present. R. F. S.

DR. FRANK McCLEAN, F.R.S.

IN Dr. Frank McClean astronomy has not only lost one of her most devoted and painstaking followers, but a generous benefactor that can ill be spared, especially in this country. His death came as a surprise to most of his friends, for, although it was known that his increasing years were beginning to tell on his general activity, it was thought that there was still much work left in him. Unfortunately, however, this was not to be, for, at the latter end of his usual trip on the Continent, he was taken ill at Brussels, and very shortly afterwards passed away on November 8 at the age of sixty-seven, surrounded by members of his family.

Dr. McClean was the son of the late distinguished engineer, Mr. J. R. McClean, F.R.S., and was born in 1837. After the completion of his education at Westminster, the College, Glasgow, and Trinity College, Cambridge, of which he was a scholar, graduating in 1859 as a wrangler, he took up the profession of his father, and became apprenticed in the same year to Sir John Hawkshaw; three years later he was taken into partnership in the firm of Messrs. McClean and Stileman.

Up to the year 1870 his energy was directed to engineering matters, but retiring from his profession, he devoted the remaining years of his life to spectroscopic researches in connection with the sun and stars. The success which rewarded his endeavours is best shown by the numerous important papers which he communicated to the Royal Society and Royal Astronomical Society, and by the fact that the council of the latter society awarded him, in 1899, the gold medal, their highest honour for astronomical research. The crowning work, which he fortunately completed, and with which his name will always be associated, was the conception and carrying out of the great spectroscopic survey of the brighter stars over the whole celestial sphere.

He commenced his spectroscopic work with several important researches, all of which were carried out with zeal, patience, and thoroughness; these were naturally closely allied, in fact preliminary steps, to the great work to which he later devoted his energies. The first of these dealt with the photography of metallic spectra by means of an induction spark, after which he turned his attention to the nearest star, the sun, and made an elaborate series of comparative photographs of the spectra at high and low altitudes. An account of this, accompanied by a beautiful atlas of plates, was submitted in 1890 to the Royal Astronomical Society. The high sun spectrum was taken as far as possible when the sun's altitude was more than 45°, and the low sun when it was under $7\frac{1}{2}$°, so that the depth of atmosphere traversed was in the proportion of one to five respectively. For securing these photographs he employed a fixed heliostat to reflect the solar light into a telescope fixed parallel to the polar axis, in conjunction with a spectroscope in which was used a large Rowland plane grating.

The investigation brought out in a striking manner the different effects of atmospheric absorption in the solar spectrum, and put one on a firmer footing as regards the variations due to atmospheric influences.

After the publication of these results, McClean turned his attention again to terrestrial spectra, and made a minute study of the comparative photographic spectra of the sun and metals. The first results were connected with the spectra of the gold and iron groups of metals. These spectra were collated by means of their common air lines with the iron spectrum, and so by means of the iron lines with the solar spectrum. In the gold group he found many lines due to these metals which up to that time had not been observed, and he also remarked some curious coincidences that existed between the air lines in the metallic spectra and lines in the solar spectrum. That he had in his mind the eventual spectroscopic study of the heavenly bodies is shown even in his brief accounts of these experiments, for in one case he writes, "the spectra of the metals appear to me to be fairly within the scope of astronomy, as our knowledge of them forms the basis of any knowledge we possess of the composition of the heavenly bodies."

At the end of 1891 he published another set of comparative spectra of the sun and metals. The two series consisted of six sections, corresponding to six sections of Angstrom's chart; they were as follows:—

Section i. contained the spectra of the sun, iron, platinum, iridium, osmium, palladium, rhodium, ruthenium, gold, and silver. The last eight constitute the platinum group of metals.

Section ii. contained the spectra of the sun, iron, manganese, cobalt, nickel, chromium, aluminium, and copper. These seven metals constitute the iron copper group.

Throughout McClean's scientific career his greatest work was undoubtedly the spectroscopic survey of every star brighter than $3\frac{1}{2}$ magnitudes scattered throughout the whole celestial sphere.

Such a programme seemed large for one man to tackle single-handed, but McClean was equal to the occasion, and succeeded not only in accomplishing it, but in discussing and publishing the results.

For the northern stars the photographs were secured at his home, Rusthall House, Tunbridge Wells. The instrument employed was a photographic telescope having an object glass of twelve inches diameter, and carrying an objective prism of the same aperture, with a refracting angle of 20°.

To secure the southern stars McClean worked at the Cape of Good Hope from May to November, 1897. He took with him the prism he had already used for the northern work, and fixed it in front of the object glass of the well-known Cape astrographic instrument, which had been placed at his disposal by Sir David Gill. Both series of photographs were thus secured with practically identical instruments, the advantage of which it is difficult to overestimate.

Space does not permit, nor is it here necessary, to enumerate at any length the results of such a far-reaching research, which were so ably discussed, and received such high praise. Mention, however, may be made of the originality he displayed in referring the stars to galactic latitude and longitude, instead of employing the usual system of right ascension and declination. The celestial sphere he divided into four equal areas by drawing a circle at a radius of 60° from each galactic pole. By means of a great circle passing through the galactic poles, he cut the sphere into two halves, so that each of the four areas was again equally divided. This apparently simple portioning of the heavens was amply rewarded.

In discussing the relation of special type stars to the Galaxy, one of the chief facts that made itself at once apparent was that "Helium" stars were not indiscriminately scattered over the heavens like the solar or other type stars, but were more thickly concentrated in the two zones north and south of the galactic equator. In addition, among many other outcomes of this survey was the discovery of oxygen in the spectrum of β Crucis, and in the helium stars generally.

The energy and stamina displayed by McClean in all his work will be best understood when it is mentioned that he employed no assistants. In his laboratory he was the sole operator, and in the observatory at night every manipulation was accomplished by his own hands. To quote the words of the president of the Royal Astronomical Society when presenting him with the gold medal, ". . . . it was his eye that measured the lines, and his was the pen that worked out the calculations. Need I add more to prove that what Mr. McClean's hand had found to do he did with all his might?"

Turning now from this very brief and incomplete summary of McClean's scientific work, reference must be made to his generosity in presenting munificent gifts for the advancement of astronomy. Being a worker himself, he was in a position to know in what direction monetary aid could be best employed. As the founder of the Isaac Newton studentships at Cambridge University, requiring an endowment of 15,000*l*., he rendered a service to astronomical science which it would be hard to overestimate, and the results that will accrue from it will, we hope, be a fitting memorial to his name.

Not content with providing in this way the means by which the study of astronomy will be encouraged, he presented the Cape Observatory, ten years ago, with a large telescope, fittings, and dome, with all the latest improvements, to accomplish work which otherwise would have been delayed possibly for many years. He saw at once the field that was open and the advance that was possible if the southern heavens were surveyed by a prismatic camera of large dimensions, and he took this opportunity to supply the necessary means.

The fact that Sir David Gill in his recent report for the year 1903 writes, "The Zeiss prism is a very perfect and transparent piece of glass, and I have no doubt that its performance will do credit to the fame of its makers. The observatory is indebted to Mr. McClean for this splendid gift, as also for the costly alterations to the spectroscope," shows that McClean's original gift has been greatly increased. As the inauguration of the "Victoria" telescope forms an epoch in the history of the Cape Observatory, may the results obtained with it play a like *rôle* in the advancement of stellar spectroscopy for the southern hemisphere.

McClean was elected a fellow of the Royal Society in 1895; the university of Glasgow conferred on him the honorary degree of LL.D., while, as previously mentioned, he obtained the gold medal of the Royal Astronomical Society.

In 1865 he married Ellen, the daughter of Mr. John Greg, of Escowbeck, Lancaster, who now mourns with her three sons and two daughters his loss. They are not, however, alone in their grief, for his death is deeply felt by a large circle of friends, among whom are many astronomical colleagues who will miss his familiar face.

The funeral, which took place on Friday last, was attended by representatives from many societies and institutions, among which may be mentioned the Cambridge University, the Royal Society, the Royal Astronomical Society, the British Association, the Institution of Civil Engineers, Greenwich Observatory, Solar Physics Observatory, and the Cambridge University Observatory.

W. J. S. L.

NOTES.

THE seventieth birthday of Prof. G. H. Quincke, the doyen of German physicists, will be celebrated at Heidelberg on Saturday next, November 19. Prof. Quincke's laboratory formed the subject of a contribution to our series of scientific centres in NATURE of April 24, 1902, and his portrait was reproduced in the article. Reference was then made to the admirable manner in which the laboratories at Heidelberg are arranged, and the many ingenious devices to be found in them, as well as to some of the investigations carried on. It is therefore unnecessary to attempt to describe again the results of Prof. Quincke's uninterrupted work in physical research for nearly half a century. Among Prof. Quincke's many pupils have been Prof. Lenard (Kiel), Prof. Braun (Strassburg), Prof. W. König (Greifswald), Profs. Elster and Geitel (Wolfenbüttel), the late Prof. Willard Gibbs, Prof. Michelson, Dr. J. T. Bottomley, F.R.S., Dr. J. McCrae (Glasgow), &c.; a complete list would include many other English and American students. To celebrate the occasion of Prof. Quincke's seventieth birthday, a committee, with Prof. Kohlrausch (Berlin) as president and Dr. R. H. Weber (Heidelberg) as secretary, has arranged for the presentation of a large and handsome album containing the autograph photographs of many of the leading physicists of all nationalities and of Prof. Quincke's former pupils. A convincing testimony of the high value set on Prof. Quincke's work in this country is supplied not only by the lists of universities and learned societies which have conferred their honours on him, but also by the fact that among the English physicists and personal friends who have contributed photographs are Lord Kelvin, Lord Rayleigh, Sir W. Huggins, Sir W. Ramsay, Sir H. E. Roscoe, Sir N. Lockyer, Sir W. H. Preece, Prof. J. J. Thomson, Sir A. Rücker, Prof. J. Larmor, Prof. J. A. Ewing, Mr. C. V. Boys, Sir O. Lodge, Prof. J. H. Poynting, Prof. G. Carey Foster, Prof. A. Schuster, Dr. W. N. Shaw, Prof. J. Perry, Prof. R. B. Clifton, Prof. J. G. MacGregor, Prof. J. T. Joly, Prof. G. H. Darwin, Prof. W. G. Adams, Prof. W. M. Hicks, Prof. H. Stroud, Prof. A. P. Chattock, Prof. A. S. Herschel, and many others.

THE American Consul at Bermuda describes in a United States Consular Report the steps which have been taken to establish there a biological station which will be to North America what the Naples station is to Europe. For several years American naturalists have carried on investigations of the natural history of the Bermudas and the surrounding sea, and have made efforts to establish a biological station in these islands. Upon the advice of the Royal Society, our Government has given its assent to the project. The Colonial Government has expressed its willingness to purchase the land and erect the building, and grants toward equipment and support of tables have been made by the Royal Society and the Carnegie Institution. Harvard University and New York University, in connection with the Bermuda Natural History Society, have already commenced work in a temporary laboratory close to what will be the permanent quarters of the station, and the United States Government has been asked to give generous support to the station. America has already founded a tropical botanical laboratory in buildings of the Government of Jamaica at

Cinchona, and has now secured a biological station, so that it appears as if the Americans are rapidly getting the control of the scientific interests of our western tropical possessions. While we cannot but admire the interest shown in the establishment of these stations by universities and colleges in the United States, it is impossible not to regret the apathy with which our home and colonial Governments regard such matters. Surely it is the duty of the State to encourage the pursuit and cultivation of natural knowledge throughout the Empire, and to realise the richness of its possessions in material for scientific study as well as in precious minerals. It is a reproach to our nation that a biological station has not been established by us in the Bermudas; for now, instead of American investigators carrying on their work in a British station, we have to face the fact that, though the station will be on British soil, it will belong to the United States, and our own countrymen will be guests in it. So far as the interests of science are concerned, probably this does not matter; for, as Mr. Balfour wrote a few days ago to the translator of his British Association address, community of aim "binds together the scientific men throughout the world into one international brotherhood." But it should be evident to some of our ministers, at least to Mr. Balfour, who has often expressed sympathy with scientific progress, that it cannot be to the advantage of the State for another nation to accept responsibilities which belong to us. Mr. Balfour is gratified at the success of the translation of his address into German, but apparently he does not consider that the interest shown in scientific matters in Germany is due to the active and practical part played by the State in helping scientific education and research. What we want here and in all parts of the Empire is more practical help of the kind given by the United States and Germany to save us from the future regret of lost opportunities.

REUTER's Agency states that a long report has been received from the members of the expedition of the Liverpool School of Tropical Medicine now investigating sleeping sickness in the Congo. Complete observations have been made on the spread and distribution of sleeping sickness along the Congo River for a distance of nearly 1000 miles between Stanley Pool and Stanley Falls. From Leopoldville to Bumba cases of sleeping sickness were present in every town visited, and a large percentage of the population harboured trypanosomes. From Basoko to the falls only imported cases were met with, with two exceptions, and trypanosomes were not found among the general population. Observation seems to show that enlarged cervical glands are an early sign of the disease, recognisable before trypanosomes make their appearance in the general circulation, and in a little fluid withdrawn from a gland with a hypodermic needle trypanosomes may be detected. Tsetse flies were incessantly present up to Basoko, the species being *Glossina palpalis*, after which they became infrequent, their distribution thus corresponding with that of sleeping sickness.

MR. W. H. PICKERING, late chief of the inspecting staff for the Yorkshire and Lincolnshire mining districts, has been appointed Chief Inspector of Mines in India.

DR. CATTO has been awarded the Craggs prize of the London School of Tropical Medicine for his discovery of a new *schistosomum* parasite of man. The Craggs prize, of the value of 50*l.*, was founded some years ago by Sir John Craggs, and is awarded annually in October to that student of the London School who is considered to have carried out the best piece of research work, or made an important discovery, in tropical medicine during the preceding year.

IN a letter to the *Speaker* of November 5, Mr. J. A. Reid urges that educationists should consider the desirability of teaching children the principles of evolution in schools. In considering how the subject might be taught, Prof. W. K. Clifford remarked in 1878: "The teacher, knowing what is to come in the end, may so select the portions of various subjects which he teaches at an earlier stage that they shall supply in a later stage a means of understanding and estimating the evidence on some question of evolution."

THE inaugural meeting of the Association of Economic Biologists was held at Burlington House on Tuesday, November 8. Mr. F. V. Theobald occupied the chair, and in the course of his introductory remarks he detailed the steps taken by Mr. Walter E. Collinge to found the association. He hoped that the association would welcome all investigators in economic biology, whether agricultural, medical, or commercial. The relationship between biology and agriculture was apparent to all, but only recently had the importance of its relationships with medicine and commerce been realised. Membership of the association will be confined to workers in economic biology. The following officers have been elected for 1904–5:—president, Mr. Fred V. Theobald; vice-president, Mr. A. E. Shipley, F.R.S.; council, Prof. G. S. Boulger, Prof. A. H. R. Buller, Prof. Geo. H. Carpenter, Dr. Francis Marshall, Mr. Robert Newstead, Major Ronald Ross, F.R.S., Mr. Fraser Storey, Mr. Cecil Warburton; hon. treasurer, Mr. Herbert Stone; hon. secretary, Mr. Walter E. Collinge. The next meeting will be held at Birmingham in April, 1905.

ON December 4, 1804, Joseph Lebon, who is considered in France as the inventor of lighting-gas, was found murdered by an unknown hand in the Champs-Elysees, near the site where is now the Grand Palais. In memory of this sad tragedy, and to pay due honour to the celebrated inventor, the Compagnie Parisienne du Gaz has given a certain quantity of gas, free of charge, to the Aero Club and Société française aérienne. Ascents will accordingly be made on December 4 by members of these two societies. On December 5 an exhibition will be held in the Grand Palais by the Automobile Club.

AT a meeting of the Société astronomique de France held in Paris on November 2, M. Lippmann being in the chair, the Comte de la Baume-Pluvinel gave an address on the forthcoming total eclipse of the sun on August 30, 1905. He mentioned the intentions of American astronomers to send expeditions to Labrador, Spain, and Upper Egypt. After the address the society decided to appoint a committee for determining the part which France should take in observing the eclipse. It is fairly certain that the principal work of this committee will be concerned with observations in Algeria and Tunis, through which the line of totality passes. This eclipse was also commented upon at the last meeting of the St. Petersburg Scientific Aëronautic Congress, officially held in the rooms of the Imperial Academy of Sciences under the chairmanship of the Grand Duke Constantin Constantinovitch, president of the academy. Colonel Vives y Vich has announced that he will make an aëronautical ascent from Burgos on this occasion, for the purpose of ascertaining the part the clouds may possibly play in the apparent brightness and shade of the corona. In addition, the international committee of *ballons-sondes* has decided that atmospheric observations shall be made at the great altitudes of the various observatories connected with the institution during August 29, 30, and 31 for ascertaining the changes the eclipse may introduce in the prevailing winds and temperatures at different altitudes.

THE *Scientific American* of October 22 contains the portrait of a white raccoon-dog from northern Japan, in the New York Zoological Park, which is regarded as representing a new species, and is accordingly named *Nyctereutes albus*. The ordinary raccoon-dog of Japan and China is an animal closely allied to the true dogs, but with a marked superficial resemblance to a raccoon. If the New York specimen really indicates the existence of a white species of raccoon-dog, the fact will be of considerable zoological interest.

IN the second part of the Bergen Museum *Aarbog* for the current year Prof. G. O. Sars describes a small crustacean (*Paracartia grani*) recently discovered in the oyster-beds of western Norway which is of great interest from the point of view of distribution, since the only other known representative of the genus inhabits the Gulf of Guinea. The author considers that the creature reached Norway from the south during a warm period, and that it survives on the bays of the west coast owing to the circumstance that a superincumbent layer of fresh water renders the subjacent salt water unusually warm. The same explanation accounts for the prolific oyster-beds on this coast.

IN the November number of the *Century Magazine* Prof. H. F. Osborn publishes *in extenso* the lecture on the evolution of the horse in America which he delivered at the recent Cambridge meeting of the British Association. Omitting reference to that portion of the article devoted to the origin of the Equidæ generally, we may mention that the author regards North America as the ancestral home of the genus Equus, the American horses passing into South America by way of Panama, and into Asia by a land-bridge across Bering Strait about the early or middle portion of the Pliocene period, giving rise in the latter area to the Siwalik horses (which, by the way, are not later than older Pliocene age). Horses of all kinds died out both in North and in South America, according to the author's belief, before the European conquest. The American Miocene and Pliocene horses are considered to have been striped; but the splitting of Equus into the true horses, asses, and zebras probably took place in the Old World. Przewalski's horse of Mongolia is regarded as representing the ancestral stock of the ordinary horses of the Old World, the long manes and tails of the latter being probably due in part to domestication. On the other hand, the author accepts the view that the blood-horse may have had a different ancestry, although he does not refer to its suggested derivation from the Indian *Equus sivalensis*.

SOME interesting experiments in blasting tree butts with gellignite—a safety explosive—have recently been carried out at Lord Leigh's Stoneleigh Abbey Estate, near Kenilworth. The usual boring was made and filled with the explosive. An electric detonator was used which enabled the operator to retire under cover at a safe distance. The butts operated upon were of various sizes and species, but in each case the method was found to give satisfactory results. It is also claimed to combine efficiency with economy.

THE comparative age of the different elements of the flora of eastern North America forms the subject of a paper by Dr. J. W. Hashberger in the September issue of the *Proceedings* of the Philadelphia Academy. Most of the flora cannot be older than the close of the Glacial period, which, from the rate of cutting of the Niagara gorge, is estimated to have occurred not more than 15,000 years ago. Some of its elements may, however, be much older, since they may be the descendants of boreal plants which flourished on unglaciated areas in the midst of the ice-sheet. Apart from these, there was firstly a wave of plant-life from the skirts of the ice-sheet. This was followed by a northern wave, many of the species of which, forming the bog-plants of the old Glacial lakes, soon occupied the tundra left by the ice; the conifers developed later, and restricted the bog-flora. Hence came the modern bog and swamp floras, while the existing Poccona flora is due to a third invasion.

THE work of the Forestry Bureau of the United States Department of Agriculture stretches far afield, and the forests of the Hawaiian Islands form the subject of one *Bulletin* by Mr. W. L. Hall, while Mr. W. L. Bray in another reviews the forest resources of Texas. The succession of the forests in Texas indicates that their distribution is primarily influenced by the amount of rainfall, and only secondarily by the nature of the soil. A remarkable instance of the spread of a successful type is furnished by the mesquite, *Prosopis glandulosa*, which has spread from the Rio Grande eastwards across the Rio Brazos, and northwards into the adjoining States of Oklahoma and Kansas. In the Hawaiian Islands a mesquite, although an alien, has established itself as a pure forest from sea-level to an elevation of several hundred feet, and is regarded as a valuable asset, because, in addition to the fuel and posts obtained from the wood, the pods furnish excellent food for stock.

IN view of the difficulties of obtaining zygospores of species of Mucor and allied genera, considerable importance attaches to a paper—"Sexual Reproduction of the Mucorineæ," by Mr. A. F. Blakeslee—which is published in the August number of the *Proceedings* of the American Academy of Arts and Sciences. The author found that the greater number of these fungi failed to produce zygospores in pure cultures, but some would do so when a mass of spores taken from an impure culture was sown together. This suggested that in the latter case zygospores were produced from different mycelia or plants, and eventually experiments demonstrated that two different strains, which may be regarded as a (+) and a (−), were required; thus two groups, the *heterothallic* and *homothallic* are distinguished. Sporodinia is homothallic, Phycomyces, Rhizopus and several species of Mucor are heterothallic. Differences of colour, luxuriance and duration of conjugating ability were noted, but the most interesting results obtained were incipient attempts at hybridisation by opposite strains of allied heterothallic forms.

WE learn from the *Standard* that, under the auspices of the Meteorological Council, a new observing station for London has just been established in St. James's Park. The station is situated in an open spot a few yards distant from the iron railings bordering on the Horse Guards Parade, and is equipped with a set of thermometers, mounted in a Stevenson screen, and two rain gauges—one of quite an ordinary kind, the other a self-registering gauge of the pattern designed by Mr. F. L. Halliwell, of Southport. Just within the park railings are placed two ornamental wooden frames one containing, for the previous twenty-four hours automatic records of bright sunshine, of rainfall, and of temperature all made in Westminster; the other copies of the latest weather charts and forecasts prepared at the Meteorological Office.

WE have received a copy of the results of the magnetical and meteorological observations made at the Royal Alfred Observatory, Mauritius, in the year 1901. The observatory has a complete equipment of instruments recording photographically the variations of the principal magnetic and meteorological elements and of earth movements, in addition to a self-registering "Beckley" rain gauge and other automatic apparatus. The tables, containing hourly and mean values, have been carefully prepared on the Greenwich pattern, and are, therefore, quite clear and convenient for reference. Mr. Claxton prints the results of an interesting investigation of the degree of accuracy of self-registering maximum and minimum thermometers. He finds that maximum thermometers read higher in a horizontal position than when inclined to the horizon; the excess may amount to 1° F. Also, that the indications of spirit minimum thermometers are untrustworthy, owing chiefly to evaporation of the spirit. They should be used in conjunction with an ordinary mercurial thermometer.

A PAPER on Britain's place in foreign markets is contributed to the *Economic Journal* for September by Prof. A. W. Flux. The author has had considerable difficulty in drawing up statistics owing to the great discrepancies which he finds in the returns from different countries. He, however, considers that the market for British goods in Germany, France, and the United States, though narrowed by the tariff policy of the third, is still of great importance, and is expansive in some degree except in the case of the United States. In all three cases, however, the trade done by other countries as a whole has grown faster than their trade with us.

DURING March, 1903, several excursions were made to the Phlegræan fields of Naples by Dr. G. de Lorenzo and Sir Archibald Geikie. At the suggestion of the latter the former has now published a short history of volcanic activity in this region (*Rendiconto* Naples Academy, May to July). Dr. de Lorenzo divides the volcanic formations into three periods, the first being represented by the pipernoid tufa of the Campagna and by conglomerate and breccia at Cuma, Camaldoli and Procida, the second by the yellow tufa of Posilipo, Nisida, Pozzuoli, Capodimonte, &c., and the trachitic masses of the Vomero, and the third period by the eruptions of the Solfatara, Monte Nuovo, the Lago d'Agnano and similar formations.

IN the *Rendiconto* of the Naples Academy for March and April, Prof. Orazio Rebuffat describes some interesting and simple experiments with radium salts. When a glass rod was rubbed with wool in the common way for producing electric sparks the author found that if the experiment was performed in a medium containing a radium salt a luminous glow followed the wool, and when the finger was brought near the excited glass a glow was again seen. By taking a vacuum tube and opening connection with a small tube containing a salt of radium, and then rubbing the outside of the glass tube with wool, a brilliant glow was seen within. By means of this experiment Prof. Rebuffat considers it possible to demonstrate the production of emanations from radium preparations of very feeble activity.

DR. R. VON LENDENFELD, of Prague, has published in *Globus*, lxxxv., 24, a discussion of the melting of glaciers in winter. The author considers that the earth's interior heat is incapable of accounting for any considerable part of the phenomenon; indeed, he only attributes about 3 per cent. to 6 per cent. of the result to this cause. Another cause which may account for a further 1 per cent. is the slow conduction of the summer heat to the interior. The main cause of the melting is attributed to the heating of the ice by the work done in its descent. This work is converted into heat in overcoming friction, viscosity, and similar resistances, just as in Joule's classical experiments. A further increase in the internal melting during the winter is probably due to the pressure produced by the winter snows.

A SPECIAL report of the seventy-sixth meeting of the German Association of Naturalists and Physicians is contained in the number of the *Physikalische Zeitschrift* for October 20. The meeting was held at Breslau from September 18 to 24, and the physical papers include the following:—E. Hoppe, constitution of magnets; H. Hartl, lecture apparatus; C. Pulfrich, coast surveying, &c.; F. Müller, vacuum apparatus; C. Dieterici, energy of water and its vapour; W. Scheffer, stereoscopic problems; A. Köhler, photomicrography by ultra-violet light; J. Stark, mercury lamps of quartz glass; O. Lummer and P. Weiss, *n*-rays; W. Nernst, chemical equilibria at high temperatures; L. Grunmach, properties of emanium and liquid nitrous oxide; A. Wehnelt, negative ions from incandescent metallic oxides; O. Lummer, resolution of fine spectrum lines; W. Schmidt, models of wave motion; H. T. Simon, a phasemeter; M. Reinganum, molecular volumes of halogen salts; L. Graetz, radiations from hydrogen peroxide; J. Rosenthal, Sprengel pumps; W. Stern, tone-variators; K. Schreber, explosion motors, also force, weight and mass; G. Bredig and F. Epstein, kinetics of adiabatic reactions; and E. Meyer, combustion engines. In addition a discussion took place on mathematical and scientific teaching in the higher schools, including addresses by K. Fricke, F. Klein, F. Merkel, and G. Leubuscher. In the general meetings papers were read on the Ice age by Messrs. Brückner, Meyer and Partsch, on the Antarctic expedition by Prof. Gazert, and on biological mechanics by Prof. Roux.

THE scientific methods which have characterised Japanese operations in the Far East are not the only results of the well developed system of education which the last thirty-five years has seen established in Japan. Some fifty years ago Japan was a hermit nation more than five centuries behind the times, to-day she constitutes a new and important factor in the problem of the distribution of the world's commerce. The story of the foreign commerce of Japan since the restoration of imperial authority in 1868 is told by Mr. Yukimasa Hattori in Nos. 9 and 10 of series xxii. of the *Johns Hopkins University Studies in Historical and Political Science*, copies of which have reached us. Mr. Hattori considers his subject under three headings: the volume of trade, the character of Japan's commerce, and the geographical distribution of trade. Two remarks towards the end of his paper will show the conclusions to which Mr. Hattori has come. "Japan must rely on industrial development rather than on agriculture, and must try to excel in the quality of the goods produced rather than in quantity." "Japan possesses all the advantages necessary to make her a great manufacturing country. Her people possess exceptional skill, and labour is relatively cheap; coal is abundant, and the raw material is easily obtainable either at home or in the neighbouring countries." Those readers who have followed the steps in Japan's development since 1868 will be prepared to agree with Mr. Hattori that his country is but "at the very beginning of beginnings" of what will yet be seen.

A SECOND edition of Mr. Drinkwater Butt's "Practical Retouching" has been published by Messrs. Iliffe and Sons Ltd., at 1*s*. net.

MESSRS. MACMILLAN AND CO., LTD., have in the press an English translation of Dr. Cohnheim's "Chemistry of the Proteids," prepared with the author's sanction from the second edition of that work by Dr. Gustav Mann, of the physiological laboratory at Oxford, and author of "Physiological Histology." Dr. Cohnheim's book, which, in its second edition, has been entirely re-modelled, deals with all recent advances made in analysing and synthetising proteids. Several special features have been introduced into the English translation, and some of the chapters have been re-written.

AN English edition of Prof. Weismann's "Evolution Theory," which has been translated, with the author's co-operation, from the second German edition (1904) by Prof. J. Arthur Thomson, of Aberdeen University, and his wife, will be published in two volumes by Mr. Edward Arnold toward the end of this month.

To commemorate the twenty-fifth anniversary of the founding of the firm of Burroughs, Wellcome and Co., Mr. Henry S. Wellcome is arranging an exhibition of historical objects in connection with the history of medicine, chemistry, pharmacy, and the allied sciences, the object being to illustrate the art and science of healing in all ages. The date of the opening of the exhibition is not yet fixed.

THE Cambridge University Press will publish very shortly in the Cambridge Biological Series "Morphology and Anthropology," by Mr. W. L. H. Duckworth. The volume will present a summary of the anatomical evidence bearing on the problem of man's place in nature. The Cambridge University Press has also in preparation "Studies from the Anthropological Laboratory in the University of Cambridge," by Mr. Duckworth.

THE November number of the *Popular Science Monthly* is devoted entirely to the St. Louis Congress of Arts and Science. The representative administrative board, it will be remembered, adopted the plan proposed by Prof. Münsterberg, of Harvard University, to hold one congress of the arts and sciences which should attempt to promote and demonstrate the unity of science. An appreciation of the work of this international congress, interspersed with portraits of representative men of science from various parts of the world, is contributed by Mr. W. H. Davis, of Lehigh University, one of the secretaries. A selection from the addresses given at the congress completes an interesting number of the magazine.

OUR ASTRONOMICAL COLUMN.

ENCKE'S COMET (1904 *b*).—A telegram from Prof. Max Wolf to the *Astronomische Nachrichten* (No. 3975) states that on October 28 the ephemeris published by M. Kaminsky in No. 3973 of that journal needed corrections of $+11s. -2'{\cdot}4$, and, further, that the magnitude of the comet was 12·5.

Visual observations have not, as yet, been fruitful. Prof. E. Millosevich vainly sought for this object on September 15 and October 5.

DESLANDRES'S FORMULA FOR THE LINES IN THE OXYGEN BAND SERIES.—Referring to a note on the results obtained by Mr. O. C. Lester concerning the oxygen bands in the solar spectrum, which appeared in these columns on October 20, Prof. Deslandres directs attention to the fact that a modification of his first formula (viz. $N = a + bn^2$), equivalent to that now proposed by Mr. Lester, was published by him in his original (*Comptes rendus*, August, 1886) and succeeding memoirs on this subject.

Mr. Lester's statement that the first law requires the modification which he proposes is obviously justified, but he appears to have omitted to study the original memoirs, and to have accepted the epitomised and generally known results as being complete. This does not, however, lessen the importance of the valuable experimental results he obtained in measuring the old and new bands on his large dispersion photographs.

ANNUAL REPORT OF THE CAPE OBSERVATORY.—In the report of the Cape Observatory for 1903 Sir David Gill records several important additions to and modifications of the instrumental equipment.

The work of the new transit circle has been greatly facilitated, and the results improved by the adaptation of a Repsold automatic transitting device to the instrument.

The line-of-sight spectroscope which is used in connection with the Victoria telescope has been re-modelled, and an extremely delicate thermostatic arrangement has been fitted so that the temperature of the prism box can be maintained constant, within $\pm 0^\circ{\cdot}05$ F., during a three or four hours' exposure.

In the astrophysical department several stellar spectra have been completely reduced in the region λ 4200 to λ 4580, and those of Canopus and Sirius have been discussed in connection with the corresponding terrestrial origins of their lines. The results of the line-of-sight work have been made more trustworthy by measuring only those lines which, on traversing either the thin or the thick ends of the prisms, show no relative displacement, and α Phœnicis has been shown to have a very large radial velocity. In December this star was apparently receding from us at the rate of 105 km. per second.

A large amount of routine work in connection with the maintenance of an efficient time service and the completion of the Cape zone for the astrographic chart was accomplished during the year. Important operations were also carried out in connection with the geodetic survey of South Africa, whilst the Government survey of the Transvaal and the Orange River Colony and the topographic survey of South Africa have been planned, the former having been commenced.

THE TRANSITION FRDM PRIMARY TO SECONDARY SPECTRA.—Some very interesting experimental results, obtained with the idea of determining as definitely as possible the points at which, under various conditions, the primary is replaced by the secondary spectrum in gases, are published by Mr. P. G. Nutting in No. 2, vol. xx., of the *Astrophysical Journal*.

The general method was to determine what current capacity caused the above named change when either the wave-length, the pressure, the nature of the gas, the inductance or the resistance was altered, and this was called the "critical capacity."

Among other results the experiments showed that this critical capacity is a function of the wave-length, and that it increases slightly as the pressure decreases down to about 1 mm. of air, when it suddenly becomes infinite. All the elements tested have the same critical capacity for the same wave-length and pressure, although the critical point is more marked in some elements than in others. The introduction of inductance always relatively weakens the secondary and strengthens the primary spectrum, although no amount of inductance will completely annul the effects of capacity. Resistance acts similarly to inductance. The critical capacity of any vapour in a mixture of vapours was shown to be the same as when no other gases were present.

NEW BUILDINGS OF THE UNIVERSITY OF LIVERPOOL.

The George Holt Physics Laboratory.

THE George Holt Physics Laboratory, which was declared open by Lord Kelvin on November 12, will be valued by the University of Liverpool as a magnificent addition to its fabric, as well as a memorial to one of the wisest and most generous supporters of that college from which the university has been developed.

The laboratory covers an area of 9600 square feet, and has an average height of 55 feet. The architects are Messrs. Willink and Thicknesse, of Liverpool, with whom there is associated Prof. F. M. Simpson, now of University College, London. The external walls, which are very substantial, are built in best common brick with broad courses of red brick and dressings of Storeton stone. The basement floors are asphalte on a bed of concrete resting on the continuous rock which is the foundation of the whole building. All the upper floors are fire-proof; they consist of a bed of concrete which encases a lattice-work of steel girders, and supports a layer of coke breeze, upon which tongued and grooved pitch-pine boards are stuck down with bitumen and nailed. The resulting surface is both noiseless and steady, and the whole building is made very rigid by the girders employed.

In the basement there is a large workshop, fully fitted with machine tools, store-rooms, a room containing a liquid air plant, a furnace room, an accumulator room, a room for the custody and comparison of standards, and a number of research rooms in which extra steadiness, complete darkness, or constancy of temperature can be respectively secured.

On the ground floor, close to the entrance hall and cloak-rooms, are the doors of the large lecture theatre, a smaller class-room, and a large laboratory for elementary students. This floor also contains the preparation room, the apparatus

FIG 1.—The George Holt Physics Laboratory, Liverpool.

room, and a sitting-room, office, and private laboratory for the professor.

The first floor is set apart for the teaching of senior students. It contains two large students' laboratories, four smaller rooms suitable for optical and acoustical experiments, a students' workshop, a library, and two sitting-rooms for demonstrators.

The second floor consists almost entirely of research rooms of various sizes. Of these some are designed for special purposes, such as spectroscopy, but the majority are planned so as to be adaptable to as great a variety of needs as possible.

A photographic dark room is provided on each floor; that in connection with the preparation room is adapted for the making of lantern slides and enlargements. There is also a small observatory on the roof, containing a four-inch equatorial telescope.

An electrically driven lift, working in the centre of a tower, is available for the conveyance of heavy apparatus from floor to floor. It can also be used to give access for experimental purposes to all points of two vertical walls which extend to the full height of the tower, about 75 feet. In another part of the laboratory access over a horizontal distance, about 90 feet, nearly equal to the whole length of the building, is secured.

The rooms are heated by low pressure hot water, and are ventilated by an exhaust fan in the roof. They are adequately supplied with gas, with sinks to which hot and cold water are led, with electric power from the corporation mains, and with wires from a switch-board in the basement to which the accumulators are connected. The wiring is run in wood casing on the surface of the walls; all pipes are fully exposed, and, wherever a floor or wall is pierced, an opening is left through which further permanent or temporary connections can be made as required.

The apparatus and preparation rooms have galleries round them, so that their whole wall-space is rendered available for cupboards and drawers. Special devices have been adopted for the ready darkening of the lecture theatre, and for the provision of rigid points of attachment above the whole length of the lecture table. The counter-shafting in the workshop is supported so as to be entirely independent of the rest of the building, and thus silence and freedom from vibration are secured.

The erection of the laboratory was rendered possible by the munificence of a small body of donors, Mrs. and Miss Holt, Sir John Brunner, the late Sir Henry Tate, the executors of the late Rev. J. H. Thom, Mr. Alfred Booth, Mr. Holbrook Gaskell, Mr. J. W. Hughes and Mr. John Rankin, who together subscribed the sum of 23,600*l.*, which by the addition of interest has increased to 25,900*l.* The cost of the building, with furniture and fittings, is 21,600*l.* A sum of 1200*l.* has already been spent upon machinery and new apparatus, and thus about 3000*l.* is available for the completion and maintenance of its equipment.

It is hoped that the general scheme according to which the laboratory is arranged will prove favourable to simplicity and economy of administration, and will allow teaching and research to flourish side by side, not hampering but supporting each other.

New Medical Buildings of the University of Liverpool.

The new medical buildings opened at Liverpool on November 12 go far to complete the university school of medicine in that city in a thoroughly efficient and modern manner. They provide accommodation chiefly for the subjects of anatomy, surgery, and materia medica, the school of dental surgery and the school offices, and forensic medicine. There are four full floors to the building, and the ground plan is of an L shape. One limb of the L-shaped figure joins the fine Thompson-Yates laboratories opened six years ago for physiology and pathology. The other limb forms a wing ending freely towards the north. In the angle of junction of the two portions of the building are placed large theatres, one on the ground floor for surgery, the other upstairs for human anatomy. The pitch of the benching is steep, and the lighting is extremely good from a series of long windows following the curve of the rounded angle of the building. In the wing, lighted by windows east and west, is a spacious museum for anatomical preparations. Above this is a large room for dissection, especially well lighted from the east. An excellent theatre for operative surgery forms a feature of the surgical equipment.

In addition to the theatres, museum, and dissecting room are rooms for a library, and for smaller classes than those the theatres are intended to accommodate. In the front portion of the building is the medical faculty meeting room for transacting the business of the faculty and of its various committees, also for meetings of the veterinary board which manages the newly started university school of veterinary medicine. Next to the medical faculty meeting room is the spacious room providing an office for the Dean of the faculty. No effort or expense has been spared in making the construction at once durable, well lighted within, and handsome from the exterior. Admirable lighting has been secured throughout, even to the basement rooms, which are particularly good, so as to provide a much needed reading room for students. The erection was begun three years ago, and part of the building has already been in occupation for more than a year. The architects are Messrs. Waterhouse, of London, who have designed most of the older buildings of the university. The group of medical school buildings now in use have cost altogether about 80,000*l*., including, with the building opened on Saturday, the Thompson-Yates laboratory and the Johnston laboratory. The Chancellor of the university, Lord Derby, formally inaugurated the new buildings on the same afternoon as Lord Kelvin opened the new university laboratory for physics. With these fresh additions to its accommodation and teaching equipment, and with the fine new laboratories for zoology and for electrical engineering now rapidly nearing completion, the University of Liverpool will rank among the best provided university institutions in the country.

PROF. MENDELÉEFF ON THE CHEMICAL ELEMENTS.

THE last half-volume (eightieth) of the new Russian "Encyclopædic Dictionary" contains a remarkable paper by Prof. Mendeléeff on the chemical elements, of which the following is a slightly abridged translation. Together with the articles on matter and on the periodic law, which Mendeléeff contributed to previous issues of the same dictionary, and a paper, "An Attempt at a Chemical Comprehension of the World's Ether," published in a Russian review, this article represents the fundamental physical and chemical conceptions of the great chemist as they now appear in connection with the discoveries of recent years.

"Human thought," he begins, "has always endeavoured to simplify the immense variety of phenomena and substances in nature by admitting, if not the full unity of the fundamental elements (Democritus, Epicurus), at least the existence of a limited number of elements capable of producing all the variety of substances. In antiquity this tendency often resulted even in confusing the phenomena with the substances (earth, water, air, and fire)." Since the time of Lavoisier such a confusion has become certainly impossible: the substances are sharply separated from the phenomena which are associated with them. Of course, there may be partial returns to the old view. "However," Mendeléeff continues, "the solidity of the now prevailing conception as to the profound difference existing between substances and phenomena is the result of such a mass of coordinated knowledge that it cannot be shattered in the least even if a small portion of the men of science return to the "dynamism" of old which endeavoured to represent matter also as one of the forms of phenomena. Consequently we are bound now to recognise the substances (the masses) and the phenomena (the movements) as two quite separate, independent categories, such as space and time, the substance of which our thought has not yet penetrated, but without which it cannot work. Thus, for example, we are far yet from understanding the cause of gravitation, but with its aid we understand many phenomena, even though up till now it is not quite evident whether attraction acts through the aid of an intervening medium or represents a fundamental force which acts at a distance. Progress in the understanding of nature depends, therefore, not upon our reducing everything to one final conception—to one 'principle of all principles'—but in reducing the great variety of substances and phenomena which act upon our senses to a small number of recognised fundamental conceptions, even though these last be disconnected. One of such conceptions is that of the recognised chemical elements.

"The simplest way of conceiving matter in this case is to consider it as the result of combinations of elements which themselves are matter; and the phenomena as the results of movements which are the property of these elements or their aggregations. It was from this point of view that the conceptions were elaborated as to the distinction, not only between phenomena and substances, but also between simple bodies and elements; because the conception of a simple body implies the idea of an impossibility of transforming certain bodies into other bodies, while the conception of a chemical element is merely determined by the desire of diminishing the number of substances which are required for explaining the great variety of the latter."

Mendeléeff passes next to the so-called "rare" elements. Leaving aside historical details concerning them, he remarks that it is the more necessary to dwell upon them as they complete to a great extent our knowledge of the periodic law. "Our information about them," he continues, "can also, in our opinion, contribute towards explaining the relations between the phenomena and the substances in nature; because for the understanding of a multitude of natural phenomena it is necessary to resort to the conception of the so-called luminiferous ether, which by all means must be considered as a ponderable substance, and consequently must have its place in the system of elements, inasmuch as it reminds us of the properties of helium, argon, and other similar elements. The conception of the ether was resorted to at the outset exclusively for explaining the phenomena of light, which, as is known, can be best understood as the result of vibrations of the ether. However, later on, ether, considered as being distributed throughout the universe, was resorted to in order to explain, not only electrical phenomena, but also gravitation itself. In consequence of that, a very great importance has to be attributed to the ether; and as it cannot be considered as anything but ponderable matter, we are bound to apply to it all the conceptions which we apply to matter in general, including also the chemical relations. But as, at the same time, we are bound to admit that this matter is not only distributed throughout stellar space (in order to explain the light which reaches us from the stars), but also penetrates all other substances; and as also we must admit that the ether has no capacity of entering into chemical reactions, or of undergoing any sort of chemical condensation, therefore the above mentioned elements, helium and argon, which are characterised precisely by the absence of that property of entering into chemical reactions with other substances, show in this respect a certain similarity with the ether.[1]"

Referring further to radium, Mendeléeff remarks that there can be no doubt as to its being a separate element, extremely rare in nature. As to the emanation of helium by radium, and the presence of the helium spectrum in the spectrum of radium, he explains these facts by the occlusion of helium in a compound of radium, and considers that "nothing gives us reason to think that radium should be transformed into helium." "Notwithstanding the extremely small quantities of radium occurring in nature, Madame Curie has succeeded in obtaining a compound of it, and in establishing its kinship with barium, as also in finding its atomic weight to be near 224, which permits us to complete the periodic system of elements by placing radium in the second group, in the 12th row, in which we have already thorium and uranium, the ores of which are possessed of radio-activity.[2]

"As to argon and its congeners—neon, krypton, and xenon—these simple gases, discovered by Ramsay, differ from all the known elements in that, up till now, notwithstanding the most varied attempts, they could not be brought into combination with any other substance, or with each other. This gives them a separate place, quite distinct from all other known elements in the periodic system, and induces us to complete the system by a new separate group, the group zero, which precedes group i., the representatives of which are hydrogen, lithium, sodium, and so on.

"The placing of these elements in a new group is fully supported by the atomic weights which are deduced for these gases on the basis of their densities, if we admit that the molecule of each of them contains but one atom.

1 "About this resemblance between argon and helium and the substance of the world's ether I have already written in a separate article entitled 'An Attempt at a Chemical Comorehension of the Ether,' in the review *Messenger and Library of Self-Education*, in the first four numbers of 1903. This article was translated into German in the *Prometheus* of 1903 by M. Tshulok, and into English by M. Kamenskiy under the title 'A Chemical Conception of the Ether' (Longmans, Green and Co., London, 1904). I must, however, remark that the German translation is a complete one, but that the editors of the English translation have omitted the introductory general philosophical remarks about the fundamental distinction between substances (masses), forces (energy), and spirit. This omission deprives the article of the realistic meaning which I intended to give it by introducing ether into the system of elements."

2 "Some later researches lead us to believe that the atomic weight of radium is slightly above the figure found by Madame Curie, but it seems to me that it still remains doubtful whether the conclusion of Madame Curie has to be altered."

Thus, helium must be placed before lithium, and argon before potassium, as is seen from the table, into which radium has also been introduced. In this table there are, in the group zero, two unknown elements, x and y, which have been introduced for two reasons: first, because in the corona of the sun, above the region of incandescent hydrogen, there has been noticed an element which has an independent spectrum, and therefore is named coronium; and although it is yet unknown (helium was also first characterised by Crookes as an element, on account of the independence of its spectrum), it must have a density, and consequently an atomic weight, both smaller than those of hydrogen (in the table, this element is marked as y); and secondly, because there is no reason to believe that the system of elements is limited in the direction of the lightest ones by hydrogen. The presence of the elements x and y in the group zero makes us think that the elements which correspond to these positions in the system will be distinguished by the absence, in a high degree, of the capacity of chemical combination—a property which belongs also, as has been already pointed out, to helium, argon, and their analogues.

"The same property must be attributed to the substance of the ether, which must possess, moreover, an extremely low density, and consequently a very great rapidity of motion of its molecules, in order to have the possibility of escaping from the spheres of attraction, not only from the atmosphere of the earth, but also from the atmospheres of our sun and other suns the masses of which are greater than that of ours. The researches concerning the double stars prove that the masses of the stars which we know do not exceed the mass of our sun more than thirty-two times, while in other cases they are equal to it; therefore, if we attribute to the ether the properties of gases, we must admit, on the basis of the kinetic theory of gases, that its specific gravity must be very much smaller than the specific gravity of hydrogen. In order that the ether may escape from the sphere of attraction of stars the mass of which is fifty times greater than the mass of the sun, it must, while it chemically resembles argon and helium, have an atomic weight not more than 0·000 000 000 053 (and a density, in relation to hydrogen, half as large, as I have proved in the above mentioned article on ether). The very small value of this figure already explains why there is little hope of isolating the substance of the ether in the near future, as it also explains why it penetrates all substances, and why it is condensed in a small degree, or collects in a physicomechanical way, round ponderable substances—being mostly condensed round such immense masses as that of the sun or of stars.[1]"

In conclusion, Mendeléeff indicates that while the conception of the chemical elements is connected in the most intimate way with the generally received teachings of Galileo and Newton about the mass and the ponderability of matter, as also with the teaching of Lavoisier concerning the indestructibility of matter, "the conception of the ether originates exclusively from the study of phenomena and the need of reducing them to simpler conceptions. Amongst such conceptions we held for a long time the conception of imponderable substances (such as phlogiston, luminous matter, the substance of the positive and negative electricity, heat, &c.), but gradually this has disappeared, and now we can say with certainty that the luminiferous ether, if it be real, is ponderable, although it cannot be weighed, just as air cannot be weighed in air, or water in water. We cannot exclude the ether from any space; it is everywhere and penetrates everything, owing to its extreme lightness and the rapidity of motion of its molecules. Therefore such conceptions as that of the ether remain abstract, or conceptions of the intellect, like the one which also leads us to the very teaching about a limited number of chemical elements out of which all substances in nature are composed."

Row.	Group zero	Group I.	Group II.	Group III.	Group IV.	Group V.	Group VI.	Group VII.	Group VIII.	
0	x									
1	y	H=1·008								
2	He=4·0	Li=7·03	Be=9·1	B=11·0	C=12·0	N=14·04	O=16·0	F=19·0		
3	Ne=19·9	Na=23·05	Mg=24·1	Al=27·0	Si=28·4	P=31·0	S=32·06	Cl=35·45		
4	Ar=38	K=39·1	Ca=40·1	Sc=44·1	Ti=48·1	V=51·4	Cr=52·1	Mn=55·0	Fe=55·9, Ni=59	Co=59 (Cu)
5		Cu=63·6	Zn=65·4	Ga=70·0	Ge=72·3	As=75·0	Se=79	Br=79·95		
6	Kr=81·8	Rb=85·4	Sr=87·6	Y=89·0	Zr=90·6	Nb=94·0	Mo=96·0	—	Ru=101·7, Pd=106·5	Rh=103·0 (Ag)
7		Ag=107·9	Cd=112·4	In=114·0	Sn=119·0	Sb=120·0	Te=127	I=127		
8	Xe=128	Cs=132·9	Ba=137·4	La=139	Ce=140	—	—	—	— — —	(—)
9		—	—	—	—	—	—	—		
10	—	—	—	Yb=173	—	Ta=183	W=184	—	Os=191, Pt=194·9	Ir=193 (Au)
11		Au=197·2	Hg=200·0	Tl=204·1	Pb=206·9	Bi=208	—	—		
12	—	—	Rd=224	—	Th=232	—	U=239	—		

[1] "It is worth noting that all the incandescent, self-luminous celestial bodies are immense as regards their masses, in comparison with the cooler bodies like the earth or the moon; perhaps this depends upon the distribution of the ether, which is condensed precisely round such very big masses as the sun and the stars. It is also worth noticing that the atomic weights of radium, as also of thorium and uranium, are very great in comparison with those of the other elements."

WELSH CONFERENCE ON THE TRAINING OF TEACHERS.

THE Welsh National Conference on the Training of Teachers was held in Shrewsbury on November 10 and 11, and although no special reference was made to science teaching, still the subject of education is now in a fair way to be considered a science, since it has been included as a section of the British Association.

The conference was convened by the Central Welsh Board and the University of Wales, and in addition to these bodies, representatives attended from every county education authority in Wales, from every type of educational institution, from the National Executive of Welsh Councils and from all the associations of masters and mistresses. Upwards of 200 delegates attended in all, most of whom remained throughout all four sessions.

At the first session, which was devoted to "The Special Aspect of the Problem of Training Presented in Wales," Principal Griffiths, vice-chancellor of the University of Wales, presided, and in his opening address submitted the points which it was most important that the conference should decide. Briefly they were these: What were the real demands of the Principality, and how far were they met by existing institutions? Was Wales to import the shortage of teachers, or to increase her own production? In what manner could the schools be best utilised as training grounds without injuring the schools? and should local education authorities undertake the training of secondary teachers? To these questions no uncertain answer was suggested, although the conference abstained from passing formal resolutions until an opportunity had been accorded the members to consider the verbatim report, which it was decided to publish at an early date.

At the second session Mr. Lloyd George, M.P., presided, and a paper was read by Lord Stanley of Alderley, chairman of the Anglesea Education Committee, and late chairman of the London School Board, on "The Point of View of the Local Authorities." The debate was opened by Mr. S. J. Hughes, county alderman of Glamorganshire. Both Lord Stanley and Alderman Hughes emphasised the paramount importance of training for the elementary school teacher. In summing up the debate, Mr. Lloyd George replaced the sword by the trowel, and emphasised the need for additional accommodation and for subsidising the buildings and the staffs. Enthusiasm was required, he said, to meet the increased burden on the rates, but he believed that the enthusiasm would be forthcoming. At this stage the only resolution of the conference was passed. This was moved by Principal Griffiths, and asserted "That it is the duty of the Principality to undertake the training and supply of teachers sufficient to meet the requirements of the Principality."

At the third session, which was presided over by Sir John Gorst, "The Special Aspects of the Problem of the Training of Elementary Teachers" was considered, a paper being read by Mr. T. John, vice-president of the National Union of Teachers. The experiments already being tried in the utilisation of the intermediate schools of Wales for the training of pupil teachers were described in detail, but the general opinion of the conference was unmistakable—that any half-time system should be a temporary expedient only.

As regards the question of the concurrent instruction of primary and secondary teachers, it was agreed that it is necessary for the separation of the primary teacher's professional training from his general education, and that under certain conditions it is possible and desirable that primary and secondary students should be trained together. The important question of the further training of those acting teachers whose qualifications are incomplete was introduced by Mr. Badger, director of higher education for Monmouthshire.

The relations between the various qualifying examinations were considered, and there was practical unanimity that matriculation should be a condition of entering the primary training departments of the three university colleges of Wales.

Mr. Humphreys Owen, M.P., chairman of the Central Welsh Board, presided over the fourth session, which was devoted to the "Special Aspects of the Problem of Secondary Training." Two papers were read, by Miss E. P. Hughes, late principal of the Cambridge Training College for Secondary Teachers, and Mr. Trevor Owen, Swansea, who acted as the official spokesman of the Association of Welsh County Schoolmasters. The conference was decidedly of opinion that secondary training should be post-graduate and completely differentiated from the degree course, but that the training college should be essentially attached to the university college. Representatives of the Association of Assistant Masters also addressed the conference and endorsed the views expressed by the readers of the papers.

There can be no doubt that the ultimate result of the conference will be far-reaching and beneficial. The interchange of ideas always makes for good, and it is not too much to hope that from the deliberations there may be devised a scheme which will be workable for all parts of the Principality, and will in time produce a supply of fully trained teachers of all grades, which, like her system of secondary education already established, will be a lasting and tangible proof of the enthusiasm of the Welsh people for education.

THERAPEUTIC BACTERIAL INOCULATION.[1]

ALTHOUGH the majority of diseases are produced directly or indirectly by the invasion of microbes, it has come to be generally recognised that the soil in which they grow plays a cardinal part in determining the ultimate effect or fate of the microbe. The finding of a pathogenic microbe, and even the accessory disposing factors of a disease, are, however, after all only the beginnings of the greater problem which is the end and aim of all medical science, viz. the cure of the disease.

To attack the causal agent is manifestly a solution of the problem, and this was the method originally advocated by Lister, who may be regarded as the founder of the doctrine of the ætiological curative principle. Experience has, however, shown that the attempt to destroy by means of ordinary chemical poisons the microbes in the living body is fraught with danger, for long before the protoplasm of the microbe is destroyed the cells of the body are irreparably damaged. Internal antiseptic therapy is a thing of the past. To-day we must rely on the stimulus produced by bacteria in the body whereby the cells of the latter elaborate substances which are antagonistic to these same bacteria. These substances—germicidal in the widest sense of the word—differ considerably in their mode of action. Some neutralise the bacterial poisons, others produce a solution—a lysis—of the bacteria. In other cases, again, Metchnikoff claims that the destruction takes place by a kind of digestion in the interior of certain cells of which the chief representatives are the wandering corpuscles of the blood.

The inoculation of a living microbe for the purposes of prophylaxis dates from the time of Edward Jenner, whose work was widely extended by Pasteur. It is not even necessary to use living bacteria, dead bacteria being likewise capable of conferring immunity. In any case, with the exception of diphtheria antitoxin, previous attempts have aimed at prevention rather than cure. The authors of the papers before us are the first who have utilised bacterial inoculations as a curative agent. Dr. A. E. Wright, late professor in the Army Medical School, is already widely known for his method of the preventive inoculation against typhoid fever—a method which is admitted to have led to a marked diminution of this disease in the British Army. His most important work, however, has been the discovery of therapeutic inoculation. To introduce bacteria into an individual already infected with the same bacteria would at first sight appear to be a paradox, but the results obtained justify the means. By the invention of accurate methods of testing the effects produced in the body by the inoculations, Dr. Wright has been able to demonstrate that the elaboration of protective substances follows a general law, characterised at first by a negative phase and followed by a positive phase in which the protective substances in the blood are increased in quantity.

In a series of papers he has likewise shown that in so-called phagocytosis there is really a cooperation of the cells and fluids of the body, and that in the latter there are substances—opsonins—which in some way or other act upon the microbes and prepare them for subsequent destruction by the leucocytes. This opsonic type of immunity is applicable to a number of diseases, but the present researches show that the mere presence of these opsonins is not sufficient to induce immunity. They must be in the proper place and at the required time if they are to exert their action, and a great deal of art is required on the part of the inoculator to create the most advantageous conditions for his patient. The methods advocated by Prof. Wright are so new that it is difficult to foresee how far they may go, but the striking curative results obtained justify one in prophesying that the time is not so very far distant when the abilities of the physician will be judged by his successes as an immunisator, for it must not be imagined that

[1] "On the Action exerted upon the *Staphylococcus pyogenes* by the Human Blood Fluids, and on the Elaboration of Protective Elements in the Human Organism in response to Inoculations of a Staphylococcus Vaccine." By Dr. A. E. Wright and Capt. Stewart R. Douglas, I.M.S. (*Proc.* Roy. Soc., September, 1904).

"On the Action exerted upon the Tubercle Bacillus by the Human Blood Fluids, and on the Elaboration of Protective Elements in the Human Organism in response to Inoculations of a Tubercle Vaccine." By the same Authors (*Proc.* Roy. Soc., September, 1904).

immunisation consists in the subcutaneous inoculation of some mysterious bacterial fluid prepared in the laboratory. On the contrary, it is a complex process, and it is only with the help of accurate scientific measuring methods that the physician will be able to gauge whether he is helping or injuring his patient. B.

PALÆOZOIC SEED PLANTS.

IT may be doubted if those who are not directly concerned with the study of the vegetable kingdom appreciate the full significance of the distinction which the botanist maintains between plants of seed-bearing and spore-bearing habit. For this reason the recent and important discoveries proving that the seed-bearing habit existed among more than one group of Palæozoic vegetation, discoveries which will form a historical landmark in the study of fossil plants, may not attract the attention which is their due outside the circle of workers on recent and fossil botany.

The seed-bearing habit is, from many points of view, regarded as a far higher stage in plant evolution than that attained by any known member of the vegetable kingdom in which the fertilised megasporangium remains without any integument of the nature of a seed-coat. So far, the botanist has associated the seed habit with two classes of plants, the gymnosperms (Coniferæ, Cycadeæ, &c.) and the angiosperms or flowering plants, and with these alone. It has not been suspected that members assigned to other groups, including the great race of vascular cryptogams (Pteridophyta), had at any period in their evolution attained to this high status. Yet such has recently been shown to be the case.

It is interesting to notice that these discoveries have been mainly due to the British school of palæobotany. Although it has been known for a long period that remains, obviously of the nature of seeds, occur here and there in the sandstones and shales of the Carboniferous period, Carruthers was the first to suggest, in 1872, that some of these fossil seeds may be attributed to the genus Cordaites, an extinct race, of gymnospermous affinities. This conclusion was subsequently confirmed by Geinitz, Grand'Eury, Renault, and other Continental botanists, who have greatly extended our knowledge of this Palæozoic type.

Until recently Cordaites has remained the solitary Palæozoic genus which was known to have attained the seed-bearing habit.

In 1901, however, Dr. Scott published a full description of a Carboniferous cone, Lepidocarpon, of undoubted lycopodian affinities, where integumented megasporangia are found when fully mature, and in which each sporangium contains a single embryo-sac. It has thus become clear that in the history of the lycopodian stock the evolution of seed-bearing members had taken place. More recently other evidence has accumulated which not only confirms this conclusion, but tends to show that Lepidocarpon did not stand alone among lycopods in this respect.

It is to discoveries still more recent of a similar nature, but affecting other lines of descent, that special attention may be directed. They are concerned with a synthetic type of Upper Palæozoic vegetation of great interest, which has become widely known under the name Cycadofilices. More than one genus of this group has now been shown to have reached the seed-bearing status.

The credit of the first discovery of this nature is due to Prof. Oliver and Dr. Scott, who recently published a full account of the seed and the evidence for its attribution in the *Philosophical Transactions* of the Royal Society. The more important conclusion of these authors may be briefly summarised as follows. It has been found that a seed, already recorded by Williamson as *Lagenostoma Lomaxi,* was borne by the fossil plant known as Lyginodendron. The two have not been found in continuity, but the evidence for this conclusion, although in the main indirect, is none the less conclusive. The chief point lies in the identity of the glandular structures found on an organ termed the "cupule," which envelops the seed, with those already known to occur on the stems, petioles and pinnules of Lyginodendron, which are peculiar to this genus among Carboniferous plants.

Within a few months of the earlier record of this remarkable research by Prof. Oliver and Dr. Scott, their main conclusion was confirmed in an unexpected manner by the discovery, on the part of Mr. Kidston, of the seed of another genus of the same group, Medullosa, of which an account has also appeared in the *Philosophical Transactions.* In this case the pedicel of a large seed, of the type known as Rhabdocarpus, was found to bear pinnules identical with those of the frond *Neuropteris heterophylla,* the foliage of a Medullosa.

Here absolute continuity, an extremely rare circumstance among fossil plants, exists between a foliar and a reproductive organ.

Further evidence, but more inconclusive and indirect, also exists, but space forbids any notice here. Attention may, however, be directed to an interesting and suggestive communication published by M. Grand'Eury in the *Comptes rendus* during the present year on the same subject.

The discoveries under discussion have made it clear that at least two genera of the Cycadofilices possessed the seed-bearing habit, and evidence is also available which suggests that Lyginodendron and Medullosa did not stand alone in this respect.

Prof. Oliver and Dr. Scott have concluded that "the presence in the Palæozoic flora of these primitive, Fern-like Spermophytes, so important as a phase in the history of evolution, may best be recognised by the foundation of a distinct class which may suitably be named Pteridospermeæ." This suggestion would seem to be a happy one, even though it may eventually involve the absorption of the whole group now familiar as the Cycadofilices.

In connection with these researches of Prof. Oliver, Dr. Scott, and Mr. Kidston, many further points of interest, and in some cases of criticism, might be discussed, but it must suffice here to direct attention to one or two valuable clues which these discoveries afford. The phylogeny of the cycads, a race with a great past, and still existing though in greatly diminished numbers, is in its main outlines now clear. There can be little doubt that the cycads are sprung from this same pteridospermous stock, which in its turn originated from a truly fern-like ancestor.

In the investing envelope of the young seed of Lagenostoma, which Prof. Oliver and Dr. Scott have spoken of as the "cupule," it is not improbable that homologies may eventually be recognised with protective structures existing among members belonging to other lines of descent, which may have great value as a contribution to other phylogenetic problems.

In conclusion, the existence of the seed-bearing habit among certain members of three out of the six great groups of Upper Palæozoic times raises the interesting speculation whether other groups may not eventually be found to have attained to the same status. The Calamites, the representatives of the Equisetales, are at present above any real suspicion in this respect, yet it would now be hardly surprising if further discoveries revealed the existence of seed-bearing members in this group, although it is by no means safe to assume that the seed-bearing habit must necessarily have existed in any group. E. A. N. ARBER.

ANTHROPOLOGICAL NOTES.

THE *Reliquary and Illustrated Archaeologist* for October contains, as is usual with this journal, interesting and well illustrated articles, among which may be noted one on "the funambulist," or rope-walker, by Mr. Arthur Watson; some Norman and pre-Norman remains in the Dove-Dale district, by Mr. G. le Blanc Smith; medallic portraits of Christ in the sixteenth century, by Mr. G. F. Hill; a carved bone of the Viking age, by Mr. J. Romilly Allen.

All who are interested in primitive technology will welcome the new instalment of Dr. Walter E. Roth's monograph on North Queensland ethnography. *Bulletin* No. 7 deals with domestic implements, arts, and manufactures, and is illustrated by twenty-six plates containing 250 figures. Dr. Roth not only describes the objects in daily use of the Queensland blacks, but, what is of very much greater importance, he usually describes how and of what they are made. Of especial interest and importance is his description of the manufacture of stone implements. He says:—

"I am afraid that too much importance has been hitherto attached to the differentiation of stone-celts into axes, adzes, wedges, scrapers, &c.: the savage certainly does not recognise the fine distinctions embodied on the labels attached to these articles in an ethnological museum. . . . The actual manufacture of a celt is now a lost art in Queensland. . . . The original celt in its simplest form is a water-worn pebble or boulder, an adaptation of a natural form; otherwise, it is a portion removed from a rock, &c., *in situ*, either by fire, indiscriminate breakage or flaking."

A record of a careful excavation of Jacob's Cavern, McDonald County, Missouri, by Messrs. Charles Peabody and W. K. Moorehead, is given in *Bulletin* i., department of archæology, Phillips Academy, Andover, Mass. The implements are of well known types, and nothing suggestive of Palæolithic culture was discovered; it is possible that the cave-dwellers were different from the Osages and from the lower Mississippi tribes. The paper is illustrated by eleven plates. The Phillips Academy is to be congratulated on its activity.

An interesting and well illustrated *résumé* of the recent archæological discoveries in Crete is given by M. S. Reinach in *l'Anthropologie* (Tome xv., Nos. 3–4, p. 257). The author tentatively proposes the following chronology of the development of the Cretan civilisation:—(1) 4500 (at least) to 2800, Neolithic period. Black pottery, with angular designs and no spirals; numerous stone vessels; no metal; rudimentary figurines of burnt clay. (2) 2800 to 2200, period of Kamares or Minoan I. About 2800 first certain contact with Egypt (twelfth dynasty); introduction of copper and bronze into Crete; painted pottery derived from Neolithic pottery. (3) 2200 to 1900, period of transition or Minoan II. Building of first palace. Continuation of relations with Egypt and commercial dealings with the islands of the Archipelago, notably with Melos. (4) 1900 to 1500, culmination of the period of Kamares or Minoan III. Building of the second palace; great development of ceramics, glyptics, and painting. An artist of Knossos went to Phylakopi, in Melos, and executed the "flying-fish fresco"; the linear Cretan writing occurs on Melian pottery. An insular confederation (?) took possession of Knossos and there established a new dynasty (?). (5) 1500 to 1200, Mycenæan period. Ceramics with zoomorphic and curvilinear designs. The centre of civilisation passed to the Peloponnesos; decadence and abandonment of the palace. The last king of the Minoan dynasty, Idomeneus, left Crete about 1200 for Italy, and founded Salentium; shortly afterwards the Dorians conquered Crete, and the island entirely retrogressed into barbarity.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The report of the studies and examinations syndicate on the previous examination, in which it is proposed that a modern language may be substituted for Greek or Latin, will be discussed in the Senate House on December 1.

Dr. H. F. Baker, F.R.S., St. John's, and Mr. F. H. Neville, F.R.S., Sidney, have been appointed members of the general board of studies. Prof. J. J. Thomson, F.R.S., has been appointed a manager of the Gerstenberg studentship in moral philosophy for students of natural science.

Dr. Myers has been appointed demonstrator of experimental psychology.

The Isaac Newton studentship in astronomical physics and optics, value 200*l*. a year for three years, will be vacant next term. Candidates must be B.A.'s of the university, and under twenty-five years of age on January 1, 1905. Application is to be made to the Vice-Chancellor before January 26.

Additional benefactions to the university, amounting to some 3500*l*., have been paid or promised since February of the present year. A considerable number are ear-marked for the endowment of a Huddersfield lectureship in special pathology.

Two Walsingham medals in biology have been awarded this year, one to Mr. R. P. Gregory, fellow of St. John's College (for botany), and one to Mr. K. Lucas, fellow of Trinity College (for physiology).

NEW buildings of the Borough Polytechnic Institute, including buildings for engineering, building trades, domestic economy, &c., are to be opened as we go to press by Mr. J. W. Benn, M.P., chairman of the London County Council.

LORD REAY will deliver the prizes at the Northampton Institute for the session 1903–4 on Friday, December 9, at 8 o'clock. The prize distribution will be followed by a conversazione, which will be continued on Saturday, December 10.

DR. FREDERIC ROSE, His Majesty's Consul at Stuttgart, and the author of a series of diplomatic and consular reports on technical instruction in Germany, has been elected assistant educational adviser to the Education Committee of the London County Council.

THE committee in charge of the fund for the development and better equipment of the science schools in Trinity College, Dublin, has announced that 15,886*l*. has now been subscribed towards the 78,000*l*. necessary for the annual up-keep of the new schools. It will be remembered that Lord Iveagh offered to provide the sum of 34,000*l*. required to erect the new buildings if the amount required for up-keep were obtained by public subscription. The committee, in making an earnest appeal for further subscriptions, points out that the next most urgent need of the university is the development of the school of botany and plant physiology.

IT may be taken as indicative of the widespread interest in higher education among the Welsh people that large sums of money are contributed in a great number of small amounts towards the expenses of the university colleges. For instance, in the preliminary list of subscriptions, paid or unpaid, towards the permanent buildings fund, published in the calendar of the University College of North Wales for the session 1904–5, we notice that more than 6500*l*. is made up of amounts under five pounds, and, in addition to this, there are more than two hundred gifts of five guineas or five pounds. The total amount of subscriptions up to the present towards the permanent buildings fund reaches 27,190*l*.

THE Education Committee of the County Council of the West Riding of Yorkshire arranged last summer for the attendance of a group of art-masters from the schools in their administrative area to attend for six weeks at the School of Industrial Arts, Geneva. The committee has now published extracts from the report received from the administrator of the Geneva school on the work of the Yorkshire teachers, and a summary of the reports submitted by the art-masters who studied at Geneva. The teachers seem to have benefited greatly by their visit, and there can be little doubt that a first-hand acquaintance with Continental methods is of great value to English teachers. One interesting way in which scientific observation may be rendered useful in art instruction comes out in the report of one of the visiting masters, who writes of the Geneva School of Industrial Arts that: "Another very useful adjunct is a garden where Nature is allowed to have very much of her own way. Here the form and colour of plants and flowers and their growth at various stages can be carefully and leisurely studied."

SPEAKING at the Birmingham Municipal School on Tuesday, Mr. Alfred Mosely referred to some lessons taught by the American educational system. He remarked that America differs from us in an intense belief in education, and the realisation by manufacturers of the value of the thoroughly trained college student in their factories. We are face to face with a condition of things which is somewhat alarming. A scientific education has become an absolute necessity if we are to hold our place industrially. We have an Empire such as those who have not travelled do not realise, an Empire teeming with natural resources in every direction, merely awaiting the skilled hands of the mechanic and farmer to develop them. What we have in Canada and our other colonies makes the United States pale by comparison, but the United States have learnt to develop their resources, while we have been quarrelling over the village pump. It is Mr. Mosely's intention at an early date to approach some of the steamship companies to see whether facilities can be arranged for some school teachers to visit the United States and observe what is done there.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, November 3.—Prof. W. A. Tilden, F.R.S., in the chair.—The following papers were read:—Studies on the dynamic isomerism of α- and β-crotonic acids, part i.: R. S. **Morrell** and E. K. **Hanson**. Preliminary experiments on the freezing points of mixtures of the two acids furnish no evidence as to the existence of a compound of α- and β-crotonic acids between 100° and 168°, and between 15° and 71°·9.—The constitution of nitrogen iodide: O. **Silberrad**. In the interaction of zinc ethyl with nitrogen iodide it was found that trimethylamine was produced. This confirms Chattaway's view that the iodide has the constitution $NH_3:NI_3$.—The available plant food in soils: H. **Ingle**. Extraction with a 1 per cent. solution of citric acid for seven days renders a soil much less fertile, especially at first, but chemical changes in such soil, during the growth of the plants, gradually render it again capable of supplying plant food.—The basic properties of oxygen: compounds of the ethers with nitric acid: J. B. **Cohen** and J. **Gatecliff**. It is shown that with aliphatic ethers unstable compounds of the type X_2O,HNO_3 are formed.—Note on the influence of potassium persulphate on the estimation of hydrogen peroxide: J. A. N. **Friend**. It is shown that a secondary reaction, represented by the following equation,

$$H_2O_2+K_2S_2O_8=K_2SO_4+H_2SO_4+O_2,$$

probably takes place in addition to the main reaction.—The influence of sunlight on the dissolution of gold in aqueous potassium cyanide: W. A. **Caldecott**.—The fractional hydrolysis of amygdalinic acid, *iso*-amygdalin: H. D. **Dakin**.—The effect of anhydrides on organo-magnesium bromides, part i., the action of phthalic anhydride on magnesium α-naphthyl bromide: S. S. **Pickles** and C. **Weizmann**.—The combustion of ethylene: W. A. **Bone** and R. V. **Wheeler**. The principal results of these experiments are as follows:—(1) there is no preferential combustion of either carbon or hydrogen; (2) formaldehyde is the most prominent intermediate oxidation product; (3) there is no separation of carbon or liberation of acetylene.—The decomposition of methylcarbamide: C. E. **Fawsitt**. The decomposition of methylcarbamide by acids is due to a transformation of the methylcarbamide into methylamine cyanate, which is subsequently decomposed by the acid.—Position isomerism and optical activity; the methyl and ethyl esters of di-*o*-, -*m*-, and -*p*-nitrobenzoyltartaric acids: P. F. **Frankland** and J. **Harger**. The authors describe the preparation and properties of the six esters in question.—The action of nitrogen sulphide on organic substances, part ii.: F. E. **Francis** and O. C. M. **Davis**.—Reduction products of $\alpha\beta$-dimethylanhydracetonebenzil, and condensation products of benzaldehydes with ketones: F. R. **Japp** and W. **Maitland**.—Interaction of sodium phenylglycidate with phenylhydrazine: F. R. **Japp** and W. **Maitland**.—α-Benzoyl-β-trimethacetylstyrene: F. R. **Japp** and W. **Maitland**.—Olefinic ketonic compounds: S. **Ruhemann**.—Δ^α-Oleic acid: H. R. **Le Sueur**.—Action of magnesium alkyl halides on derivatives of camphor: M. O. **Forster**.—Sulphonchloroalkylamides: F. D. **Chattaway**.

Linnean Society, November 3.—Prof. W. A. Herdman, F.R.S., president, in the chair.—Mr. G. Claridge **Druce** showed specimens of a new British grass, *Koeleria valesiaca*, Gaud., which he had found in the herbarium of Dillenius at Oxford, and recently re-found in the original locality at Brent Down, Somersetshire.—The Rev. John **Gerard**, S.J., brought specimens of a proliferous plantain (*Plantago major*) from the neighbourhood of Clitheroe, Lancashire.—Mr. Frank **Crisp** brought for exhibition a flower of *Schubertia graveolens*, Lindl., an asclepiad, which, deprived of its corolla and with a portion of its calyx cut away, viewed from the side, presented the genitalia in the shape of a skull.—A note on some points in the structure of the gill of the Ceylon pearl-oyster: the **President**.—Notes on the "sudd" formation of the Upper Nile: A. F. **Broun**. The author gives a list of the plants forming the mass of vegetation, which, favoured by the silt brought down by the White Nile, helps to block the shallow channels.—Bryozoa from near Cape Horn: A. W. **Waters**. The paper deals with specimens which were collected by the French "Mission scientifique du Cap Horn," but were not mentioned by Jullien in his report on the "Bryozoaires" of that expedition, published in 1888. From this material, which Jullien had presumably not handled, Mr. Waters adds twenty-eight species to the original list of fifty-six. He gives further particulars in regard to some of those named by his predecessor, and points out that eight species established by Jullien had been already described under other names. He rectifies two erroneous identifications, enlarges the range of distribution for several species, and for six of them calls to mind that they were first discovered by the *Challenger*.

Mathematical Society, November 10.—Prof. H. Lamb, president, in the chair.—The council and officers for the ensuing session were elected. They are as follows:—president, Prof. Forsyth; vice-presidents, Prof. Burnside, Prof. Elliott, Prof. Lamb; treasurer, Prof. Larmor; secretaries, Prof. Love and Mr. Grace; other members of council, Mr. Berry, Mr. Campbell, Dr. Glaisher, Dr. Hobson, Major MacMahon, Mr. Mathews, Mr. Western, Mr. Whittaker, Mr. A. Young.—Prof. Forsyth having taken the chair, Prof. **Lamb** delivered an address on deep-water waves. He reviewed the theory of the waves produced on deep water by a local disturbance of the surface. The theory developed independently by Poisson and Cauchy had often been regarded as obscure, and it had never been interpreted completely. The problem has a deeper significance in that it offers perhaps the simplest example of the propagation of waves in a dispersive medium, and was the origin of the theory of group velocity, which has so many applications in various branches of physics. After tracing the history of the problem, the author proceeded to disengage the essential results of the theory from the clouds of analysis in which they had been involved; he pointed out the connection of the analytical results with the analysis which was used at a later date for the investigation of the phenomena of diffraction; he traced the forms of the waves due to a local initial elevation both at considerable and at small distances from the source of disturbance; and he pointed out the significance of the results when interpreted by means of modern notions concerning waves of approximately simple harmonic type and the propagation of groups of such waves. Finally, he discussed the solution of the problem of waves generated by a local and periodic variation of pressure.—The following papers were communicated:—Note on the application of the method of images to problems of vibrations: Prof. **Volterra**. It is shown how to obtain by means of the method of images a complete solution of the problem of vibrations of a membrane, and it is pointed out that although the train of images may be infinite, yet the number of terms in the solution is finite.—The zeros of certain classes of integral Taylor's series, two papers: G. H. **Hardy**. The nature of the zeros of some particular classes of functions, allied to the exponential function, is determined with much greater precision than can be attained by any of the known general theorems. If $\phi(n)$ is an integer when n is an integer, and the increase of $\phi(n)$ is regular and sufficiently rapid, there are exactly $\phi(n)$ zeros of $\Sigma\frac{x^{\phi(n)}}{\phi(n)!}$ within the circle $|x|=\phi(n)$, and their positions can be determined very precisely. In the second paper similar investigations are given for other functions of which $\Sigma\frac{x^n}{(np+1)^{\alpha n}!}$ is an example.—On the reducibility of covariants of binary quantics of infinite order: P. W. **Wood**. The paper contains the conditions that any covariant linear in the coefficients of each of δ binary quantics of infinite order should be expressible in terms of products of covariants of lower total degrees. The reducibility of covariants of degree 4 is determined completely, and certain classes of reducible covariants of degree δ and weight $\geqslant(2^{\delta-1}-1)$ are discussed.—The linear difference equation of the first order: Rev. E. W. **Barnes**. The questions to be considered relate to the existence of solutions, their analytical expression, and their place among transcendental functions. These questions are discussed from the point of view of the theory of functions of complex variables, the arguments of the functions which occur in the difference equations being assumed to be complex.—Curves on a conicoid: H. **Hilton**.—Remarks on alternants and continuous groups: Dr. H. F. **Baker**.—Expansions of the elliptic and Zeta functions of $\frac{2}{3}K$ in powers of q: Dr. J. W. L. **Glaisher.**—Examples of perpetuants: J. E. **Wright.**—Two simple results in the attraction of uniform wires obtained by quaternions: Prof. **Genese.**—A theorem relating to quotient groups: Prof. **Miller.**—On certain classes of syzygies: A. **Young.**

CAMBRIDGE.

Philosophical Society, October 31.—Annual general meeting, Dr. Baker, president, in the chair.—Prof. Marshall Ward, F.R.S., was elected president for the session 1904–5. —On the dimorphism of the English species of Nummulites: J. J. **Lister,** F.R.S. The author gave an account of his examination of the characters of three English species of Nummulites, *N. laevigata* (Brug.), *N. variolaria* (Lam.), and *N. elegans* (Sow.), with respect to dimorphism. It appears that these species, far from invalidating the conclusion that the species of Nummulites are dimorphic, are in complete accord with it.—A problem concerning wood and lignified cell-walls: Prof. Marshall **Ward,** F.R.S. Dr. W. J. Russell some time ago showed that if a block of wood is laid on a photographic plate, and kept in the dark for some time, a photographic image will be found on the plate after ordinary development, although no light has had access; and he has summarised his numerous and important observations in a recent paper in the *Philosophical Transactions.* Since resinous woods were found especially active, Russell suggested that some active body of resin-like nature was the agent concerned, and that hydrogen peroxide was developed. Prof. Marshall Ward's paper describes experiments which were directed to the questions, (1) can this photographic contact-method be utilised to obtain images of thin and microscopic sections of wood? and (2) what other substances, *e.g.* in woods devoid of resin, are active? The author showed photographs, obtained without light, of thin sections of many different kinds of wood, and demonstrated that in most cases resin and allied bodies cannot be the active agents. He also showed that a thin section which gives a very faint image, or even no recognisable image at all, if used dry and untouched, may give a very deep one if soaked in a weak solution of tannin, gallic acid, pyrogallol, &c., and then dried before being placed on the plate. A striking result is obtained if such solution is streaked across the section; the treated streak or figure comes out deep black on a pale ground-work of the part untreated. Xylol, clove oil, tannic acid, and some other bodies are also active. The author thinks that a careful comparative investigation of all kinds of woods might lead to important results regarding that very difficult question, the constitution of lignified cell-walls.—The pine-apple gall of the spruce: note on the early stages of its development: E. R. **Burdon.** The galls are caused by certain Aphidæ belonging to the genus Chermes. The insect drives its proboscis into the bud, and sets up an irritation which results in the young shoot becoming modified into a gall. The early stages of the gall take place whilst the shoot is still enclosed in the winter bud scales. The cells are forced into precocious growth, and a parenchymatous tissue, consisting of swollen cells with vacuolated protoplasm and enlarged nuclei, is formed. The chlorophyll, tannin, resin, resin canals, and secretory cells all disappear, but an abundant supply of starch is laid down which may possibly arise as the ultimate product of the disintegration of the tannin. The chromatin network of the nuclei becomes aggregated into wart-like nucleoli. The mitotic figures appear to be of the usual somatic type, and no indication of heterotypical mitoses has yet been found. There is reason for believing that the ultimate cause is an injection by the insect, and that this injection will cause a gall growth only when it acts on embryonic tissues which are not confined by other lignified or cuticularised tissues.—On certain quintic surfaces which admit of integrals of the first kind of total differentials: A. **Berry.**

MANCHESTER.

Literary and Philosophical Society, November 1.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—On alkaline borates: C. H. **Burgess** and A. **Holt,** jun. The authors found that nearly all the glasses obtained by fusing boric anhydride with varying quantities of sodium carbonate could be transformed, wholly or in part, into stable, crystalline forms, which invariably melt at a higher temperature than the glasses from which they were derived. The study of the melting points of these mixtures, and the analyses of the crystals and glasses, point to the probable existence of both sodium metaborate and a further compound containing only a quarter equivalent of sodium. Anhydrous borax itself does not appear to be a definite compound; it is almost a eutectic mixture of the solid solution of the two above mentioned compounds. The glasses appear to be a superfused state of the crystals. The familiar colours of borax beads seem to be due to the formation of a complex sodium ion, and can be changed in tint by increasing or decreasing the amount of alkali present.—Note on the electrolytic preparation of titanous sulphate: W. H. **Evans.** The results show that a low current density, high concentration, and a temperature of about 70° C. are the most favourable for obtaining an efficient yield in this reduction process. Moreover, the author has found that the preparation can be carried out without the use of any diaphragm to separate the anode from kathode chambers of the cell.

DUBLIN.

Royal Irish Academy, November 14.—Prof. R. Atkinson, president, in the chair.—On the discovery of hyæna, mammoth, and other extinct Mammalia in a Carboniferous cavern in the county of Cork: R. J. **Ussher.** After recapitulating the work that has been done in Irish caves, Mr. Ussher described an extensive cavern in county Cork, near Doneraile, in every portion of which that he has examined remains of extinct Mammalia have been found. Mammoths, old and young, have been met with in several places; bears and reindeer were abundant; Irish elk, wolf, and hyæna were also found; the last, identified by Dr. Scharff from a portion of a skull with teeth, is an addition to the Irish fauna. These remains were in red sand beneath a floor of crystalline stalagmite, which was present in the various chambers and galleries.

PARIS.

Academy of Sciences, November 7.—M. Mascart in the chair.—Researches on the desiccation of plants and vegetable tissues: final equilibrium, under average atmospheric conditions: M. **Berthelot.** The rate of loss of moisture is proportional at any instant to the quantity of water remaining in the plant. A further amount of moisture is driven off at 110° C.—On the absolute desiccation of plants and vegetable materials: period of artificial desiccation. Reversibility by atmospheric moisture: M. **Berthelot.**—On the preparation in a state of purity of boron trifluoride and silicon tetrafluoride, and on some physical constants of these compounds: Henri **Moissan.** The boron fluoride was prepared in two ways, by heating a mixture of boric anhydride and calcium fluoride with sulphuric acid, and by direct synthesis from boron and fluorine. After purification, the gas was frozen by liquid air, foreign gases pumped off, and the solid allowed to volatilise. The boron fluoride melted at $-127°$ C. and boiled at $-101°$. Silicon fluoride, purified in a similar manner, melts at $-97°$, and passes into the gaseous state without melting. The experiments establish the physical identity of BF_3 and SiF_4 prepared synthetically with the compounds prepared by the ordinary chemical methods.—On the nature of *charriage*: Ed. **Suess.** —Remarks by Michel **Lévy** on the preceding paper.—On a hyperelliptic surface: M. **Traynard.**—On the complementary geodesic triangulations in the higher parts of the French Alps: P. **Helbronner.**—On a new mode of constructing aërial helices: Ch. **Renard.** The helices described are 2·5 m. in diameter, and are perfectly rigid when rotated by power, although their weight is only 3 kilograms. —On explosions in boilers: L. **Lecornu.**—Retrograde diffusion in electrolytes: E. **Bose.** The author points out that the results obtained experimentally by Thovert were predicted by Abegg and Rose on Nernst's theory.—On the estimation of temporary radio-activity for its therapeutic utilisation: Th. **Tommasina.**—The proof of a radio-activity peculiar to living beings, vegetable and animal: Th. **Tommasina.**—The action of low temperatures on colouring matters: Jules **Schmidlin.** An alcoholic solution of rosaniline chlorohydrate shows a clear diminution in the intensity of the red colour, and at the same time developes a fine greenish-yellow fluorescence.—Heats of combustion of triphenylmethyl and some derivatives of triphenylmethane: Jules **Schmidlin.**—The preparation of iodide of gold by the action of iodine on gold: Fernand **Meyer.** The iodide AuI can be obtained by the direct action of iodine upon gold at temperatures between 50° and 100°. Below 50°, or above 200°, there is no action. In the presence of water in a closed vessel iodine gives with gold the same aurous iodide.—On a yttrium earth near to gadolinium: G. **Urbain.** An attempt to isolate an element characterised by the band $\lambda = 488$.—On β-bromobutyric acid: M. **Lespieau.** The amide of this acid is obtained by saturating allyl cyanide with hydrobromic acid in the cold. A crystalline mass separates, which, when dissolved in concentrated hydrobromic acid solution, deposits white crystals of the amide.—The oxidation of acetol: André **Kling.**—On the formation of formaldehyde during the combustion of tobacco: A. **Trillat.** The experimental results show that aldehydes are formed during the combustion of tobacco, notably formaldehydes. The toxic effects, however, are modified by the fact that these aldehydes immediately combine with the nitrogenous bases given off at the same time.—On the germination of the spores of *Atrichum undulatum* and *Hypnum velutinum*, and on their nutrition in sterilised liquid media: Paul **Becquerel.**—On the development of the kidney and Leydig's gland in the Elasmobranchs: I. **Borcea.** The kidney of the Elasmobranchs has the same value as that of the higher vertebrates.—The influence of the feeding on the length of the intestine of the larvæ of *Rana esculenta*: Émile **Yung.**—On an infectious disease of horses, with alterations in the bones, observed at Madagascar: MM. **Charon** and **Thiroux.**—On the general structure of the Tyrolese Alps west of the Brenner Railway: Pierre **Termier.**—Modifications undergone by the nutritive exchanges in skin disease: A. **Desgrez** and J. **Ayrignac.**

NEW SOUTH WALES.

Royal Society, September 7.—Mr. C. O. Burge, president, in the chair.—Notes on the theory and practice of concrete-iron constructions: F. M. **Gummow.** The author outlined the theory from the present standpoint of scientific research, and after reviewing the principal applications, concluded his paper by giving particulars of a test of concrete-iron plate beams, carried out on a large scale.—Further experiments on the strength and elasticity of reinforced concrete: Prof. W. H. **Warren.** The author stated that the paper consisted of an experimental investigation of the physical properties of Portland cement mortars and concrete when reinforced with steel.

Linnean Society, September 28.—Dr. T. Storie Dixson, president, in the chair.—Monograph of the Australian Cicadidæ: Dr. F. W. **Goding** and W. W. **Froggatt.** Descriptions of all the Cicadidæ attributed to Australia, amounting to 115 species, comprised in 21 genera, are given. In connection with the geographical distribution of the species it may be mentioned that though many are strictly confined to the coastal forests of eastern Australia, others are found sporadically over a very large area, reappearing in widely separated districts if the suitable class of country presents itself. For example, *Tibicen willsi*, Dist., described from Rockhampton, ranges up the Queensland coast to Townsville, occurs also at Bourke, N.S.W., and reappears at King's Sound, N.W.A. Indo-Malayan affinity is indicated by the occurrence of the genera Gæana and Huechys.—Notes on Neuroptera, with descriptions of new species: W. W. **Froggatt.**—Ngarrabul and other aboriginal tribes, part ii., distribution of the tribes: J. **MacPherson.** The distribution of twenty-four tribes in north-east New South Wales and South Queensland, in accordance with the languages spoken and as gleaned from Ngarrabul sources of information, is discussed and mapped.—Notes on the native flora of New South Wales, part i., the Tumbarumba and Tumut districts: R. H. **Cambage.** These notes comprise observations on the conspicuous vegetation of the country between Wagga, Tumbarumba, Tumut, and Gundagai during the drought of 1903, and serve to show the striking differences between the flora of the low country round Wagga (600 feet above sea-level) and that of Laurel Hill or Bago, near Tumbarumba (about 3300 feet), where the vegetation presents a recognisable Tasmanian facies.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 17.

ROYAL SOCIETY, at 4.30.—Air Resistance Encountered by Projectiles at Velocities up to 4500 Feet per Second: A. Mallock, F.R.S.—Theory of Amphoteric Electrolytes. Part II.: Prof. J. Walker, F.R.S.—Enhanced Lines of Titanium, Iron, and Chromium in the Fraunhoferic Spectrum: Sir Norman Lockyer, K.C.B., F.R.S., and F. E. Baxandall.—On the Group IV. Lines of Silicium: Sir Norman Lockyer, K.C.B., F.R.S., and F. E. Baxandall.—The Electrical Conductivity and other Properties of Sodium Hydroxide in Aqueous Solution, as Elucidating the Mechanism of Conduction: W. R. Bousfield, K.C., M.P., and Dr. T. Martin Lowry.—On the Wetting of Cotton by Water and by Water Vapour: Prof. D. Orme Masson, F.R.S.

LINNEAN SOCIETY, at 8.—On the Structure of the Stems of Plants: Lord Avebury, F.R.S.—Observations on Undescribed or Little Known Species of Membracidæ: G. B. Buckton, F.R.S.

FRIDAY, NOVEMBER 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Impact Tests on the Wrought Steels of Commerce: A. E. Seaton and A. Jude.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—The Inaugural Address on the Epidemiological Aspects of Industrial Diseases: the President, Dr. Whitelegge, C.B.

TUESDAY, NOVEMBER 22.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Distribution of Electrical Energy: J. F. C. Snell.

WEDNESDAY, NOVEMBER 23.

GEOLOGICAL SOCIETY, at 8.—On an Ossiferous Cavern of Pleistocene Age at Hoe Grange Quarry, Longcliffe, near Brassington, Derbyshire: H. H. Arnold-Bemrose and E. T. Newton, F.R.S.—The Superficial Deposits and Pre-Glacial Valleys of the Northumberland and Durham Coalfield: D. Woolacott.

FARADAY SOCIETY, at 8.—Recent Investigations Bearing on the Theory of Electrolytic Dissociation: Prof. L. Kahlenberg.—The Potential of the Hydrogen-Oxygen Cell: F. J. Brislee.

SOCIETY OF ARTS, at 8.—The Systematic Promotion of British Trade: Ben. H. Morgan.

THURSDAY, NOVEMBER 24.

ROYAL SOCIETY, at 4.30.

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NATURDENKMÄLER.

Die Gefährdung der Naturdenkmäler und Vorschläge zu ihrer Erhaltung. By H. Conwentz. Pp. xii+207. (Berlin: Borntraeger, 1904.) Price 2 marks.

READERS may naturally ask, "What is a Naturdenkmal?" and, since the word is a comparatively new one to the German vocabulary, necessitating its elucidation by the author even for German readers, it may not be out of place if we explain its meaning, as near as possible, in his own words. The usual meaning of "Denkmal" to the German mind suggests a monument or memorial to commemorate some famous personage or victory (for example, Gœthe-Denkmal, Sieges-Denkmal). But in addition to this the title is often applied to outstanding works in science, literature, music, &c. Further, the remains of ancient buildings or works of art of whatever kind which have a historical, technical, or educative value, are spoken of as Bau- and Kunst-Denkmäler. Also the term is applied to prehistoric remains, such as lake-dwellings, burying mounds, urns, tools and weapons of stone or metal; however, the author points out that all those Denkmäler are of artificial origin, that is, the result of man's work and ingenuity. The term Naturdenkmal has a wider application, and includes certain results of nature's handiwork, for example, the elaborately carved stone obelisk is a Denkmal of recent times, and the rough stone-block, erected by the hand of man to commemorate the dead, forms a prehistoric Denkmal; while the Glacial boulder, carried from afar in a former epoch and deposited on the plain by natural forces, forms a Denkmal of nature, or as the artificially built up cairn and rampart wall of a former age may form prehistoric Denkmäler, so the hill and mountain range, formed without man's intervention, are Denkmäler of nature.

Also the whole natural landscape, with its various soil formations, with its water courses and lakes, with its special plant and animal communities, as well as single rare species and individuals of the original flora and fauna, represent "Naturdenkmäler." Although only virgin lands, together with their plants and animals undisturbed by man, should come within the strict sense of the term, still we must here and there allow a certain latitude in its application, because undisturbed localities are scarcely to be found in many of the modern cultured States. For example, any striking feature in the landscape, even if it is a deserted valley or village, must not be struck off the list. Also a natural forest growth which, by self-seeding, has followed the destruction of the original forest by man, must also be reckoned a Naturdenkmal.

On the other hand, artificially planted trees, such as are found in many villages, avenues, and parks, no matter how interesting they may be, cannot be regarded in the strict sense of the term as Naturdenkmäler. In many cases the local conditions must be taken into account in reckoning any natural phenomenon as a Denkmal, for example, a part of the forest which has remained unexploited by man (virgin forest) or the still living representatives of a disappearing species of plant or animal, is universally regarded as a Naturdenkmal; but in other cases, according to the country and locality, we find certain exceptions, for example, in north Germany the traces of glaciers on the rocks are among the greatest rarities, and must, therefore, be regarded as Naturdenkmäler. But on the coast of Scandinavia their occurrence in places is so frequent that there they are no longer Naturdenkmäler. In like manner the Cornel (*Cornus Suecica*) occurs in a few localities in north-west Germany, and in the east it is only found in one place, hence here it is a Naturdenkmal; but in north Russia, Finland, Sweden, &c., its occurrence is frequent over large areas, hence there it is no longer a Naturdenkmal. Similar examples may be given for many other plants and birds. From the foregoing it will be seen that a number of different factors determine whether a natural object can be reckoned a Naturdenkmal or not, and a decision can only be come to by taking the surrounding conditions in each case into account.

The dangers which threaten those natural curiosities and rarities are many, and the author devotes almost one-half of the above memorial to an enumeration of many cases where, through ignorance, indifference, or natural causes, many unique Naturdenkmäler have been considerably damaged, if not entirely destroyed. As an example of the damage which may be done through ignorance or indifference, the author points out the way in which the most beautiful parts of the forests, within reachable distance from Berlin, are often rendered anything but attractive by the traces which trippers and picnic parties so commonly leave behind them. Frequently, also, the most beautiful spots are disfigured by unsuitable and unattractive buildings, principally for the accommodation of visitors. The author also complains that many of the most picturesque hill-tops are disfigured by monuments and towers which are entirely out of harmony with their beautiful, natural surroundings. Then, again, the landscape is subjected to considerable disfiguration by the many devices employed by the advertising agent. Those in high authority are themselves not always free from blame. In one of the German Federated States it was at one time proposed that, in order to preserve the banks and channels of the water-courses, all trees and shrubs should be removed from the sides of brooks and streams. This movement was, however, happily frustrated, otherwise not only the æsthetic features of the landscape would have been entirely destroyed, but also many plant and animal communities would also have disappeared.

The author then brings a long list of charges against tourists and visitors, showing how in many places characteristic plants of the coast and mountains have been almost entirely rooted out. The so-called sportsman, too, is responsible for the wanton destruction of many song-birds in certain parts of the Continent, especially Italy. The author further mentions the extremely regrettable manner in which the reindeer, now confined to Spitsbergen, Nova Zembla, Greenland, Siberia, &c., is systematically hunted and wantonly destroyed in the name of sport. Two cases are mentioned where well educated people in high positions organised expeditions to the native haunts of the reindeer, where in one or two days more than 100 head were killed, and the greater number of them allowed to lie and rot on the ground. The author further gives a long list of birds which are threatened with extinction unless something is done for their preservation. The dangers to which Naturdenkmäler are exposed through the drainage and reclamation of lands, utilisation of water-power, stone-quarries, exploitation of moors for peat, &c., also the dangers of scientific forestry, leading to the disappearance of all the virgin forest, the uprooting of certain plants for commercial purposes, trapping of birds for cages, and collecting by ornithologists, are too numerous to mention in detail.

Around the ever-increasing centres of industry in Germany the pollution of air and water is becoming greater every day, with the result that plant and animal communities, as well as the whole natural landscape, are undergoing a rapid and radical change, which is necessarily accompanied by the disappearance of rare and valuable Naturdenkmäler. The proposals put forward by the author for their preservation occupy the larger part of the book. Generally speaking, they fall into three groups, viz.:—making a record of the various Naturdenkmäler for the different States throughout the Empire; providing for their protection in the various places; and making them generally known. In carrying out these proposals, it is necessary that the Government should take an active part by the passing of certain laws and allowing the active cooperation of different officials in the various departments. Also communities, societies, and private individuals are called upon to lend their aid. The various details in this proposed organisation for the protection of nature's "monuments" seem quite reasonable and eminently practical, but with laudable modesty the author does not insist that they should be accepted in their entirety. He puts them forward more as a working basis, the details of which may be subject to alteration from time to time as experience and trial should suggest. He is, however, confident that the time will come when the "monuments" of nature will receive the same care and reverence as that which has for long been bestowed upon the monuments of early art and civilisation.

PRINCIPLES OF FUEL COMBUSTION.

Smoke Prevention and Fuel Economy. By Wm. H. Booth and John B. C. Kershaw. Pp. 194. (London: Archibald Constable and Co., Ltd., 1904.) Price 6*s.* net.

IN the preface the authors state their object to be the "bringing before the fuel using public the principles of fuel combustion," more especially in relation to the smoke question and the economic use of fuel. They express their belief in the possibility of burning bituminous coal perfectly, and that black smoke is merely so much evidence of improper design. "Both on humanitarian and economic grounds its suppression is called for."

The general principles are clearly stated, and a brief description of selected types of furnace arrangement, stokers, &c., illustrated by good diagrams, makes the whole a useful compilation. It cannot be claimed that any addition has been made to our general knowledge of the subject, for the importance of proper air supply, perfect mixing of the gases and air for combustion, the maintenance of a sufficiently high temperature for unchecked combustion, and other points have long been recognised in books dealing with boiler management. Smoke, in fact, is possibly not so much the result of ignorance as of conservatism and false economy.

The book contains many statements in reference to water-tube boilers which few who have had practical knowledge of their working will altogether agree with. Thus "when moderately worked, some degree of safety, or at least a danger much less than attached to the discarded Howard boiler." Surely the rapid adoption of boilers of this type in the large electric lighting and power stations, engineering works, &c., is a sufficient answer to this.

After a reference to the development and satisfactory working of water-tube boilers with anthracite coals in America, the authors refer to the same boilers being erected in this country to burn bituminous coal, and "being set exactly as in America, the results have been hopelessly bad, *and the present smoke of London is due to this boiler more than anything else*" (p. 19). It cannot be denied that the total sum paid in fines for permitting smoke from steam plant of this type has been fairly large, but does the total number of water-tube boilers in London, many of them giving grand results, bear any large proportion to boilers of the old pattern, in spite of the rapid adoption of the former in recent years? The statement we print in italics is far too sweeping and altogether unjustified.

As the authors point out, in many cases boilers, presumably those in which the tubes are more nearly horizontal than vertical, were often set too near the fire, so that combustion was checked by the chilling action of the tubes; but this certainly does not apply to another type of water-tube boiler in use where the tubes are more nearly vertical than horizontal, for here ample combustion space is provided. Several excellent furnace arrangements are described and illustrated which provide for the maintenance of a high temperature until combustion is complete with these boilers, including the excellent one due to Mr. Miller. Engineers, however, do not seem very favourably disposed to much firebrick in the furnace, for it is not easy to ensure its standing the high temperature for any length of time, and water-tube boiler makers rather fight shy of such arrangements owing to the excessive heating of the lower tiers of tubes.

Closely connected with this question is that of the chain grate. As mentioned by the authors, this practically fell into disuse until the advent of the water-tube boiler resuscitated it, and yet we find the statement "it (the chain grate) must fail under the straight ascending flow of the usual setting of the water-tube boiler." Everything turns on the *usual* setting. There must be a number of unusual settings about, or it is not easy to understand why this grate has been so extensively adopted for these boilers. Certain it is that with no further elaboration of the furnace than a short firebrick arch at the fore-part (illustrated in Fig. 15) they will perform their work very efficiently, and with practically no smoke when using a bituminous coal.

A chapter is devoted to the chemistry of the combustion process. In referring to the hydrogen in fuels, the statement occurs, "it is generally assumed to be present combined with carbon to form hydrocarbons. The most important of these for the fuel user are —methane, ethylene and acetylene." A small amount of at least the first may be present in coal, but are we to assume the authors to mean that these are the important hydrocarbons existing in the coal before it has been heated?

In view of Bone's work (mentioned in a short footnote) it is a pity the authors did not revise their theory to account for the formation of smoke, seeing that the book was not published until a twelvemonth after Bone and Wheeler's paper appeared in the *Journal* of the Chemical Society (August, 1903), and Armstrong's paper in the same number, in which it is definitely stated "neither hydrogen nor carbon being burnt preferentially." J. S. S. B.

SCHOOL MATHEMATICS.

New School Arithmetic. Part ii. By Charles Pendlebury, assisted by F. E. Robinson. Pp. vi+207 to 468+xliv. (London: George Bell and Sons, 1904.) Price 2*s.* 6*d.*

New School Arithmetic. By Charles Pendlebury, assisted by F. E. Robinson. Pp. xvii+468+xliv. (London: George Bell and Sons, 1904.) Price 4*s.* 6*d.*

New School Examples in Arithmetic. By C. Pendlebury, assisted by F. E. Robinson. Pp. xiii+223+xliv. (London: George Bell and Sons, 1904.) Price 3*s.*

A School Geometry. Part vi. By H. S. Hall and F. H. Stevens. Pp. iv+347 to 442+iv. (London: Macmillan and Co., Ltd., 1904.) Price 1*s.* 6*d.*

Theoretical Geometry for Beginners. Part iv. By C. H. Allcock. Pp. 224. (London: Macmillan and Co., Ltd., 1904.) Price 1*s.* 6*d.*

Elementary Plane Geometry. By V. M. Turnbull. Pp. vi+136. (London: Blackie and Son, Ltd., 1904.) Price 2*s.*

Mathematical Problem Papers. By the Rev. E. M. Radford. Pp. vi+203. (Cambridge: University Press, 1904.) Price 4*s.* 6*d.* net.

PART II. of Messrs. Pendlebury and Robinson's "New School Arithmetic" has followed quickly on the publication of part i., and this excellent text-book is now complete. The second part is concerned mainly with the application of arithmetic to the transactions of commerce, dealing with such subjects as interest, discount, commission, stocks and shares, profit and loss, &c. Ratio and proportion find a place, and they are illustrated largely by this class of problem. The authors devote a little space to the training of youths in computations suitable to experimental work in the laboratory. Thus we find that algebraical symbols are freely introduced, and chapters are given on averages, approximations, graphs, elementary mensuration, and logarithms. This portion of the book might well have been extended even at the expense, if necessary, of some of the chapters relating to purely business matters. But the subjects treated are very numerous, affording considerable ground for selection, and many teachers will no doubt, and with advantage, omit some of the technical commercial chapters. At every stage examples are introduced in great abundance, the answers to which extend to nearly fifty pages. The book concludes with a collection of test papers, and a large number of miscellaneous problems. Parts i. and ii. are published separately, and also in one volume. The examples and answers may also be obtained without the other text. Altogether the book is one that deserves, and will no doubt obtain, an extended circulation.

With the issue of part vi. of Messrs. Hall and Stevens's "School Geometry," this popular text-book must now be nearing its completion. The present section corresponds, substantially, with Euclid, Book xi., 1–21, and it further deals with the mensuration of the simpler geometrical solids. In establishing the theorems of pure solid geometry, the authors follow Euclid rather closely, but there are some useful additions. Thus it is shown how a point in space is located by means of rectangular coordinates; but it is not shown how position and form may be exhibited graphically by means of projections. In dealing with areas and volumes, elementary trigonometry is used. The prismoidal formula is also introduced, but its value is scarcely made sufficiently manifest, and it is not shown how to deal approximately with irregularly shaped figures, by means of Simpson's or other rules. The book is printed in very distinct type, and the figures and diagrams are beautifully designed and executed. The subject-matter is presented and developed in the clear and attractive style which is always found in the authors' text-books, and is illustrated by well chosen examples.

Part iv. of Mr. Allcock's "Theoretical Geometry for Beginners" treats, in the first instance, of ratio and proportion, with geometrical applications. The propositions correspond roughly with Euclid, Book vi., but the style of proof is different. The reader is first introduced to the conception of ratio and proportion by means of numerical and algebraical examples, and his knowledge of arithmetic and algebra is drawn upon in establishing some preliminary theorems, which are subsequently used in demonstrating the various theorems. The latter half of the book is devoted to modern geometry, including chapters on harmonic pencils, the complete quadrilateral, poles and polars, centres of similitude, inversion, maxima and minima, and envelopes. Some numerical examples are given at intervals, but, as the title implies, the propositions and the exercises thereon are almost entirely confined to deductive geometry, and from this point of view the treatment is eminently satisfactory. The book is got up and printed in a way that leaves nothing to be desired.

The "Elementary Plane Geometry" by Mr. Turnbull is intended for youths who have already had a course of experimental geometry, and is almost entirely devoted to demonstrative geometry. It is divided into four sections, dealing respectively with triangles and quadrilaterals, circles, areas, and with ratio, proportion, and similar figures. Most of the propositions contained in the volume belong to Euclid, but the author has allowed himself that freedom of treatment that is now happily prevalent. The book shows no conspicuous merits such as would render its general use either likely or desirable.

In the volume by the Rev. E. M. Radford, the author has compiled and arranged a hundred test or examination papers, each containing twelve problems; a large number of the latter are stated to be original, and many are taken by permission from published examination papers. The collection is "intended primarily for the use of candidates for mathematical entrance scholarships at Oxford and Cambridge," and the subjects on which problems are set comprise "pure geometry, algebra, trigonometry, analytical conics, and elementary mechanics," with the addition in the last fifty papers of elementary theory of equations and elementary differential calculus. The book will no doubt prove useful to the class of student for whom it is intended, but the problems show no sign whatever of having been influenced by the reform in the teaching of mathematics which is now in progress. The author hopes shortly to publish a volume of solutions, and this will be very acceptable to teachers who may use the work.

OUR BOOK SHELF.

Handbuch der Laubholzkunde. Charakteristik der in Mitteleuropa heimischen und im Freien angepflanzten angiospermen Gehölz-Arten und Formen mit Ausschluss der Bambuseen und Kakteen. By Camillo Karl Schneider. Erste Lieferung, pp. 160; Zweite Lieferung, pp. 161–304. (Jena: Gustav Fischer, 1904.) Price 4 marks for each Lieferung.

THESE two parts form the commencement of a work intended to render possible the identification of the hardy species of angiospermous trees and shrubs indigenous to, or cultivated in, Central Europe. Such a work invites comparison with Koehne's well known book on the same subject rather than with the more comprehensive descriptive works by Koch and Dippel. From the first named it differs in the vastly greater number of illustrations, and in the fuller details given regarding the characters of buds and twigs. These additional details contained in Schneider's book go far towards removing the uncertainty of diagnosis involved in the provisional identification by means of the dichotomous keys employed throughout the work. The present Lieferungen, dealing with the Salicaceæ, Myricaceæ, Betulaceæ, Fagaceæ, Ulmaceæ, Moraceæ, Urticaceæ, Santalaceæ, Loranthaceæ, Aristolochiaceæ, Polygonaceæ, Chenopodiaceæ, Phytolaccaceæ, Caryophyllaceæ, Trochodendraceæ, Ranunculaceæ, Lardizabalaceæ, and some species of Berberis, nominally include 197 illustrations, but in reality contain quite 2000 figures of buds, twigs, leaves, inflorescences, flowers, fruits, and their parts. In addition, the free use of abbreviations and of small print has rendered possible the condensation into small compass of much information concerning not only diagnostic characters of species, varieties, and forms, but also concerning their nomenclature, distribution, and phenology. To illustrate the method of treatment adopted by the author, *Populus alba* may be selected from the twenty-three species of Populus considered in this work. Three varieties of this tree are sufficiently described as regards their distinctive features; figures are given of resting-buds, twigs and their transverse sections, four forms of leaves, flowers, seed, embryo, and seedling; information is tendered as to the times of flowering, of flushing of the vegetative buds, and of fruiting, also as to the germination, distribution, and age attained by this species; and finally hybrids including this species are noted. In so thorough a work it is exceedingly difficult to avoid making statements not universally applicable, but the solitary one that the reviewer has observed is to the effect that *Carpinus Betulus* has a trunk with a light grey coating of cork. The work may be strongly recommended to all engaged in the study of dicotyledonous woody plants growing in the open in this country.

PERCY GROOM.

The Cancer Problem in a Nutshell. By Robert Bell, M.D. Pp. 39. (London: Baillière, Tindall and Cox, 1904.) Price 1s. net.

DR. BELL in this pamphlet ascribes the development of malignant disease to a withdrawal of some controlling influence exerted by the thyroid gland upon the cells of the body, caused by some toxic state of the blood. He therefore advocates the administration of thyroid gland or of its active principle in the treatment of the disease, and claims to have obtained successful results. Little or no evidence is given in support of these views, and since malignant disease occasionally, though unfortunately rarely, undergoes spontaneous cure, the apparent success of any form of medical treatment has to be carefully controlled before such a result can be admitted. Dr. Bell's suggestions for the prevention of malignant disease may be of some value.

R. T. H.

Photography on Tour. Pp. 132. (London: Published for the *Photogram*, Ltd., by Dawbarn and Ward, Ltd., n.d.) Price 1s. net.

IN these pages, the sizes of which are only $3\frac{3}{4}$ inches by $4\frac{3}{4}$ inches, we have a number of useful hints and instructions which are well worth an amateur's time to read. When the photographer is away from his base, and has to invent all sorts of makeshifts, he may find many a useful wrinkle given here for which he may later be very thankful. The author seems to have brought into a very small compass a great deal of information covering a wide field, and this pocket book for the touring photographer should serve a useful purpose.

The Story without an End. From the German of Carové. By Sarah Austin. Illustrated by Paul Henry. Pp. vii + 77. (London: Duckworth and Co.) Price 1s. 6d. net.

IN this allegory a child is introduced to the beauties of plants, birds, insects, and other forms and aspects of nature. It pleases children to imagine themselves in close communion with inanimate nature, and they have no difficulty in endowing all the objects around them with human attributes. Poetic feelings, and sympathetic interest in plant and animal life, are appealed to by this daintily bound and gracefully illustrated contribution to literature.

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.*]

On the Origin of Flagellate Monads and of Fungus-germs from Minute Masses of Zooglœa.

BACTERIAL scums are exceedingly common in ditches and ponds, nature's laboratories, and it is a matter of much importance to know what goes on therein. Some light may be thrown upon this subject by making infusions or macerations from cut fragments of various plants, and then examining, at different periods, the scum or pellicle that forms on such fluids. What I have now to say will refer almost exclusively to infusions made from hay. The hay employed may be either fresh or old, but it does not do to substitute for hay mere unripe grasses. I have elsewhere shown how remarkably different are the products derivable from living unripe grasses and from ordinary hay.[1]

In making such an infusion I have been accustomed to cut the hay into short pieces, to place these in a little beaker, and then to add water so as well to cover the fragments. After maceration for three or four hours at a temperature of about 86° F. (30° C.), the infusion has been filtered through two or three layers of the finest Swedish filtering paper into another small beaker. In this way all but the smallest particles, 1/12,000 of an inch or thereabout, will be excluded. For observation of the changes now to be described it is best that the bacterial scum, which soon forms on the surface of the fluid, should be very thin, therefore the depth of the fluid ought not to be more than about one and a half inches—though if one is seeking to make out the origin of ciliated Infusoria infusions of greater depth should be employed in order that a fairly thick pellicle may form.

When such an infusion is kept under a bell-jar (to exclude dust) at a temperature of about 65° F. (18° C.), the pale sherry-coloured fluid in less than twenty-four hours becomes lighter in colour and very turbid. Soon a scum, almost invisible, begins to form on the surface, composed of several different kinds of bacteria, and in about thirty-six hours small Zooglœa masses of the most varied sizes and shapes begin to appear therein. In Fig. 1, A, a portion of such a scum is shown as it appeared at the end of the third day on a hay infusion in which the masses of Zooglœa were exceptionally numerous. The portion of this scum here represented had been transferred on the tip of a sterilised scalpel to a drop of a dilute solution of eosin, which stained the surrounding bacteria a pale red tint, but left the Zooglœa masses unstained, so that they were rendered very distinct. Had logwood been used the results would have been reversed—that is, the Zooglœa areas would have been more or less deeply stained, while the surrounding bacteria would have remained unstained.

Examination of one of these masses with a high power will show its constitution, and reveal the fact that we have to do with an aggregation of separate bacteria imbedded in a jelly-like material. This may be seen from Fig. 1, B, which shows a highly magnified portion of one of the Zooglœa masses from the same pellicle after it had been immersed in a drop of a weak solution of Ehrlich's eosinophyle fluid, which stained the surrounding bacteria a yellow tint, while it left the Zooglœa mass unstained. The slightly altered bacteria within the Zooglœa mass are at this early stage plainly to be seen, though later on they become more or less obscured by reason of progressive molecular changes taking place in the mass during its subsequent transformation.

Some of these Zooglœa masses are destined ultimately to be converted into numbers of flagellate Monads or of Amœbæ, while others become resolved into heaps of Fungus-germs. I have found it impossible to tell from the mere microscopical appearance of the Zooglœa masses whether they are destined ultimately to yield Monads or Fungus-germs. The latter transformation is undoubtedly by far the commoner of the two, and when I was working for many months at this subject during 1899 I was unable to find any good specimens, capable of being photographed, showing the conversion of Zooglœa masses into Monads, although I many times saw and photographed Monads originating from the pellicle as discrete motionless corpuscles—especially when the infusions were kept at a temperature of about 72° F. (22° C.).[1] But one day last month, on October 19, desiring to make certain observations, I made a weak infusion from a portion of a small handful of hay gathered in Norway more than two months previously, which had since been kept in a small cardboard box. The infusion was prepared and filtered in the manner already indicated, and divided into two portions: one, which we may name A, being placed in a small open beaker and left beneath a bell-jar at the end of the mantelpiece in my study; while the other (a very small portion), which we may name B, was put into a small half-ounce earthenware pot, over which the cover was placed. The two specimens of the infusion, covered and uncovered, were then left side by side beneath the bell-jar, so that the temperature to which they were exposed might be as nearly as possible similar. Some of the changes in the scums that formed on the surface of these fluids are now to be described.

Origin of Flagellate Monads from Minute Masses of Zoogloea.

A. When examined fifty-one hours after the time of filtration the scum on this infusion was found to be very thickly crowded with small masses of Zooglœa varying much in shape and actual size, as shown in Fig. 1, A.

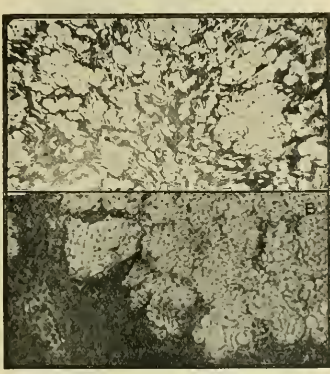

FIG. 1.—A, Zooglœa masses in the scum on a hay infusion (×100); B A portion of one of these masses showing the contained bacteria (×500)

In the course of the fourth day very many of the smallest masses were seen to be undergoing segmentation into small motionless spherical bodies, while multitudes of active flagellate Monads of the same size were for the first time seen in the fluid and in the midst of the portion of the scum under examination. When a similar examination had been made twelve hours previously not a single Monad was seen; now there were swarms of them, and all were of about the same size.

In Fig. 2, A (×500), some of these small masses are shown together with their contained bacteria; B (×375) shows a number of the small masses undergoing segmentation; while C (×700) shows one of these bodies more highly magnified, in which the segmentation into embryo Monads, still in a motionless condition, is almost complete.

In the course of the next day the Monads were found in prodigious numbers. They were spherical or ovoidal in shape, and provided with a single flagellum about twice the length of the body. Under a high power a nucleus could be distinctly seen, generally surrounded by a circle of very minute granules. In addition, two or three larger granules were to be seen—one of them, larger and more highly refractive than the others, being often present in the

[1] "Studies in Heterogenesis," p. 87 (1904).

[1] "Studies in Heterogenesis," pp. 69-73, Figs. 53-55.

posterior half of the body of the organism, and there showing faint oscillations. Numbers of the Monads that were aggregated between three small contiguous air bubbles are shown in Fig. 2, D (×125), as they appeared under a low power of the microscope. Many of them were in active

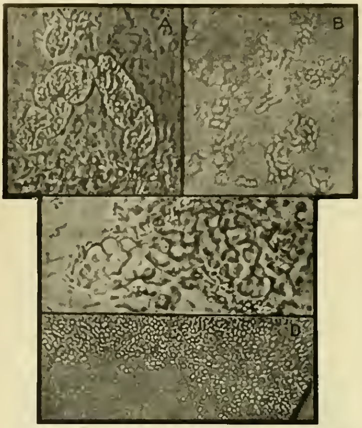

FIG. 2.—A. Small Zooglœa masses from the hay infusion (×500); B, Other of these masses undergoing segmentation (×575); C, One such mass the segmentation of which is nearly complete (×700); D, Monads derived from products of segmentation (×125).

movement and are not shown, but those that were stationary were photographed by a very brief exposure. I found it impossible to photograph these particular Monads under a high power because they were mixed up with active bacteria, and were themselves very delicate in texture. The movements of these bacteria could not be arrested except by a

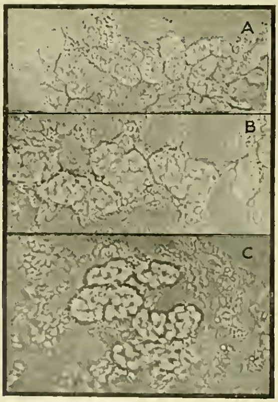

FIG. 3.—A, Portion of pellicle taken from the pot (×500); B, Small Zooglœa masses about to segment (×500); C, Small Zooglœa masses which have undergone complete segmentation (×500).

comparatively strong osmic acid solution, or by exposure to the vapour of a 1 per cent. solution for more than half a minute, and in either case the result was to make the Monads almost invisible, if it did not cause their complete diffluence.

B. The closed pot was not opened until the end of the fifth day, and I then found the surface of the infusion covered with a very thin, scarcely perceptible film of bacteria, which on microscopical examination was seen to be densely crowded with very minute Zooglœa masses such as are shown in Fig. 3, A (×500). Not a single Monad was to be seen, but many of the masses were found to be about to segment as in B, or actually segmenting as in C, into a number of motionless spherical corpuscles.

During six subsequent days I uncovered the pot for a moment to take up on the tip of a sterilised scalpel a portion of the scum for examination, and on each occasion found the minute Zooglœa masses presenting similar characters, except that day by day a rather larger number of them showed evidences of segmentation, though not a single active Monad was to be seen.

The Zooglœa masses formed in the dark, and in a comparatively airless pot, were not only different in character from those formed in the open vessel, but it would seem that their process of change was slower and was in part arrested by the opening of the pot, since after eleven days there was still not a single active Monad to be seen, though in the open vessel swarms of them were found during the fourth day.[1] This arrest of the process of change recalls the similar arrest which was always found to occur when the pot was opened in which Hydatina eggs were being transformed into ciliated Infusoria of the genus Otostoma.[2]

It so happened that on the very day that I first observed the segmentation of the small Zooglœa masses in A I had

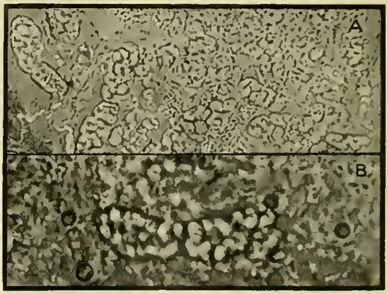

FIG. 4.—A, Minute Zooglœa masses in various stages of change (×500); B One of these masses in which segmentation has been nearly completed (×700).

on my work-table under a bell-jar a small petri dish in which a tuft of dead lichen had been soaking for a few days in distilled water. There was a very thin scum here and there on the surface of this water, and on examining a portion of it I was surprised to find that it also was crowded with small Zooglœa masses, many of which were apparently in different stages of segmentation into Monads, though the majority of them showed no signs of segmentation. Being busy with what seemed at the time to be the more important A infusion, I did not examine this new scum again until after the expiration of two days, and then I found crowds of active Monads, and all the Zooglœa masses now in different stages of segmentation such as are shown in Fig. 4, A (×500). The only portion of an unaltered mass that I could find is seen on the left hand side of this figure, contiguous to the black speck. In the two days all the small Zooglœa masses had either

[1] Examinations of the scum taken from the pot have since been made at intervals during another week and still, up to the eighteenth day, not a single Monad has been met with, though very many of the small Zooglœa masses have been found segmenting into pale brown Fungus-germs. But nine days ago (in order to test the question whether the *premature* opening of the pot had caused an arrest of the formation of Monads) I made another similar infusion from the same hay, and placed some of it in another small half-ounce pot, which was opened for the first time to-day. In the first portion of the scum obtained from this second pot I found swarms of active Monads, and also heaps of the small brown Fungus-germs resulting from the segmentation of other of the Zooglœa masses.—*November* 14.

[2] "Studies in Heterogenesis," pp. 49-51, and xiv.

become converted into Monads or altered in a more or less irregular manner. I attempted to stain some of the masses with a dilute solution of gentian violet. One of these, in which segmentation is pretty complete, is shown in B (×700), while the scattered products of another mass are

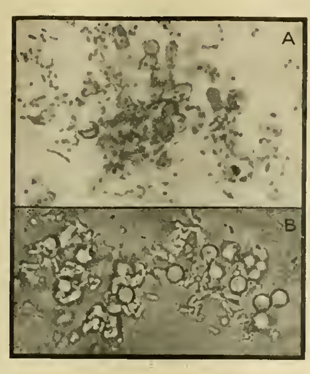

FIG. 5.—A, Products of segmentation stained, and appearing as minute spherical nucleated cells (×900); B, Monads in a resting stage (×700).

shown in Fig. 5, A (×900), after they had been lightly stained with Westphall's mastzellen fluid. In this embryonic condition the future Monads are seen as spherical nucleated cells, either single or in pairs. Some of the

FIG. 6.—A, Monads developed from Zoogloea masses in a hay infusion (×500); B, Amœbæ stained with logwood, from an egg and water emulsion (×200); C, Amœbæ originating in the scum from an egg and water emulsion (×125).

Monads which were found a few days later in a motionless, resting condition, are shown in B (×700).

On other occasions I had been a little more successful in photographing Monads produced from Zooglœa areas in a hay infusion. Thus Fig. 6, A (× 500), shows some such Monads, found on the third day, which had been developed from discrete corpuscles, and which were rendered motionless by a very weak osmic acid solution. These discrete corpuscles, as well as the motionless corpuscles derived from the segmentation of Zooglœa masses, sometimes become converted into Amœbæ rather than into Monads. What the conditions are that favour this particular change I have

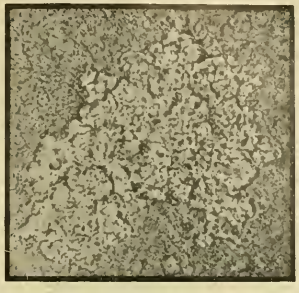

FIG. 7.—A Zooglœa mass undergoing change (×375).

been unable to ascertain, though I know that in rare cases swarms of minute Amœbæ rather than Monads appear in this way in hay infusions. The production of swarms of minute Amœbæ is, however, the rule in the pellicle that forms on an emulsion made by pouring about eight ounces of water on a teaspoonful of mixed white and yolk of egg. Such Amœbæ, slightly stained with logwood, are shown in Fig. 6, B (×200), taken from a pellicle on the seventeenth day, while in C (×125) they are seen, as I believe, originating in another egg and water emulsion on the eighteenth day, in the midst of irregular clumps of bacteria. These aggregates of bacteria had been noticed for several days, but when first observed not a single Amœba had, up to this time, been seen either in them or in the surrounding

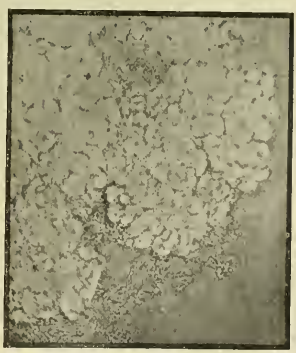

FIG. 8.—Portion of a Zooglœa mass about to segment (×500).

fluid. Then there were appearances as though changes were taking place within the aggregates, followed in two or three days by the presence of swarms of minute sluggish Amœbæ around, and issuing from, the bacterial aggregates, as shown in the figure under a low magnification.

In reference to the occurrence of these swarms of minute Amœbæ, I may say that I have never seen one of them multiply by fission, and certainly their vast numbers are not to be accounted for in this way. I make these remarks concerning Amœbæ without pretending that what I have here said in regard to them is quite conclusive, or in any way comparable to the convincing evidence above adduced concerning the heterogenetic origin of Monads from the transformation of Zooglœa masses—a transformation in which we have vegetal organisms giving rise to animal organisms of a totally different kind, though between these two forms of life no relation of kinship has ever been admitted, or even suspected, by the great majority of biologists.

Origin of Fungus-germs from Masses of Zoogloea.

It has seemed to me, as I have said, impossible to say from the mere microscopical characters of the masses of Zooglœa whether they are likely to yield Monads or Fungus-germs. It will be observed, however, that in the three cases to which I have just referred the masses giving rise to embryo Monads have all been small, and that they have tended to go through their metamorphoses with some rapidity.

It is certain, however, that the great majority of the larger Zooglœa masses tend rather to produce Fungus-germs of one or other kind, and to go through their changes at a slower rate. These statements may be illustrated by a record of the changes taking place in the larger Zooglœa masses that were found in great abundance in the pellicle forming on infusion A. These larger masses of Zooglœa, and also all the later changes which I am now about to

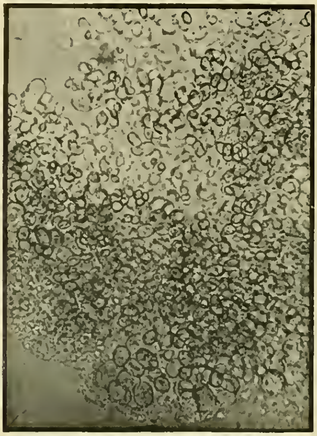

FIG. 9.—Development of small brown Fungus-germs from a mass of Zooglœa (×500).

describe, were, however, wholly absent from the pellicle on infusion B, up to the eleventh day.[1]

Where the changes occur to which I would now direct attention the Zooglœa masses gradually become larger and much more refractive, while they also stain much more deeply with logwood, gentian violet, or other of the aniline dyes. At the same time the constituent bacteria, which are so very distinct in the early stages, seem to become enlarged and gradually more or less hidden as the molecular changes taking place in the mass increase. One of these aggregates in this refractive, glistening stage, which was found and photographed on the fifth day, is shown in Fig. 7 (×375).

The next stage of change is revealed by distinct indications of segmentation beginning to show themselves through the mass, such as may be seen in Fig. 8 (×500), which represents a portion of a large Zooglœa mass that was found on the sixth day. This condition may persist for several days, but occasionally further changes occur rapidly, as may be seen by Fig. 9 (×500), showing a portion of another large Zooglœa mass found on the seventh day, in which minute ovoid germs of different sizes are separating from the mass, and at the same time assuming a brown colour. This change was proceeding more rapidly at the edge of the mass; but further in, as may be seen in the upper portion of the figure, the mass shows more of the appearance to be seen in Fig. 8. Although the germs seem to separate from the metamorphosed Zooglœa mass as bodies of varying size, I think there can be no doubt that some of the separate units subsequently increase distinctly in

FIG. 10.—A portion of the brown mycelium (×125).

size—though whether they undergo segmentation is not so clear. On the following day numerous heaps of brown Fungus-germs were found derived from these Zooglœa masses, forming clusters so thick and dense that their constituents could only be shown by pressing upon the cover glass firmly and thus breaking up the masses of germs. Portions of such a broken up mass are represented in Fig. 11, A (×500).

As a rule, these bodies show little tendency to germinate,

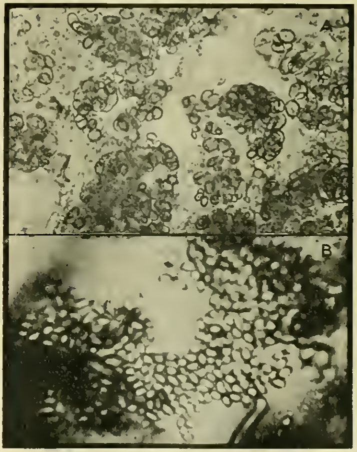

FIG. 11.—A, Heterogenetic Fungus germs (×500); B, Acrospores produced from the mycelium (×500).

but occasionally they do so, and two or three masses of mycelium to which they had given rise (also of a brown colour) were found on the eighth day. One of them had sent a hypha above the surface, and there produced a great number of ovoid acrospores having a bluish-black appearance. Some of the mycelium is shown in Fig. 10 (×125), while the acrospores are represented in Fig. 11, B (×500)

[1] See note on p. 78.

It will be noted that the acrospores are comparatively uniform in size, and are wholly different from the extremely variable brown Fungus-germs produced from the Zooglœa masses.

What has just been illustrated is only one of the ways in which Fungus-germs are produced in the pellicle from Zooglœa masses. Anyone working at this subject will have no difficulty in recognising many other modes in which they originate. Sometimes the germs separate from the Zooglœa masses as colourless units, and then take on an almost black colour before they begin to germinate, as in the specimen shown in Fig. 12, which was taken on the twelfth day from another pellicle on a hay infusion.

I have frequently found that these heterogenetic Fungus-germs are small ovoid bodies with one, or sometimes two, nuclear particles such as may be seen in this case, and also in some of the small brown units shown in Fig. 9. It is interesting, moreover, to find that the immediate products of segmentation which are about to develop into flagellate Monads present, except for their spherical shape, very similar characters, as may be seen by reference to Fig. 5, A.

It seems to me impossible to doubt that we have in the processes which I have just described definite instances of heterogenesis. The fact of the individualisation and the segmentation of these Zooglœa masses cannot be denied. It is plain, indeed, that from such aggregates of bacteria, by common consent regarded as belonging to the vegetal kingdom, we have the production of typical animal organisms, and that, as I have said, no kinship between

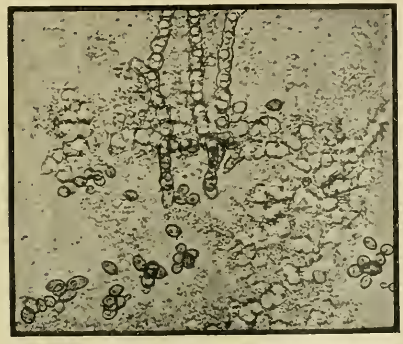

FIG. 12.—Heterogenetic Fungus germs becoming black and germinating (×500).

bacteria and flagellate Monads has ever been recognised, or even suspected, by the great majority of biologists; and, though it cannot be said that there is the same lack of kinship between bacteria and Moulds, it can certainly be said that the majority of biologists have never suspected any such relation between these two forms of life as that which has now been made known.

I care little what names may be given to the bacteria, though I am certain that many different varieties are prone to form zooglœal aggregates, and to go through one or other variety of such changes as have just been described. Being much interested with these processes that go on in nature, and under more or less natural conditions, I have been familiar with such phenomena for more than a generation[1]; but although they were made known so long ago I am not aware that any bacteriologist in Europe, America or elsewhere has ever repeated my observations. Bacteriologists to whom I have personally mentioned the subject have, with only one exception, shown not the least desire to examine specimens or to follow up the inquiry. They seem wedded to their strict laboratory methods, and seemingly prefer to have dealings with nothing but pure cultures and sterilised media. I do not deny for a moment the enormous increase of knowledge, and the benefit which has accrued to the human race, from their studies, but should like to see a little more toleration displayed for those who prefer to work in a different way, and strive to find out what goes on under more natural conditions—undeterred by the much talked of but much over-rated risk of "infection." Assuredly, in the future, much of what is now ascribed to "infection" will be differently regarded as the "origin of species" by heterogenesis becomes more and more known.

If such processes as have just been described are continually going on in nature, but are not to be met with in the laboratories of bacteriologists, it should make us hesitate to repudiate a natural origin of living matter at the present day simply because undoubted proof of its occurrence cannot be produced by laboratory experiments. If it occurred in the past the law of Continuity would lead us to expect that it has been continually occurring ever since, and, as I said in my letter of November 10, "if the origin of living matter takes place by the generation in suitable fluids of the minutest particles gradually appearing from the region of the invisible, such a process may be occurring everywhere in nature's laboratories, though altogether beyond the ken of man."

H. CHARLTON BASTIAN.

[1] See *Proceedings* of the Royal Society, 1872, vol. xx. p. 239.

The Temperature of Meteorites.

DURING the early part of the year 1901, when I was on the staff of the Elswick Works, it occurred to me that it would be useful and interesting if a connection could be made between the conditions of the flight of artillery shells and of meteorites. Later in the same year I made a preliminary mathematical investigation into the matter, and as a result a paper on the temperature of meteorites was sent in as an essay to compete for the Smith prizes at Cambridge. It was distinguished from other essays sent up in not receiving a prize.

It has since remained a strong wish on my part some day to work up the subject into a form fit for presentation to a scientific society, but the pressure of other matters has prevented this. In order, therefore, to preserve at least its outlines, I give here a brief exposition of the premises, the procedure, and the conclusions of the essay.

Ordinary ballistic tables contain a wealth of information as to the retardation experienced by projectiles of all sizes and of one general shape. The shape of the shell is well known. If the same rules can be made to fit the motion of meteorites it is clear that the velocity at any time can be obtained, and thence the loss of energy due to the obstruction caused by the air. This energy reappears as heat, sound, electrical energy, chemical energy, &c. Of these by far the most important is heat. Thus the conditions under which a meteorite "heats up" can be ascertained, and if it be assumed that all the energy is so spent, it is obvious that a superior limit to the resulting temperature may be obtained. One further point should, however, be mentioned—a meteor which reaches the earth is called a "meteorite," and the velocity necessary for this is such that the time of passage through the material part of the earth's atmosphere is so short, say five seconds, that chemical burning will not, in general, introduce any sensible error. Such error as might be introduced would be of the opposite sense to radiation losses, themselves small for much the same reason.

Meteorites may be of almost any shape. I have only considered the shell shape, as it is the only one the flight of which has been thoroughly investigated by exhaustive experiment.

According to Ingall's "Exterior Ballistics," the law of the resistance of the air is a function of the velocity which, for velocities above 1380 feet per second, is the velocity squared. For meteoric problems, velocities less than this are unimportant. Whether this simple law would hold good for velocities of, say, 20 miles a second, or even the 7 miles a second which the earth can impose, is not known, but for lack of a better it has been necessary to employ it.

The next difficulty, and of difficulties there is no small number, lies in the varying density of the air. A few thousand feet is the upward limit of ordinary projectiles. Even for howitzer shell the correction for rarefaction is so slight that the simplest kind of correction is enough. For meteorites, however, more extended treatment is required. I have taken the resistance to be in direct proportion to the density of the air. To do even this requires a knowledge of the density at all altitudes, and for this I have assumed an isothermal distribution of temperature. The theory of adiabatic distribution makes the atmosphere cease at distances well within twilight and meteor phenomena, and is therefore of no use. Probably something between these two would be most accurate, but its precise form is not of great importance in this investigation owing to the very slight influence of the uppermost reaches of the air on the motion of meteorites.

I now come to the meteorites themselves. Many sizes have been considered, but chiefly diameters of 0·10 inch and 12·0 inches. I refer to these as the "small" and the "large" meteorites. When other sizes are mentioned their diameters are given. I have further taken two materials, viz. iron and stone (trap rock), representing holosiderites and asiderites. The thermal constants for the materials are those found by Forbes.

I stated above the circumstances in which a knowledge of the heat energy given to the meteorite might be taken to be known. To find the temperature distribution in the *interior* of the iron or stone I have adopted the approximation of considering the meteorite to be cylindrical, and then utilising ordinary cylindrical coordinates. During the investigation a good many results were obtained which indicated methods by which the simple labour of the work could be lightened. Some of the more cumbersome expressions could be simplified by dividing the distance between the earth's surface and infinity into two regions, that within the sensible effect of the atmosphere and that without.

Many results were obtained during the investigation. In the large meteorite it was found that for all velocities of approach the temperature at the centre was a most minute fraction of that at the surface. For the small meteorite it was found that the final velocity was always very small and the time of flight correspondingly great, with the result that the whole of the material would be consumed before reaching the earth's surface—this would then properly be termed a meteor, not a meteorite. In its turn this consideration gives the altitude at which incandescence would occur. The small iron meteor would burst into brilliance at 45 miles up, and the stone one at 68 miles. To obtain a superior limit to the point of incandescence I assumed a meteor the diameter of which was only a millionth of an inch. For iron, brilliancy is obtained at 106 miles, and for stone at 129 miles. These figures are obtained by assuming the meteors to have the maximum velocity which the earth could impose. If, however, an initial velocity of 250 miles per second be assumed, surely a superior limit, incandescence would occur some 35 or 40 miles further off, so that the greatest height for visibility would lie well within some 170 miles.

An iron meteorite 3 inches in diameter falling to the earth from an infinite distance would begin to get warm about nine seconds before reaching the earth, and continue to increase in temperature for about seven seconds, after which its velocity would be practically "killed," and two seconds later it would reach the earth at about two-thirds of a mile per second. This represents a typical case for what might be termed the "twelve pound shell" size.

In the "twelve pound shell" size the internal temperature falls off very rapidly towards the interior. Thus, taking the mean temperature in the severest case as 1·00, the surface temperature was 2·2, and at a depth equal to a fifth of the radius (0·30 inch) the temperature was about 0·3 only, whilst at the centre it was 0·0016. So that for the most excessive surface temperatures the central temperature would be well below the temperature of liquid air, assuming, of course, that the initial temperature of the meteorite is at the absolute zero.

The steepness of the heat gradient at or near the surface is the probable cause of the nodular appearance of meteorites. Great resistance to the inward flow of heat would be offered by any internal veining, and as a result such surfaces of separation would tend to become the limiting surfaces for any burning which might occur.

The various formulæ used to obtain the above results were suited to a subsidiary investigation, viz. that of the problems connected with the ejection of rock from terrestrial volcanoes. The results of such an investigation may be briefly summarised as follows:—Had the earth no atmosphere all masses shot off vertically at 7 miles a second and over would fail to return. With the existing atmosphere the large meteorite would require a velocity of 13 miles per second, and the "twelve pound shell" would want a velocity of 78 miles per second. These velocities are not without interest in view of the theory that meteorites originated from terrestrial volcanoes. Smaller velocities would suffice were the masses discharged from high altitudes. Thus, from a height of 5 miles, the velocity for the large iron meteorite would be only $8\frac{3}{4}$ miles per second, and for the "twelve pound shell" only 18 miles a second. Further calculation shows that with an initial velocity of 7 miles a second the large meteorite would rise to only some 120 miles, and the "twelve pound shell" to between 40 and 50 miles, and both would then fall back to the earth.

In conclusion, the result of the investigation may be said to have created a strong presumption in favour of the following general deductions:—

(*a*) That the velocities of meteorites are materially changed by the resistance of the atmosphere, and, in general, by a fractional part of the velocity which is independent of the velocity of approach.

(*b*) That the superior limit for incandescence is probably about 150 miles above the earth's surface.

(*c*) That no iron meteor the original weight of which was less than 10 to 20 lb. reaches the earth's surface, and that when a meteor does do so the temperature of its centre is not in general above that of liquid air (assuming the temperature of space to be zero).

I am aware that the whole structure of the investigation rests on the evil principle of extrapolation, but until man is capable of experimenting with velocities of 10 or 20 miles a second, and surviving thereafter to record his results, no other manner of investigation seems possible.

London, November 13. H. E. Wimperis.

Mount Everest: the Story of a Controversy.

I have read with interest in your columns under this title a carefully compiled and instructive account of the discussions that have from time to time during the past fifty years broken out with regard to the naming of the highest measured point on the earth's surface, Peak XV of the Indian Survey.

I have long maintained it to be a matter for regret that the monarch of mountains should be called after any individual, however eminent, and I am still of this opinion, which is shared by most mountaineers and mountain lovers. We should prefer that Peak XV should bear a Nepalese or a Tibetan name, even had one to be invented for it, as twenty years ago Alpine Clubmen, in accord with Russian surveyors, found or invented native names for many of the great peaks of the Caucasus.

But, since your correspondent appeals to me not to prolong the controversy further, I must remind him that the opinion I have expressed is an individual and not an official opinion. For ten years I have had no official connection with the Royal Geographical Society.

Should the council of that body resolve that, considering the length of time the title "Mount Everest" has been more or less in use in this country for Peak XV, the absence of any evidence that that individual peak is designated as, or included in the designation of, Gaurisankar by the Nepalese, and the practical inconvenience (whether the name be authentic or not) of introducing a new Tibetan name such as Chomo- or Jamokangkar, it is expedient that the title Mount Everest should be generally accepted, I shall acquiesce. For I attach greater importance to the general principle than to the particular case, and I believe the protracted discussion and many protests summarised in your columns have served their purpose in helping to discourage the practice of giving personal names to mountains.

I should add that foreign geographers are not, as your correspondent suggests, mainly dependent on the *Geographical Journal* for information in this matter. Captain Wood's report has been noticed in that well known periodical *Petermann's Mitteilungen*.

Douglas W. Freshfield.

Observations of the Leonid Meteors, 1904.

Observations by the writer this year go to show that the intensity was much below that of last. Briefly, the nights of November 12 and 13 were heavily overcast, but the night of November 14 and early morning of November 15 were fortunately clear. The display lasted about an hour, say from 12.30 until 1.30 a.m., maximum 1 o'clock a.m. (local times), hourly rate, low, 20 to 25. Bright meteors, however, continued to appear at intervals up to 3 a.m., when clouds coming on stopped further observation. A couple of hours' watch before and after midnight of November 15 gave only two Leonids, while another two hours' watch on the night of November 16 showed the radiant, which was sharply defined the previous nights, at $150° + 23°$, near Zeta, to be quite quiescent. Other radiants active were :—

	R.A. Dec.	
	° °	
(1) Leonids (No. 2) ...	165 + 25 ...	Strong, bright.
(2) Ursids	155 + 47 ...	,, ,,
(3) Præsepids	125 + 20 ...	Slow, small, wiry.
(4) Cancrids	130 + 5 ...	Short, bright.
(5) Geminids	108 + 28 ...	(One) short, bright.

It would be interesting to hear of observations made during the hour or so before daybreak on the morning of November 15, as it is just possible the increased intensity noticed in previous years may not be real, but due rather to the fact of the radiant being near the meridian, and the smaller meteors coming down more direct at that time are the better able to penetrate to the lower layers of the atmosphere.
W. H. Milligan.

Holywood, co. Down, November 18.

The Discovery of Argon.

In your translation of Prof. Mendeléeff's interesting paper on the chemical elements (November 17, p. 94) I see that he attributes the discovery of argon and its congeners to Ramsay. Am I not right in believing that it was Lord Rayleigh who discovered argon, and that it was he who gave that impulse to chemistry which Sir William Ramsay has carried forward to such remarkable results?

November 20. G. H. Darwin.

Blue-stained Flints.

Some years ago there were many blue-stained flints on a road near Cambridge. Lime from gas-works was about to be mixed with the flints used as road-metal, and the two different materials had lain for some time in heaps by the roadside. The blue colour, in some instances very intense, was developed wherever a heap of flints and one of lime touched each other; from which I surmised that the calcium sulphide of the gas-lime had reacted with an aluminium compound present in the flints, producing a substance akin to ultramarine.
F. J. Allen.

Cambridge, November 19.

Inheritance of Acquired Characteristics.

It may be worth noting that since my letter to you of some months back, in which I gave an instance of fox-terrier pups being born with short tails, I have heard of two similar cases. In one of these cases the dog was owned by one of the managers of the Rhodes' Fruit Farms, near Cape Town. The other case occurred in the Transvaal at Sabi, one out of a litter of four being born with a short tail.
D. E. Hutchins.

Forest Office, Cape Town, October 18.

DR. KOENIG'S METHOD OF COLOUR PHOTOGRAPHY.

In the methods of three-colour photography hitherto practised the colours are used as inks, stains, or pigments already prepared, and their distribution is effected indirectly by the action of light. In the imbibition process three thin gelatin reliefs are prepared (using potassium bichromate to sensitise the gelatin), and after each relief is stained with its appropriate colour the three films are superposed. The method recently described by Dr. Koenig is of the multiple film kind, but the colours are produced by direct exposure to light.

Many organic colouring matters yield by reduction colourless bodies that are more or less easily re-oxidised with the production of the original colours. The oxidation of these leuco colouring matters is generally if not always quickened by light. If, therefore, the leuco-compound produced from a dye of a suitable red colour is caused to impregnate a film, and this is exposed beneath the negative made to give the red image in three-colour work, the red image may be produced by direct exposure to light. A similar procedure will of course give the yellow and blue images, and so the complete colour print may be obtained. Such are the general principles upon which Dr. Koenig's process depends, but to elaborate the details of a successful process on these lines it was necessary to overcome many practical difficulties.

It was necessary, in the first case, to select only those dyes (of suitable colours, of course) that yield leuco-derivatives of sufficient stability to stand the necessary manipulations. Then it was found that the leuco-bases selected as otherwise suitable gave but a feeble image even after long exposure; but it was observed that when collodion was used as the medium the sensitiveness was greatly enhanced, and the vigour of the image very much improved. This improvement was traced to the action of the nitrocellulose, and other nitric acid esters were found to have a still greater effect. Nitromannite especially is useful for sensitising purposes. Dr. Koenig emphasises the fact that the leuco-bases in an inert film are useless, as the action of aërial oxygen, when it has reached its maximum, gives only a flat and feeble image.

The fixing of the image was the next difficulty, for obviously it is necessary to remove the excess of the leuco-body without interfering with its coloured oxidation product. It is well known that many dyes show a great tendency to remain attached to a fabric or film in spite of the application of solvents, but the leuco-bases employed also have a similar tendency. Dilute mineral acids, though they dissolve the greater number of the leuco-bases, would not remove them from collodion films. A 10 per cent. solution of monochloracetic acid was found to be the best fixing agent.

The various solutions required are supplied ready for use, and the following summary of the instructions issued with them will give a general idea of the manipulation required. A piece of baryta coated paper rather larger than the negative has its edges turned up, and is coated with a $1\frac{1}{2}$ per cent. collodion to which has been added the leuco-derivative of the blue dye and a solution containing the necessary additions. When dry it is exposed under the appropriate negative (for, say, twenty to forty seconds in bright sunshine), soaked in the fixing bath for a few minutes, washed for a few minutes, dipped into a gelatin solution that contains a little chrome alum, and hung up to dry. The print is then turned so that its lower edge shall be uppermost, again dipped into the gelatin solution, and again allowed to dry. The gelatin coating is applied to isolate the collodion film so that it may not be interfered with by the application of the second collodion. The print is then coated with collodion to which the materials for the blue image have been added, exposed under the proper negative, fixed, and coated twice with gelatin as before. A similar procedure follows for the yellow image, and after the final gelatin coating it is well to varnish the print. It is claimed for the dyes employed that the blue, which is the one most liable to change, is more permanent than Prussian blue.

THE NEW WHALE FISHERIES.[1]

IN the story of the rise and fall of the whale fisheries history has many times repeated herself. The Basque fishery, the oldest of all, the fragmentary records of which go back beyond the middle ages, which extended centuries ago to the other side of the Atlantic, which long furnished harpooners to our own fleet, and which has left us the harpoon and its name, finally passed away during last century with a practical extinction of the object of its pursuit. Our own Greenland, or right whale, fishery, in which for one hundred years some 250 vessels were employed, hailing from almost every east coast port, has been now for nearly another century on the decline, and some half dozen whalers from Dundee are all that is left of the once great argosy. A few fine old American ships, with dark-skinned harpooneers from the Cape Verdes, still chase the sperm whale throughout its world-wide habitat, in place of the 700 sail that followed the business sixty years ago. Zorgdräger, Scoresby, Scammon, and a host of lesser men have left us records of these old fisheries, of the methods employed, and of the marvellous success achieved; but, nevertheless, the naturalist has much to regret in the passing away of these great industries, in the near approach to extermination of the most valuable and most interesting species, and in the scantiness of the material that has as yet been saved. Our chief museum contains, I believe, neither skeleton nor even skull of the Greenland whale, and the difficulties in the way of procuring one now-a-days seem to be very great indeed. We have to go to Stockholm or St. Petersburg to see the entire skeleton of such a whale, with the huge fringes of whale-bone still in place in the jaws. Nor, by the way, would our knowledge seem to be more adequate than our anatomical material, for a writer in a standard text-book told us only the other day that a single whale may yield us "several tons" of whale-bone!

While the fisheries before mentioned, and others like to them, are passing or have passed away, a new fishery has sprung up that has for the object of its pursuit a class of whales that formerly had been left in peace. This is the fishery for the great rorquals, or finner whales, first instituted by Captain Svend Foyn at Vadsö in 1864. The fishery is carried on by means of small steamers, carrying at their bows a harpoon gun which discharges a line and explosive bullet. The steamer tows the fish home, to be flensed and worked up in the factory ashore. Twenty years after Svend Foyn's small beginning there were more than thirty such factories on the coasts of Finmark, but all of these have very recently been disestablished by the Norwegian Government, which, in deference to temporary and local prejudice, is robbing its country of a profitable and ill-spared industry. The great success and profit of this fishery has led to its extension to Iceland, Færöe, Newfoundland, and lastly, to Shetland and the Hebrides; but it is still almost wholly in Norwegian hands, and a factory at Tonsberg enjoys a practical monopoly of the machinery employed.

One consequence of the growth of this new industry has been to impress upon us, or to remind us of, the fact that at least certain species of whales exist in their native seas in prodigious numbers, seldom though the occasional traveller has the luck to see them. Once, in the North Pacific, on a calm summer's day, I saw for an hour the ship surrounded on every side by great whales to the number of many hundreds, and a somewhat similar display is said to have been witnessed to the north of Shetland during the past summer. Dr. Hjort calculates that from the beginning until 1901 the finner whale fishery resulted in the capture of some 27,000 fish, a vast number in itself, though not great in comparison to the yield of the Arctic fishery in its palmy days, for the Dutch alone are reckoned to have taken no less than about 575,900 Greenland whales and "Nordkapers" or Biscayan whales, between 1669 and 1778. Probably long lived, but certainly slow breeding, the whale must in the end give way before a wholesale persecution; but meanwhile several species are still immensely numerous, and the naturalist has at least the consolation that pursuit tends to cease as scarcity becomes manifest, and long before actual extermination is achieved.

FIG. 1.—The Common Rorqual, Snook's Arm, Newfoundland.

The new industry has many attractions and opportunities for the naturalist. The stations are in many cases within reach of easy travel, and the manner in which the carcases are drawn up for flensing on the shore affords a perfect spectacle of the entire creature. The volume which has suggested the present article, by Dr. F. W. True, of the U.S. National Museum, is the outcome of a careful use of the opportunities afforded by the Newfoundland whaling stations, supplemented by abundant use of literature and study in American museums. Dr. True, who is already well known as a student of the Cetacea, seems to have made it his first object to investigate the specific characters of the larger whales, with the exception of the Greenland whale, and to determine, once for all, whether specimens of the various forms from the two sides of the Atlantic be specifically identical.

[1] "The Whalebone Whales of the Western North Atlantic." By Frederick W. True. (Smithsonian Contributions to Knowledge.) Pp. iv+332, and plates. (Washington: Smithsonian Institution, 1904.)

This question is answered, in general, in the affirmative, with some reservation as to the possible existence of varietal or subspecific differences in the case of the humpback, Megaptera, and the lesser piked whale, *Balaenoptera rostrata*, or *acutorostrata*, as our author, following Lacépède, prefers to call it. Furthermore, additional evidence is adduced in support of the identity of the North Pacific species with those of the North Atlantic. This conclusion is entirely confirmatory of the views of European naturalists, and Dr. True's remarks on the distribution of the various forms deserve to be read in connection with Dr. Guldberg's recent very interesting papers on the probable course of the annual migrations of several species around the circuit of the North Atlantic.

But Dr. True has given us other things besides a careful account of specific characters. He has given us, in the first place, a singularly interesting epitome of the early history of whaling in America, downwards from the mythical days of the Saga of Thorfinn. It will be news to the citizens of New York that, in the seventeenth and eighteenth centuries, there was a not unimportant whale fishery on Long Island and in Delaware Bay, and that so late as 1823 (?) there was a family on Long Beach, N.J., who every winter sought for and "sometimes captured" whales, in which business they had been engaged, father and sons, ever since the Revolution. In the next place, and of still more popular interest, Dr. True has enriched his book with fifty large plates, for the most part taken directly from photographs, of whales as they lay on the beach at the Newfoundland factories. A few similar photographs have recently appeared from Norwegian and Scottish sources, but no such excellent and comprehensive series as Dr. True's has yet been made, though, by the way, one series of *B. musculus*, published about twenty years ago by M. Yves Delage, could scarcely be surpassed.

Five or six species of whales are obtained, more or less abundantly, at the various whaling stations. These are the great "sulphur-bottom," or Sibbald's rorqual, the blue whale of the Norwegians, which, rare on our own coasts, is the chief source of profit to the Icelandic and Newfoundland whalers; secondly, the common rorqual; thirdly, Rudolphi's rorqual, the Seihval of the Norwegians, which seems to be rare on the other side of the Atlantic, but which in certain years has bulked very largely in the Finmark catch; lastly, the humpback, Megaptera. Besides these a sperm whale is caught every now and then, and the Icelanders still take an occasional Nordkaper, or Biscayan whale. Thus the "finner" industry furnishes not only a large number of individuals, but a great variety of species to the observation of the naturalist. Several curious points crop up in regard to the relative commercial value of the several forms. Thus, for instance, Rudolphi's whale, a species very similar to the common rorqual, long overlooked and afterwards considered very rare by naturalists, is now a most valuable element in the fishery, its whale-bone, though no bigger and longer than that of the common species, being worth, from its intrinsic quality, just about ten times as much.

Dr. True's photographs show us, with a wealth of illustration, Sibbald's whale, the common rorqual, the humpback, and the Nordkaper as they lie upon the beach. Many interesting points are excellently well shown the distribution of colour, the curious pleatings of the ventral skin, the contrast in form between the long, slender, lanky Sibbald's whale and the shorter, stouter body of the common species, the tubercles on the head of Megaptera, the huge flippers with their garniture of barnacles in the same species.

Fig. 2.—The Humpback, Balena Station, Newfoundland.

It is a common practice of American naturalists, and Dr. True is no exception, to deal somewhat harshly with received nomenclature in the quest after "priority." Rightly or wrongly, the common rorqual is invariably known to us as *B. musculus*, but that name is here transferred to what we call *B. sibbaldii*; the former is here designated *B. physalus*, L., and *B. biscayensis* figures as *B. glacialis*, Bonnaterre. The work as a whole does not lend itself to epitomisation, and the foregoing brief account does not do justice to its scientific interest.

D. W. T.

NOTES.

The directors of the Ben Nevis Observatories, which were closed on October 1, have just issued a circular describing the circumstances in which these observatories have at last been discontinued. The maintenance of the two stations at Fort William and on the summit of Ben Nevis has involved an average yearly expenditure of 1000*l*. Of this sum, 350*l*. has been supplied by the Meteorological Council, and the remainder has been obtained from various private sources. It was hoped that the Treasury Committee which was appointed to consider the question of the annual grant to the Meteorological Council would deal adequately with the position of the Ben Nevis Observatories in its report, but in their circular the directors express disappointment that this was not done. The directors remark:—"Some of their number, including the two secretaries, were examined, and fully stated their case, besides handing in detailed memoranda regarding the history, work, and cost of maintenance of the observatories. Yet, with all this information before them, the committee state in their report that 'it appears that only 350*l*. per annum is required to ensure the continued maintenance of the observatories.' The directors lost no time in calling the attention of the First Lord of the Treasury to this 'inexplicably erroneous' statement, and in appealing to him that means should be found to prevent the abandonment of the observatories. The Treasury, however, could not see its way to any further increase of the contribution from the Parliamentary Grant, but offered to continue the allowance of 350*l.* a year hitherto received from the Meteorological Council. As this arrangement would have left the directors exactly where they were before, face to face with the impossibility of continuing to raise 650*l.* every year, and with the obvious hopelessness of obtaining adequate pecuniary support from the Government, there was no alternative but to close the observatories."

IT is announced in the *Times* that a donor, who desires to remain anonymous, has placed a sum of 1000*l.* in the hands of the treasurer of the Royal Society, to be devoted to the advancement of science. By his wish 500*l.* of this gift is to be placed to the credit of the "Catalogue of Scientific Papers Account" of the Royal Society, and the remainder to the credit of the "National Physical Laboratory Account" of that body, with the request that the executive committee of the laboratory will accede to any personal wish of the director as to its expenditure.

A STRONG, detailed indictment of the department of the War Office which should be responsible for the production of necessary maps appeared in Saturday's *Times* from the military correspondent of that journal. The war in the Far East has lasted now for nearly nine months, and not a single map of the seat of war has been issued by the Government department which is the chief recipient of the results of our geographical research. The vexatious thing is that the information, even the maps, exist, but that no endeavour has been made to utilise them for the public benefit. The Russian and Japanese Staff maps of Manchuria exist in London, but neither map can be purchased by the public through the trade, though, as both are in the hands of individuals in London, and whole sheets of the Japanese map have been reproduced by the Japanese Press, the presumption is that the mapping section of the director of military operations also stands possessed of them. A map intended to be of use to the public must be a compilation of these and other materials; but no such map has been issued officially at all. The only excuse for this deplorable want of sense is the lack of staff and of time to produce the map for which there is a public demand. In this case nothing could be simpler than to provide some house in the trade with the information available, and allow suitable maps to be produced by private enterprise. Our official maps are, the article affirms, nothing less than a national disgrace. Not only all the Great Powers, but even those of the second and third rank, are infinitely superior in cartography. These facts are then employed to direct attention to the whole question of the teaching of geography, and to warn us of a serious defect in our system of national education. We have suffered in the conduct of military operations because the teaching of geography has not assumed its proper place in the education of our army officers.

THE death is announced of Dr. Karl H. Huppert, emeritus professor of physiological chemistry in the University of Prague, at seventy-two years of age.

THE scientific committee of the Royal Horticultural Society met recently and received with regret the resignation of Prof. Henslow, who for more than a quarter of a century has acted as its secretary. Mr. F. J. Chittenden, who has been for some time a member of the scientific committee of the society, has undertaken to discharge the duties of secretary until the end of the current session.

IT is stated by the *Pioneer Mail* that the Burma Government has decided to discontinue the experiments for the improvement of the indigenous silk industry in the more important silk centres of the Province by the importation of silkworm eggs from France. Owing to climatic and other causes, rearing has failed with foreign imported eggs, and it is not considered worth while pursuing the experiments without the aid of an expert.

MR. J. N. HALBERT has been appointed assistant in the Dublin Museum in succession to Mr. G. H. Carpenter, who held the post for many years. Mr. Halbert is known as the author, in collaboration with the Rev. W. F. Johnson, of a list of the beetles of Ireland (*Proc.* R. I. Acad.). He has also published some papers in the *Zoologischer Anzeiger* and the *Annals and Magazine of Natural History*, on freshwater mites.

THE applications for space in the forthcoming automobile exhibition at Paris on December 4 far exceed the space available in the Grand Palace of Fine Arts, so it may be necessary to hold the exhibition at the Galerie des Machines. One of the curiosities of the exhibition will be the *Lebaudy II.* exhibited in a reduced model. To November 18 the Lebaudy dirigible balloon had executed not less than fifty-four ascents, and on the fifty-first the return to the Moisson Aërodrome, the starting point, was accomplished. From the last day of October to November 18 ten ascents were successfully executed.

THE first meeting of the annual session of the German Society of Naval Architects was held at the Technical High School at Charlottenburg on November 17. The Emperor William, the honorary president of the society, the Grand Duke of Oldenburg, the Secretary of State for the Imperial Navy, Admiral von Tirpitz, and the secretary of the British Institution of Naval Architects were present. Prof. Ahlborn, of Hamburg, read a paper on the spiral formation of water under the action of a ship's screw, and on the movements produced in the water by the revolution of the screw; and Prof. Braun, of Strassburg, dealt with the methods and aims of wireless telegraphy.

THE *Journal* of the Society of Arts states that among the congresses arranged in connection with the Liège International Exhibition of next year, and with which the cooperation of the Belgian Government is ensured, one on chemistry and pharmacy, convoked by the Belgian Chemical Society and the Liège Pharmaceutical Association, will be held at the end of July. The congress is to be divided into the following sections:—(1) general chemistry, physicochemistry; (2) analytical chemistry, apparatus and instruments; (3) industrial mineral chemistry, including metallurgy; (4) industrial organic chemistry (sugar-boiling, fermentation, tanning, dyeing, &c.); (5) pharmaceutical chemistry; (6) the chemistry of food substances; (7) agricultural chemistry, manures; (8) biological and physiological chemistry (application to hygiene and bacteriology); (9) toxicology; (10) practical pharmacy; and (11) legislation and professional interests, deonthology. The president of the organising committee is Prof. A. Gilkinet, of Liège.

A CONFERENCE on physical education was held on November 16 at the Education Offices of the London County Council, the Bishop of Bristol presiding. Miss Johnson, of the Swedish Institute, Clifton, advocated the organisation of physical education on the lines of the Royal Central Institute of Sweden, which she described. Sir W. Church, president of the Royal College of Physicians, moved a resolution to the effect that it is desirable that a national system of physical education should be established in the United Kingdom. This was seconded by Sir Lauder Brunton, and supported by other speakers, including Lord Londonderry and Sir W. Broadbent. The *Times* of November 17, in a leading article on the subject of the conference, while acknowledging our supineness in this respect in the past, rightly deprecates any hasty action in the matter, and remarks that while Swedish and other systems have their merits, what we want here is not a system borrowed from Sweden, Denmark, or Japan, but a British system growing out of the British character, and suited, as no borrowed system can ever be, to British needs, and considers that we must begin with the children in our elementary schools.

IN the *Times* of November 17 appeared a letter stating that skulls and limb-bones of horses of known pedigree, no matter what their breed, are required by the natural history branch of the British Museum, and the cooperation of horse-owners is invited in the endeavour to bring together a large series of such specimens. No mention is made in the letter of the special purpose for which a collection of this nature is required. Those who have kept abreast of zoological literature for the last year or two will, however, have scarcely failed to notice how much attention has been directed by naturalists to the problem of the origin of the various breeds of domesticated horses, and especially to the idea that thoroughbreds and Arabs have a different parentage from the "cold-blooded" horses of western Europe. The circumstance that some horses of eastern origin show a vestige of the cavity for the "tear-gland" of the hipparions has been recently brought to notice as an important factor in the problem. To ascertain the frequency of this feature is probably one of the objects of making the collection, while a second may be to ascertain the constancy of certain proportionate relations between the limb-bones of racers and cart-horses. The museum already possesses the skeleton of "Stockwell," from whom are descended most of our best thoroughbreds, and likewise the skull of "Bend Or," presented by the Duke of Westminster, and Mr. W. S. Blunt has promised a skull of one of his famous Arabs.

WE have received from Messrs. Friedlander, Berlin, a catalogue of books on comparative anatomy, which is divided into three sections, the first dealing with vertebrates and the second with invertebrates, while the third is devoted to comparative embryology and morphology.

No. 9 of vol. xxxi. of the *Proceedings* of the Boston Natural History Society is devoted to the North American parasitic funguses of the group Ustilagineæ. These organisms, which have been hitherto very imperfectly known, infest various parts of herbaceous flowering plants, and are represented by twenty-four genera included in two families. Much still remains to be done in determining their distribution, and some of the hosts of certain species are given on the authority of observers other than the author of this paper, Mr. G. P. Clinton.

AN account of the method of preparing *clayed* cocoa appears in the *Bulletin* of the Trinidad Botanical Department for July. The cocoa-beans, after being fermented and dried, are collected in heaps, upon which men are set to dance, while others replace the beans as they scatter. Meantime the heaps are dusted over with powdered clay which adheres to the gummy surface of the beans and acts as a polish, so that finally the beans assume the appearance and colour of polished mahogany; careful drying completes the process, which results in the beans carrying and keeping better on account of the protective covering formed.

THE Cosmo Melvill herbarium, now the property of Owens College, Manchester, is estimated by the donor to contain five thousand genera, or two-thirds of the total number recorded in the "Genera Plantarum," exclusive of others since instituted, and the phanerogams alone amount to 36,000 different species. From a geographical point of view nearly every country appears to have furnished a quota. Amongst the more important collections mention should be made of Sir Joseph Hooker and Dr. Thomson's Indian plants, Dr. Henry's Chinese collections, Mr. C. G. Pringle's Mexican plants, and the specimens collected by Dr. Nuttall in North America.

THE Deutsche Seewarte has added another to its many useful publications, *Tabellarische Reiseberichte*, a collection of tabular reports of the meteorological logs received during the year 1903 from observers on ships. It has several times been suggested that observations made at sea should be published in a tabular form, similarly to those made at land stations; the late Admiral Makaroff was the last to urge the importance of doing so, but the question of expense has always stood in the way. The work in question does not attempt such a regular tabulation of observations, but gives a useful summary of some of the principal phenomena recorded on each voyage, *e.g.* the limits of the trade winds and monsoons, the force of wind, the storms experienced and the behaviour of the barometer during their occurrence, noteworthy currents, sudden changes of sea temperature, &c. Each report also gives the length and nature of the voyage, so that any person interested in the meteorology of any particular part of the ocean can determine approximately the amount of materials available. It is proposed to issue a similar volume for each year.

DR. H. HERGESELL, president of the International Aëronautical Committee, has contributed to *Beiträge zur Physik der freien Atmosphäre* an interesting account of his kite observations on the Lake of Constance. The ascents were first made in the year 1900, and subsequently in the years 1902 and 1903, on both occasions with the assistance of Count Zeppelin, who lent his motor-boat for the purpose. It is understood that such observations are somewhat difficult at an inland station, as the wind velocity necessary for raising the kite (about 8 metres per second, or 18 miles per hour) is not always available without the artificial wind produced by the motion of a boat. Dr. Hergesell's experiments clearly show that, frequently, inversions of temperature and humidity occur at certain levels, which are not exhibited by observations made on mountain peaks, and the opinion is expressed both by Prof. Mascart (president of the International Meteorological Committee) and by himself that however useful in various ways, observations on mountain stations have not led to the results that were expected from them. He is of opinion that if any improvement is to be made in what he terms the present stagnant condition of meteorological science, it will be by the investigation of the upper strata of free air rather than by piling up observations made at ordinary meteorological stations—in other words, by making meteorology a study of the physics of the atmosphere.

IN a communication to the Institution of Mechanical Engineers Mr. R. M. Neilson discusses the possibilities of gas turbines from a scientific standpoint, a region of study to which up to the present little systematic attention has been given. The author considers that there are four different cycles which could be applied with advantage to a gas turbine, giving efficiencies of from 0·25 to 0·84, and two of them admitting of several different cases. The necessity of keeping the temperature of the blades of the turbine down to about 700° C. to a certain extent limits the efficiency, but, as the author points out, a decrease in the temperature of the source in a Carnot's cycle affects the efficiency less than an increase in the temperature of the refrigerator of the same amount.

We have received from the Stanley Electric Manufacturing Co., of Pittsfield, Mass., an interesting wall map showing the long distance power transmission lines in California. There are six power houses situated on the western slopes of Sierra Nevada from which power is transmitted electrically to San Francisco and the surrounding district. The longest transmission is from the De Sabla power house to Sansaulito, which is to the north of San Francisco, on the opposite side of the Golden Gate; the length of this line is 232 miles. More than 10,000 h.p. is being supplied to San Francisco itself from the electric power house which is 147 miles away. An additional power house is proposed, and also several additional lines.

At a recent meeting of the Faraday Society, among other papers was one by Miss B. Pool on a suggested new source of aluminium. This consists of the vast deposits of laterite which occur in several parts of India; these laterites are closely analogous to bauxite, from which aluminium is at present manufactured. The paper gives analyses of several of the laterites in different districts, and the author concludes that this raw material, on account of its purity, ready accessibility, and association with flowing water should be almost an ideal source of aluminium. Mr. W. M. Morrison, in the discussion, questioned whether it was probable that the Indian laterites would be used in this country, as the supply of bauxite near at hand was plentiful, though it was not unlikely that at some future date they might be worked *in situ*.

We have received from Messrs. Christy and Co., of Old Swan Lane, Lower Thames Street, E.C., a few samples of the several varieties of Dr. Schleussner's dry plates, and have found them to vindicate, practically, the commendations bestowed upon them by many Continental men of science, including several well known astronomers. The "ordinary" plates are characterised by their great sensitiveness and the evenness of their emulsion. The "special rapid" plates, intended chiefly for stellar photography and general scientific work, were found excellent, especially in stellar work, even faint stars giving fairly dense trails when the plates were exposed in a stationary camera. The results in this direction especially are enhanced by the very smooth grain of the finished negative. On testing the "orthochromatic" plates in terrestrial and stellar spectroscopic work they were found to be extremely sensitive, and, with relatively short exposures, gave spectra extending well up into the orange with only a short break on the less refrangible side of the "F" line. The "Viridin" are especially sensitive in the green, with reduced sensitiveness in the blue and violet, and should be found very useful in landscape work where the use of a screen is inconvenient or likely to lengthen the exposure unduly. All the plates were easy to develop with normal pyro-soda, and gave excellent, fine-grained negatives free from any trace of fog. Messrs. Christy are the sole agents for these plates in Great Britain.

No. 9 of vol. cvi. of the *Bulletin de la Société d'Encouragement* contains several papers of metallurgical interest. M. H. Le Chatelier describes a photographic method of recording the temperature of pieces of steel at every instant during the rapid cooling which accompanies hardening, and investigates the law of this cooling in the case of the commoner baths, such as water, oil and mercury, which are employed in industry. Contrary to the usually accepted view, the rate of cooling by means of mercury is much smaller than that due to water; the specific heat of the quenching material, and not its thermal conductivity, is obviously the principal factor to be considered in such cases. The cooling by oil is relatively very slow, owing to its low specific heat and to its viscosity, which prevents loss of heat by convection. M. L. Guillet describes in the same part the properties of tin and titanium steels, and M. P. Mahler discusses the reversible actions occurring in the blast-furnace.

We have received a copy of the "British Standard Specification and Sections for Bull Headed Railway Rails," issued by the Engineering Standards Committee. It has been resolved that the steel used in these rails shall be of the best quality, the constituents conforming to the following limits:—carbon from 0·35 to 0·5 per cent., manganese from 0·7 to 1·0 per cent., silicon not to exceed 0·1 per cent., phosphorus 0·075 per cent., and sulphur 0·08 per cent. The manufacturer shall make and furnish to the purchaser a carbon determination of each cast, and a complete chemical analysis representing the average of the other elements present shall be given for each rolling. A table of the general dimensions of the "B. S." rails is given, with illustrative sections. For straight lines, the committee recommends the adoption of the following as the normal lengths of the rails, namely, 30 feet, 36 feet, 45 feet, and 60 feet. The tensile strength must not be less than 38 tons per square inch nor more than 45 tons per square inch, and a 5-feet length of rail shall respond satisfactorily to the blows of a falling weight of 2240 lb. The inspection and testing of the rails by the purchaser during the course of their manufacture are suitably provided for.

An interesting paper by Mr. L. Gilchrist on the electrolysis of acid solutions of aniline appears in the November number of the *Journal of Physical Chemistry*. On electrolysing a hydrochloric acid solution, aniline black is formed, the depolarising effect amounting to about 0·3 volt. Substituted chloranilines are not formed to any appreciable extent. Electrolysis of a hydrobromic acid solution, which has a considerably smaller decomposition voltage, leads on the other hand to bromanilines, and no aniline black is produced.

The *Proceedings* of the Royal Dublin Society (vol. x., No. 23) contain a report by Dr. E. J. McWeeney on the cases of carbon monoxide asphyxiation which have occurred in Dublin since the addition of carburetted water gas to the ordinary coal gas. It appears that from 1880 to 1900, before the addition of carburetted water gas was practised, there was no recorded case of death from coal gas poisoning, whilst during the four years that have elapsed since the addition was made, there have been ten cases with seven deaths due to that cause.

In a paper published in the *Manchester Memoirs* (vol. xlix., 1904) Mr. W. Thomson describes experiments which show that arsenic is rapidly eliminated from the system by kidney secretion. After the administration of one-fiftieth of a gram of arsenious oxide, about 16 per cent. was found to be eliminated in this way within twenty-four hours. The amount of arsenic in the secretions of people in towns where large metallurgical operations are carried on is found in some cases to be as high as one-thirtieth of a grain per gallon.

A SECOND edition of Prof. Hantzsch's "Grundriss der Stereochemie" has just been published by J. A. Barth in Leipzig. The rapid advances which have taken place in this branch of chemistry during the last ten years have rendered considerable additions necessary. Sections are now included dealing with the stereochemistry of diazo-compounds and complex inorganic bodies, and with the molecular asymmetry of nitrogen, sulphur, selenium, and tin compounds. The connection between configuration and biological activity, the reciprocal transformation of optical antipodes, and the phenomenon of steric hindrance are also treated in the new edition, which should be welcomed by all classes of chemists.

A THIRD edition of the "Elements of the Mathematical Theory of Electricity and Magnetism," by Prof. J. J. Thomson, F.R.S., has been published by the Cambridge University Press. A new chapter on the properties of moving electrified bodies has been added, and other minor changes have been made.

MESSRS. BELL AND SONS have published separately, under the title "Examples in Algebra," a selection of the examples in the recently published "Elementary Algebra," by Messrs. W. M. Baker and A. A. Bourne. The price is 3s., and the new volume may also be had in two parts at 2s. each.

THE yearly volume for 1904 of the *Reliquary and Illustrated Archaeologist* has now been published. The four separate issues, which have been referred to from time to time in these columns, together form a handsome volume. Some articles in the volume will appeal to students of science who are not archæologists. Among these may be mentioned a well illustrated article by Mr. W. H. Legge "About Almanacs," and Mr. F. W. Galpin's "Notes on a Roman Hydraulus."

IN order to meet the requirements of the new syllabus in chemistry of the matriculation examination of the University of London, Dr. G. H. Bailey has taken advantage of the demand for a second edition of his book on chemistry to re-write and enlarge it. In its present form "The New Matriculation Chemistry" contains everything that a candidate at the matriculation examination is likely to require. An introductory course of experimental work has been inserted in addition to other new matter. The volume is published by Mr. W. B. Clive, and edited by Dr. William Briggs.

OUR ASTRONOMICAL COLUMN.

ENCKE'S COMET (1904 *b*).—On a photograph obtained on October 28 with two hours' exposure, using the Bruce telescope, Prof. Max Wolf discovered a faint image of Encke's comet, the apparent position of which at 28d. 7h. 13m. 48s. (Konigstuhl M.T.) was

$$\alpha = 23h.\ 37m.\ 51{\cdot}41s.,\ \delta = +26^\circ\ 0'\ 38''{\cdot}0.$$

A faint tail, extending in a northerly direction, was suspected.

On the same night Prof. Millosevich at Rome was able to find the comet with the 39 cm. equatorial of the Roman College Observatory. The object was extremely faint, and had the following position at 6h. 30m. (October 28, Rome M.T.), $\alpha = 23h.\ 37m.\ 58s.$, $\delta = +26^\circ\ 1'{\cdot}4$.

Prof. E. Hartwig also observed the comet visually, using the large refractor of the Bamberg Observatory, at 9h. 18m. 11s. (Bamberg M.T.) on October 30, and determined the following as its position :—

$$\alpha\ (\text{app.}) = 23h.\ 28m.\ 1{\cdot}01s.,\ \delta\ (\text{app.}) = +25^\circ\ 23'\ 25''{\cdot}1.$$

The comet was very diffuse with a faint central condensation, and a diameter of more than 10′ (*Astronomische Nachrichten*, No. 3977).

OBSERVATIONS OF PERSEIDS.—The results of a large number of independent observations of the Perseid shower of last August, together with a detailed exposition by M. Chrétien of the process by which the positions of meteor radiants may be determined from the observed data by the method of least squares, are published in the November number of the *Bulletin de la Société astronomique de France*.

Among other results, those obtained by M. Perrotin at Nice and by M. G. A. Quignon at Mons are given. The former have already been summarised in these columns; the latter are as follows :—

During a total watch of 7h. 15m. between August 7 and 12, M. Quignon observed 110 meteors, chiefly Perseids, and determined the position R.A. = 44°, dec. = +59°, as the mean radiant point of the shower. The maximum display took place between 22h. 40m. and 23h. 10m. on August 11, when 21 meteors, or 42 per hour, were seen.

HEIGHTS OF METEORS.—In a letter to the November number of the *Observatory* Mr. Denning publishes some data regarding the observed heights of the appearances and disappearances of several different classes of meteors.

He states that, generally speaking, the swift meteors become visible at a greater height than the slower ones, and do not approach so near to the earth's surface before disappearing. Thus for the Leonids and Perseids, both of which are characterised by their comparative swiftness, it has been determined that the former are generally more lofty than the latter, the average heights being as follows :—

	Height at beginning	Height at ending	No. of meteors
Leonids ...	84 miles ...	56 miles ...	25
Perseids ...	80 ,, ...	54 ,, ...	40

On the other hand, the mean heights of the very slow meteors appear to average about 65 miles at the beginning to 38 miles at the end of their appearance. These, however, appear to form two distinct classes :—(1) those having very low radiants, extending from 64 miles to 48 miles; and (2) those having fairly high radiants, extending from 66 miles to 28 miles.

The swiftest meteors apparently become visible when nearly 20 miles higher than the very slow meteors, whilst those of the latter which have high radiants come 20 miles nearer the earth than those having very low radiants.

Seven Quadrantids and four Lyrids gave mean heights of 67 miles to 52 miles and 84 miles to 50 miles respectively.

THE PHOTOGRAPHIC SPECTRUM OF JUPITER.—Using the large refractor of the Meudon Observatory in conjunction with a spectrograph containing one 60° prism and having a focal length of 292 mm., M. G. Millochau obtained a number of photographs of the spectrum of Jupiter during December and January.

A study of the resulting spectra, which were obtained on Lumière panchromatic plates and extend from F to C, showed a number of bands at λλ 618, 607, 600, 578, and 515, which are apparently the same as those observed by Keeler in the spectrum of Uranus. It further disclosed the facts that the water vapour and α bands were greatly strengthened in the planetary spectrum, and that all the bands were relatively more intense in that part which was produced by the light from the south equatorial band of the planet's apparent disc.

The appearance of the band at λ 618, which has been previously observed in the spectra of the superior planets, and of several new faint bands in the Jovian spectrum, indicates the existence of a gas in the atmospheres of the outer planets which does not exist at all, or only in much feebler proportions, in the atmospheres of the inferior planets.

M. Millochau intends to prosecute this research further at the Mont Blanc Observatory, where the clearer atmosphere should permit of better results being obtained (*Bulletin de la Société astronomique de France*, November).

SCIENCE AND THE STATE.[1]

I HAVE long held that there is a certain class of work performed by institutions which should undoubtedly be carried on by some department of the State, specially devoted to such work.

The work to which I refer is such as is not suitable, or to be expected from societies or individuals. It is work which is continuous and must expand in the flux of time, which is recognised by the public as useful, which is not and cannot be remunerative, which requires a staff larger than is required by the ordinary demands of a society, and cannot be dropped without serious detriment to the public.

When there is some pressing need Government does administer branches of a department which has to carry out scientific investigation. Thus the medical branch of the Local Government Board has been laboriously and gradually built up. It is far otherwise, however, with that scientific work which has no department specially interested in or needing it, though it is for the public weal; as the State departments only exist for ministering to that weal, it appears that some department should be created or enlarged to take charge of such work. This view, which I have long held, has been more than confirmed by the evidence given before a recent committee, which the Treasury practically appointed, to consider the present position of the Meteorological Office, but limiting the recommendation to be made so far as the grant made to it is concerned.

Meteorological science has been greatly retarded in Great Britain by want of funds. Perhaps the latest example occurred in 1902, when there was a proposal to obtain further information about atmospheric currents and conditions by the use of balloon and kite observations, an international scheme of work being contemplated. The small sum of 500*l*. a year would have been necessary to carry out this research, but the Royal Society was obliged, on behalf of the Meteorological Office, to reply that they had no funds, a reply which it would have been difficult to make had the Meteorological Office been part of a Government department. Let us look across the water at our American cousins and see how they regard the science of meteorology, and whether or not it is important enough to attach it to the State. According to evidence given to the committee, the Weather Bureau in America, corresponding to our Meteorological Office and forming part of the Department of Agriculture, was spending 230,000*l*. a year on the same work as that of the Meteorological Committee, whose funds at the maximum were confined to 15,300*l*. In Germany, where very large sums are spent on the oceanic part of meteorology, it is a part of the Navy Department. We, with our splendid navy and mercantile marine, surely ought to see that this part of meteorology is as well cared for as it is in Germany, and that there is no lack of funds. The evidence given before the committee showed that without the help of the hydrographic branch of the Navy the work could not have been carried on with anything like success. I am not intending to enter into a discussion of meteorological science, but it has been pointed out that if forecasts are any good (and we have it on record that from 68 per cent. to 75 per cent. of them are successful) they ought to be made as good as possible. There is no doubt that kite and balloon observations, and the use of wireless telegraphy in mid-ocean, would give a still higher percentage of successful forecasts. But the additions must remain in abeyance owing to the money limit which has been fixed at the same standard for so many years.

Again, we find that a very large item of expenditure by the Meteorological Office is the cost of telegrams. It has to pay the same price for the use of the Post Office telegraphs as any private individual, whereas every Government office has the free use of the wires, and has not to consider whether a telegram runs to 12 or 120 words, or whether it sends 1 or 100. The main object of the Meteorological Office is to assist the public, and this is the same as that of Government departments, yet the one is hampered by the cost of publishing information (which to be of the greatest use must be transmitted at once), whilst the other is not. The view of the committee which sat was strongly that this disability ought to be removed, so that wide publicity to weather reports, especially in harvest time, should be given. Finally, the committee almost unanimously reported in favour of the office being attached to some Government department, and proposed that this should be the Board of Agriculture, a department which at present is not overweighted.

I must remind you that our great Indian dependency has been more alive to the question of meteorology than we have at home; but I trust that, backward as we are, we may, before long, attain that excellence of administration which the Indian Meteorological Department has exhibited under its present and past able administrators.

What the Government intends to do with the committee's report I do not know. Judging from previous history, there seems to be a dread at the Treasury of any of the present departments having more to do with science than is absolutely forced upon them. Perhaps this is natural. The lay official mind has, with some few exceptions, never fully grasped the importance of orderly and continued scientific investigation in order to increase national prosperity. It recognises this in a way, for the need is continually brought into prominence by the Press, but to it the easiest plan is to leave all such investigation to societies. In Great Britain it has never been realised that to foster such work is a duty of the nation. We have ignored the very patent fact that in free America and in other countries the necessity of annexing to the State all utilitarian research (when such research is carried out with the definite object of public usefulness) is fully recognised. I am not proposing for an instant that the work which is carried out by individuals or societies should be curtailed, but there are questions which are too large, too expansive, and bearing too much on the public weal which should be dealt with in Great Britain as they are in (say) America.

I have only so far referred to the Meteorological Committee, but, at all events, there is another institution, the National Physical Laboratory, which should come into the same category of quasi-public departments.

The Government has given the National Physical Laboratory buildings, and a sum of 19,000*l*. to make the additions to them, which were absolutely necessary to commence with. It granted 4000*l*. a year for four years, and afforded assistance to it through the Office of Works. The term of years for which the grant was made runs out in March next, and its financial position has to be reviewed by the State through the Treasury. Its existence and development has become a necessity through the excellent work that it has already done. But there is work of first-class importance to the public which the laboratory has been forced to refuse owing to lack of funds. Standardising is not a luxury in the present day, and England has suffered much in its trade owing to the want of it.

The table on p. 91 will show the amounts granted by the different States in regard to these laboratories.

Here we have a direct comparison of grants and turn-out of work. Great Britain, I think I may say, has no reason to be ashamed of the work, though it has of the grants. In connection with the results given in the table, I may point out that France and the United States started their institutions after the inauguration of our own laboratory.

The idea of making any such institution a State institution, it may be supposed, was never entertained by the Government, such a notion being foreign to existing precedent. The precedent—bad precedent too—had to govern the situation. We have only to look across the Atlantic to see how our Anglo-Saxon cousins treat such matters. There, institutions such as I have here described are part and parcel of a State department, and have a handsome annual grant allotted to them. The Government of the United States recognised the public need, and so did Congress, with the result that the public need is catered for by a public department, as it should be.

In regard to the National Physical Laboratory, it is no secret that at the present moment it is hampered by want of funds for equipment and staff. Its refusal of work has only proceeded from this cause. The report which it issued showed that its expenditure had been larger than its income

[1] Abridged from the inaugural address delivered at the Society of Arts on November 16 by Sir William Abney, K.C.B., F.R.S., vice-president and chairman of the council of the Society.

of 9000*l.*, an income which is derived from a variety of sources:—Treasury grant, 4000*l.*; Gassiot Fund, 400*l.* (about); from Meteorological Committee, 400*l.*; fees, &c., 4200*l.* (about). In addition to this there has been 1200*l.* in donations.

Whether the laboratory can become self-supporting is a matter of doubt to my mind. Even if it should be so, that is no reason for taking it away from State control, which always gives an impress to decisions, and it is a pledge that gain is not its only object. Certainly it would never arrive at the proportions that the huge, more than self-supporting department, the Post Office, has arrived at. The example of Germany, where the State takes the fees, and supports the institution, is worth following.

Country	Name	Cost: Building	Cost: Equipment	Annual Grant	Receipts from annual work	No. of tests made	Staff
Germany	Reichsanstalt	£200,000		£16,000	£3,000[2]	22,469	112
	Aichungs-kommission	48,000		8,500	—	—	—
	Versuchsanstalt	137,000		15,000	8,000[2]	5,000	140
		£385,000		£39,500	£11,000	27,469	252
France	Laboratoire de l'état	£27,000 and some buildings.	£20,000	5,500	—	—	12
U.S.A.	Bureau of Standards	£70,000	45,000	19,000	114[3]	1,666[3]	22
Great Britain	National Physical Laboratory	£19,000 including some buildings.	[1]	4,000	4,042[4]	30,807[4]	50

1 The annual grant was made before the work was started, and any balance left after paying salaries I believe was available for apparatus.
2 In these cases the State takes the fees. 3 For the first year. 4 Includes the Observatory Department.

I might refer to researches in solar physics also, which are carried out in the iron shanties at South Kensington, under the control of the Board of Education. The sum of 700*l.* is allotted as a grant in aid for the work that is carried out there, and some of the staff are borne on the estimates; but if, as is to be believed, some of the tremendous problems of the causes of famine and plenty are dependent on the solar phenomena, then this work should be enlarged and encouraged. The expenditure of ten times the sum in one year may enable millions of pounds and lives to be saved which may be lost from the scant supply of needful means. It is true that the Solar Physics Observatory is under the Board of Education, but if its history were written, I doubt not that it would be found that from its very first inception (due to the repeated recommendation of a host of scientific men who foresaw something of what might be expected from it) the State wanted none of it. It may be said that if the Meteorological Office and the National Physical Laboratory were attached to a Government department, they might be starved in the same way. I do not believe it possible that such would be the case, for these two are of ostensible use to the ordinary public, and appeal to that most sagacious and popular person the man in the street, in a way that solar physics does not. The last deals with problems which are for future use, but it is intimately, most intimately, connected with meteorology. If the Meteorological Office becomes attached, as it eventually must be, to a Government department, the Solar Physics Observatory and staff should be attached to the same department.

If the Government will recognise the two institutions as doing essentially public service, and ask for the necessary funds, I believe Parliament would vote the supplies in the same ungrudging manner that Congress has done, as they would look upon them as a paying investment. Parliament realises most frequently before Government does the importance of any public work. The most happy solution of the problem would be (1) to have some department of State to which these and other kindred scientific institutions should be attached; (2) to have a scientific advisory board; (3) to distinguish clearly between grants for research, equipment, and material, and those for staff.

THE BEN BULBEN DISTRICT.

THE region lying north of Sligo, which was visited by a large party of naturalists last July on the occasion of the fourth triennial conference of the Naturalists' Field Clubs of Ireland, is one of much beauty and interest. In its general aspect it recalls the best features of the Yorkshire Carboniferous Limestone area. Its setting, with the great limestone plain of Ireland stretching away on one hand, and the Atlantic Ocean on another, adds a dignity and impressiveness to this group of cliff-rimmed, flat-topped hills which might not be bestowed by their height alone, though they are of no mean elevation (Truskmore, the highest point, rises to 2113 feet). The Ben Bulben range, which derives its name from that of one of its spurs which projects boldly towards the Atlantic, represents the wreck of the Upper Limestone of this district. The fertile undulating low grounds all around are occupied by a lower and more argillaceous series, through which one of the old Caledonian folds of Ireland projects as a knobby ridge, its rugged outlines forming a charming contrast with the green and grey tabular forms of the limestone. The Upper Limestone, 700 feet or 800 feet thick, massive and strongly jointed vertically, rests on the lower series as a cliff-bound plateau, intersected by several grand glens, which are cut through the limestone deep into the less resisting rocks underneath. The mural precipices are the result of the characteristic weathering of the massive limestones. Below them, where not obscured by talus, the Middle Limestones and shales fall away in steep concave slopes into the plain. The exquisite valleys of Glencar and Glenade cut right through the plateau, the first in an east and west direction, the other north and south. Each is from one to two miles wide from cliff-top to cliff-top, and about a thousand feet deep (Fig. 1). The floors of these valleys are undulating, and the scenery is much enhanced by the fact that each embosoms a lake at the point where the cliff scenery reaches its best.

On some parts of the plateau-edge denudation has been more severe, as in the beautiful wedge of Ben Whiskin (1666 feet), the western side of which displays a characteristic precipitous front, while the eastern side has been worn down to a uniform steep slope which drops into Gleniff.

The uniformity of the post-Carboniferous uplift is shown by the almost absolute horizontality of the beds of limestone throughout the region. The surface of the plateau, while retaining in a general way this horizontality, is seen on a nearer approach to be undulating, a feature chiefly due to the fact that patches of the Yoredale sandstone still remain here and there isolated on the surface of the limestone. The whole plateau, limestone as well as sandstone, has in general a thick covering of peat.

To the botanist the Ben Bulben range is well known as the only British habitat of *Arenaria ciliata*, a species with a high northern and alpine distribution, which is locally abundant on these hills. This plant strikes the key-note of the flora of the district, which is essentially northern and alpine in its characters. Adjoining on the south, in Mayo, the Lusitanian heaths, *Erica mediterranea* and *Dabeocia polifolia*, and other plants fully represent the remarkable southern flora which characterises the western sea-board of Ireland, and a few miles on the northern side the same features are repeated in Donegal in the occurrence of *Saxifraga umbrosa*, *Euphorbia hiberna*, and *Trichomanes radicans*. But in the Sligo flora the southern element is absent, saving the occurrence of *Adiantum Capillus-Veneris*, which may be found growing at sea-level in company with *Draba incana* and *Saxifraga aizoides*.

As it is with the plants, so with the animals. The characteristic southern forms of western Ireland are scarcely represented, while northern animals are conspicuous. The Field Club entomologists found *Pelophila borealis* literally to swarm on the shores of Lough Gill, which is only a few feet above sea-level; *Xenylla brevicauda*, an Apteron new

FIG. 1.—Entrance of Glencar. Showing the southern cliff-wall of Carboniferous Limestone, which rises a thousand feet above the valley.

to the British Isles, which accompanied it here, is likewise northern; and other instances might be quoted. Among other results of the Field Club visit (which are fully described in the September number of the *Irish Naturalist*) may be mentioned the discovery of three water-mites, one of which, *Eylais bicornuta*, is new to science, and the two others new to Britain.

COAST EROSION AND PROTECTION.

TWO papers on this subject were recently read at the Institution of Civil Engineers, one by Mr. A. E. Carey on coast erosion, and the other by Mr. E. R. Matthews, the borough engineer of Bridlington, on the erosion of the Holderness coast of Yorkshire.

The first paper deals generally with the whole coast of England, and briefly enumerates the salient geological features of the coast line and points out their connection with the relative rates of erosion. The second paper is confined to the erosion taking place on the Yorkshire coast between Bridlington and Spurn, and the works that have been carried out in constructing promenades, sea walls, and groynes at Bridlington.

There is no novelty in the descriptive parts of these papers. It is a well known and recognised fact that on certain parts of the coast of this country considerable loss of land is taking place by the erosion of the sea. The subject occupied the attention of the geological section of the British Association in 1885, when a committee was appointed to investigate the subject of coast erosion, and reports of experts having local knowledge were obtained from all parts of the coast and printed in the reports issued from time to time, the last, which was confined to recent evidence obtained from the coast guards, being published in the report of the meeting held at Southport in 1903. We have ourselves dealt with the subject in articles in NATURE in our number for June, 1899, and on sea coast and destruction in August 23, 1900. The destruction of the Holderness coast and the protective works put up to stop the erosion at Hornsea, Withernsea, and Spurn were dealt with in a paper by Mr. Pickwell on the encroachments of the sea from Spurn Point to Flamborough Head printed in the *Minutes of Proceedings* of the Institution of Civil Engineers, vol. li., 1878.

The whole subject, both as descriptive of the coast of England, the losses that have taken place, and the works that have been carried out to prevent erosion, is also very fully dealt with in the work on "The Sea Coast" published by Messrs. Longmans in 1902.

Mr. Matthews in his paper makes a statement that has frequently been made before, but for which there does not appear to be any warrant, to the effect that the material eroded from the Holderness coast is carried into the estuary of the Humber. This subject was very fully dealt with in a paper read at the British Association at Glasgow in 1901 on the source of warp in the Humber, in which it was conclusively shown that it is physically impossible for this material to be carried into the Humber, and that, as a matter of fact, no warp is carried into the river from the sea, but that the warp in suspension is derived entirely from the solid matter brought down by the various tributaries of the river. The paper describes this matter as oscillating backwards and forwards with the tides in a zone confined to the lower reaches of the Ouse and the Trent, except that when heavy freshets are running it extends into the Humber and is then partly carried out to sea. This peculiar action is made use of to improve the value of the land adjacent to the rivers by the process of "warping." Any solid matter brought into the Humber on the flood tide consists entirely of clean sand, and has no relation to the waste of the Holderness coast.

The only novel features, therefore, in these papers is the suggestion of Mr. Carey that the matter should be taken up by Parliament, and that a body of commissioners should be created with the special function of dealing with the foreshores of England and Wales. He proposes that the coast should be divided into districts placed under commissioners, each having an engineer to act as coast warden, with power to deal with the material on the beach, and the general control and management of all foreshore lands, the costs incurred by this commission to be divided between the Treasury, the local authorities, and the landowners.

Mr. Matthews confines his ideas of Government interference to the coast of Yorkshire, and suggests that this ought to be protected against the inroads of the sea by the Government, quoting as a precedent for this that the Board of Trade protects the Spurn Peninsula. He loses sight, however, of the fact that this is done for the protection of the lighthouses which stand on the peninsula, and for the preservation of the entrance to the Humber. Mr. Matthews gives an estimate for protecting this reach of coast by sea walls and groynes, and shows, as has been done by others on previous occasions, that the value of the land swallowed up by the sea within a reasonable period would not amount to one-third of the first cost of the protective works, apart from their maintenance.

It will be remembered that recently, owing to the great destruction of sea protective works that occurred at Lowestoft and Southwold, the representatives of the sea coast towns on the east of England held a conference at Norwich and appointed delegates to interview the Prime Minister and the officials of the Government departments more particularly concerned in this matter, urging that the preservation of the coast and the sea defence works ought to be a national charge. So far, however, they do not appear to have justified their claims for such aid. It has been pointed out that most of these towns have gradually emerged from mere fishing villages into sea-side resorts, and have erected promenades and other similar works for the purpose of making their places popular, and have by this means increased the value of the land in the neighbourhood from a mere agricultural price to that of building land, very greatly to the profit of the owners of such land. It appears therefore manifestly unfair to ask the owners of the agricultural land at the back, whose rents have already been greatly depleted by the fall in value of agricultural produce during the last few years, to contribute towards works for the improvement of their neighbours' land on the coast, which they would have to do if these works were made a charge on the national revenue, and it would be equally unjust to levy contributions on inland towns which have borne the costs of large improvements for sanitary and health purposes out of their own rates.

Mr. Carey describes in his paper the evolution of a sea-side village, subject to intermittent inundation, into a watering place, in front of which the local authority charged with the works not only encloses within the sea wall nearly the whole of the shingle beach which afforded a natural protection to the shore, but also by groynes traps the whole of the travelling shingle, with disastrous results to the owner of the land to leeward. It may also be pointed out, as stated in the British Association report for 1895, that many of the disasters that occur to the sea walls and promenades of these sea-side towns are due to defective engineering and a complete disregard of the laws of nature.

It is obvious that it would be very desirable to set up some better control over the works now carried on along the sea shore either by increasing the powers of the Board of Trade or by the appointment of a special commission, as suggested by the author of the paper. The great difficulty will be in dealing with the rights of the persons claiming the ownership of the beach material, which in many cases is sold and removed in very large quantities for concrete making, road repairs, or other purposes. The Board of Trade occasionally, on being applied to, intervenes and issues notices prohibiting the removal of sand and shingle, but its power to do so is not so well defined as it ought to be, and the whole subject requires investigation, and legislative action for regulating and controlling works carried out on the sea shore and the removal of beach material; but the preservation of the property of landowners and urban authorities out of funds provided from the national exchequer would be entirely contrary to the methods of administration hitherto pursued in this country.

THE NOVEMBER METEORS OF 1904.

THOUGH there was no prospect of a brilliant display this year, there seemed the probability of a pretty conspicuous shower. In 1838—five years after the great meteor-storm of 1833—Mr. Woods, of London, reported in the *Times* that on the night of November 12, between 15h. 25m. and 15h. 55m., "nothing could exceed the grandeur of the heavens. Meteors fell like a shower of bombshells in a bombardment and in such rapid succession as to defy every attempt to watch their particular directions or to ascertain their numbers." Mr. Woods estimated that he saw 400 or 500 meteors during the half-hour mentioned.

In 1872 also, about five years after the brilliant displays in 1866, 1867, and 1868, the Leonids returned pretty abundantly, for on November 13, 12h. to 18h., several observers at Matera, Italy, counted 638 meteors, and the display was regarded as having been much brighter than usual.

In these circumstances it was expected that the return of 1904 would be deserving of careful observation, and so it has proved, though the shower was perhaps not quite so rich as expected. The earth, however, probably passed through the denser part of the stream at about Greenwich noon on November 15, and thus it must have escaped observation in England. Reports from American stations are awaited with interest. In this country fogs were very prevalent at the important time, and at some places appear to have obliterated the phenomenon.

At Bristol during the night of November 13 there were very few meteors visible, with only occasional Leonids, but the stars were dim in the fog.

On November 14 the conditions were more favourable. Between 13h. 30m. and 15h. 45m. about 55 meteors were seen (including 33 Leonids) by the writer during a watch extending over $1\frac{1}{2}$h. of the period named. It was considered that Leonids were appearing at the horary rate of 25 for one observer. After 16h. increasing fog interfered with observation. The Rev. S. J. Johnson at Bridport had, however, a very clear sky after 16h., and noted a fairly numerous display of Leonids, including one as brilliant as Venus and several equal to Jupiter. He does not mention the exact number seen.

Mr. C. L. Brook at Meltham, near Huddersfield, watched on November 14 between 16h. and 18h., and counted 69 Leonids, of which number 17 were observed in the first quarter of an hour. Other results have come to hand which corroborate Mr. Brook's figures, and show that the maximum was attained between 15h. 50m. and 16h. 20m., when the rate of apparition was 1 Leonid per minute in the sphere of vision commanded by one observer.

There appear to have been very few Leonids seen either on the nights of November 13 or 15.

As observed at Bristol, the radiant seemed to be an area 4 or 5 degrees in diameter, with its centre slightly west of γ and ζ Leonis, or at $151^\circ+23^\circ$. There were several minor showers visible, and two of these were well pronounced at $43^\circ+21^\circ$ and $144^\circ+37^\circ$.

W. F. DENNING.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Rhodes trustees have decided to add 200*l.* a year for the next five years to the stipend of the reader in pathology. Mr. Alfred Beit and Mr. Wernher have supplied sufficient money to endow a professorship of colonial history, and to appoint an assistant professor in the same subject. They have also made a gift to the Bodleian Library.

Magdalen College has made a grant to the delegates of the university museum of 250*l.* a year for the next two years for the purpose of the payment of scientific assistants. The following examiners have been appointed:—in chemistry, W. H. Perkin, jun.; in preliminary physics, E. S. Craig; in preliminary chemistry, J. E. Marsh; in preliminary animal physiology, W. Ramsden; in preliminary zoology, E. S. Goodrich; in medicine, organic chemistry, N. V. Sidgwick; in human anatomy, A. Thomson; in materia medica, R. Stockman; in midwifery, J. S. Fairbairn; in pathology, G. Sims-Woodhead; in forensic medicine and public health, J. D. Mann and A. L. Ormerod; and in human physiology, L. E. Hill.

THE Treasury, at the instance of the Colonial Office, has made a grant of 500*l.* a year to the Liverpool School of Tropical Medicine.

THE prizes and certificates gained by students at the Sir John Cass Technical Institute during the past session will be distributed by Sir William H. White, K.C.B., F.R.S., on Thursday, December 1. The laboratories and workshops of the institute will be on view, and there will be exhibitions of students' work.

AT Bedford College for Women two occasional lectures, open to the public without fee, will be delivered on November 25 and December 8. The first lecture will be by Prof. Karl Pearson, F.R.S., on "Recent Work and some Unsolved Problems in Heredity," and the second by Miss C. A. Raisin on "London, its Early Foundation and Later Growth, a Geological Study."

THE alumni of the Massachusetts Institute of Technology are collecting, says *Science*, a fund for current expenses, which now amounts to more than 20,000*l.*, to be used in the course of the next five years. We learn from the same source that Harvard University has received from Miss Whitney a gift of 1000*l.*, the income of which is to be applied as a scholarship to aid meritorious students in the study of field geology or geography in the summer months, preferably in the mountain region of the western United States.

APPLICATION will be made to Parliament in the ensuing session for an Act to transfer University College, London, exclusive of the North London or University College Hospital, the medical school, and the boys' school, to the University of London, and to dissolve or provide for the dissolution of the college itself. The Bill will contain a clause authorising and providing for the making by the Senate of the university, or by such other body or persons as the Act may prescribe, of statutes and regulations for the management of the college; and provision will also be made for carrying on the work of the hospital, the medical school, and the boys' school.

THE new buildings of the Borough Polytechnic Institute were opened by Mr. Benn, chairman of the London County Council, on November 16. The buildings, which were urgently needed for the large number of students, have cost with equipment more than 24,000*l.* Toward this amount the central governing body of the City of London Parochial Charities contributed 3000*l.*, the London County Council 16,000*l.*, with a promise of a further sum. The council also meets the cost of installation of the electric light and equipment, amounting to 2950*l.* The total cost of the land, about $1\frac{3}{4}$ acres, buildings and equipment, by the end of the year will be not less than 96,000*l.*

WITH the object of giving to the school children of the United Kingdom better knowledge of the colonies, and of giving to the school children of each colony better knowledge of the United Kingdom and of other parts of the Empire, a syllabus of seven lectures on the United Kingdom, each to be illustrated by about forty lantern slides, has been drawn up by a committee connected with the Colonial Office. The subjects of the lectures are:—(1) the journey from the East to London; (2) London the Imperial city; (3) scenery of the United Kingdom; (4) historic centres and their influence on national life; (5) country life and the smaller towns; (6) great towns, the industries, and commerce; (7) defences of the Empire. Mr. H. J. Mackinder will give an account of the scheme, and exhibit some of the slides which have been prepared to illustrate it, at the Whitehall Rooms, Hôtel Métropole, on Wednesday, December 7, at 5 p.m. The Colonial Secretary has consented to preside.

AT the inaugural meeting of the new session of the Royal Statistical Society on November 15, the new president, Sir Francis Sharp Powell, Bart., M.P., delivered an address on education in which he presented specially impressive figures to illustrate prominent educational features of various countries. The activity in educational matters of to-day was commended, and attention directed to the growing conviction that a more liberal education than that provided by purely technical instruction is necessary in this country. Among other interesting comparisons instituted in the address was one dealing with the average expenditure on education per child in Prussia and in England. Exclusive of central and local administration, it appears that the average expenditure per child on the register is in Prussia 1*l.* 15*s.* 6*d.* if buildings are included, and 1*l.* 10*s.* 8*d.* exclusive of buildings. The corresponding figures in England are 2*l.* 12*s.* 9*d.* and 1*l.* 17*s.* Further, the number of scholars per teacher is 66 in Prussia and 57 in England, excluding pupil teachers. It seems clear from these figures that Germany, with a smaller expenditure per child than our own, succeeds in securing better results, and it is to be hoped that English education soon may be conducted more scientifically, so that the value of our education may be more in accordance with our expenditure. The address also pointed out that in secondary education German activity is shown in the provision of technical schools for special branches of metal industries, for wood-working, engineering, and textile industries, and for agriculture.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 16.—"Hydrolysis of Cane Sugar by *d*- and *l*-Camphor-β-Sulphonic Acids." By R. J. **Caldwell**, B.Sc.

The rates of inversion of cane sugar by two stereoisomeric acids were determined in order to compare the results with the case of inversion by enzymes, which are apparently all asymmetric substances. Wilhelmj's law holds accurately for half normal solutions of both dextro- and lævo-camphor-β-sulphonic acids. The velocity constant κ (equal to $10^4/t \log_{10} a/a-x$, where a is the initial cane sugar concentration, and x the concentration of the inverted sugar at the end of t minutes) was found to be 10·07 and 10·13 in two experiments with the dextro-acid, and 10·05 and 10·08 for the lævo-acid. The author concludes that there is no difference in the inverting power of the two acids attributable to their asymmetric structure. This result is in accord with the conclusion arrived at by Emil Fischer regarding the *d*- and *l*-camphoric acids (*Zeits. Physiol. Chem.*, 1898, vol. xxvi. p. 83). The relative activities of hydrochloric acid and camphor-β-sulphonic acid towards cane sugar are 100 : 90, whereas for milk sugar the ratio is 100 : 70.

November 17.—"Enhanced Lines of Titanium, Iron, and Chromium in the Fraunhoferic Spectrum." By Sir J. Norman **Lockyer**, K.C.B., LL.D., F.R.S., and F. E. **Baxandall**, A.R.C.S.

In this paper the authors give the results of a detailed study of the enhanced lines of Ti, Fe, and Cr in relation to the lines of the Fraunhoferic spectrum. In previous Kensington publications it had been shown that the enhanced lines of some of the metals are prominent in the spectra of α Cygni and the sun's chromosphere, whilst it has been generally recognised that the lines in the Fraunhoferic spectrum are mainly the equivalents of lines in the arc spectra of metals. In connection with the work on enhanced lines, it has been noted that some of them, at least, appear to correspond with comparatively weak solar lines to which Rowland has attached no origin. With the object of possibly tracing some of the unorigined solar lines to their source, a careful comparison has been made between the enhanced lines shown in the photographic spark spectra of Ti, Fe, and Cr and the solar lines. The photographs used for this purpose were all taken with a Rowland grating, and on such a scale that the length of spectrum between K and F is about 14 inches (35 cm.). The chemical elements named were first selected for investigation because they furnish by far the greater number of enhanced lines which have been shown to occur in the spectrum of α Cygni.

It was found that many of the enhanced lines fell exactly on isolated lines of the solar spectrum, and in these cases the solar wave-lengths were adopted and the identification considered established. If, however, for any of these solar lines Rowland had given alternative origins, special comparisons were made of the enhanced line photograph with those of the metals given by Rowland. Notes (given at the end of the tables) were made as to the agreement or non-agreement of the metallic lines involved, and also of the relative intensities in their individual spectra, so that due weights could be given to the respective metallic lines which were thought conjointly to produce compound solar lines.

Where there was any doubt as to the exact coincidence of a metallic and solar line, or where by the close grouping of several solar lines it was not possible to say by direct comparison to which solar line the metallic line corresponded, careful measures were made of the metallic line, and its wave-length found by interpolation between closely adjacent lines of known wave-length. The resulting wave-lengths were then compared with Rowland's solar wave-lengths, and in cases of close agreement with solar lines it was deemed probable that the two lines were really identical.

A final table is given of the enhanced lines of the three elements which are considered, as a result of the analysis, to be identical with lines in the Fraunhoferic spectrum. Forty-two of these agree with solar lines unorigined by Rowland, and as the majority of them are conspicuous lines in stellar spectra of certain types, it has been thought that these results will be of importance in standardising the wave-lengths of many stellar lines.

Physical Society, November 11.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—Investigation of the variations of magnetic hysteresis with frequency: Prof. T. R. **Lyle**. The experiments were made on two rings of laminated annealed iron, in one of which the radial breadth of the iron was considerable relative to its mean radius. These rings were magnetised by alternating currents of different strengths and periods; both the magnetising-current wave and the magnetic-flux wave were quantitatively determined by a wave-tracer (described by the author in the *Phil. Mag.*, November, 1903), and the wave-forms so obtained subjected to harmonic analysis. The experiments were divided into series, in which the period and wave-form of the magnetising current were kept as nearly constant as possible throughout any one series, while its strength was varied. The analytic expressions for the associated current and flux waves for a few series are given in tabular form. From the analytic expressions for each pair of associated waves it was found that when the magnetising current was approximately sinusoidal the total iron loss (I) was, within certain limits of the induction, given by a formula $I=(a+bn)\mathfrak{B}^{1\cdot57}$ where n is the number of periods per sec., $\mathfrak{B}$ the "effective induction," and a and b are constants. When from the total iron loss per c.c. per cycle the sum of the statical hysteresis and the value that theory assigns to eddy-current loss was subtracted, a considerable quantity remained, which increased both when the frequency and the flux-density increased. This quantity, called by Fleming the kinetic hysteresis, has been obtained for each experiment.—On the practical determination of the mean spherical candle-power of incandescent and arc lamps: G. B. **Dyke**. Mr. Dyke points out the need of an improved method of expressing the efficiency of glow-lamps, and adopts the suggestion of Dr. Fleming of expressing the whole flux of light in lumens per watt. The expression of the efficiency in this manner involves the determination of the mean spherical candle-power (M.S.C.P.), and the paper describes a method of doing this. The objects of the paper are:—(1) to obtain curves showing the variations of candle-power of glow-lamps in a horizontal plane; (2) to obtain reduction factors by which the mean horizontal candle-power (M.H.C.P.) may be calculated from the maximum horizontal candle-power (C.P.); and (3) to obtain reduction factors for deducing the M.S.C.P. from the M.H.C.P. and from the C.P.—Exhibition of apparatus: R. W. **Paul**. The construction of highly sensitive pivoted electrical instruments has been rendered difficult by the fact that delicate pivots will not admit of transporting without injury. A number of galvanometers were shown in which the design was based upon the use of a moving coil, supported on one pivot in a powerful and uniform magnetic field, and controlled by a spring. A simple non-reflecting, suspended-coil galvanometer for the student's use, with a sensibility of 1 division per micro-ampere, was also exhibited. A new design of lantern, adapted for science lectures, and for use with three Nernst filaments arranged closely together, was shown in action. It is capable of being instantly changed from horizontal to vertical projection, can be fitted with a reversing prism, and has a wide adjustment for focusing. Another exhibit was an Ayrton Mather reflecting electrostatic voltmeter with a magnetic damping device. The instrument shown had a sensibility of 500 mm. at 1 m. for 30 volts, but similar instruments are made to give this deflection with pressures as low as 8 volts.

PARIS.

Academy of Sciences, November 14.—M. Mascart in the chair.—Researches on the desiccation of plants: the period of vitality. Moistening by liquid water: imperfect reversibility: M. **Berthelot**.—New researches on the Cañon Diablo meteorite: Henri **Moissan**. A very careful and complete examination was made of a block of this meteorite weighing 183 kilograms. It was found to be distinctly heterogeneous in structure, containing iron, nickel, sulphur, phosphorus, silicon, and carbon. The latter element was present in several forms: amorphous carbon, graphite, and diamonds, both the black and transparent variety of the diamond being separated. Characteristic green hexagonal crystals of silicon carbide were also isolated, the author remarking that this is the first time that this compound has been met with in nature.—The measurements of the velocity of propagation of earthquakes: G. **Lippmann**. An instrument is described capable of determining to 1/5 of a second the exact time of the commencement of a seismic shock at any given point. The author also discusses the following problem: to find the direction of the seismic wave front at the surface of the earth, in a given region, and to measure the velocity of its horizontal propagation.—On the inscription of seismic movements: G. **Lippmann**. In the photographic self-recording apparatus in common use for earthquake phenomena, owing to the considerable expense of the strip of sensitised paper, its velocity through the apparatus is very slow, about 12 cm. per hour. In the modification now proposed, the slit through which the ray of light falls on the paper is closed by a shutter, and this is operated electrically by the seismic shock. By this means the speed may be greatly increased, since the paper is only used up during the period of the earthquake shocks.—On the seeds of the Neuropterideæ: M. **Grand'Eury**. As the result of the examination of more than 1000 specimens of fossil seeds, usually attributed to ferns, the author distinguishes 15 genera or subgenera of Neuropterideæ, and 25 specific types.—Remarks on Hugoniot's adiabatic law: M. **Jouguet**.—On the use of helium as a thermometric substance and on its diffusion through silica: Adrien **Jaquerod** and F. Louis **Perrot**. An attempt to determine the melting point of gold with a thermometer of fused silica, and containing helium, failed owing to the rapid diffusion of the gas through the silica at the high temperature. The velocity of diffusion appears to be proportional to the pressure of the gas, and is very considerable, since after six hours' heating at 1100° C. the pressure of the helium had fallen to about one-seventh of the initial pressure. Below a red heat, at about 510° C., the diffusion is still fairly rapid, and a very slow effect could even be traced at 220° C. For practical purposes, therefore, the nitrogen thermometer remains the best instrument for high temperatures.—Researches on dielectric solids: V. **Crémieu** and L. **Malcles.** In the course of his researches on electric convection, Crémieu observed some anomalies of electrical influence through solid dielectrics. The authors have commenced a systematic study of these phenomena, and give an account in the present paper of the apparatus used, reserving the results for a future communication.—On the conductivity of gases from a flame: Paul **Langevin** and Eugène **Bloch.** The coefficient of re-combination of the ions from a flame has been measured, and found to be equal to about 0·7. This value is less than one, as the theory requires, and is much greater than in the case of the Röntgen rays.—On the absorption of hydrogen by rhodium: L. **Quennessen.** Contrary to the statement given in the text-books, the absorptive power of rhodium for hydrogen is nil. Rhodium is not analogous with palladium in this respect.—The action of boric acid on the alkaline peroxides and the formation of perborates: George F. **Jaubert.** By the action of boric acid upon sodium peroxide a perborate of sodium is formed, the analysis of which leads to the composition $Na_2B_4O_8,10H_2O$. On re-crystallising this a substance possessing more oxygen, $NaBO_3,4H_2O$, is formed, and this is very stable at the ordinary temperature, although decomposed rapidly at 100° C. The latter substance, treated with 50 per cent. sulphuric acid, gives after filtration through guncotton a solution of hydrogen peroxide of a strength of 150 to 200 volumes.—On thioformic acid: V. **Auger.** The author has shown in a previous paper that the substance regarded by Wöhler and Limpricht as thioformic acid is in reality trithioformaldehyde. The method which was found to give the best yield of sodium thioformate was the interaction of sodium hydrogen sulphide with phenyl formate. The latter substance was incidentally obtained in the pure state for the first time, and details of its preparation are given.—The synthesis of $\beta\beta$-dimethyladipic acid: G. **Blanc.**—On a new sugar from the berries of the mountain ash: Gabriel **Bertrand.** The sugar is isomeric with, but distinct from, sorbite and mannite, and is provisionally named sorbierite. Its physical properties are given, and its composition as a hexahydric alcohol determined by the production of a hexacetate.—The development of the organic material in seeds during their ripening: G. **André.**—On the detection of cotton seed oil in olive oil: E. **Milliau.** The test proposed is a modification of the reduction test with silver nitrate.—Anhydrobiosis and tropisms: Georges **Bohn.**—On the growth of man and of living beings in general: Charles **Henry** and Louis **Bastien.**—The evolution of the weight and organic material of the leaf during necrobiosis in white light: L. **Beulaygue.**—On heterogeneity in the Stichodactyline group: Armand **Krempf.**—The comparative influence of some organic compounds of phosphorus on the nutrition and development of animals: A. **Desgrez** and A. **Zaki.**—On the inoculation of cancer: M. **Mayet.**—On the bleaching of flour by electricity: M. **Balland.** The treatment of flour by electrified air has a bleaching action, and produces chemical changes corresponding to the effect of age.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 24.

ROYAL SOCIETY, at 4.30.—On the Refractive Indices of the Elements: C. Cuthbertson.—The Flow of Water through Pipes. Experiments on Stream-line Motion and the Measurement of Critical Velocity: Drs. H. T. Barnes and E. G. Coker.—On Galvanic Cells produced by the Action of Light. Preliminary Communication: Dr. M. Wilderman.—Some Physical Characters of the Sodium Borates, with a New and Rapid Method for the Determination of Melting Points: C. H. Burgess and A. Holt, jun.—On the Convergence of Infinite Series of Analytic Functions: H. A. Webb.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Hydrodynamical and Electromagnetic Investigations regarding the Magnetic-Flux Distribution in Toothed-Core Armatures: Prof. H. S. Hele-Shaw, F.R.S., Dr. Alfred Hay, and P. H. Powell.

FRIDAY, NOVEMBER 25.

PHYSICAL SOCIETY, at 5.—The Measurement of Small Differences of Phase: Dr. W. E. Sumpner.—On the Curvature-method of Teaching Geometrical Optics: Dr. C. V. Drysdale.—(1) Exhibition of Specimens of Crystals showing the Phenomenon of Luminous Rings; (2) On a Rapid Method of Approximate Harmonic Analysis: Prof. Silvanus P. Thompson.—Exhibition of Apparatus by Prof. Dalby, Mr. Darling, Dr. Drysdale, and Prof. Thompson.

SATURDAY, NOVEMBER 26.

ESSEX FIELD CLUB (at Essex Museum, Stratford), at 6.30.—Delegate's Report British Association: F. W. Rudler.—Notes on Supposed Lake Settlement at Skitt's Hill, Braintree: F. W. Reader.—Coast Erosion in East Anglia: John Spiller.

MONDAY, NOVEMBER 28.

SOCIETY OF ARTS, at 8.—Musical Wind Instruments: David J. Blaikley (Cantor Lecture I.)

INSTITUTE OF ACTUARIES, at 5.—Inaugural Address by the President, Mr. Henry Cockburn.

TUESDAY, NOVEMBER 29.

ZOOLOGICAL SOCIETY, at 8.30.—Some Observations on the Field Natural History of the Lion: Capt. Richard Crawshay.—On some Nudibranchs from East Africa and Zanzibar. Part VI.: Sir Charles Eliot, K.C.M.G.—The Altai Lynx: R. Lydekker, F.R.S.—On Old Pictures of Giraffes and Zebras: R Lydekker, F.R S.—On the Morphology and Classification of the Asellota Group of Crustaceans, with Descriptions of the Genus Stenetrium and its Species: Dr. H. J. Hansen.—On the *Lacerta depressa* of Camerano: G. A. Boulenger, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion*: Distribution of Electrical Energy: J. F. C. Snell.

WEDNESDAY, NOVEMBER 30.

SOCIETY OF ARTS, at 8.—The British Canals Problem: Arthur Lee.

THURSDAY, DECEMBER 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—The Ascent o Water in Trees: Dr. A. J. Ewart.—On the Presence of Tyrosinases in the Skins of some Pigmented Vertebrates. Preliminary Note: Miss F. M. Durham.—On Chemical Combination and Toxic Action as Exemplified in Hæmolytic Sera: Prof. R. Muir and C. H. Browning.—Histological Studies on Cerebral Localisation. Part II.: Dr. A W. Campbell.

CHEMICAL SOCIETY, at 8.—The Nitrites of the Alkali Metals and Metals of the Alkaline Earths, and their Decomposition by Heat: P. C. Rây.

RONTGEN SOCIETY, at 8.15.

LINNEAN SOCIETY, at 8.—Proteid Digestion in Animals and Plants: Prof. Sidney H. Vines, F.R.S.

FRIDAY, DECEMBER 2.

AERONAUTICAL SOCIETY, at 8.—The Aëronautical Exhibits at the St. Louis Exhibition: the President, Major B. Baden-Powell.—Kites, Kite-flying and Aëroplanes: W. H. Dines.—The Work of the International Aëronautical Commission: Dr. M. H. Hergesell.—Captive Balloon Photography: Griffith Brewer.

CONTENTS.

THURSDAY, DECEMBER 1, 1904.

DAI NIPPON.

Dai Nippon, the Britain of the East, a Study in National Evolution. By Henry Dyer, D.Sc., &c. Pp. xvi+450. (London: Blackie and Son, Ltd., 1904.)

THE story of how Japan jumped from what she was to what she now is will always form one of the most remarkable episodes in the history of material civilisation. Not only is it this, but it is also a remarkable illustration of the results that can be achieved by occidental education fostered by and implanted on a system of oriental ethics.

This story, under the title of "Dai Nippon," or "Great Japan," is told by Dr. Henry Dyer, who for about ten years was principal of the College of Engineering in Tokyo. From it we learn that Japan has taken from Europe and America every concrete aid to progress on which she could lay her hands, and in return for this she now offers a code of morals. When we realise that it is Japanese ethics which are at the base of Japanese character, and that these ethics led to the desire to acquire European knowledge, they commend themselves for close consideration.

We may give water to a horse, but to make him drink is another matter. In a similar manner we may cover a country with schools, but to induce people who have neither the ability nor desire to learn to take advantage of such schools is a formidable task. The Japanese had ability in a marked degree. Their extraordinary power of memorising, which the few Europeans who have noticed the same have only regarded as an abnormal curiosity, may possibly be the resultant of committing to heart the sayings of eastern sages and endless idiographs. A philosophy which had sunk into the hearts of the people while many Europeans still revelled in a feral state no doubt played its part in the suggestion that it was advisable to fall in line with western progress. The main lever, however, which forced Japan from its insular Utopia into the never-ending struggle amongst the comity of nations was the feeling that national and personal honour had been affronted. A civil war was ended, the Tokugawa party had been defeated, and the feudal barons had been united under the Emperor who still reigns. Internal dissensions had ceased, but western demands had settled like a cloud upon the nation. Treaties had been made with thirteen States, each of which had its courts of justice; Japan was powerless to fix its tariffs; Yokohama was policed by a British regiment, and legations kept their guards. In these and other directions Japan felt that, notwithstanding she possessed a culture about which the man in the street is yet profoundly ignorant, she was humiliated and looked down upon as an inferior. Buddhism and Shintoism had resulted in an extraordinary patriotism and loyalty, while the "Bushido" of the "Samurai" gave a system of moral principles "which entered more deeply into the national life of Japan than do those of the religion we profess into Western civilisation."

Among these ethical teachings those bearing upon wisdom, benevolence, and courage were preeminent. Wisdom meant intellectuality rather than mere knowledge. Benevolence resulted in social relationships, so that beggars are practically unknown, whilst State aid for the poor is seldom sought. Courage embodied the idea that it is better to die for one's country rather than yield. Commerce had always been looked down upon as a low pursuit. A nation saturated with such ethical teachings was naturally proud of her autonomy, and sought to escape from occidental restrictions. The escape she chose was by an education in western utilitarian knowledge, wisely backed by an army and a navy.

In 1868, when the present Emperor ascended the throne, he took an oath embodying five principles, the objects of which were to act as beacons in the ocean of international struggles of the world. In the fourth of these we read that "all purposeless principles and useless customs" were to be discarded, whilst the fifth directs that "knowledge and learning shall be sought after throughout the whole world, in order that the status of the Empire of Japan may be raised ever higher and higher." When this announcement was made the education of Japan chiefly consisted in memorising Chinese classics and characters, learning to reckon on the abacus, and studying history and edicts. Knowledge relating to science and its applications was almost non-existent, and we can well imagine the doubts of those who were entrusted with the administration of the imperial command as to the courses they should follow. In 1871 a department of education was created, and with it schools of various grades were established throughout the country. The children of the lower classes, including females, were admitted, while the schedules of study of preexisting schools were re-modelled. At the present time it may be said that Japan bristles with schools, and that there is not an ignorant family in the country.

A child, possibly commencing at a kindergarten, is admitted to a common school at the age of six. After four years he passes to a higher grade school, where there is also a four years' term. Above this there is a middle school with a five years' term. Graduates from this school can by competitive examination pass to one of six higher middle schools, above which stand two imperial universities, in connection with which there are colleges of literature, science, medicine, engineering, law, and agriculture. The number of elementary schools is 27,109. Usually no fees are charged, but in special cases the local governor may allow charges varying between $2\frac{1}{2}d.$ and $5d.$ per month.

In the training of children moral education takes precedence of instruction in facts of practical use in daily life. Bodily development is not neglected, but good manners and etiquette rank higher than minds stored with information.

In the secondary schools, although mathematics, natural history, physics, chemistry, and other subjects are taught, we again find—and find in institutions of all grades—that "morals" (without religious dogma) head the list. It is clear that the Japanese want good citizens, citizens who recognise the symbol of authority

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rather than practical demonstrations of the same. In Japan a crowd will halt before a straw rope on which flutters a tiny paper notice. In Europe police and truncheons might be required. The good manners of the East are hardly so superficial as popularly imagined. They are the outcome of their philosophy emphasised by special training, the end of which is "to cultivate your mind that even when you are quietly seated not the roughest ruffian can dare make an attack on your person."

The higher secondary schools are preparatory to the universities, the objects of which are to teach "such arts and sciences as are required for purposes of the State." To each is attached a university hall, which is established for purposes of original research. In the six colleges forming the university the professors and assistants number 245, and the students 3121. The entrance fee is 2 yen, and the annual tuition fee is 25 yen (1 yen = 2*s*.). For those who cannot proceed to the universities, industrial, agricultural, commercial, and other technical schools have been established. In 1902 there were 845 such schools, attended by 55,596 scholars. The expenditure on these in 1902 was 2,739,297 yen, of which 285,253 yen was State aid. The total annual expenditure by the Government in connection with the educational department is roughly six million yen (600,000*l*.).

In addition to the schools mentioned, Japan has its naval, military, art, and music schools. Over and above these, again, we find educations in departments of life which in Europe have received but little attention. Chess, or rather "*go*," clubs are common throughout the country, and for proficiency in the game certificates are awarded. Certificates can also be obtained in the art of flower arrangement, an art which has its terminology and canons, but which in Europe finds its perfection in "studied negligence."

In connection with education, a point which Dr. Dyer has not emphasised, but which is in strict accordance with the imperial edict of 1868, is that the Government keeps up a stream of its best educated men flowing round the world, each being a specialist, visiting countries and institutions with the object of gathering together what is valuable in his own vocation. Originally it was the Japanese student who was sent abroad; now it is the professional man. You may not know it, but often he may be able to give more information than he receives. Generally speaking, in Dr. Dyer's words, the Japanese Government finds that money spent on education is a good national investment.

The chapters devoted to industrial development, the army and navy, commerce, politics, and other subjects are as interesting and full of information as those bearing upon education.

With regard to the future of Japan, Dr. Dyer tells us that his ideas are decidedly optimistic, and he believes "that in material, intellectual and moral influence Japan will fully justify her claim to be called the Britain of the East." So far as the concrete adjuncts of civilisation are concerned, Japan might be pleased could she be on the same platform as her ally, but it is doubtful if she aspires to much more. Her 46 millions of people have smiling faces, their courtesy and politeness have attracted the attention of all travellers, they are scrupulously clean and see a bath-tub every day, to show anger is to put yourself on a level with a dog, and should two persons have an altercation, for one to dub the other as a "shaba fusagi" or an "impeder of the world's progress" would be an epithet not to be forgiven. The courage of her soldiers needs no comment, while the endurance of a "jinricksha" man, who for a week can pull a heavy European with his baggage 40 or 50 miles per day, is, from an occidental point of view, quite phenomenal.

The Japanese are temperate, frugal, modest, and happy, while the world knows that they possess artistic instincts. In many directions a Japanese is distinctly superior to the European. The nation has a soul, and if we reflect on the components which make up that soul—the soul of Ruskin—it seems that in certain directions European countries might be benefited if only they were able to raise themselves to the level of Dai Nippon. Although by the opening of the country much has been gained, there are many signs indicating that the blessings have not been unalloyed. Commerce, competition, and the accumulation of wealth have been accompanied by increasing poverty, whilst those whose vocations have been at the open ports have acquired the manners of those with whom they came in contact. So far is this marked that a Japanese who has been a servant in a European house may be handicapped in obtaining similar employment amongst his own people. To say the least, he has become too brusque. Side issues of this nature may cause a nation to regard with regret the disappearance of old conditions, but, taking all in all, Japan has gained more than she has lost. She is no longer a pupil, but a teacher.

SYLVESTER'S MATHEMATICAL PAPERS.

The Collected Mathematical Papers of James Joseph Sylvester. Vol. i., 1837–1853. Pp. xii+650. (Cambridge: University Press, 1904.) Price 18*s*. net.

THE appearance of this volume is very welcome for more reasons than one. Sylvester's papers were published in a variety of journals, and generally contained a considerable number of misprints; they will now be available in an attractive form, with their accidental blemishes removed by a very careful and competent editor. The work of preparing these papers for the press must be troublesome and tedious, and the thanks of mathematicians are due to Dr. Baker for having undertaken it. Special attention should be directed to the note at the end of the volume on Sylvester's theorems about determinants, some of which require correction.

The papers here published range in date from 1837 to 1853. The first three relate to mathematical physics; but Sylvester soon followed his natural bent, and all the rest of this volume is pure analysis, mostly algebra. Historically, the most notable results are those on elimination, canonical forms, and the theory associated with Sturm's method of locating the real roots of equations. Moreover, there is the paper on the contacts of lines and surfaces of the second order, where the invariant factors of a matrix are recognised, and the system of two quaternary quadratics is considered in detail with reference to the simplest simultaneous reduction of the forms.

Appreciations of Sylvester's character and of the value of his mathematical work have been written by able hands, and it is unnecessary to enlarge upon them here. His egotism was obvious and often amusing, but never offensive; his enthusiasm was refreshing, and though his temper was touchy, he was very generous and kind. As a master of formal analysis he has few equals; the birth of the calculus of invariants occurred just at the right time to attract his attention, and his contributions to this subject alone are enough to make him famous. He had the instincts of an architect, and it is well, on the whole, that he did not always trouble to clear away the chips. The casual remarks scattered about his papers and the fragmentary nature of some of them, help to make the reading of them very stimulating; he takes us into his confidence, shows us how his ideas arose, and gives us hints of unexplored regions. He was eminently original, and spent little time in studying the works of his contemporaries; thus he did not even realise that his theory of reciprocants had been more than anticipated by others, especially by Lie. But any misunderstanding arising from this source must have been long since dissipated, and his place among the great mathematicians of his time is quite secure.

Sylvester's occasional notes on the theory of numbers and his lectures on partitions suggest problems to those who are interested in arithmetic. The present volume, for instance, contains three notes on cubic Diophantine equations, a subject not yet exhausted, though Sylvester's own theory of resideration throws much light upon it. The late Henry Smith once referred to this problem as being one which might be hopefully attacked with the engines of modern analysis; perhaps the appearance of this edition of Sylvester's works may lead to the discovery of a complete theory.

A good example of Sylvester's power of illuminating and drawing general conclusions from the simplest mathematical problem is the note (p. 392) on an elementary geometrical theorem for which no direct proof had been discovered. He observes that the proof may be made to depend on showing that a certain analytical equation has no real root, and suggests that in all such cases where the analytical proof consists in demonstrating the *non-existence* of roots, the geometrical proof must necessarily be indirect, while in other cases the *reductio ad absurdum* may be convenient, but is not necessary. This observation reminds us at once of Gauss's discussion of the division of the circle, and if Sylvester's conjecture is true it gives another case of the curious points of contact that exist between analysis and geometry.

It is not to be expected, or even desired, that many should share Sylvester's keen delight in the beauty of formal analysis; but it is a mistake to discourage those who are inclined to enjoy it, however unpractical parts of the subject may be. Quite apart from other reasons, the study of pure mathematics may be defended, like that of music or chess or painting, from the merely æsthetical side, and this Sylvester does in terms both vigorous and quaint. For example:—

"The fortunate proclaimer of a new outlying planet has been justly rewarded by the offer of a baronetcy and a national pension, which the writer of this wishes him long life and health to enjoy. In the meanwhile, what has been done in honour of the discoverer of a new and inexhaustible region of exquisite analysis?" the latter reference being to Cayley's discovery of the calculus of invariants. Fortunately Cayley was saved in another way from the cares of money-making, and he lived long enough to realise to the full his great reputation among those who would appreciate his work. Sylvester in his early life suffered unjustly from the current prejudice against his race; so far as it was possible this was afterwards atoned for, and it is to be hoped that no bitter feeling was left behind.

G. B. M.

MENTAL AND SOCIAL MEASUREMENTS.

An Introduction to the Theory of Mental and Social Measurements. By Edward L. Thorndike, Professor of Psychology in Teachers' College, Columbia University. Pp. xii+212. (New York: The Science Press, 1904.) Price 1.50 dollars net.

AMERICAN colleges seem more awake than our own to the fact that the newer methods of statistics have made it possible to deal with facts with which they are directly concerned, and to discuss them with far more completeness than was practicable a few years ago. They are making in consequence large collections of anthropometric data to serve as tests of health and development, and for comparisons between colleges. Again, there are more teachers in America than in this country who, appreciating the fact that the above methods have far wider applicability, extend the range of their measurements to psychophysical subjects. They are also eager to deal with purely psychical matters that elude direct measurement but admit of being arranged by mutual comparison into their proper class places, or to utilise a third and still more general method, which deals with such objects as can be sorted into a few distinct classes without regard to their internal arrangement. The author is fully justified in saying that

"The obscurest and most complex traits, such as morality, enthusiasm, eminence, efficiency, courage, legal ability, inventiveness, can be made material for ordinary statistical procedure, the one condition being that the general form of distribution of the trait in question shall be approximately known."

In these circumstances a system of elaborate measurements has come into vogue in many American colleges. Whether the authorities have always planned their measurements wisely, and whether they discuss them adequately and accurately, will not be considered here. The volume is written to direct and to warn, in doing which it reveals some grave blunderings. Unfortunately, it is composed chiefly for those persons who are ignorant of even simple mathematics. The author is fully conscious of the serious embarrassments of the position he has chosen, but bravely attempts the well-nigh impossible task of overcoming them. Thus he says:—

"If this book were written by a mathematician for the mathematically minded, it would not need to be one fifth as long. If read by such a one it may well seem intolerably clumsy and inelegant."

Whether he succeeds under these difficulties in giving easily intelligible explanations may well be doubted; indeed, his language, though frequently lucid, is often quite the reverse. Still, if the volume were used as a text-book in the hands of an enthusiastic and capable teacher good results might follow, but it requires an optimistic disposition to believe that it would prove more than superficially instructive, if it were intelligible at all, to the mass of ordinary and unassisted readers. The author might, however, claim a higher rank for it than he has done on the ground that it teems with instructive illustrations by which everyone may profit, and that it presents familiar ideas from slightly new points of view, much to the advantage of even well instructed readers.

There is no science more handicapped by cumbrous and repellent terminology than that of the higher statistics. Its ideas are not always intrinsically difficult to grasp, but the phrases by which they are expressed are both ugly and unexpressive. The writer believes that a student, however mathematically minded he may be, would save himself time and annoyance if he prefaced his earliest studies by a few hours of what might be called *kindergarten* exercises with beans, acorns, or the like. By the process of sorting them into arrays and picking out the medians, quartiles, &c., then by measuring them individually and extracting from the measures the remaining statistical constants, he would soon obtain a serviceable familiarity with the more elementary technical terms and the ideas they represent. It would be easy to devise a suitable course that would prove a welcome help to students who are enthusiastic about measurements, and it is to be hoped that the next writer on popular statistics will elaborate one.

The author gives a large number of frequency polygons, derived from a wide variety of data, which are of interest. It is to be wished that attempts were more frequently made to reduce the variously shaped polygons obtained by experience into a few classified types, to append to each type the names of the objects that had been found to conform to it, and to analyse the causes of its shape in each instance. It is difficult to doubt that by so doing some desirable help would be given to the interpretation of any new polygon. It is perfectly true that almost any curve or polygon *may* be built up in various ways by different types of curve or polygons appropriately superposed, but experience alone will tell whether there is not a much greater probability of such and such a type being due to such and such combinations rather than to others. Through these means many hypothetical sources of origin might be found so rare as to be hardly worth considering, and so the field of probable interpretations would be narrowed. Speaking generally, the interpretation of results is a branch of statistics that has hitherto received less attention than it deserves. It is no doubt a great thing to be able to describe groups and to determine correlations between them with precision, but this is not all that is wanted. It is another and even more important achievement to dissect and analyse results and to discover the dominant causes that produced them, but the art of doing this seems as yet inadequately developed and to offer a promising field for research.

F. G.

OUR BOOK SHELF.

Practical Chemistry, a Second Year Course. By G. H. Martin, M.A. (N.D.). Pp. 41. (Bradford: G. H. Martin, The Grammar School.) Price 1s.

MR. MARTIN has arranged in an unpretentious form a most excellent syllabus of experiments and examples suitable for boys beginning the study of chemistry.

It is satisfactory to find that, in a school of such high standing as the Bradford Grammar School, the science master has seen the wisdom of devoting a whole year (it is to be hoped it will be extended to a second year) to teaching the simple facts which underlie important principles without recourse to tests and tables.

One suggestion may be offered. If the book is to have a wide circulation, which it certainly deserves, it will be necessary to fill in the outline of experiments, and perhaps to illustrate the results by actual examples, possibly in a companion volume.

Boys cannot be expected to work out details of apparatus in the short time allotted to science during school hours if substantial progress is to be made. No doubt the author has his apparatus set up and gives an appropriate demonstration to the class, but this will not help those teachers who wish to profit by the book unless their technical difficulties are solved for them.

J. B. C.

Retouching. By Arthur Whiting. Pp. xvi+91. (London: Dawbarn and Ward, Ltd., 1904.) Price 1s. net.

IT very often happens that photographic negatives require a certain amount of careful manipulation owing to defects caused by photographic methods, scratches, &c. It is also desired sometimes to eliminate small defects due to slight movement of the object, or to alter or improve portions of the picture to attain a desired end. The author has endeavoured in these few pages to place before the reader the different methods and devices that are in use to cope successfully with the various defects that may be encountered. In the first instance the tools required are described, and the special objects of each explained. The reader is then shown how, in the case of portraits, to preserve the likeness but yet to eliminate the blemishes caused by optical or chemical or other action; he is here introduced in a few words to the elements of facial anatomy. The author has considered it necessary to insert a special chapter on retouching portraits of professionals, in which the main principle to be kept in view is to produce a beautiful face. To attain such an ideal, mouths are reduced, jaws cut down, ears knifed, eyes enlarged, and various other surgical operations performed. Working up draperies, retouching landscapes, preparing prints for the press, and how to make a portable retouching desk, form other topics for treatment. The book should serve as an admirable guide to amateurs, and will be found useful to those who go more especially into this class of work. Numerous illustrations accompany the text.

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.*]

Average Number of Kinsfolk in each Degree.

As Dr. Galton has completely misunderstood the point of my last remark, I fear it will be necessary again to re-open a discussion which I had thought was satisfactorily closed.

My point is this: If we take a large number n of families containing in the aggregate nd sons and nd daughters, and remove on an average one child *of specified sex* from each family, we shall have a preponderance of the opposite sex in those that remain. The *average* numbers under this condition will be d and $d-1$, and not $d-\frac{1}{2}$ and $d-\frac{1}{2}$, and this was how I was originally led to my first conclusion.

If, however, we wish to test the question whether a girl has the same average number of brothers as sisters, we are only concerned with families containing at least one girl, and therefore families containing only boys must be left out of account, as I stated. When these have been removed there will be a preponderance of girls in the families that are left. It is this cause which enables us to reconcile the fact that, while the probable total numbers of girls and boys in any family may be equal, the probable numbers of brothers and sisters of a single individual of specified sex, say a girl, may still be equal. This may not be such a rigorous method as Dr. Galton employs, but it at least shows that the result is not necessarily opposed to what one would naturally infer from general considerations. G. H. Bryan.

Compound Singularities of Curves.

The compound singularities of algebraic curves may be divided into three *primary* species. First, *point singularities*, or multiple points, which are exclusively composed of nodes and cusps; secondly, *line singularities*, which are exclusively composed of double and stationary tangents; thirdly, *mixed singularities*, which are composed of a combination of simple point and line singularities. Amongst compound line singularities may be mentioned (α) a double tangent which osculates a curve at one of its points of contact, the constituents of which are one stationary and two *ordinary* double tangents; (β) a tangent having a contact of the fourth order with a curve, the constituents of which are three double and three stationary tangents.

The third species comprises the majority of compound singularities, and may be divided into the following subsidiary ones:—

(1) Nodes and multiple points, any tangent at which has a contact of a higher order than the first with its own branch, and does not touch the curve elsewhere. The flecnode and biflecnode are the most familiar examples of this species.

(2) Nodes, cusps, and multiple points, any tangent at which has a contact of the first or some higher order at some other point or points on the curve. For example, it is possible for each of the six nodal tangents of a trinodal quintic to touch the curve elsewhere, and it can be shown that the six points of contact lie on a conic.

(3) Two or more nodes, cusps or multiple points may have a common tangent. Thus the reciprocal of a biflecnode is a pair of cusps having a common cuspidal tangent, whilst a septimic curve may possess a node and a rhamphoid cusp having a common tangent.

(4) Singularities of the tacnode and oscnode type. When the number of constituent double points is unequal to $\frac{1}{2}n(n-1)$, where n is a positive integer, the singularity cannot be a multiple point, but must be of the tacnode type; and since the constituents of a tacnode are two nodes and two double tangents, every singularity of this species must contain double or stationary tangents, or both. When the number of double points is equal to $\frac{1}{2}n(n-1)$, the singularity *may* be a multiple point, but when it contains line as well as point singularities, it is of the same type as the oscnode, which is composed of three nodes and three double tangents.

(5) A tangent at a node or a multiple point, which has a contact of a higher order than the first with its own branch, may coincide with some other tangent at the singularity. When both tangents at a flecnode coincide, the resulting singularity is a tacnode; but the coincidence of two or more tangents at a multiple point, any of which possess this property, gives rise to a variety of peculiar singularities which do not appear to have been completely examined.

It is also possible for a mixed singularity to be formed in more than one manner; in other words, it may possess more than one penultimate form. Thus an oscnode may be formed by the union of two cusps and two stationary tangents, and additional singularities of this character are possessed by quintic and sextic curves.

To call a cissoid or a cardioid a *nodal* curve appears to me a glaring misuse of language, since both curves are *nodeless*. A. B. Basset.

November 18.

The Origin of Life.

No doubt "Geologist" points out a literal flaw in my statement, but I thought it would be obvious that by the "potentiality of life," which would be destroyed by heat, I meant potentiality of life, appearing within the time of the experiment. Given countless ages, then, on the evolution hypothesis, the potentiality of life, as of the rest of nature as we know it, existed in the fluid mass of the uncooled earth, and I did not mean to say anything inconsistent with this. Nor, on the other hand, did I mean to say that by the heat applied the potentiality of life in the matter under test would be destroyed for all time. I meant potentiality of appearing within a given time, the time of the experiment, and I cannot help thinking this was the natural sense of my words.

In asking me to explain the introduction of life or its potentiality into this planet, "Geologist" shows that he has entirely mistaken the purport of my letter. My aim was only logical, not constructive. If I could explain how life first appeared on the earth, I should probably be able to suggest a more promising line of experiment than that hitherto followed, which I find myself unable to do. My sole object was to point out a logical error, as it seemed to me, in the view commonly taken by men of science of the results of these experiments, an error, if my memory serves me, fully shared by Huxley—in admiration for whom, I hasten to say, I yield to no one. Huxley, if I remember rightly, was so impressed with the strength of the evidence against the contemporary origination of life that he practically gave up the idea, and put the date back. In this, I am venturing to suggest, he was illogical; through having overlooked the fact that in all the experiments the agent, which was used to destroy actual life and its germs, would probably be efficacious in destroying the potentiality of life in non-living matter on the point of assuming life, if any such there were, and, consequently, the positive result having artificially been made impossible, the negative result meant nothing, and should not be allowed to influence opinion. George Hookham.

Change in Colour of Moss Agates.

The following observations may perhaps throw light on the colour changes in moss agate and flint noted by Messrs. Whitton and Simmonds in your issues of November 10 and 17. Specimens of the flints from Bournemouth referred to by Mr. Simmonds were brought to this laboratory some months ago, and, though they were not submitted to any very searching examination, it was found that the colouring matter could be removed on boiling a fragment with hydrochloric acid, while the solution gave well marked reactions for iron and phosphoric acid. Now the compound $Fe_3(PO_4)_2.8H_2O$, whether prepared in the laboratory or occurring as the mineral vivianite, is colourless when pure, but becomes oxidised to ferrosoferric orthophosphate, and turns blue, when exposed to the atmosphere. It seems probable, then, that the change of colour of these flints is due to a layer of vivianite which alters on exposure.

In considering the case of the agate penholder, it should be noted that such objects are but rarely made of agate in its natural condition, it being the practice of the manufacturers to colour the stone artificially by chemical treatment. Thus a fine blue colour can be developed by soaking the stone first in a solution of potassium ferrocyanide and then in a solution of a ferric salt. Now as exposure to the action of alkalies, or in some cases to direct sunlight, suffices to destroy the blue colouring matter, it would seem probable that it is in this direction that an explanation of the change observed by Mr. Whitton is to be sought.

In conclusion, I may add that a very instructive series of specimens illustrative of the artificial colouring of agate is on exhibition in the mineral gallery of the British Museum (Natural History). A. HUTCHINSON.

The Mineralogical Laboratory, Cambridge, November 21.

Eocene Whales.

IN NATURE for September 29 (p. 543) "R. L." reviews Dr. Fraas's paper on the Egyptian zeuglodonts, dissenting from the conclusions that the zeuglodonts are not whales, and that the ancestors of the whales are at present unknown. I trust "R. L." will pardon me for in turn dissenting from these assertions, and for agreeing entirely with Dr. Fraas. So long ago as 1900, in discussing the pelvic girdle of Basilosaurus, I pointed out that the vestigial femur suggested that of a creodont, while later, in *Science* for March 11, I recorded my utter disbelief in any relationship between Basilosaurus and existing whales. Consequently, while greatly pleased at the results of Dr. Fraas's study of the small zeuglodonts, I was not at all surprised. It seems to me that our knowledge of Eocene mammals is really very small, and that it will be many years before we will be able to trace the line of descent of many existing forms with any degree of certainty. This is most emphatically true of the whales, the ancestry of which is still obscure. At the same time I have pointed out (*Science*, March 11) that the Eocene deposits of the southern United States contain remains of a large cetacean that is at present known to us by a few caudals alone. This form is undescribed, because it seemed to me best to await the discovery of better material than caudals. So while the ancestors of whales are still unknown, we have a hint that they may be discovered any day. F. A. LUCAS.

Brooklyn Institute Museum, November 4.

The Discovery of Argon.

IN reference to the slip indicated in the last issue of NATURE by Prof. G. H. Darwin, permit me to mention that the slip was mine—not Mendeléeff's. In Mendeléeff's text it stands: "As to argon and its congeners—helium, neon, krypton and xenon—these simple gases discovered *mainly* (*preimuschestvenno*) by Ramsay. . . ." I am sorry to see that I had omitted the word "mainly."

In reality, my manuscript (which I enclose) contained, as you see, the words "discovered chiefly by Ramsay," but as "chiefly" was not the proper word it was struck out, probably by myself, in the proof. THE TRANSLATOR.

The Leonids, 1904.

WATCHING was begun on November 14, when between 18h. 10m. and 18h. 40m., in a sky rapidly brightening with approaching sunrise, one certain Leonid, of magnitude excelling that of Sirius, shot from Cancer into Gemini.

November 15.—Watch from 12h. 5m. to 12h. 40m., and 14h. 5m. to 15h. 45m. The heavens were very clear at the start. I had just commenced looking out when a beautiful tailed Leonid, of mag. 3, shot from $85\frac{1}{2}°+2\frac{1}{2}°$ to $74°-2°$. At 12h. 17m. thin, broken clouds began to pass over, the sky becoming completely covered at 12h. 40m. At 12h. 38m. a huge-headed Leonid, outrivalling Venus in brilliancy, was seen travelling behind small, broken clouds from $129°+35\frac{1}{2}°$ to $107°+43°$ in three-quarters of a second. The path here given is probably a little too long. About 13h. 30m. the sky began to clear again, and was pretty good by the time of the commencement of the second watch. There were many thin clouds, but the interspaces were large and very clear. At 15h. 25m. the heavens became quite unclouded. In this last look-out Leonids were more numerous, six being between 14h. 45m. and 15h. 38m. The increase in frequency of meteors of the dominant shower at this period was not due to improvement of seeing conditions.

In the latter watch three shooting stars coming from $160°+48\frac{1}{2}°$ were mapped. The radiant point of the Leonids of November 15, as determined from eight tracks, was at $151°+20°$. The meteors were swift, and mostly left streaks. There was a decided tendency towards green in their colouring.

Below are particulars of some of the most interesting Leonids, other than those mentioned above:—

November 15.

G.M.T.	From	To	Mag.	Duration	Length	Remarks
h. m.	° °	° °		secs.	°	
14 46	$181\frac{1}{2}+28$	$186+28\frac{1}{2}$	>1	$\frac{1}{4}$	4	Swift. Greenish-yellow. Directed from 1° N. γ Leonis.
15 6	$71-9\frac{1}{2}$	$64-11$	>1		$7\frac{1}{2}$	Very swift. White, tinged blue.
15 26	$101+16\frac{1}{2}$	$88+12\frac{3}{4}$	$<$S	1	14	Green-yellow.
15 38	$172+34\frac{1}{2}$	$179\frac{1}{2}+37\frac{3}{4}$	S − ♃		7	White, tinged green. Streak.

Sheffield, November 24. ALPHONSO KING.

Intelligence in Animals.

HAVING recently seen in NATURE some accounts of the sagacity of cats, I trust that the following facts, for which I can personally vouch, may also be interesting to your readers.

We have a cat, an ordinary tabby, which, when out and anxious to gain admittance into the house, not only lifts the weather-board of either our front or back hall-doors three or four times in succession, thereby causing a loud knock each time, but has also instructed her young kitten to perform the same feat.

Both mother and daughter now regularly knock in this manner in order to be let in. J. E. A. T.

MY room opens by a door to a hall; when our fox-terrier wants to come into my room from the hall he *scratches* at my door. When he finds himself in the hall and wants to go out by another door to the garden or back-hall, he *whines* for me, and, going out, I find him by the door he wants opened. This—my leisure regrets—is of daily occurrence. F. C. CONSTABLE.

Wick Court, near Bristol, November 27.

PATAGONIA.[1]

THE dispute between the Argentine Republic and Chile with regard to the boundary line of their Patagonian possessions threatened at one time to result in a prolonged and sanguinary struggle. Happily this misfortune was averted by the decision, honourable to both nations, to refer the differences that had arisen to the arbitration of our Sovereign. A British Commission was accordingly appointed to examine the geographical features of the country and judge how far they could be reconciled with the terms of the treaties the interpretation of which was in question. As the head of this commission was chosen Sir Thomas Holdich, who had served his country as boundary commissioner in the wild inaccessible lands that lie to the north and west of our Indian possessions, and this selection was abundantly justified by the tact and skill with which a frontier more than 800 miles in length was traced in such a manner as to accomplish the almost unprecedented feat of satisfying both parties.

In the present volume Sir Thomas Holdich has given us his impressions of the progressive republics of Chile and the Argentine, and of the scene of his

[1] "The Countries of the King's Award." By Sir Thomas Holdich K.C.M.G. Pp. xv+420. (London: Hurst and Blackett, Ltd., 1904. Price 16s. net.

labours in Patagonia—impressions all the more valuable because they are those of a distinguished soldier and man of science who has spent the greater part of his life in the East, and whose principal achievements have been amongst the great mountain masses and plateaux of Central Asia, which find their only parallel in the Andes. Again and again he dwells on the likeness and on the contrasts between the new lands that he was visiting and those with which he had long been familiar.

We have only space to quote one passage (p. 149):—"One could not see the stiff rows of poplars streaking the stony slopes of the eastern Andes near Mendoza without being forcibly reminded of the Indian frontiers; and the plains of Chile round about Santiago might be the plains of Afghanistan round about Kabul. Standing on the slopes of the hills near Kabul, where Baber's tomb overlooks the Chardeh valley and the flat range of the Hindu Kush fills up the western horizon, where interlacing lines of poplars chequering the purple and yellow fields mark the course of the irrigation channels, an impression once drifted in upon my mind of a land of promise set in the midst of barren hills, specially designed to illustrate man's ingenuity in making green things to grow where no green thing had been before. It was the wealth of the poplars and the willows which produced the impression, contrasted with the sterility of the mountains which formed their background and which were only faintly visible through the summer haze, with just the glint of snowpatch here and there. The impression was reproduced with the first view of the plains stretching from the foot hills of the Andes outwards to the Pacific. For twenty-five years Time might have stood still, and Chardeh, Maidan, and the road to Ghazni were all back again before me."

It is, however, the pages that describe the author's experiences in Patagonia that will appeal most strongly to the scientific reader. The international differences have borne at least some good fruit. In the hope of finding evidence to support one view or the other the interior of Patagonia has been so energetically explored that there are few countries of which there has been so rapid an increase of our geographical knowledge in recent years. Comparatively little of the tract examined by Sir Thomas Holdich had been trodden by the foot of civilised man a dozen years before his visit.

We follow with absorbing interest the author in his rapid journey through the varied scenery of the central depression between the Andes on the one hand and the pampas on the other—a fertile land of hill and valley, with here and there great lakes that occupy the deeper hollows and overflow, some to the Atlantic and others through deep breaks in the mountains to the Pacific. Everywhere there are evidences of important changes in the still recent past—the shrinkage or complete disappearance of lakes, the diversion of the drainage from the Atlantic to the Pacific, and the retrocession of the glaciers.

Elsewhere we read of cruises amid the channels and inlets of the Pacific coast, which form the submerged continuations of the central valley of Chile, and of the glens of the rivers that traverse the Andean chain. Further inland these latter are filled with alluvium overgrown with impenetrable jungle. On this side, too, of the Andes there is evidence of recent changes, for—as Darwin was the first to point out—high above the sea-level are raised beaches and deposits containing shells of forms that still live in the neighbouring ocean.

But although the axis of the Cordillera and the outer

Fig. 1.—Corcovado Valley. From "The Countries of the King's Award."

chain of islands appear to be rising from a position of depression, the line of the great Chilian valley is probably still sinking, for near the head of the Gulf of Penas, and south of the isthmus of Ofqui, that connects the peninsula of Taitao with the mainland, are found forests so recently submerged as to render it necessary to be cautious in steering amongst the tree tops. Future generations of mankind, the author thinks, may see the isthmus submerged beneath the ocean, above which it is even now but slightly raised.

Part of this isthmus is occupied by Lake San Rafael, which is remarkable as the "terminus of an enormous glacier that scatters huge icebergs about its waters." "Is there any other glacier," the author asks, "descending to sea level in latitude 47° either N. or S.?" We know of none; but however that may be there are several that reach the sea between this point and the Straits of Magellan; and yet southern Patagonia is a land of luxuriant vegetation, at least on its western coasts. "Forest was everywhere about us, dense, shadowy, dark and generally dripping. The long lines of the higher sierra were thick with it up to the point where the granite cliffs polished and smoothed by ice-cap and glacier gave foothold to vegetation only on their flat ledges. The little islets that seemed to chase one another through the streaky grey sea were rounded and packed with it." In the Ultima Esperanza district in latitude 52° there are grazing grounds where the sheep fatten quickly on the tufted grass of the country, and are left to find their own shelter, while in the neighbouring woods the puma waits his opportunity as he does in the tropical forests of Brazil. And over the whole country, mountains, valleys, and pampas alike, blow untiringly the strenuous western winds, for the most part in blustering gales that succeed one another in quick succession. "In no country in the world," remarks our author, "must 'weather' and climate be so differentiated as in Patagonia. The weather is bad as bad can be—wild and boisterous, bursting into fury, breaking into sunshine, freezing the blood in one's veins with a biting blizzard, or suffocating the system with the still steady glare of a noonday sun, and it may do all this and more in the course of a few hours' interval; but whether storming or shining, tearing one's tent to rags or bathing the landscape in sunshine, who can describe the life-giving, purifying, sweetening, strengthening effects of the climate."

Such is Patagonia, a land that seems destined to nourish a hardy race woven of many strands, among which the sturdy Welsh colonists of the 16th of October Valley, of whom the author has much to tell us, will not be least important. To the man of science it is a land of striking illustrations of long established principles and of problems that will require many years of research to solve, for of the story of its making scarcely the first chapter a chapter of which Darwin wrote the opening pages—is yet complete.

J. W. E.

LORD KELVIN AND GLASGOW UNIVERSITY.

THE installation of Lord Kelvin as Chancellor of Glasgow University, which took place in the Bute Hall on Tuesday, is an event which has few, if, indeed, it has any, precedents in the recent annals of our universities. The Chancellor is the head of the whole university, but in practice he is rarely present except on ceremonial occasions, and a great part of the work which he has had to do officially is done for him in Scotland, as it is at Oxford, Cambridge, London, or in the newer English universities, by the Vice-Chancellor. Many occasions arise, however, when it is of importance to the universities concerned that statesmen, such as the Prime Minister, who is Chancellor of Edinburgh, Mr. Chamberlain, who is Chancellor of Birmingham, Lord Rosebery, who is Chancellor of London, and Lord Spencer, who is Chancellor of Manchester, should represent their universities in Parliament or elsewhere, and such men have usually been elected not so much on account of their own connection with the universities they preside over as of the eminent place they have taken in the State, and the weight which must on all occasions be attached to their considered opinions. Lord Kelvin has been connected with the University of Glasgow since his early boyhood, he has spent his life within her walls, and he built up his enduring fame during the fifty-three years when he was professor of natural philosophy in the university.

Lord Kelvin's father was a north of Ireland man, preparing for the ministry of the Presbyterian Church. In his day, and until the foundation of the Queen's Colleges in Ireland, Glasgow was the university to which many north of Ireland men resorted, and Lord Kelvin's father was a distinguished student in Glasgow, gaining prizes in many classes more than ninety years since. About eighty years ago he gave up his studies for the ministry and became professor of mathematics in the Belfast Academical Institution. Eight years later—in 1832—he was elected to the chair of mathematics in Glasgow, which he filled for sixteen years with eminent success. There were no better text-books anywhere than those which he published on the subjects of his chair, and the small number of his students who remember him can testify that they never met a clearer or better teacher of mathematics. Prof. James Thomson had a genius for teaching other things besides mathematics, and both Lord Kelvin and his elder brother, who was professor of engineering first in Belfast and afterwards in Glasgow, owed the best of their education to their father. Lord Kelvin was only twenty-two years old when the university had the courage to elect him to the chair of natural philosophy, on the strength of his quite exceptional brilliancy as a student first in Glasgow and afterwards in Cambridge. How he has discharged the duties of his chair and how wide and fruitful have been his conception of its duties is known to the whole world of science.

On Tuesday, after Lord Kelvin had been formally installed as Chancellor of the University, he proceeded to confer the following honorary degrees of LL.D. on the recommendation of the Senate.

Princess Louise (Duchess of Argyll), who was president of Queen Margaret College until the college was incorporated with the university in 1893. The Marquess of Ailsa, who has taken a great interest in naval architecture, and in its practical application to the building of yachts and other vessels. Dr. J. T. Bottomley, F.R.S.; Dr. James Donaldson, principal of the University of St. Andrews; Admiral Sir John Charles Dalrymple Hay, G.C.B., F.R.S.; Dr. J. M. Lang, principal of the University of Aberdeen; Mr. G. Marconi; Mr. Andrew Graham Murray, M.P., Secretary for Scotland; the Hon. C. A. Parsons, F.R.S.; and the Lord Provost of Glasgow, Sir John Ure Primrose, Bart.

After conferring these degrees Lord Kelvin delivered an address, in the course of which he spoke as follows:—

To be Chancellor of one of the universities of our country is indeed a distinguished honour. For me to be Chancellor of this my beloved University of Glasgow is more than an honour. I am a child of the University of Glasgow. I lived in it sixty-seven years (1832 to 1899). But my veneration for the ancient Scottish university, then practically the university for Ulster, began earlier than that happy part of my life. My father, born in County Down, was for four years (1810 to 1814) a student of the University of Glasgow, and in his Irish home, first as professor of mathematics in the newly-founded Royal Belfast Academical Institution, his children were taught to venerate the University of Glasgow. One of my earliest memories of those old Belfast days is of 1829, when the joyful intelligence came that the Senate of the University of Glasgow had conferred the honorary degree of Doctor of Laws on my father. Two years later came the announcement that the faculty of Glasgow College had elected him to the professorship of mathematics.

In 1834, two years after my father was promoted from Belfast to the Glasgow professorship of mathematics, I became a matriculated member of the University of Glasgow. To this day I look back to Prof. William Ramsay's lectures on Roman antiquities and readings of Juvenal and Plautus as more interesting than many a good stage play that I have seen in the theatre. Happy it is for our university, and happy for myself, that his name, and a kindred spirit, are with us still in my old friend and colleague, our senior professor, George Ramsay. Greek, under Sir Daniel Sandford and Lushington, logic under Robert Buchanan, moral philosophy under William Fleming, natural philosophy and astronomy under John Pringle Nichol, chemistry under Thomas Thomson (a very advanced teacher and investigator), natural history (zoology and geology) under William Couper, were, as I can testify by my own experience, all made interesting and valuable to the students of Glasgow University in the 'thirties and 'forties of the nineteenth century. Sandford, in teaching his junior class the Greek alphabet and a few characteristic Greek words, and the Scottish pronunciation of Greek, gave ideas, and something touching on philology, to very young students, which remains on their minds after the heavier grammar and syntax which followed have vanished from their knowledge. Logic was delightfully unlike the Collegium Logicum described by Goethe to the young German student through the lips of Mephistopheles. Even the dry bones of predicate and syllogism were made by Prof. Buchanan very lively for six weeks among the students of logic and rhetoric in Glasgow College sixty-seven years ago; and the delicious scholastic gibberish of "Barbara, Celarent" remains with them an amusing recollection. A happy and instructive illustration of the inductive logic was taken from Wells's "Theory of Dew," then twenty years old. My predecessor in the natural philosophy chair, Dr. Meiklebam, taught his students reverence for the great French mathematicians, Legendre, Lagrange, Laplace. His immediate successor in the teaching of the natural philosophy class, Dr. Nichol, added Fresnel and Fourier to this list of scientific nobles; and by his own inspiring enthusiasm for the great French school of mathematical physics, continually manifested in his experimental and theoretical teaching of the wave theory of light and of practical astronomy, he largely promoted scientific study and thorough appreciation of science in the University of Glasgow. In this hall you see side by side two memorial windows presented to the university to mark permanently its admiration of three men of genius, John Caird, John Pringle Nichol, and his son, John Nichol, who lived in it, and worked for it and for the world, in the two departments of activity for which universities exist, the humanities and science. As far back as 1818 to 1830 Thomas Thomson, the first professor of chemistry in the University of Glasgow, began the systematic teaching of practical chemistry to students, and by aid of the faculty of Glasgow College, which gave the site and the money for the building, realised a well equipped laboratory, which preceded, I believe, by some years Liebig's famous laboratory of Giessen, and was, I believe, the first of all the laboratories in the world for chemical research and the practical instruction of university students in chemistry. That was at a time when an imperfectly informed public used to regard the University of Glasgow as a stagnant survival of mediævalism and to call its professors the Monks of the Molendinar!

The university of Adam Smith, James Watt, and Thomas Reid was never stagnant. For two centuries and a quarter it has been very progressive. Nearly two centuries ago it had a laboratory of human anatomy. Seventy-five years ago it had the first chemical students' laboratory. Sixty-five years ago it had the first professorship of engineering of the British Empire. Fifty years ago it had the first physical students' laboratory—a deserted wine cellar of an old professorial house, enlarged a few years later by the annexation of a deserted examination room. Thirty-four years ago, when it migrated from its four hundred years old site off the High Street of Glasgow to this brighter and airier hilltop, it acquired laboratories of physiology and zoology, too small and too meagrely equipped. And now every university in the world has, or desires to have, laboratories of human anatomy, of chemistry, of physics, of physiology, of zoology. Within the last thirty years laboratories of engineering, of botany, and of public health have been added to some of the universities of the British Empire, with highly beneficent results for our country and the world. All these the University of Glasgow now has. During the last fifty years our university has grown in material greatness and in working power to an extent that its most ardent well-wishers in the first half of the nineteenth century could scarcely have imagined possible. Two successive legislative commissions (1858 and 1889) have re-formed its constitution and broadened its foundations, and added to its financial resources, and admitted women to its membership, with all the privileges of students and graduates. Splendidly liberal subscriptions by the people of Glasgow and by a world-wide public outside, backed by powerful aid from the National Treasury, enabled the university, on leaving its ancient site, to enter into the grand group of buildings on Gilmorehill, in which it has happily lived ever since. A few years later the generous gift of 45,000*l*. by the late Marquis of Bute built the hall called after his name, in which we are now met. At the same time the adjoining Randolph Hall and staircase were built by a portion of the legacy left to the university by the late Mr. Randolph. The Queen Margaret College and grounds were presented to the university by Mrs. Elder, who also added largely to the endowment of the engineering professorship, and founded the professorship of naval architecture. Other generous donors have given an engineering laboratory with lecture-rooms, and botanical buildings, and great and much needed extensions in the anatomical department. The Carnegie Trust and the principal's university equipment scheme are at present providing two new buildings; one of these is for extensions in the medical school. The other, in which I naturally take the most personal interest, is for the natural philosophy department, including lecture-rooms and a physical laboratory, all designed and at present being realised under the able direction of my successor in the natural philosophy chair, Prof. Andrew Gray.

In the province of the humanities the working power of the university for instruction and research has been largely augmented during the last fifty years by the foundation of new professorships, conveyancing, English language and literature, Biblical criticism, clinical surgery, clinical medicine, history (in my opinion the most important of all in the literary department), pathology, political economy. In mathematics and in the science of dead matter, professorships of naval architecture and geology; lectureships of electricity, of physics, and of physical chemistry; and demonstratorships and official assistantships in all departments have most usefully extended the range of study, and largely strengthened the working corps for research and instruction. I venture to congratulate the city of Glasgow on having for her god-daughter a university so splendidly equipped and so admirably provided with workers.

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE report of the council of the Royal Society was presented at the anniversary meeting held yesterday, November 30, and the president, Sir William Huggins, K.C.B., F.R.S., delivered the annual address.

The council refers to the second general assembly of the International Association of Academies last Whitsuntide as one of the chief events of the year. At the close of the meeting, Vienna was chosen by a unanimous vote as the place of meeting of the next general assembly. A complete protocol of the proceedings of the assembly has been drawn up, and will be issued before the end of this year. Other matters referred to in the report are the African geodetic arc, the international congress of aëronautics held at St. Petersburg in August, the international laboratory of physiology on Monte Rosa, the Royal Society "Catalogue of Scientific Papers," the "International Catalogue of Scientific Literature," the Government grant for scientific investigations, and the expenses of special Government inquiries.

The Royal Society is frequently requested by various departments of the Government to advise upon, or in some cases to undertake the supervision and control of, and in others the entire responsibility for, scientific investigations of national importance, but no provision has been made by Government to meet expenses to which the Society has been put in acceding to these requests. As the result of pointing out this unsatisfactory position, H.M. Treasury has approved of an alteration in the regulations for administering the Government grant of 4000*l.* for scientific purposes which will permit a sum to be set aside out of the reserve fund of the grant for printing and office expenditure incurred "in undertaking, controlling, supervising or advising upon matters which the President and Council may, at the request of the Government, undertake, control, supervise or advise upon." That is to say, the Royal Society is graciously permitted by the Treasury to use a part of the annual Government grant for scientific investigations to meet expenses incurred in answering Government inquiries.

Mention is also made in the report of the radium research grant of the Goldsmiths' Company, the Treasury inquiry into the Meteorological Office, and the letter on scientific education sent by the council to all British universities last January. The following extracts from other parts of the report of the council are of interest:—

Sleeping Sickness.

The investigation of this disease in Uganda was continued after Colonel Bruce's return to England by Dr. Nabarro and Captain Greig, of the Indian Medical Service. A further report (No. 4) by Colonel Bruce has been published, and its general conclusions, briefly stated in the last report of the council—namely, that the sleeping sickness is caused by the entrance into the blood and thence into the cerebro-spinal fluid of a species of Trypanosoma (*T. gambiense*), and that these trypanosomes are transmitted from the sick to the healthy by a species of tsetse fly (*Glossina palpalis*)—have been confirmed by subsequent observations. The efforts of the observers are now being directed to the attempt to discover a means of eliminating the trypanosomes from the blood and tissues of the infected in the early stages, and before severe damage has been done to the nervous centres. In the meantime the Royal Society Committee has advised the Government to adopt such preventive measures as are found practicable for protecting a non-infected area where the carrier fly is found from the incursion of emigrants from the infected areas.

Antarctic Expedition and Investigation.

The Antarctic ship *Discovery*, accompanied by the relief ships *Morning* and *Terra Nova*, returned safely in March last to Lyttelton, and a "Summary of Proceedings" was forwarded thence by Captain Scott by post to the presidents of the Royal and Royal Geographical Societies. The *Discovery* arrived in England at the beginning of September, when a joint letter of welcome from the president and the president of the Royal Geographical Society was dispatched to Captain Scott.

The natural history specimens and notes and drawings have been sent to the British Museum (Natural History Department), to be preserved there as part of the national collection, the trustees of the museum having agreed to organise and undertake the publication of these results of the expedition, under the editorship of the director of the museum.

The laborious duty of arranging for the reduction and publication of the magnetic and meteorological observations made by the expedition has been undertaken by the Royal Society. Two special expert committees have been appointed, and are already dealing with these two classes of material.

As regards the magnetic observations, the Hydrographic Department of the Admiralty has undertaken the reduction of about one-third of the material, and the remaining two-thirds, consisting of the slow-run magnetograms, remain to be dealt with. The committee for magnetism have accordingly arranged that these observations shall be reduced, under the superintendence of Dr. Chree, their secretary, in the observatory department of the National Physical Laboratory; and the Royal Society has undertaken responsibility for the cost of these reductions, to the extent of 400*l.*, by an advance from the donation fund, in the full hope that this expenditure will be refunded out of the proceeds of the sale of the *Discovery*.

Committees have been arranged for dealing with other observations. The reduction of the meteorological observations has been undertaken by the Meteorological Council with the aid of a sum of 500*l.* guaranteed by the Royal Geographical Society in anticipation of the sale of the *Discovery*. It is hoped that the publication of these results will be undertaken by H.M. Stationery Office.

The committees are working as far as possible in concert with the authorities engaged in the reduction of the observations of the German and Scottish Antarctic Expeditions, which in part covered the same period of time.

It is proposed that the special scientific results of the expedition shall be published in a uniform series of volumes similar to the published records of the *Challenger* Expedition.

Mediterranean Fever.

In February last a letter was received from the Colonial Office asking whether the Royal Society would be willing to appoint an advisory board in this country for the purpose of supervising investigations into Mediterranean fever, to be carried out by a commission representing the Navy, the Army, and the Civil Government of Malta.

The matter was referred to the tropical diseases committee of the society, which had superintended the investigations into malaria and sleeping sickness, and upon their advice the council decided to accede to the request of the Colonial Office, provided that the appointment of investigators rested with the Royal Society, and that all expenses in connection with the investigation were borne by the Government. These conditions were accepted by the Government with a modification, which the council acceded to at the particular request of H.M. Treasury, viz. that the Royal Society should participate by defraying (out of the Government Grant Reserve Fund) the cost of scientific equipment to an amount not exceeding 200*l.* The advisory board was constituted as a subcommittee of the tropical diseases committee, with Colonel Bruce, F.R.S., as chairman. Members of the commission of investigation were nominated, with the approval of this committee, by the Navy, the Army, and the Civil Government of Malta, and Colonel Bruce himself went out to Malta on behalf of the committee to start the inquiry, which is now in active progress.

National Physical Laboratory.

The National Physical Laboratory has continued its work with success during the year, the last of the five for which the original annual grant of 4000*l.* was made by the Treasury.

This fact has been prominently before the committee at its various meetings. In reply to an inquiry by the chairman, a letter was received from Sir E. W. Hamilton to the effect that while there was no idea of stopping the grant, the question before H.M. Treasury was whether there should be an increase in its amount, and suggesting that the committee should formulate "constructive proposals" with detailed estimates of the expenditure, both capital and recurring, required to put the laboratory on a satisfactory footing. Accordingly this was done, and a memorandum on the future organisation and expenditure of the laboratory, which was drawn up by the executive committee on February 19, was sent to the Treasury by the president and council, who strongly supported the proposals of the committee.

The main recommendations of the memorandum were (1) that a sum of nearly 30,000*l.* was required for capital expenditure, and (2) that the annual grant should be raised in the course of four years to 10,000*l.*; while, with a view to supporting these proposals, a request was made for an official inquiry into the work and organisation of the laboratory.

To this request the Financial Secretary of the Treasury replied, stating that the question of the increase must stand over until the estimates for 1905–6 were under consideration, and suggesting that meanwhile the executive committee should consider which of the new works were of the most pressing importance, and make application accordingly.

In answer, a further memorandum was prepared, pointing out that the question at issue was whether the laboratory is to be allowed to remain undeveloped in its present condition, with its limited powers and opportunities, or whether it is to be adequately developed, and ultimately placed on a footing similar to that of the corresponding institutions in other countries, and asking that the First Lord of the Treasury would receive a deputation to support the request already made, "That an inquiry might be instituted into the work and organisation of the National Physical Laboratory with a view to laying down the lines that ought to be followed in its future development."

In consequence of this request, a conference took place early in August at the House of Commons between the Prime Minister, the Chancellor of the Exchequer, and the President of the Board of Trade on the one hand, and Lord Rayleigh, Sir F. Hopwood, the treasurer and senior secretary of the Royal Society, with the director, representing the laboratory, at which the matter was discussed.

The donations and subscriptions promised to the laboratory, in most cases for five years, have increased, and now reach a total of about 2000*l.*

While the report is one of progress, the committee of the laboratory feel that with adequate financial support they might do much more. It is not yet sufficiently recognised how substantial is the assistance the laboratory can render to commerce and manufactures. The grant made by the Government is treated by them as one in aid of science itself, although it is applied under the highest scientific direction to facilitate the applications of science to manufacture. This distinction is an important one, which needs to be emphasised; when it is fully grasped the progress of the laboratory, as an aid to national industry, will be much more rapid.

In his anniversary address the president referred at first to the scientific careers of the thirteen fellows of the Society lost by death since the previous anniversary. He then gave a sketch of the work the society has done and is doing for the nation, and showed how the generous intentions of the founder, Charles II., were never fulfilled. From this survey of the history of the society, we have taken the following extracts, with the descriptions of the scientific work of this year's medallists:—

During the last few years a very large amount, increasing each year, of work outside the reading, discussion, and printing of papers, of a more or less public character, has been thrown upon the Royal Society—so large indeed as at present to tax the society's powers to the utmost. A not inconsiderable part of this work has come from the initiation by the society itself of new undertakings, but mainly it has consisted of assistance freely given, at their request, to different departments of the Government on questions which require expert scientific knowledge, and which involve no small amount of labour on the part of the officers and staff, and much free sacrifice of time and energy from fellows, in most cases living at a distance.

There is little doubt that this largely-increased amount of public work has arisen, in part naturally from the greater scientific activity of the present day, but also, and to a greater extent, from the fuller recognition by the Government and the public of the need for scientific advice and direction in connection with many matters of national concern.

It may not be inopportune, therefore, for me to say a few words on the advisory relation in which the society has come to stand to the Government, and to review very briefly the great work which the society has done, and is doing, for the nation.

Among academies and learned societies the position of the Royal Society is, in some respects, an exceptional one. In the British dominions it holds a unique position, not only as the earliest chartered scientific society, but in its own right, on account of the number of eminent men included in its fellowship, and the close connection in which it stands, though remaining a private institution, with the Government. The Royal Society is a private learned body, consisting of a voluntary and independent association of students of science united for the promotion of natural knowledge at their own cost.

The Royal Society, while remaining a purely private institution for the promotion of natural knowledge, has been regarded by the Government as the acknowledged national scientific body, the advice of which is of the highest authority on all scientific questions, and the more to be trusted on account of the society's financial independence; a body, which, through its intimate relations with the learned societies of the Colonies, has now become the centre of British science. The society's historical position and the scientific eminence of its fellows have made it naturally the body which the scientific authorities of foreign countries regard as representing the science of the Empire, and with which they are anxious to consult and to cooperate, from time to time, on scientific questions of international importance.

On their part, the fellows of the Royal Society, remembering that the promotion of natural knowledge is the great object for which it was founded and still exists, and that all undertakings in the home and in the State, since they are concerned with nature, can be wisely directed and carried on with the highest efficiency only as they are based upon a knowledge of nature, have always recognised the fundamental importance of the society's work to national as well as to individual success and prosperity, and their own responsibility as the depositories of such knowledge. They have always been willing, even at great personal cost, ungrudgingly to afford any assistance in their power to the Government on all questions referred to them which depend upon technical knowledge, or which require the employment of scientific methods. In particular the society has naturally always been eager to help forward, and even to initiate, such national undertakings as voyages of observation or of discovery of any kind, or for the investigation of the incidence of disease, which have for their express object the increase of natural knowledge.

At the same time, as the society is dependent upon the voluntary help of its fellows, whose time is fully occupied with their own work, the society may reasonably expect the Government not to ask for assistance on any matters of mere administration that could be otherwise efficiently provided for. The hope may be expressed that in the near future, with increased official provision in connection with the recognition of science, the position of the society to the Government may not extend beyond that of a purely advisory body, so that the heavy responsibilities now resting upon it, in respect of the carrying out of many public undertakings on which its advice has been asked, may no longer press unduly, as they certainly do at present, upon the time and energy of the officers and members of committees. The society regards this outside work, important as it is, as extraneous, and therefore as subordinate, and would not be justified in permitting such work to interfere with the strict prosecution of pure natural science as the primary purpose of the society's existence, upon which, indeed, the society's importance as an advisory body ultimately depends.

The society has accepted heavy responsibilities at the instance of the Government in respect of the control of scientific observations and research in our vast Indian Empire. In 1899, the India Office inquired whether the Royal Society would be willing to meet the wishes of the Indian Government by exercising a general control over the scientific researches which it might be thought desirable to institute in that country. A standing committee was appointed in consequence by the council for the purpose of giving advice on matters connected with scientific inquiry, probably mainly biological, in India, which should be supplementary to the standing observatories committee which was already established at the request of the Government as an advisory body on astronomical, solar, magnetic, and meteorological observations in that part of the Empire.

An investigation, onerous indeed, but of the highest scientific interest and of very great practical importance, has been carried on by a series of committees successively appointed at the request of the Government for the consideration of some of the strangely mysterious and deadly diseases of tropical countries. In 1896 a committee was appointed at the request of the Colonial Secretary to investigate the subject of the tsetse-fly disease in South Africa. Two years later Mr. Chamberlain, Secretary of State for the Colonies, requested the society to appoint a committee to make a thorough investigation into the origin, the transmission, and the possible preventives and remedies of tropical diseases, and especially of the malarial and "blackwater" fevers prevalent in Africa, promising assistance, both on the part of the Colonial Office and of the Colonies concerned. A committee was appointed, and, under its auspices, skilled investigators were sent out to Africa and to India. In the case of the third committee the society itself took the initiative. An outbreak in Uganda of the disease, appalling in its inexorable deadliness, known as "sleeping sickness" having been brought to the knowledge of the society, a deputation waited upon Lord Lansdowne at the Foreign Office, asking him to consider favourably the dispatch of a small commission to Uganda to investigate the disease. He gave his approval, and a commission of three experts, appointed on the recommendation of the committee, was sent out to Uganda, 600*l.* being voted out of the Government grant towards the expenses of the commission.

The investigations in tropical diseases, promoted and directed by these committees, have largely increased our knowledge of the true nature of these diseases, and, what is of the highest practical importance, they have shown that their propagation depends upon conditions which it is in the power of man so far to modify, or guard against, as to afford a reasonable expectation that it may be possible for Europeans to live and carry on their work in parts of the earth where hitherto the sacrifice of health, and even of life, has been fearfully great. A general summary of the work already done on malaria, especially in regard to its prevention, and also on the nature of "blackwater" fever, has been published in a Parliamentary paper, which records Mr. Chamberlain's acknowledgment to the Royal Society for its cooperation in the work undertaken by the Colonial Office. The reports on sleeping sickness up to this time form four whole numbers of the *Proceedings*, giving evidence in support of the view that this deadly disease is caused by the entrance into the blood, and thence into the cerebro-spinal fluid, of a species of Trypanosoma, and that these organisms are transmitted from the sick to the healthy by a kind of tsetse fly, and by it alone; sleeping sickness is, in short, a human tsetse-fly disease.

In 1897, the council was requested to assist the Board of Trade in drawing up schedules for the establishment of the relations between the metric and the imperial units of weights and measures. A committee was appointed, which, after devoting much time and attention to the matter, drew up schedules which were accepted by the Board of Trade and incorporated in the Orders of Council.

Soon after the reports were received of the appalling volcanic eruptions and the loss of life which took place in the West Indies in 1902, the council received a letter from Mr. Chamberlain to ask if the society would be willing to undertake an investigation of the phenomena connected with the eruptions. The council, considering that such an investigation fell well within the scope of the objects of the society, organised a small commission of two experts, who left England for the scene of the eruption eleven days only after the receipt of Mr. Chamberlain's letter, the expenses being met by a grant of 300*l.* from the Government Grant Committee. Six weeks were spent in the islands, including Martinique, by the commission, which was successful in securing results of great scientific interest. A preliminary report was published at the time, and a full report has since appeared in the *Transactions*.

Time forbids me to do more than mention the successive expeditions sent out by the society, conjointly with the Royal Astronomical Society, for the observation of total solar eclipses; and the onerous work thrown upon the society for several years in connection with the National Antarctic Expedition, undertaken jointly with the Royal Geographical Society, which has this year returned home crowned with success; but the society's labours are not at an end, for the prolonged and responsible task of the discussion and publication of the scientific results of the expedition is still before them.

To the Royal Society is entrusted the responsible task of administrating the annual Government grant of 4000*l.* for the purpose of scientific research, and a grant of 1000*l.* in aid of the publication of scientific papers.

In addition to these permanent responsibilities, which are always with the society, its advice and aid are sought from time to time both by the Government and by scientific institutions at home and abroad, in favour of independent objects of a more or less temporary character, of which, as examples, may be taken the recent action of the society for the purpose of obtaining Government aid for the continuation through Egypt of the African arc of meridian, and for the intervention of the Government to assist in securing the fulfilment of the part undertaken by Great Britain in the International Astrographic Catalogue and Chart.

Upon the present fellows falls the glorious inheritance of unbounded free labour ungrudgingly given during two centuries and a half for the public service, as well as of the strenuous prosecution at the same time of the primary object of the society, as set forth in the words of the Charter: "the promotion of Natural Knowledge." The successive generations of fellows have unsparingly contributed of their time to the introduction and promotion, whenever the opportunity was afforded them, of scientific knowledge and methods into the management of public concerns by departments of the Government. The financial independence of the Royal Society, neither receiving, nor wishing to accept, State aid for its own private purposes, has enabled the society to give advice and assistance which, both with the Government and with Parliament, have the weight and finality of a wholly disinterested opinion. I may quote here the words of a recent letter from H.M. Treasury:—"Their Lordships have deemed themselves in the past very fortunate in being able to rely, in dealing with scientific questions, upon the aid of the Royal Society, which commands not only the confidence of the scientific world, but also of Parliament."

In the past the Royal Society has been not infrequently greatly hampered in giving its advice by the knowledge that the funds absolutely needed for the carrying out of the matters in question in accordance with our present scientific knowledge would not be forthcoming. Though I am now speaking on my own responsibility, I am sure that the society is with me, if I say that the expenditure by the Government on scientific research and scientific institutions, on which its commercial and industrial prosperity so largely depend, is wholly inadequate in view of the present state of international competition. I throw no blame on the individual members of the present or former Governments; they are necessarily the representatives of public opinion, and cannot go beyond it. The cause is deeper, it lies in the absence in the leaders of public opinion, and indeed throughout the more influential classes of society, of a sufficiently intelligent appreciation of the supreme importance of scientific knowledge and scientific methods in all industrial enterprises, and indeed in all national undertakings. The evidence of this grave state of the public mind is strikingly shown by the very small response that follows any appeal that is made for scientific objects in this country, in contrast with the large donations and liberal endowments from private benefaction for scientific purposes and scientific institutions which are always at once forthcoming in the United States. In my opinion, the scientific deadness of the nation is mainly due to the too exclusively mediæval and classical methods of our higher public schools, and can only be slowly removed by making in future the teaching of science, not from text-books for passing an examination, but, as far as may be possible, from the study of the phenomena of nature by direct observation and experiment, an integral and essential part of all education in this country.

I proceed to the award of the medals.

Copley Medal.

The Copley Medal is awarded to Sir William Crookes, F.R.S., for his experimental researches in chemistry and physics, extending over more than fifty years. Ever since his discovery of the element thallium in the early days of spectrum analysis, he has been in the front rank as regards the refined application of that weapon of research in chemical investigation. Later, the discrepancies which he found in an attempt to improve weighings, by conducting the operation in high vacua, were tracked out by him to a repulsion arising from radiation, which was ultimately ascribed by theory to the action of the residual gas. This phenomenon, illustrated by the radiometer, opened up a new and fascinating chapter in the dynamical theory of rarefied gases, which the genius of Maxwell, O. Reynolds, and others, has left still incomplete. The improvements in vacua embodied in the Crookes tube led him to a detailed and brilliant experimental analysis of the phenomena of the electric discharge across exhausted spaces; in this, backed by the authority of Stokes, he adduced long ago powerful cumulative evidence that the now familiar kathode rays, previously described by C. F. Varley, must consist of projected streams of some kind of material substance. His simple but minutely careful experiments on the progress of the ultimate falling off in the viscosity of rarefied gases, from the predicted constant value of Maxwell, at very high exhaustions, gave, in Stokes's hands, an exact account of the trend of this theoretically interesting phenomenon, which had already been approached in the investigations of Kundt and Warburg, using Maxwell's original method of vibrating discs.

These examples, not to mention recent work with radium, convey an idea of the acute observation, experimental skill, and persistent effort, which have enabled Sir William Crookes to enrich physical science in many departments.

Rumford Medal.

The Rumford Medal is awarded to Prof. Ernest Rutherford, F.R.S., on account of his researches on the properties of radio-active matter, in particular for his capital discovery of the active gaseous emanations emitted by such matter, and his detailed investigation of their transformations. The idea of radiations producing ionisation, of the type originally discovered by Röntgen, and the idea of electrified particles, like the kathode rays of vacuum tubes, projected from radio-active bodies, had gradually become familiar through the work of a succession of recent investigators, when Rutherford's announcement of a very active substance, diffusing like a gas with a definite atomic mass, emitted by compound of thorium, opened up yet another avenue of research with reference to these remarkable bodies. The precise interpretation of the new phenomena, so promptly perceived by Rutherford, was quickly verified, for radium and other substances, by various observers, and is now universally accepted. The modes of degradation, and the enormous concomitant radio-activity, of these emanations, have been investigated mainly by Rutherford himself, with results embodied in his treatise on radio-activity and his recent Bakerian lecture on the same subject. It perhaps still remains a task for the future to verify or revise the details of these remarkable transformations of material substances, resulting apparently in the appearance of chemical elements not before present; but, however that may issue, by the detection and description of radio-active emanations and their transformations, Prof. Rutherford has added an unexpected domain of transcendent theoretical interest to physical science.

Royal Medal.

A Royal Medal is awarded to Prof. W. Burnside, F.R.S., on the ground of the number, originality, and importance of his contributions to mathematical science. The section of our "Catalogue of Scientific Papers" for the period 1883–1900 enumerates fifty-three papers by Prof. Burnside, the first dated 1885, and the "International Catalogue of Scientific Literature" thirteen more. His mathematical work has consisted largely of papers on the theory of groups, to which he has made most valuable additions. In 1897 he published a volume "On the Theory of Groups of Finite Order," which is a standard authority on that subject. Two recent papers on the same theory, published in 1903, may be specially mentioned. In one of these he succeeded in establishing by direct methods, distinguished by great conciseness of treatment, the important subsidiary theory of group-characteristics, which had been originally arrived at by very indirect and lengthy processes. In the other he proved quite shortly the important result that all groups of which the order is the product of powers of two primes are soluble.

Besides the treatise and papers relating to group theory, Prof. Burnside has published work on various branches of pure and applied mathematics. His work on automorphic functions dealt with an important and difficult special case which was not included in the theory of these functions as previously worked out. The paper on Green's function for a system of non-intersecting spheres was perhaps the first work by any writer in which the notions of automorphic functions and of the theory of groups were applied to a physical problem. He has also made important contributions to the theory of functions, non-Euclidean geometry, and the theory of waves on liquids. His work is distinguished by great acuteness and power, as well as by unusual elegance and most admirable brevity.

Royal Medal.

The other Royal Medal is awarded to Colonel David Bruce, F.R.S., who, since 1884, has been engaged in prosecuting to a successful issue researches into the causation of a number of important diseases affecting man and animals. When he went to Malta in 1884 the exact nature of the widely prevalent "Malta," "Rock," or "Mediterranean" fever was entirely unknown. After some years' work at the etiology of this disease, he discovered in 1887 the organism causing it, and succeeded in cultivating the *Micrococcus melitensis* outside the body. This discovery has been confirmed by many other workers, and is one of great importance from all points of view, and perhaps more especially as, thanks to it, Malta fever can now be separated from other diseases, *e.g.* typhoid, remittent, and malarious fevers, with which it had hitherto been confounded.

During the next few years he was engaged in researches of value on cholera, and on methods of immunisation against this disease. He also carried out some work on the leucocytes in the blood, published in the *Proceedings* of the Royal Society, 1894.

In 1894 he was requested by the Governor of Natal to investigate the supposed distinct diseases of "nagana" and the tsetse-fly disease. In the short time of two months he made the most important discovery that these two diseases were one and the same, and dependent upon the presence of a protozoan organism in the blood, known as a trypanosome. Some six months later Bruce was enabled to return to Zululand, and remained there two years, studying the disease and making the discovery that the tsetse fly acted as the carrier of the organism which caused it. He was thus the first to show that an insect might carry a protozoan parasite that was pathogenic. This observation was made in 1895.

Bruce not only determined the nature and course of "nagana," but in addition he studied the disease in a large number of domestic animals, and also observed the malady in a latent form in the wild animals of South Africa. Subsequent observers have found but little to add to Bruce's work on this subject.

In 1900 Bruce was ordered to join a commission investigating the outbreak of dysentery in the Army in South Africa, and a great part of the laboratory work performed by this commission was carried out by him.

In 1903 Colonel Bruce went, at the request of the Royal Society, to Uganda, to investigate further the nature of sleeping sickness. It was very largely, if not entirely, owing to him that the work of the Royal Society's commission was brought to a successful issue. At the time when he arrived a trypanosome had been observed by Castellani in a small number of cases of this disease; thanks to Bruce's energy and scientific insight, these observations were rapidly extended, and the most conclusive evidence obtained, that in all cases of the disease the trypanosome was present. He showed further that a certain tsetse fly, the *Glossina palpalis,* acted as the carrier of the trypanosome, and obtained evidence showing that the distribution of the disease and of the fly were strikingly similar.

Bruce has therefore been instrumental in discovering and establishing the exact nature and cause of three widespread diseases of man and of animals, and in two of these, nagana and Malta fever, he discovered the causal organism. In the third, sleeping sickness, he was not the first to see the organism, but he was quick to grasp and work out the discovery, and he made the interesting discovery of the carrier of the pathogenic organism, and thus discovered the mode of infection and of spread of the malady, matters of the highest importance as regards all measures directed to arrest the spreading of the disease.

All this research work has been done whilst serving in the Royal Army Medical Corps, and engaged in the routine work of the Service.

Davy Medal.

The Davy Medal is awarded to Prof. W. H. Perkin, jun., F.R.S., for his masterly and fruitful researches in the domain of synthetic organic chemistry, on which he has been continuously engaged during the past twenty-five years.

Dr. Perkin's name is identified with the great advances which have been made during the past quarter of a century in our knowledge of the ring or cyclic compounds of carbon. Thus, in the year 1880, the cyclic carbon compounds known to chemists were chiefly restricted to the unsaturated groupings of six carbon atoms met with in benzene and its derivatives, whilst the number of compounds in which saturated carbon rings had been recognised was very limited, and it was indeed considered very doubtful whether compounds containing carbon rings with more or less than six atoms of carbon were capable of existence.

The starting point for Dr. Perkin's researches in this field of inquiry was his investigation of the behaviour of the di-halogen derivatives of various organic radicals with the sodium compounds of malonic, aceto-acetic, and benzoylacetic esters, which led to the synthesis of the cyclic polymethylene compounds up to those of hexamethylene, whilst heptamethylene derivatives were obtained by an adaptation of the well known reduction of ketonic bodies leading to pinacones. The reactions thus introduced by Perkin are now classical, having proved themselves of the highest importance for synthetical purposes, and having been instrumental in stimulating the further investigation of the cyclic compounds of carbon.

Dr. Perkin also extended the same methods to the synthetical formation of carbon rings of the aromatic series, obtaining by means of ingeniously designed reactions derivatives of hydrindonaphthene and tetrahydronaphthalene.

But whilst the above achievements depend mainly on happily conceived and brilliantly executed extensions of the malonic and aceto-acetic ester syntheses, Perkin has, by a remarkable development of the Frankland and Duppa reaction for the synthesis of hydroxyacids, been successful in building up the important camphoronic acid in such a manner as to place its constitution beyond doubt (1897).

Dr. Perkin has further devoted much attention to the important subject of the constitution of camphor, towards the elucidation of which he has contributed valuable experimental evidence embodied in a most important and elaborate paper, containing the results of many years' work in conjunction with numerous pupils, entitled "Sulphocamphylic Acid and Isolauronolic Acid, with Remarks on the Constitution of Camphor and Some of its Derivatives" (1898). Bearing on the same subject are later communications on camphoric acid and isocamphoronic acid.

About the year 1900, Perkin, in prosecuting his researches on the constitution of camphor compounds, succeeded in devising synthetical methods for the production of what he has termed "bridged rings," of which a simple example is furnished by the hydrocarbon dicyclopentane

$$CH_2\left\langle\begin{array}{l}CH-CH_2\\ \;|\qquad\;\;|\\ CH-CH_2\end{array}\right.$$

The universal admiration of organic chemists has been called forth by these investigations; they reveal, indeed, a wonderful capacity for devising reactions which coerce carbon atoms to fall into the desired groupings.

Of other publications displaying not only extraordinary experimental skill but close reasoning and the power of interpreting results, mention may be made of Dr. Perkin's memorable researches on the constitution of dehydracetic acid, berberine, brasilin, and hæmatoxylin respectively.

During the present year (1904), Dr. Perkin has made perhaps the most remarkable addition to the long list of his achievements by successfully synthesising terpin, inactive terpineol, and dipentene, substances which had previously engaged the attention of some of the greatest masters of organic chemistry.

In conclusion it may be stated that Prof. Perkin is not only the author of the above and numerous other important researches which are outside the scope of this brief summary, but that he has also created a school of research in organic chemistry, which stands in the very highest rank.

Darwin Medal.

The Darwin Medal is awarded to Mr. William Bateson, F.R.S., for his researches on heredity and variation.

Mr. Bateson began his scientific career as a morphologist, and distinguished himself by researches on the structure and development of Balanoglossus, which have had a far-reaching influence on morphological science, and which established to the satisfaction of most anatomists the affinity of the Enteropneusta to the Chordate phylum. Dissatisfied, however, with the methods of morphological research as a means of advancing the study of evolution, he set himself resolutely to the task of finding a new method of attacking the species problem. Recognising the fact that variation was the basis upon which the theory of evolution rested, he turned his attention to the study of that subject, and entered upon a series of researches which culminated in the publication in 1894 of his well-known work, entitled "Materials for the Study of Variation, &c." This book broke new ground. Not only was it the first systematic work which had been published on variation, and, with the exception of Darwin's "Variation of Animals and Plants under Domestication," the only extensive work dealing with it; but it was the first serious attempt to establish the importance of the principle of discontinuity in variation in its fundamental bearing upon the problem of evolution, a principle which he constantly and successfully urged when the weight of authority was against it. In this work he collected and systematised a great number of examples of discontinuous variation, and by his broad and masterly handling of them he paved the way for those remarkable advances in the study of heredity which have taken place in the last few years, and to which he has himself so largely contributed. He was the first in this country to recognise the importance of the work of Mendel, which, published in 1864, and for a long time completely overlooked by naturalists, contained a clue to the labyrinth of facts which had resulted from the labours of his predecessors. He has brought these results prominently forward in England in his important reports to the Evolution Committee of the Royal Society, and in papers before the Royal and other societies, and also before horticulturists and breeders of animals. He has gathered about him a distinguished body of workers, and has devoted himself with great energy and with all his available resources to following out lines of work similar to those of Mendel. The result has been the supporting of Mendel's conclusions and the bringing to light of a much wider range of facts in general harmony with them. It is not too much to say that Mr. Bateson has developed a school of research to which many biologists are now looking as the source from which the next great advance in our knowledge of organic evolution will come.

Sylvester Medal.

The Sylvester Medal is awarded to Georg Cantor, professor in the University of Halle, on account of his researches in pure mathematics. His work shows originality of the highest order, and is of the most far-reaching importance. He has not only created a new field of mathematical investigation, but his ideas, in their application to analysis, and in some measure to geometry, furnish a weapon of the utmost power and precision for dealing with the foundations of mathematics, and for formulating the necessary limitations to which many results of mathematics are subject.

In 1870 he succeeded in solving a question which was then attracting much attention—the question of the uniqueness of the representation of a function by Fourier's series. The extension of the result to cases in which the convergence of the series fails, at an infinite number of suitably distributed points, led him to construct a theory of irrational numbers, which has since become classical. From the same starting point he developed, in a series of masterly memoirs, an entirely new branch of mathematics—the theory of sets of points.

Having established the fundamental distinction between those aggregates which can be counted and those which cannot, Cantor showed that the aggregates of all rational numbers and of all algebraic numbers belong to the former class, and that the arithmetic continuum belongs to the latter class, and further, that the continuum of any number of dimensions can be represented point for point by the linear continuum. Proceeding with these researches he introduced and developed his theory of "transfinite" ordinal and cardinal numbers, thus creating an arithmetic of the infinite. His later abstract theory of the order-types of aggregates, in connection with which he has given a purely ordinal theory of the arithmetic continuum, has opened up a field of research of the greatest interest and importance.

Hughes Medal.

The Hughes Medal is awarded to Sir Joseph Wilson Swan, F.R.S., for his invention of the incandescent electric lamp, and his other inventions and improvements in the practical applications of electricity. Not as directly included in the award, his inventions in dry-plate photography, which have so much increased our powers of experimental investigation.

NOTES.

THE council of the Royal Society of Edinburgh at its recent meeting decided to award Sir James Dewar, F.R.S., the Gunning Victoria Jubilee prize for 1900–4 for his researches on the liquefaction of gases extending over the last quarter of a century, and on the chemical and physical properties of substances at low temperatures.

THE *Times* reports that a telegram by wireless telegraphy has been transmitted by Mr. Marconi from the Marconi Company's station at Poldhu, Cornwall, to a station belonging to the Italian Government at Ancona, Italy. The distance between Poldhu and Ancona, about 1000 miles, is almost entirely overland, and in order to reach their destination the ether waves had to pass over nearly the whole of France and a considerable part of Italy, including some of the highest mountains of the Alps.

THE will of the late Dr. Frank McClean, F.R.S., includes the following bequests:—5000*l.* to the University of Cambridge to be expended in improving the instrumental equipment of the Newall Observatory, 5000*l.* to the University of Birmingham (in addition to his previous subscription) to be applied in the department of physical science, 2000*l.* to the Royal Society, 2000*l.* to the Royal Institution, 2000*l.* to the Royal Astronomical Society, and to the University of Cambridge for presentation to the Fitzwilliam Museum all the testator's illuminated or other manuscripts and early printed books, and all objects of mediæval or early art which the director of the museum may select as being of permanent interest to the museum.

IN a recent letter to the *Times* Prof. T. Clifford Allbutt directs attention to the paramount importance of considering the question of diet in all schemes of physical education. It is important that there should be no hasty legislation in this matter, especially in view of the important researches which are now approaching completion. Prof. Allbutt gives in his letter a brief account of the results at which Prof. Atwater, of Middletown, Connecticut, and Prof. Chittenden, of Yale University, have arrived. Prof. Atwater has measured accurately, upon healthy persons in uniform circumstances, the intake of food, and the output of waste and work, and has endeavoured to determine the modes and rates of conversion of foods into bodily and mental energy. Much of this expenditure of energy is upon an excess of food taken beyond the needs of the individual. Such excess (or not more than 4 per cent. of it) does not escape mechanically and cheaply from the body, but is absorbed, distributed, and excreted; to this process no little energy is diverted. In this useless effort energy is chiefly wasted by the nitrogenous foods. Excessive starches and sugars are burned off in the lungs almost directly, and at far less cost. Prof. Atwater teaches that the ordinary man eats too much, and in so doing wastes energy which he might have used to profit. Prof. Chittenden comes to a like conclusion by somewhat different methods. He will publish shortly tables to show how, on a closer adjustment of kinds and quantities of food to the useful work required, not only is this much work still sustained, but, by release of energy ordinarily dissipated in the demolition of food excess, the sum of work put out is prodigiously increased, in some cases even by so much as 60 per cent. or 70 per cent. It is clear enough already that one of the chief factors of physical well-being is to know what to eat, and what quantity of it results in the production of the maximum of useful energy. Until this is known with more exactitude than is common to-day, systems of physical education must be tentative and imperfectly conceived.

PROF. S. NEWCOMB has been elected corresponding member of the Berlin Academy of Sciences.

PROF. FEHR contributes to *l'Enseignement mathématique* for November 15 a list of the principal exhibits of models and books at the mathematical congress last August. Among the publishing firms exhibiting books, Germany was represented by six, Austria by two, France by four, Italy by five, Switzerland, Belgium and Denmark each by one. This is exclusive of books exhibited by societies and individuals, under which category we find the solitary British exhibit, by the Royal Irish Academy. Among the exhibitors of models our country was represented by Prof. Greenhill.

THE Belgian Government has decided upon the construction of a turbine steamer for its Channel fleet. Gradually the 19-knot steamers on this international service will be replaced by new turbine boats, with a speed of 23 knots, so that eventually even the slowest mail boats under the Belgian flag will have a speed of 21½ knots, or 24 miles an hour. The steamer which will inaugurate this departure in the progress of the service is at the present moment on the stocks at Hoboken, near Antwerp, and it will shortly be launched. Until quite recently, all steamships in the Channel and Irish Sea services were of the paddle-wheel type, a class admirably adapted for these comparatively short journeys. Drawing little water, they were able to enter any of the shallow harbours, and, at the same time, were capable of developing a speed altogether out of proportion to their draught. Since the introduction of turbines the diminution of the diameter of the propeller and of the weight of the engines has been rendered possible, so that what was until lately considered a mechanical impossibility, namely, to construct a steamer drawing only 9¾ feet and developing 12,000 indicated horse-power, may now be taken as a problem solved. The new Dover-Ostend mail boat will be a triple-screw steamer driven by Parsons' marine steam turbines. There will be three turbines—a high-pressure one in the centre, receiving the steam direct from the boilers, and a low-pressure one on each side, driven by the exhaust from the central engine. The Marconi system of wireless telegraphy will be installed, and remain at the service of the travelling public, as on all the Belgian mail steamers.

The articles in the fourth part of vol. xxxii. of Gegenbaur's *Morphologisches Jahrbuch* are two in number, the one, by Dr. Böse, on variations in certain muscles of the human thorax, and the other, by Mr. A. Gierse, on the brain and cephalic nerves of the small deep-sea teleostean fish *Cyclothone acclidens.* The latter is remarkable for possessing a median cephalic sympathetic nerve-cord, apparently unknown in any other vertebrate.

According to the report of the annual meeting held in May last, the Boston Society of Natural History (U.S.A.) is devoting attention to the display in its museum of the fauna of New England. New England palæontology is to be shown in the eastern end of the building between the rooms devoted to the palæontology of the rest of the world, while the remaining available space will be devoted to the recent birds and mammals. In the galleries will be arranged the lower vertebrates and the invertebrates. Accordingly, the local fauna, which is to be the leading feature of the museum, will occupy the most prominent and central position, from which the various portions of the general collection will diverge. This is as it should be, and when complete the museum promises to be a model for other local institutions of a similar nature.

The first part of vol. lxxviii. of the *Zeitschrift für wissenschaftliche Zoologie* is devoted to the fourth and apparently concluding section of Dr. E. Rohde's valuable and exhaustive account of the structure of the organic cell, and to an article by Mr. D. Deineka on the constitution of the swim-bladder of fishes. In the second of these articles the author supports the view that the main function of the swim-bladder is hydrostatic; fish in which this organ has been pierced, and the whole or part of its contained gas withdrawn, or replaced by water, completely lose their balance, in some cases falling on one side, in others standing nearly perpendicular in the water with the head downwards, and in others, again, floating belly upwards. Whether, however, the swim-bladder has a double function, and acts also as a respiratory organ, is, in the author's opinion, extremely doubtful.

In the September issue of the *Proceedings* of the Philadelphia Academy Miss A. M. Fielde records three instances of curious traits displayed by ants kept under observation in the laboratory at Woods Holl, Mass. In the first case the actions recorded suggest something akin to hypnotism, while from the third there seems a possibility that these insects may be able to remember and recognise individuals of their own kind after a separation of several years. The reactions of ants to vibrations form the subject of a second article by the same author in conjunction with Mr. G. H. Parker. In this it is urged that it is misleading to ascribe or to deny hearing to these insects. They are very sensitive to the vibrations of solids, but not to those of air, and their reactions to these might as well be described as due to touch as to hearing.

The appearance of a bark disease among the Para rubber trees in certain districts in Ceylon during 1903 created some alarm among rubber planters, but prompt measures for its treatment were carried out under the advice of the Government mycologist. Mr. J. B. Carruthers, the officer in question, gives an account of its occurrence in his report, which forms No. 16 of vol. ii. of the *Circulars and Agricultural Journal* of the Royal Botanic Gardens, Ceylon, and states that the disease was due to a canker fungus; further details with regard to structure and treatment will form the subject of a separate circular.

The *Journal of Botany* (November) contains the first part of a detailed description of the plants collected in Patagonia by Mr. Hesketh Prichard, of which a preliminary list was given in his book "Through the Heart of Patagonia." The identification has been undertaken by Dr. Rendle, who prefaces the list of plants with a short account of the region in which the collections were made, and the typical elements which are represented. The new species belong chiefly to characteristic temperate South American genera. To the same number Mr. A. B. Jackson contributes some notes on Leicestershire plants which summarise observations made since the year 1886, when the "Flora of Leicestershire" was published.

Dr. W. E. de Korté, at a meeting of the Pathological Society of London on November 15, described what he believes to be the parasites of small-pox and vaccinia. In the lymph of the eruptive spots in both these diseases he has detected bodies measuring about 1/2500 inch in diameter, amœboid, and containing refractile granules; these he regards as amœboid protozoa. They are extremely delicate, breaking up and disappearing on all but the gentlest manipulation, and on attempts to stain or preserve. They seem to be very similar to the bodies described by Funck some years ago under the name of *Sporidium vaccinale.*

In an article on trypanosome diseases (*Brit. Med. Journ.*, November 26) Prof. Robert Koch advances arguments in favour of the view that the trypanosomes of mammals at present known belong to about three species, viz. the rat trypanosome and the *T. Theileri* of South African cattle, both of which are distinguished morphologically and by unchanging virulence and inoculability from the other trypanosomes, *i.e.* those of nagana, surra, mal de caderas, and sleeping sickness, all of which show considerable variation in morphology, virulence, and inoculability, and are therefore regarded by Prof. Koch as being probably varieties of one type.

The new number of the *Mitteilungen aus den deutschen Schutzgebieten* contains papers on the north-western boundary region of Togoland, by Count Zech, and on the results of an exploration of the healthy plateau region of the Kamerun, north of the Manenguba mountains, by Dr. Hans Zieman. The information in the former paper, and the map accompanying it, are of particular interest on account of the immediate proximity of the district to British territory.

The July number of the *Bulletin* of the Italian Geographical Society contains the concluding portion of Prof. Brocherel's report on the expedition to Central Asia in 1900. Signor Carlo Rossetti writes on the political and economic conditions of Korea, and Signor Eugenio Barbarich makes an important contribution to the physical geography and geology of Albania. Another paper deals with the award of the King of Italy in the arbitration as to the boundary between Brazil and British Guiana.

Prof. Penck's account of the progress made during the last five years in the execution of a map of the world on a scale of 1 : 1,000,000, which was presented to the International Geographical Congress at Washington, is published in the October number of the *National Geographic Magazine.* During the last four years France, Germany, and Britain have issued three series of maps, containing sixty-one sheets worked out on the same scale and in the same style of division of sheets. These maps cover nearly 10,000,000 square miles, and will ultimately embrace the whole of Africa, and large parts of Asia and America. It will be remembered that the congress adopted a resolution proposing to the Government of the United States the execution of a similar general map of America.

In a recent number of the *Bulletin* of the Italian Aëronautical Society Dr. L. Palazzo, director of the Italian Meteorological Service, gives a very interesting account of the scientific experiments in Italy with unmanned balloons. The paper contains photographic illustrations of the balloons employed, of the methods of filling them, of their flight in mid-air, and of the records of the instruments. The place chosen for the aëronautical station is Pavia, principally owing to its geographical suitability and its distance from mountains and sea. The balloons used are a preparation of india-rubber, and are made by the Caoutchouc Company, of Hanover. They are sent up in tandem fashion, and are spherical and closed, and have the faculty of expanding to about seventy times their original volume, rising rapidly to an altitude of 20,000 metres and upwards, where a temperature of 60° C. below zero may be recorded. The upper balloon eventually bursts; the second balloon, which is smaller and not fully inflated, does not burst, but acts as a kind of parachute, which commences to fall rapidly at first and afterwards more gradually. It carries the registering apparatus attached to it by a line, and is intended to attract the attention of persons in the neighbourhood of its descent. The instruments generally reach the ground somewhat gently, and are seldom broken. Dr. Palazzo acknowledges the assistance he has received from Profs. Hergesell and Assmann in inaugurating these important experiments.

We have received a reprint of a paper published by Prof. A. Righi in the *Atti dei Lincei*, vol. xiii., ii., 233, under the title of "Certain Phenomena Observed in Air which is Ionised by Radio-active Substances"; experiments are described which show the necessity that exists in making measurements of the ionising power of radio-active substances by means of the various forms of gold-leaf electroscopes to take into account the position of the leaves relatively to the walls of the electroscope, and to the direction of the ionising rays.

In a paper published in the *Physikalische Zeitschrift* (No. 20), C. Liebenow calculates that the presence of 1/5000 of a milligram of radium per cubic metre distributed uniformly throughout the earth's volume would be sufficient to compensate for the loss of heat which is caused by conduction through the crust, and thus to maintain the earth's interior at a constant temperature. The concentration which is here assumed is considerably less than that actually observed by Messrs. Elster and Geitel to hold for radium in various kinds of natural earths, but it may perhaps be assumed that the proportion of radium is greater in the crust of the earth than at the interior. In any case, the need becomes apparent of making allowance in all calculations dealing with the earth's rate of cooling, for the remarkable thermal effects of radio-active substances.

In No. 17 of the *Revue Scientifique*, Prof. R. W. Wood's recent letter to Nature (vol. lxx. p. 530) calling into question the existence of the *n*-rays is reprinted, and in No. 18 an editorial article discusses in detail the character of the evidence on which they are alleged to exist. In No. 19 of the *Revue* the opinions of Profs. Berthelot, Bouty, Pellat, Langevin, and Abraham have been ascertained with regard to the matter. Of these expressions of opinion, that of M. Langevin is the most emphatic; after making many experiments, he concludes that in no case in which the observer is unaware of the result he is to obtain is there the slightest evidence of the existence of these rays, whilst on the other hand the experimenter can readily so dispose his mind as to see whatever he wishes to see. The general attitude which is taken up in these articles is that the observed phenomena are purely subjective, and due to suggestion; they are consequently more likely to prove of importance to the psychologist than to the physicist.

In the October number of the *Gazzetta* G. Bruni and A. Callegari have established by means of cryoscopic measurements the remarkable fact that in many cases the nitroso-group in organic substances is isomorphous with the nitro-radical. The formation of solid solutions in such cases is also made evident by peculiar colour phenomena. Whilst, for instance, a solution of nitrosobenzene in benzene is green, but becomes colourless when frozen, a solution in nitrobenzene, which has the same colour, remains green after solidification. In the former case solid colourless nitrosobenzene has separated, whilst in the latter a solid solution of the substance in the solidified solvent is formed, which, like the liquid solution, is coloured green.

The numerous attempts which have been made to decide by physical methods the nature of isodynamic substances such as ethyl acetoacetate and acetylacetone have given rise to widely differing opinions. Thus Brühl, for instance, has considered that the optical properties of acetylacetone between 0° C. and 100° C. prove that, between these temperatures, it exists solely in the di-enolic form

$$CH_3.C(OH) : C : C(OH).CH_3,$$

whilst Dr. W. H. Perkin, from a study of the magnetic rotatory power of the same substance, considers that at 16° C. it consists of a mixture of this form with the keto-enolic modification, and at 93° C. of a mixture of the keto-enolic and diketonic varieties. In the October number of the *Gazzetta* F. Giolitti shows that at about 70° C. a remarkable change in the expansibility of acetylacetone occurs which conforms with Perkin's view of a change of structure at a temperature between the limits 16° C. and 93° C. The variation in the expansion of ethyl acetoacetate between −10° C. and 100° C. is, however, perfectly linear, apparently indicating that at these temperatures only one form exists, or that the rate of change of one form into another is uniform between these limits.

A correspondent points out that in Nature of November 24 (p. 88, line 19 from top, first column) the name Sansaulito is a misspelling for a well known locality near San Francisco. The correct spelling is Saucelito, which means "little willow," from *Sauce*, willow, in Spanish.

We have received from Messrs. F. Darton and Co., of 142 St. John Street, E.C., a well illustrated catalogue of electrical novelties. The pieces of apparatus, toys, and household devices of which particulars are given are ingenious in design, and some of them would make instructive presents for boys with a mechanical turn of mind.

Messrs. Watts and Co. will issue on December 7 for the Rationalist Press Association an English translation of Prof. Haeckel's "Die Lebenswunder," under the title of "The Wonders of Life." The chief aim of Prof. Haeckel in this work is to present a mass of biological evidence for the views as to the origin and nature of life which he briefly advanced in the "Riddle of the Universe."

MESSRS. GEORGE BELL AND SONS have published a revised re-issue of "Cities and Sights of Spain," by Mrs. Aubrey Le Blond (Mrs. Main). This handbook for tourists is meant as a supplement to the ordinary guide-book, and the information supplied shows that the writer has an intimate first-hand knowledge of the country. The advice as to hotels, expenses, what to do and what not to do, is of just the kind to be of assistance to visitors to Spain, of which country the writer says, "no other part of Europe offers so varied and attractive a field to nearly every type of traveller." The appearance of this re-issue is particularly opportune just now, since astronomers and others will be visiting Spain next year to view the total eclipse of the sun, as the central line of the eclipse runs in a direction N.W. to S.E. across that country. Mrs. Le Blond's book may be commended to those scientific visitors who will have time to visit some of the beauty spots of the land in which their observations will be made.

WE have received vol. xxxvi. of the *Transactions and Proceedings* of the New Zealand Institute, which contains details of the work of the year 1903. The transactions are divided into five sections—miscellaneous, zoology, botany, geology, and chemistry and physics. The total number of papers contributed in these subjects reaches fifty. Among the contributions to the miscellaneous section may be mentioned several statistical studies by Prof. H. W. Segar and an exhaustive consideration of Maori marriage customs by Mr. Elsdon Best. The president of the institute, Captain F. W. Hutton, F.R.S., is the largest contributor to the section of zoology. He describes a new fish, two new flies, a new blow-fly from Campbell Island, and has papers on a new Weta from Chatham Islands and on the occurrence of the curlew sandpiper (*Ancylochilus sub-arquatus*) in New Zealand. Prof. Benham writes of a new species of leech (*Hirudo antipodum*) recently discovered in New Zealand, of the Oligochæta of the New Zealand lakes, and of an apparently new species of Regalecus (*R. parkeri*). Prof. Park contributes to the section of geology five papers on different aspects of New Zealand geology. Of the six papers in chemistry and physics, three are the work of Mr. J. S. S. Cooper. The proceedings, which make up the second part of the volume, provide interesting particulars of the year's work of each of the seven scientific societies affiliated to the New Zealand Institute. The volume as a whole demonstrates conclusively that the men of science in New Zealand are doing successfully their part to extend the bounds of natural knowledge.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN DECEMBER:—

Dec. 1. 10h. 9m. to 12h. 8m. Transit of Jupiter's Sat. III.
,, 10h. 22m. Minimum of Algol (β Persei).
,, 13h. 56m. to 14h. 8m. Moon occults η Virginis (Mag. 4·0).
4. 7h. 11m. Minimum of Algol (β Persei).
8. 13h. 43m. to 15h. 45m. Transit of Jupiter's Sat. III.
10–12. Epoch of Geminid meteoric shower (Radiant $108^\circ + 33^\circ$).
11. 12h. 0m. Saturn in conjunction with Moon (Saturn 3° 28′ S.).
12. 1h. Juno in conjunction with Moon (Juno 0° 49′ S.).
13. 10h. 19m. to 11h. 12m. Moon occults λ Aquarii (Mag. 3·9).
,, 21h. 0m. Mercury at greatest elongation (20° 30′ E.).
16. 17h. Jupiter in conjunction with Moon (Jupiter 1° 47′ N.)
20. 6h. 1m. to 7h. 4m. Moon occults γ Tauri (Mag. 3.9).
,, 11h. 25m. to 11h. 58m. Moon occults θ' Tauri (Mag. 3·9).

Dec. 20. 12h. 21m. to 13h. 31m. Moon occults BAC 1391 (Mag. 4·9).
,, 15h. 19m. to 16h. 12m. Moon occults α Tauri (Mag. 1·1)
21. 21h. 0m. Uranus in conjunction with Sun.
24. 8h. 54m. Minimum of Algol (β Persei).
26. 9h. 2m. to 9h. 13m. Moon occults A Leonis (Mag. 4·6).
27. 5h. 43m. Minimum of Algol (β Persei).
,, 21h. Venus in conjunction with Saturn (Venus 0° 48′ S.)
28. 10h. Neptune in opposition to the Sun.
29. 12h. 0m. Neptune's Satellite at max. elong. west (distance 17″).

ENCKE'S COMET (1904 *b*).—No. 3980 of the *Astronomische Nachrichten* contains the results of further observations of Encke's comet.

Prof. Millosevich, observing at the Roman College Observatory at 6h. 26m. 15s. (M.T. Rome) on November 7, determined the position of the comet to be

$$\alpha \text{ (app.)} = 22\text{h. } 50\text{m. } 39{\cdot}93\text{s.}, \quad \delta \text{ (app.)} = +22^\circ\ 19'\ 20''{\cdot}1,$$

and recorded the object as an extraordinarily difficult one with the filar micrometer of the 39 cm. equatorial; no nucleus could be definitely seen.

On November 15 Herr Moschick, using the 6-inch telescope of the Konigstuhl Observatory, Heidelberg, found the comet to be a very faint and diffuse object with a doubtful nucleus. The position at 13h. 12m. (Konigstuhl M.T.) was α (app.) = 22h. 13m. 37·6s., δ (app.) = + 18° 14′ 26″.

The following is a corrected ephemeris, by M. Kaminsky, given in the November number of the *Observatory*:—

Ephemeris (Berlin Midnight).

1904	R.A. h. m. s.	Dec. ° ′
Nov. 29	21 18 30	+10 30
Dec. 3	21 3 50	+ 8 9
,, 7	20 49 20	+ 5 36
,, 11	20 34 10	+ 3 1
,, 15	20 16 32	+ 0 17
,, 19	19 56 38	− 2 58
,, 23	19 35 12	− 6 31

On the last mentioned date the comet will be a little north of κ Aquilæ, and owing to its proximity to the sun in right ascension will be a difficult object to observe.

As pointed out by Dr. Smart, the comet will approach very near to Mercury in January, and it is hoped that an opportunity of testing the mass of Mercury, by observations of the comet after the approach, will therefore be available.

VARIATIONS ON THE MOON'S SURFACE.—In No. 4, vol. liii., of the Harvard College Observatory *Annals* Prof. W. H. Pickering publishes a number of photographs illustrating the changes which take place in the regions about the lunar crater Eratosthenes during the commencement, the duration, and the passing of sunlight on that region of the moon's surface.

There are sixteen figures in all, the longest interval of time between the taking of any two successive figures being 1·6 days, and it is hoped that, by publishing these together with the detailed descriptions by Prof. Pickering which accompany them, the work of other selenographists may be greatly facilitated, by the possession of the knowledge of what to look for.

The mean diameter of the crater of Eratosthenes is 37 miles, that of the floor 28 miles, and measures of the shadows cast indicate that the western wall has a height of 12,000 feet, whilst the indicated height of the eastern wall is something less than 15,000 feet.

As evidence in favour of the vegetal origin of these phenomena, Prof. Pickering suggests that although water could not exist at the low pressures obtaining on the lunar surface, yet it might be retained in the soil by capillary attraction and thence feed the vegetation, which at each return of sunlight would develop and thus cause the changes illustrated in the photographs.

CELESTIAL PHOTOGRAPHY AT HIGH ALTITUDES.—An interesting account of the work performed by Prof. Payne and Dr. H. C. Wilson during their sojourn at Midvale (Montana), illustrated by reproductions of two of the photographs obtained, is given by the latter observer in No. 8, vol. xii., of *Popular Astronomy*.

The altitude of the observing station was 4790 feet above sea-level, and the results lead Dr. Wilson to the conclusion that the increase in altitude, from Northfield to Midvale, reduced the necessary exposures, other conditions being the same, by about one-half. The two reproductions accompanying the account show excellent photographs of the America nebula and of the region between β and γ Cygni taken with a $2\frac{1}{2}$ inch Darlot lens with exposures of three hours and of two hours respectively.

DISTRIBUTION OF STELLAR SPECTRA.—In No. 1, vol. lvi., of the Harvard College Observatory *Annals* the distribution of stellar spectra, mainly in reference to the Milky Way, is discussed.

The spectra dealt with are those examined by Mrs. Fleming for the Harvard catalogues, and the work is not yet complete, the present publication dealing only with the results already obtained.

The number and proportion of each class of spectra in definite regions of the heavens, as determined from the discussion of 276 plates containing the spectra of 32,197 stars, are given in a series of tables and shown on a number of curves.

The results indicate that the universe consists of two portions, (1) the first-type stars, which occur in all regions, but preponderate in the formation of the Milky Way; (2) the stars having second- or third-type spectra, which show, in general, a uniform distribution over the whole sky.

The proportion of first-type stars increases as fainter objects are included, but with the Orion stars the opposite seems to be the case. Stars with peculiar spectra seem to congregate in the Milky Way, whilst, contrary to expectation, those having spectra of class F appear to be relatively fewer in the galactic regions.

ABSORPTION BY WATER VAPOUR IN THE INFRA-RED SOLAR SPECTRUM.—An interesting series of experiments has been made at the Smithsonian Astrophysical Laboratory, by Mr. F. E. Fowle, jun., in order to test the correctness of Bouguer's formula for calculating the amount of solar energy received after atmospheric absorption.

The results, so far as they go, show that the selective absorption of water vapour is well represented by Bouguer's formula and seems to depend only on the amount of the absorbent present, that is to say, the amount of the absorption produced by a given quantity of water vapour is the same, whether the radiations pass through a *great* thickness of *small* density or *vice versâ*.

The absorption increases as the wave-lengths of the bands increase, and varies from about 10 per cent. near A ($0{\cdot}76\mu$) to nearly 100 per cent. at about $1{\cdot}80\mu$.

No indication of a general water vapour absorption has been found in the region $0{\cdot}68\mu$ to $2{\cdot}00\mu$.

Mr. Fowle's complete results, illustrated by some of the bolograms obtained, are published in No. 1, vol. ii., of the quarterly issue of the *Smithsonian Miscellaneous Collections*.

THE SUPPLY OF VALUABLE FURS.

FEW persons, other than those in some way connected with the fur trade of this country, or who have had occasion to make statistical inquiries on the subject, have any conception of its enormous volume and value. Yet every thoughtful observer who strolls along the fashionable shopping streets of the metropolis at this season can scarcely fail to be struck with the number of establishments for the sale of furs and the richness and variety of their contents, or with the great extent that furs are worn by ladies. Any real and comprehensive idea of the magnitude of the trade can, however, only be gained either by attending the great London quarterly fur sales, such as those of Messrs. C. M. Lampson and Co., or by a study of the catalogues and price-lists of such sales. By a perusal of these documents the inquirer will gain some conception of the immense number of skins of the more valuable kinds of fur-bearing animals imported into this country alone; and when the great Continental sales, such as the Leipzig and Nijni-Novgorod fairs, are also taken into consideration, he will marvel where the supply comes from, and wonder that a clean sweep has not long ago been made of the chief fur-producing species. Nevertheless, the supply of most descriptions of furs seems to be well kept up, and, with the exception of a few species, such as the sea-otter, the beaver in many districts, the West African guereza monkeys, and certain kinds of fur-seal, it does not appear that any of the valuable fur-bearing mammals are in present danger of extermination, or even of becoming unduly scarce. The truth is that we have probably little real conception of the abundance of such creatures in the more remote districts of North America and in the fur-producing countries of northern Asia.

To attempt, within moderate limits, any general account of the mammals which yield the more valuable kinds of furs is impossible, as it would be with the means at our disposal to give a survey of the world's fur trade, and we shall accordingly content ourselves with referring to some of the more striking items in trade circulars for the current year, and with making such notes on certain of the species there mentioned as may seem desirable. Here it may be recalled that there appeared in 1892 a valuable and interesting work on "Fur-Bearing Animals" by Mr. Henry Poland. This work, needless to say, is now altogether out of date, and it is much to be hoped that the author could see his way to the issue of a new edition, especially, if we may say so without offence, if he would seek the assistance of a professed naturalist in the revision.

We commence our brief review of the more interesting items in the 1903–4 sale-lists by referring to some of the most valuable descriptions of furs employed as articles of dress or as carriage rugs, a large proportion of which are yielded by the Carnivora, and especially by members of the family Mustelidæ. One of the foremost places in this respect is occupied by the sea-otter (*Latax lutris*), an animal which formerly abounded on the coasts of Kamchatka and the Aleutian Islands, but which now stands in imminent jeopardy of extermination unless prompt measures are taken for its protection. Between the years 1772 and 1774 some 10,000 skins of this species were taken in the Aleutians, while at the end of the eighteenth century the annual take was 120,000 in certain newly discovered haunts in Alaska. This number, however, soon fell to 15,000, and when Alaska was ceded to the United States it had sunk to 700. A temporary improvement then took place, but in 1901 the number had fallen to 406. In 1903 Messrs. Lampson sold 463 skins, but they had none to offer in January, 1904, and there are none down in their October list, the latter deficiency being perhaps due to the recent loss of a whole cargo of furs from the Kommandorski Islands and Kamchatka. Of late years 100*l*. is no uncommon price for a sea-otter pelt, while from 200*l*. to 300*l*., and even, it is said, 500*l*., have been paid for unusually fine skins.

These prices are, however, paralleled by those given for American silver or black fox (*Canis vulpes argentatus*). Nowadays the trade distinguishes the pure black from the silver or white-tipped skins. Black skins are said to have been sold in St. Petersburg at from 300*l*. to 800*l*. each. In London a pair of silver skins realised 480*l*. and an inferior pair 200*l*. in 1902, but single skins are reported to have fetched 200*l*. Messrs. Lampson offered 670 skins of this fox in 1903, and have 55 in their current October list. The white and blue phases of the Arctic fox (*Canis lagopus*), which are the winter dress of different animals, although often regarded as the winter and summer coats of the same form, have of late years become very fashionable. Of the former 20,341, and of the latter 3685, were sold by Messrs. Lampson last year, but none of the blue variety appear in this autumn's catalogue, against 57 in October, 1903, and it would accordingly seem that the demand is telling on the supply. White fox skins, which some years ago sold for between 2*s*. 6*d*. and 15*s*. each, have recently risen to from three to five guineas, although they are now declining; on the other hand, blue fox, which has long fetched from ten to fifteen guineas per skin, appears to be rising in value. Both white and blue fox come from the northern parts of both hemispheres; the blue should be a pure bluish French grey.

Of lynx skins 5828 were sold by Messrs. Lampson in 1903, and 6316 were offered this autumn, the catalogue prices ranging between 22*s*. and 42*s*. for good samples. Probably most of these skins belong to the circumpolar *Felis lynx*, although they may include some of the American *F. rufa*.

Another handsome fur now in considerable demand is that of the glutton or wolverine (*Gulo luscus*), of which 47,139 skins were sold last year by one firm, the catalogue price ranging this autumn from 16*s.* to 34*s.* for good samples. The sales of Russian sable (*Mustela zibellina*) by the same firm last year reached the enormous total of 29,547, which compares with a total of 9247 for the whole of London in 1891, an increase which seems to imply either the tapping of a fresh source of supply or an undue drain on the normal stock. The catalogue prices range from 10*s.* to 15*l.* per skin, but specially fine skins will fetch from 50*l.* to 70*l.* each. As its trade name implies, all the best sable comes through Russia. "Kolinsky" or Siberian sable (*M. sibirica*) is the trade name of an allied species of which enormous numbers of skins come into the market, Messrs. Lampson quoting 472,796 for last year; the price is, however, low, usually less than two shillings, and now declining.

Ermine (*M. erminea*), of which the returns for 1903 are not given in the list before us, has recently risen 30 per cent. in value; 1379 skins were sold in January, 1903, and 461 this October. From 20*s.* to 180*s.* per "timber" of 40 skins was the price some years ago. Ermine is imported both from Russia and America. When made up with specks of black fur instead of with the black-tipped tails, it is called minever. Japanese sable, of which only 179 skins were sold by Messrs. Lampson in 1903, is represented by 1211 this autumn, a circumstance which may indicate that our allies are endeavouring to make as much as possible out of their exports.

A similar increase is noticeable in the case of Japanese mink (a species it is a little difficult to identify zoologically, but which would appear to be allied to *M. sibirica*), of which 13,728 skins were disposed of at the sales in 1903, while 7228 were offered this autumn, against 3543 at the corresponding sale of last year. Of American mink (*M. vison*) the imports are always heavy, and for 1903 Messrs. Lampson record 253,001 skins, this being about 100,000 less than the total number sold in London in 1901. Prices range from 1*s.* to 13*s.*, but are on the decline. The various kinds of real marten, such as *M. martes* and *M. americana*, with 55,106, and the inferior sorts known in the trade as "baum" and "stone" (*M. foina*), with 10,940 and 8323 in the past year, bulk less large, although prices range higher, fine pelts of the pine or American marten realising from 30*s.* to 40*s.*

Leaving certain others of the marten group, we pass on to otters (*Lutra vulgaris, L. canadensis*, &c.), of which 14,757 pelts were disposed of in sales last year, the catalogue prices in January ranging to as much as from 50*s.* to 60*s.* With modern methods of curing, the handsome black and white fur of the various species of skunk (Mephitis and Conepatus) has come into extensive and fashionable use, no less than 948,447 skins having been sold last year, the price ranging from about 1*s.* to 7*s.* each. Of badger skins (*Meles taxus*) the number sold by the same firm was 13,543; formerly the price was from 1*s.* to 2*s.* per skin, but the range in the list varies now from 4*d.* to 13*s.*

Of the larger land Carnivora, the skins of which are used for fur rather than for floor rugs, we may mention the sale last year by Messrs. Lampson of 47,139 wolf skins and 12,834 bear skins. Of the former the catalogue price ranges from 1*s.* or less to 30*s.*, while for the latter, which include the brown, black, grizzly, and white species, prices up to 4*l.* are quoted. Reference has already been made to the silver, white, and blue foxes; in addition to these are quoted 62,052 skins of red fox (*C. vulpes*, &c.), 2957 of the cross-fox (*C. v. pennsylvanicus*), 64,431 of the American grey fox (*C. cinereo-argentatus*), and 2186 of the kit-fox (*C. velox*). Raccoon skins number 268,190 in the list under consideration, while 9650 civet skins are quoted in the January list.

Among rodents, beaver skins total 16,504 in the list before us, while the Hudson Bay Company sold in January last 34,806, the latter number comparing badly with the 63,419 sold by the same company in January, 1891, which was greatly inferior to the sales of half a century or so earlier. In 1891 the price varied from 5*s.* to 69*s.* per skin; in Messrs. Lampson's list quotations range up to 30*s.*, but there had been a fall of 12½ per cent. from the previous year. The next largest fur-bearing rodent is the South American coypu (*Myopotamus coypu*), known in the trade as nutria, of which 80,269 skins appear in last year's sale-list. Far more valuable are, however, the much smaller beautiful silver-grey pelts of "real" chinchilla, of which 23,587 were sold last year by Messrs. Lampson, 60*s.* to 240*s.* per dozen being the price quoted by Mr. Poland in 1891, but a maximum of 310*s.* appearing in the list before us. I take it that by "real" chinchilla is meant the typical *Chinchilla lanigera*, although the latter name is applied by Mr. Poland's book to the "bastard chinchilla" of the trade, which one would have thought meant one of the species of Lagidium. Be this as it may, "bastard chinchilla" is represented by no less than 132,996 pelts in Messrs. Lampson's 1903 sales, the maximum price being 145*s.* per dozen.

Of the smaller and less valuable rodent furs briefer notice must suffice, the chief interest connected with these being the enormous numbers in which they are imported. Thus musquash (*Fiber zibethicus*) is represented by no less than 2,979,460 pelts of the normal, and by 117,412 of the black phase, while 1,678,667 skins of the former were disposed of at the January sale this year. Squirrel (of various kinds), on the other hand, totalled only 142,501. Rabbit and hare skins are not of sufficient value to find a place in these sale-lists. Among marsupials, skins of the so-called Australian opossums, that is to say, various species of phalangers, press hard on musquash skins in point of numbers, 2,455,765 being the quotation in last year's list. True, or American, opossum (Didelphys), on the other hand, totals only 168,396. Of kangaroo skins the number in the same list is 21,963, while wallaby skins (that is to say, those of the smaller kinds of kangaroos) reach 520,087, and wombat skins 255,332.

An item of considerable interest in the sale-list of January, 1904, is 343,996 mole skins, ranging in price from 1*s.* to 7*s.* 3*d.* per hundred, such prices being stated to be exceptionally low, and not, one would think, paying for the trouble of collecting. No year's total for mole skins is given, but since Mr. Poland mentions "several thousands" as being the annual collection in 1891, it would seem that the demand—perhaps for motoring coats—has vastly increased of late years. Another item evidently connected with motoring is that of 403 musk-ox skins at the March sale of last year. The trade in these skins has only lately been developed, and it cannot but be looked upon with suspicion by naturalists, as the musk-ox might easily be exterminated.

Although the total numbers of skins offered at sales in January last compared well with those of the preceding year, prices ruled lower, which may be accounted for by the general commercial depression.

In addition to Messrs. Lampson's sales, it should be mentioned that there are the Hudson Bay Company's sales, as well as several smaller fur sales in London. In January of the present year (after the loss of a valuable cargo of furs at sea) the Hudson Bay Company sold 34,806 beaver skins, as already mentioned (against 47,777 the preceding year), and 923,053 musquash pelts (against 1,482,670 in 1903). The skins disposed of at the smaller sales we have not space to quote. We may refer, however, to the following items in Messrs. Culverwell, Brooks, and Co.'s sale catalogue of this October. These are 9280 Australian opossum, 3214 "wallarine" (smaller kangaroos), 673 chinchilla, 934 fox, 2772 wolf, and 2313 African monkey skins.

The latter probably belong in great part to the West African guereza (*Colobus vellerosus*), the species already referred to as, according to consular reports, being in danger of extermination on account of excessive pursuit.

As regards the prospects of the trade in fur-seal pelts for the current season, Messrs. Lampson, after referring to the loss by shipwreck of the Kamchatka Commercial Co.'s vessel already mentioned, and adding that in consequence they may have no Copper Island fur-seals to offer, write as follows:—

"The Alaska seal-catch this year amounts to 13,134 skins, as against 19,378 last year. . . . The North-west catch is not yet completed, but our receipts to date are about the same as at this time last year. With regard to the Lobos Island seals, no news has been received so far. . . . The total supply of seals this season is likely to fall considerably short of last year's quantity."

From the introductory statements this diminution may, however, be merely temporary, and need not necessarily indicate a permanent falling off in the supply of fur-seal pelts.

In respect to skins used solely for rugs or ornamental purposes, very few words must suffice. In Messrs. Culverwell, Brooks, and Co.'s list for October of this year appear 100 South American guanaco skins (from which the beautiful orange carriage-rugs are made), 24 tiger, and 266 leopard skins, while Messrs. Lampson's January list gives 184 tiger and 557 leopard skins (inclusive of snow-leopard and "leopard-cat").

The leopard skins range in price from 10*s*. or less to 34*s*. (55*s*. for snow-leopard), while tiger skins vary from 2*l*. to 60*l*. each.

Imperfect and sketchy as this review of recent London fur sales necessarily is, it serves to give some idea of the enormous—we may almost say appalling—number of wild animals annually slaughtered for the sake of their pelts. What, however, it does not—and cannot—give is the effect that this continuous slaughter is having on the numbers of the various species of fur-bearing animals throughout the world.

This is what naturalists want to know from the point of view of zoology, and it is also what the fur trade community ought to desire to know from the point of view of their own and the world's interest. Of late years furs have become increasingly fashionable, with a corresponding appreciation in price; but as to whether this increased demand is having any serious effect on the numbers of fur-bearing animals in general we appear, except in the case of a few species, such as the sea-otter, the beaver, the West African guereza, and the fur-seals, to be in a state of utter and hopeless ignorance. R. LYDEKKER.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The new statute, the object of which is to exempt candidates for honours in mathematics or in natural science from Greek in Responsions, was brought before Congregation on Tuesday, November 29. The changes proposed in the statute were in strict accordance with the resolutions passed by Congregation in Hilary Term, 1904, except in one small detail. Candidates for honours in mathematics or in natural science have two courses open to them under the proposed statute. They may offer the subjects required by the present regulations, viz. Greek, Latin, arithmetic, and elementary algebra or Euclid, or in place of Greek they may substitute French or German, together with a mathematical or scientific subject to be prescribed by the board of studies for Responsions. Candidates who had not offered Greek would be allowed to substitute an additional knowledge of the subject-matter of the Bible for that part of the examination in Holy Scripture which involves a knowledge of the Greek text of the Gospels. The statute was lost by 200 votes to 164.

Dr. William Osler, F.R.S., regius professor of medicine, has been elected to a studentship at Christ Church.

A NEW professorship of applied chemistry has been established at Trinity College, Dublin. Mr. Emil Alphonse Werner, assistant to the professor of chemistry, has been appointed as the first occupant of the new chair.

WE learn from *Science* that Park College, near Kansas City, has received an additional endowment of 20,000*l*., of which 5000*l*. has been given by Dr. D. K. Pearson; and that at a recent meeting of the trustees of Columbia University gifts amounting to about 9400*l*. were announced by the trustees. Among these was the sum of 3000*l*. from General Horace W. Carpentier.

THE Minister of Public Instruction for Austria has issued a decree concerning the admission to the universities of students from the Realschulen, according to which those wishing to be on the same footing as candidates from the Gymnasia are required to pass an additional examination, held twice a year, in Greek, Latin, and philosophy. Candidates may prepare for this examination either by private study or by courses held at certain secondary schools.

IT would do much good if everyone spoke their minds on the subject of free libraries as straightforwardly as did the Countess of Jersey last Saturday afternoon. When laying the foundation stone of a library which the generosity of Mr. Carnegie is providing for Hanwell, she touched on the great usefulness of books of reference, especially with regard to the particular life-work of the reader. In fact, one would judge that novels would find but a small place on the shelves if Lady Jersey were to choose all the books, for she very sensibly pointed out that the best volumes of fiction can now be bought for a few pence, and that more expensive books and those more difficult to get should form the bulk of a public library.

AT the winter session of the General Medical Council last week a report was considered from the Education Committee on the proposals for a school certificate submitted to the council recently by the Board of Education. After discussion it was decided to inform the Board of Education (1) that any well considered plan which would tend to a diminution in the number of examinations in preliminary subjects of education, and to a unification of standard of those which remain, would meet with the hearty approval of the Medical Council. (2) That if the standard of the examination contemplated in the scheme were such as to be generally accepted for matriculation by the universities, the council would be prepared to recognise it as qualifying for entrance on a course of professional study. (3) That, pending the general adoption of a uniform system of unification of educational tests, the council would welcome the establishment under the Board of Education of a central board for the purpose of classifying examinations according to standard and arranging for the mutual recognition of certificates; and, further, that they regard the establishment of such a board as highly desirable from an educational point of view.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, November 2.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Mr. J. E. **Collin** exhibited a specimen of *Platyphora lubbocki*, Verr., a species of Phoridæ parasitic upon ants. No specimen has been recorded since the one originally bred by the present Lord Avebury in 1875, and described for him by Mr. G. H. Verrall in the *Journal* of the Linnean Society for 1877.—Mr. P. J. **Barraud** exhibited an aberrant *Epinephele jurtina (janira)*, ♂, taken by him this year in the New Forest, in which the usual apical spots were absent from the fore-wings, giving the specimen a curious appearance, noticeable even when flying.—Mr. J. **Edwards** sent for exhibition three specimens of *Bagous lutosus*, Gyll., one found by himself on Wretham Heath, Norfolk, on August 4, 1900—the first authentic British example—and two taken in the same locality by Mr. Thouless on May 22, 1903; also *Bagous glabrirostris*, Herbst., from Camber, Sussex, for comparison.—Dr. T. A. **Chapman** exhibited bred specimens of *Hastula* (*Epagoge*, Hb.?) *hyerana*, Mill., from larvæ taken at Hyères last March, and said the fact that the pale forms only have hitherto been known, whereas of those bred nearly half are dark, suggests either that really very few specimens are in collections—which is the most probable case—or that melanism is now affecting the species.—Mr. W. J. **Kaye** exhibited specimens of the moths *Castnia fonscolombei* and *Protambulyx ganascus* showing protective and warning coloration of the two species.—Mr. H. W. **Andrews** exhibited specimens of *Eristalis cryptarum*, F., and *Didea alneti*, Fln., two species of uncommon Syrphidæ from the New Forest.—Mr. Edward **Harris** exhibited a brood of *Hemerophila abruptaria* reared by him this season, together with the parents, a dark male and a normal female, showing considerable variation.—Mr. Gervase F. **Mathew**, R.N., exhibited some beautiful and interesting examples of *Leucania favicolor*, Barrett, including the varieties described by Barrett in the current volume of the *Entomologist's Monthly Magazine* (p. 61), and, more recently, by Tutt in the *Entomologist's Record* for this year. He also exhibited a series of twenty-four *Camptogramma fluviata*, the descendants of a wild pair captured on September 22, 1903, showing a wide range of colour variation.—The **President** exhibited a photograph taken by Mr. A. H. Hamm to illustrate the protective flower selection of *Pieris rapae*. He also exhibited four specimens of *Conorrhinus megistus*, Burm., the large South American Reduviid which is well known to attack man; these were brought back by W. J. Burchell in the year 1828, and still have the original labels affixed to them.

Geological Society, November 9.—Dr. J. E. Marr, F.R.S., president, in the chair.—Mr. E. T. **Newton**, in exhibiting, by permission of the director of H.M. Geological Survey, a specimen of Fayolia near to *Fayolia grandis*, found by Dr. L. Moysey, of Nottingham, in the Coal-measures of Ilkeston (Derbyshire), pointed out that Fayolia was first described by Profs. Renault and Zeiller in 1884, in their monograph on the "Houiller de Commentry." In 1894 Mr. Seward described the first British specimen, from Northumberland, in the Leeds *Naturalist*, but thought that it was not a plant. There was some resemblance to certain spiral egg-cases of Elasmobranchs, but Dr. Günther was unwilling to accept the Northumberland fossil as the egg-case of a fish. Mr. Kidston had not yet seen the specimen now exhibited, but from a sketch he recognised its relation to Fayolia. At present there was still uncertainty as to the exact nature of this fossil.—Notes on Upper Jurassic Ammonites, with special reference to specimens in the University Museum, Oxford, ii.: Miss Maud **Healey.** This paper gives a re-description of the types of *Cardioceras vertebrale*, Sow., *C. scarbrugense*, Y. and B., *C. cordatum*, Sow., and *C. excavatum*, Sow., and their varieties. Four varieties of the first, nine of the second, three of the third and fourth are defined, and a description is given of a new species of Cardioceras belonging to the same group. Notes on species allied to the group and on others which have been wrongly confused with it are added. These species are so closely connected by innumerable transitional forms that their limits cannot be definitely fixed. The term "species" is therefore used as equivalent to Prof. J. W. Gregory's *circulus*: "It includes a number of 'forms,' which vary along lines radiating outward from a central type."—Sarsen-stones in a clay-pit: Rev. E. C. **Spicer.** Near to Bradenham, midway between High Wycombe and Prince's Risborough, certain clay-pits yield a clay for brick-making, in which are embedded large angular sarsen-stones, white saccharoidal sandstones with a siliceous cement.—On the occurrence of *Elephas meridionalis* at Dewlish (Dorset). Second communication: human agency suggested: Rev. Osmond **Fisher.** This paper is in continuation of one published by the author in 1888. The site in which the elephant-remains were found is a narrow trench, examined to a depth of 12 feet in places, with nearly vertical sides, a smooth, chalk bottom, and an abrupt end. It was not a fault or a stream-course, and it was partly filled with fine dust-like sand which may have been wind-borne. The trench cuts diagonally across the scarp; and, even if it could be accounted for by natural agencies, it is difficult to explain how it happened that so many elephants fell into it. The author points out that in Africa elephants are caught by the natives in pitfalls of similar character constructed on the tracks leading to watercourses. This trench is in a corresponding position with regard to a stream, and it is suggested as possible that the trench may have been of human origin. There is, however, no conclusive evidence elsewhere that man was contemporary with *Elephas meridionalis*, which is characteristic of the Pliocene age.

Royal Astronomical Society, November 11.—Prof. H. H. Turner, president, in the chair.—The long-period terms in the lunar theory: P. H. **Cowell.**—Determination of selenographical positions from measurement of lunar photographs: S. A. **Saunder.** This was the author's third communication on the subject, and in it he discussed the measures, made by Mr. J. A. Hardcastle, of four negatives taken at the Paris Observatory. The methods employed were explained, and a comparison was given with the results of other determinations, showing that a considerable increase in accuracy had been obtained.—The magnetic disturbances, 1882 to 1903, as recorded at the Royal Observatory, Greenwich, and their association with sun-spots: E. W. **Maunder.** From the examination and tabulation of the more considerable disturbances recorded, it had been found that disturbances succeeded each other at intervals corresponding to a synodical rotation of the sun. This occurred with too great frequency and regularity to be the result of chance coincidence, and it was concluded that the magnetic influence radiates from very restricted areas on the sun's surface, certain streams reaching the earth with each solar rotation. The relation of the magnetic disturbances with sun-spots was discussed, and it was pointed out that the theory threw light on the cause of the long straight rays, seen proceeding from the corona at some solar eclipses, and which sometimes reach a distance of several degrees.—Determination of the apex of the solar motion in space, and of the constant of precession, from a comparison of Groombridge's catalogue (1810) with modern Greenwich observations: F. W. **Dyson** and W. G. **Thackeray.**—The discussion on a paper by Dr. Rambaut on a very sensitive method of determining the errors of a pivot, with special reference to the pivot errors of the Radcliffe transit circle, was deferred, and other papers were taken as read.

Mineralogical Society, November 15.—Prof. H. A. Miers, F.R.S., president, in the chair.—Dr. J. W. **Evans** described two new forms of quartz-wedge by means of which approximate quantitative estimations can be readily made of the double refraction of minerals in small grains or in rock-sections.—Mr. J. **Currie** contributed a note on some new localities in Scotland and the Færöes of gyrolite and tobermorite, and Mr. C. R. **Lindsey** one on the occurrence of microscopic crystals of brookite with anatase in the Cleveland ironstone.—Mr. R. H. **Solly** exhibited and described various minerals from the Lengenbach quarry, Binnenthal. Three of these were new, viz. marrite and bowmanite, of which the chemical composition has not yet been determined, and lengenbachite, which has been shown by Dr. Hutchinson to be a sulpharsenite of lead containing some copper and antimony, and having a specific gravity of 5·8. Marrite occurs in small lead-grey crystals resembling modified cubes, and lengenbachite in thin lead-grey blade-shaped crystals, some as long as 40 mm., showing a highly perfect cleavage. Marrite crystallises in the oblique system with $a:b:c=0{\cdot}57634:1:0{\cdot}47389$ and $\beta=88^\circ\ 45'$, while lengenbachite is probably anorthic. Bowmanite occurs in small honey-yellow rhombohedral crystals with $111:100=53^\circ\ 50'$. It has a highly perfect cleavage parallel to 100, and a specific gravity of about 3·2. The author also described twinned crystals of seligmannite dispersed over large crystals of dufrenoysite and baumhauerite, and curious highly modified crystals of blende showing a thin metallic lead-grey coating.—Mr. H. L. **Bowman** described crystals of a mineral from Cornwall which had been sent to him for determination by Mr. F. H. Butler. They were found to be bertrandite, a mineral new to the British Isles.—Mr. G. F. Herbert **Smith** exhibited a slightly modified form of the hand refractometer which he had previously described.—Mr. H. **Hilton** contributed notes on some applications of the gnomonic projection to crystallography, and on the construction of crystallographic projections.

Zoological Society, November 15.—Dr. W. T. Blanford, F.R.S., vice-president, in the chair.—The mammals collected by Mr. E. Seimund in Fernando Po: Oldfield **Thomas**, F.R.S. Twenty-four species, of which two were new, were enumerated and remarked upon. Mr. Oldfield Thomas also exhibited some skulls and a piece of skin, and gave an account, of a new species of pig from the forests of Central Africa.—The crowned cranes of the genus Balearica, and a new species obtained on the White Nile by Lady William Cecil: Dr. P. Chalmers **Mitchell.**—The mouse-hares of the genus Ochotona inhabiting the Palæarctic region: J. Lewis **Bonhote.** These numbered sixteen species, one of which was described as new.—Twelve new species of earthworms from the north island of New Zealand: Prof. W. Blaxland **Benham.**

Chemical Society, November 16.—Prof. W. A. Tilden, F.R.S., president, in the chair.—The following papers were contributed:—The isomerism of the amidines of the naphthalene series (fifth communication on anhydro-bases): R. **Meldola** and J. H. **Lane.** When 2:4-dinitroaceto-α-naphthalide is reduced (1) by tin and hydrochloric acid, and

(2) by iron and hydrochloric acid, two isomeric amido-amidines are produced, the former giving rise to that having the α-NH constitution, and the latter to the β-compound. This difference in action is explained by assuming that in presence of iron the two nitro-groups are fractionally reduced while with tin both are reduced simultaneously.—Theory of the production of mercurous nitrite and of its conversion into various mercury nitrates: P. C. **Rây.** Mercurous nitrite is the first product of the action of nitric acid (containing nitrous acid) on mercury. This is converted into nitrate by the nitric acid, and finally, under suitable conditions, there ensues an accumulation of nitrite owing to the occurrence of the reaction represented by the following equation:—

$$4Hg + 4HNO_3 = Hg_2(NO_2)_2 + Hg_2(NO_3)_2 + 2H_2O.$$

—Amidechloroiodides: G. D. **Lander** and H. E. **Laws.** Benzoylaniline imidechloride reacts with hydrogen iodide furnishing an amidechloroiodide to which the constitution Ph.CClI.NHPh is provisionally assigned.—A new synthesis of *iso*caprolactone and certain derivatives: D. T. **Jones** and G. **Tattersall.** The lactone was obtained by the interaction of magnesium methyl iodide with ethyl lævulate.—The influence of substitution in the nucleus on the rate of oxidation of the side-chain, part ii., oxidation of the halogen derivatives of toluene: J. B. **Cohen** and J. **Miller.** The authors have studied the behaviour of the dichloro-, chlorobromo-, and dibromo-derivatives, and the comparative oxidisability of these compounds is discussed.—The halogen derivatives of naphthacenequinone: S. S. **Pickles** and C. **Weizmann.**—The constitution of pyrazolidone derivatives; β-phenylazo*iso*valeric acid and *s*-β-phenylhydrazidobutyric acid: B. **Prentice.**—Preliminary notice of some condensations of phenanthraquinone with ketonic compounds: F. R. **Japp** and J. **Wood.**—The decomposition of ethylene iodide under the influence of the iodide ion: A. **Slator.**—The spectrum generally attributed to chlorophyll, and its relation to the spectrum of living green tissues: W. N. **Hartley.** The author confirms his previous observations on the difference in the absorption spectra of alcoholic extracts of (*a*) fresh green leaves and (*b*) dried green leaves.—Studies on comparative cryoscopy, part ii., the aromatic acids in phenol solution: P. W. **Robertson.** The influence of various substituents on the molecular association of aromatic acids is discussed.—Isomeric change of diacylanilides into acylaminoketones. Transformation of dibenzoylaminobenzophenone into 1-benzoylamino-2-4-dibenzoylbenzene: F. D. **Chattaway** and W. H. **Lewis.**

Royal Meteorological Society, November 16.—Capt. D. Wilson-Barker, president, in the chair.—Meteorological observing in the Antarctic: Lieut. Charles **Royds,** R.N.—Decrease of fog in London during recent years: F. J. **Brodie.** The author had discussed the number of days of fog reported at Brixton, the London station of the Meteorological Office, for the thirty-three years 1871–1903, and found that the mean annual number of fog days was 55, of which 45 occurred in the winter half of the year, and only 10 in the summer half. December is the foggiest month with 9·5, the next being November with 8·5, January with 8·2, and October with 7·8. The clearest months are July with 0·4, June with 0·6, and May with 0·8. The greatest number of fog days was 86 in 1886 and 83 in 1887, and the least 13 in 1900 and 26 in 1903. Dividing the thirty-three years into three periods of eleven years each, the author showed that the mean for 1871–1881 was 55, for 1882–1892 it was 69, while for 1893–1903 it was only 41, there being thus a very marked decrease in the number of days with fog during the last eleven years.—Hurricane in Fiji, January 21–22, 1904: R. L. **Holmes.**

PARIS.

Academy of Sciences, November 21.—M. Mascart in the chair.—On the changes in dimensions and volume that the organs and tissues of plants undergo under the influence of desiccation: M. **Berthelot.** The length of the stem is not greatly affected, but the lateral dimensions, and therefore the capacity, diminishes to a considerable extent during drying.—Remarks on the necessity of studying the variations of dimensions and volume of organs and parts of living or extinct beings in anthropological and palæontological work: M. **Berthelot.**—On a general theorem concerning algebraic surfaces of linear connection superior to unity: Émile **Picard.**—On the removal of moisture from the air blown into the Isabella blast furnace, near Pittsburg, by freezing: Alfred **Picard** and M. **Heurteau.** The efficiency of a blast furnace is dependent to a considerable extent on the amount of moisture in the air supplied to the furnace. An account is given of a plant for removing this moisture by passing the air through a refrigerating chamber cooled to about $-10°$ C. The results obtained show a surprising economy of fuel, the saving in the coke used amounting to 20 per cent.—On the constitution of ricinine: L. **Maquenne** and L. **Philippe.** The authors have shown in a previous communication that ricinine is converted by the successive action of caustic potash and hydrochloric acid into a methyloxypyridone. In the present paper a detailed study of this substance is given.—New experiments on the photographic registration of the action of the *n*-rays on a small electric spark: R. **Blondlot.** A refinement of the method given in a previous paper, and an investigation of the possible sources of error. The photographic negatives obtained are regarded by the author as establishing beyond cavil the action of the *n*-rays on the electric spark.—On continued algebraic fractions: R. de Montessus **de Ballore.**—The generalisation of a theorem of Weierstrass: Maurice **Fréchet.**—Fourier's series and Taylor's series on its circle of convergence: P. **Fatou.**—On the chemical composition of the radio-active gaseous mixtures given off from the water of some thermal springs. The presence of helium: Ch. **Moureu.** The gases evolved from twelve different springs were analysed, and the figures given for the amounts of carbon dioxide, oxygen, nitrogen, and gases of the argon group.—The influence of the nature of the anode on the electrolytic oxidation of potassium ferrocyanide: André **Brochet** and Joseph **Petit.** The nature of the metal used as the anode has a very considerable effect on the electrolytic oxidation of potassium ferrocyanide, the yields varying from 75 per cent. in the case of copper to nil in the case of metals forming a soluble anode.—On the complexity of dissolved sulphates: Albert **Colson.** On the assumption that the lowering of the freezing point of a solution of sulphuric acid is due to the single molecule H_2SO_4, the author draws the conclusion that the sulphates of the bivalent metals in aqueous solution are present as double molecules.—The stimulating and paralysing influence of certain bodies in the production of rust: L. **Lindet.**—On the purification of solutions of vanadate of soda; observations relating to the methods of double decomposition for the industrial separation of metals: M. **Herrenschmidt.** An explanation of the use of vanadic acid in preference to sulphuric acid in the separation of silica and vanadic acid.—The action of iodine and yellow oxide of mercury on unsaturated acids. The separation of isomers: J. **Bougault.** The results obtained depend upon the position of the ethylene linkage in the molecule. Acids with the $\beta\gamma$ linking fix hypoiodous acid in a very stable manner, giving rise to iodolactones.—Researches on the action of hydrobromic and hydrochloric acids on triacetin. Formation of some new halogen derivatives of triacetin: R. **de la Acéña.**—The addition of hydrogen to some aromatic ketones by means of reduced nickel. A new method of synthesis of aromatic hydrocarbons: Georges **Darzens.** With nickel reduced from its oxide at a temperature of 300° C., and working the Sabatier and Senderens reaction at 190° C. to 195° C., aromatic ketones of the formula C_6H_5—CO—R are reduced to hydrocarbons of the type C_6H_5—CH_2—R, without the production of any appreciable amount of the hexahydro-derivative. If, on the other hand, the nickel is reduced at the lowest possible temperature, so that it is very active, the addition product makes its appearance. Details are given of the application of this reaction to several ketones, and the method appears to be a general one for the production of hydrocarbons.—The action of pyridine and quinoline bases on bromosuccinic and dibromosuccinic esters: Louis **Dubreuil.**—The theory of colouring matters: Jules **Schmidlin.**—On trehalase, its general presence in fungi: Em. **Bourquelot** and H. **Hérissey.** Trehalase appears to be an enzyme generally present in fungi, the times of its appearance and disappearance being possibly in close relation with the utilisation of trehalose or the storage of the latter in the form of reserve material.—On the measurement and the laws of variation of the energy shown by the ergograph according to the frequency of the contractions and the weight raised: Charles **Henry** and Mlle. J. **Joteyko**.—On the law of variation of weight of *Penicillium glaucum* as a function of its age: Mlle. W. **Stefanowska**. The results are expressed graphically, and show that the evolution of the weight of these fungi as a function of the time presents two well marked phases: a phase of rapid ascent up to the period of fructification, and a phase of decrease appearing suddenly after fructification.—Transformations of the new secreting apparatus in Conifers: G. **Chauveaud**.—On vegetation in atmospheres rich in carbon dioxide: E. **Demoussy**. With one exception, there is a marked advantage in supplying plants with an additional amount of carbonic acid, the average increase in the weight of the aërial parts of the plant being 60 per cent. greater in the case of the artificial atmosphere.—On the experimental production of radishes with starchy reserves: Marin **Molliard**.—*Solanum Commersoni* and its variations in relation to the origin of the cultivated potato: Edouard **Heckel**.—A new theory of phototropism: Georges **Bohn**.—On the geology of the Salzkammergut: Emile **Haug** and Maurice **Lugeon**.—On the mountain chains to the south of the Guadalquivir: Robert **Douvillé**.—The tension of carbonic acid in the sea and on the reciprocal influence of the carbonic acid of the sea and that of the atmosphere: August **Krogh**. From a study of the equilibrium between sea-water and the carbonic acid of the air, the conclusion is drawn that the proportion of carbon dioxide in the air tends to increase, the sea, by absorbing the gas, opposing this tendency.—The measurement of the sensitiveness of taste in men and women: N. **Vaschide**.—The elimination of sulphur and of phosphorus, the demineralisation of the organism, and the magnitude of the average molecule elaborated in persons suffering from skin diseases: A. **Desgrez** and J. **Ayrignac**.—On the relations between Surra and Mbori: MM. **Vallée** and **Panisset**.—Remarks by M. **Laveran** on the preceding communication.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 1.

ROYAL SOCIETY, at 4.30.—The Ascent of Water in Trees: Dr. A. J. Ewart.—On the Presence of Tyrosinases in the Skins of some Pigmented Vertebrates: Miss F. M. Durham.—On the Structure and Affinities of the Fossil Plants from the Palæozoic Rocks. V.—On a New Type of Sphenophyllaceous Cone (*Sphenophyllum fertile*) from the Lower Coal Measures: Dr. D. H. Scott, F.R.S.—On Chemical Combination and Toxic Action as Exemplified in Hæmolytic Sera: Prof. R. Muir and C. H. Browning.—Histological Studies on Cerebral Localisation. Part II: Dr. A. W. Campbell.

CHEMICAL SOCIETY, at 8.—The Nitrites of the Alkali Metals and Metals of the Alkaline Earths, and their Decomposition by Heat: P. C. Rây.

RÖNTGEN SOCIETY, at 8.15.—The Perspective Nature of X-Ray Projection: Dr. W. Cotton.—The New Ultra-violet Glass recently produced by Messrs. Schott and Genossen, of Jena: J. H. Gardiner. Both will be illustrated by the Epidiascope.

LINNEAN SOCIETY, at 8.—Proteid Digestion in Animals and Plants: Prof. Sidney H. Vines, F.R.S.

FRIDAY, DECEMBER 2.

AËRONAUTICAL SOCIETY, at 8.—The Aëronautical Exhibits at the St. Louis Exhibition: the President, Major B. Baden-Powell.—Kites, Kite-flying and Aëroplanes: W. H. Dines.—The Work of the International Aëronautical Commission: Dr. M. H. Hergesell.—Captive Balloon Photography: Griffith Brewer.

GEOLOGISTS' ASSOCIATION, at 8.—On the Superficial Deposits of Central and Parts of Southern England: Dr. A. E. Salter.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Midland Railway, West Riding Lines: The Construction of Contract No. 1: R. T. McCallum.

MONDAY, DECEMBER 5.

SOCIETY OF ARTS, at 8.—Musical Wind Instruments: D. J. Blaikley. (Cantor Lecture II.—Brass Instruments.)

SOCIETY OF CHEMICAL INDUSTRY, at 8.—(1) Raschig's Theory of the Lead Chamber Process; (2) Theory of the Action of Metals on Nitric Acid: Dr. E. Divers, F.R.S.—A Rapid and Accurate Method for the Estimation of Phosphorus in Iron Ores: L. J. Davies.—Fluorescope for Comparing Substances under the Influence of Radium Rays: C. S. S. Webster.

VICTORIA INSTITUTE, at 4.30.—The Right Way in Psychology: Rev. F. Storrs Turner.

TUESDAY, DECEMBER 6.

ANTHROPOLOGICAL INSTITUTE, at 8.—Exhibition of a Slate Adze and Other Objects: Rev. R. Ashington Bullen.—Lantern Illustrations of Native Types from South India: Edgar Thurston.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Distribution of Electrical Energy (*Discussion*): J. F. C. Snell.—On the Construction of a Concrete Railway-Viaduct: A. Wood-Hill and E. D. Pain.

WEDNESDAY, DECEMBER 7.

SOCIETY OF ARTS, at 8.—The International Exhibition at St. Louis: W. F. Reid.

SOCIETY OF PUBLIC ANALYSTS, at 8.

GEOLOGICAL SOCIETY, at 8.—The Chemical and Mineralogical Evidence as to the Origin of the Dolomites of Southern Tyrol: Dr. E. W. Skeats.—Certain Genera and Species of Lytoceratidæ: S. S. Buckman.

ENTOMOLOGICAL SOCIETY, at 8.—On *Erebia bejarensis* and *Erebia stygne* in Spain, with an Exhibition of Specimens: Dr. Thomas A. Chapman.

THURSDAY, DECEMBER 8.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—Memoir on the Theory of Partitions of Numbers. Part III: Major P. A. MacMahon, F.R.S.—Note on a Means of Producing a High-voltage Continuous or "Pertinacious" Current: Sir Oliver Lodge, F.R.S.—The *Rôle* of Diffusion during Catalysis by Colloidal Metals and Similar Substances: Dr. H. J. S. Sand.—The Effect of Liquid Air Temperatures on the Mechanical and other Properties of Iron and its Alloys: Sir James Dewar, F.R.S., and R. A. Hadfield.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Notes on Portland Cement: H. E. Bellamy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Hydrodynamical and Electromagnetic Investigations regarding the Magnetic-Flux Distribution in Toothed-Core Armatures: Prof. H. S. Hele-Shaw, F.R.S., Dr. A. Hay, and P. H. Powell. (Conclusion of Discussion).—Studies in Magnetic Testing: G. F. C. Searle.

SOCIETY OF ARTS, at 4.30.—Burma: Sir Frederic Fryer, K.C.S.I.

MATHEMATICAL SOCIETY, at 5.30.—On Groups of Order $p^{\alpha} q^{\beta}$: Prof. W. Burnside.—On the Linear Differential Equation of the Second Order: Prof. A. C. Dixon.—On a Deficient Multinomial Expansion: Major P. A. MacMahon.

FRIDAY, DECEMBER 9.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Ticks and Tick-transmitted Diseases: Dr. Nuttall, F.R.S.

MALACOLOGICAL SOCIETY, at 8.—Description of a new species of Trachiopsis from British New Guinea: H. B. Preston.—A Correction in Nomenclature: E. A. Smith.—Notes on the American Cyclostomatidæ and their Opercula: W. H. Dall.—Note on the Dates of Publication of the Various Parts of Moquin-Tandon's "Hist. Moll. terr. fluv. de France": J. W. Taylor.

ROYAL ASTRONOMICAL SOCIETY, at 5.

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CONTENTS.

THURSDAY, DECEMBER 8, 1904.

THE MILLAIS BRITISH MAMMALS.

The Mammals of Great Britain and Ireland. By J. G. Millais. Vol. i. Pp. xx+363; illustrated. (London: Longmans, Green and Co., 1904.) Price 6 guineas net.

IN two important features this magnificent work, of which the first volume is now before us, may lay claim to special preeminence. First, the illustrations, alike in number, size, truthfulness to nature, and artistic excellence, are unrivalled; and secondly, as regards the main and most important part of the subject, namely, the habits and local distribution of the various species, the work is in no sense a compilation, but the result of long and patient personal observation on the part of the author. Indeed, the only matter for regret connected with the work is that its price puts it out of the reach of a large percentage of field naturalists; bearing in mind, however, the style in which it is got up and the wealth of illustration, it is difficult to see how it could have been offered to the public at an appreciably lower figure.

As an author of a work like the present, Mr. Millais has one incomparable advantage over the great majority—if not, indeed, over all—of his fellow-naturalists in this country, namely, that he is a great painter. In this double capacity of artist and naturalist he is consequently able to present the public not only with exquisite artistic pictures of the animals he describes, but also with portraits which emphasise and bring into prominence their special generic and specific characteristics. It is, indeed, this judicious blending of the artistic with the zoological aspect that confers on the coloured illustrations in this work such peculiar value. Too often in paintings of this description we find either zoological details more or less completely sacrificed to artistic effect or the former brought into undue prominence to the destruction of all that is really artistic and pleasing. In hitting off the happy medium between these extremes, Mr. Millais and the other two artists who have assisted in the work have been remarkably successful. In addition to the coloured pictures, there are a number of sketches, and in some cases photographs, showing the various animals in characteristic attitudes, in pursuit of their prey, &c., which illustrate their natural history almost without the necessity for letter-press. Nor is this all, for there are several sketches illustrative of the mammalian life of our island in prehistoric times; and although some of the details of form and colour assigned to certain of the extinct forms may be open to criticism, these certainly convey a good idea of the richness of this fauna as compared with that of the present day. No illustrations are given in the text of either skulls or teeth, which is perhaps somewhat to be regretted, as the latter receive mention in the text.

As regards the amount of time and labour the author has devoted to the work, it may be mentioned that, according to a statement in the preface, he made four successive expeditions, during as many years, in order to acquire a full knowledge of the grey seal alone, and that the best part of five years has been spent on the task in general.

The present volume contains the preface and introduction to the entire work, together with the text and illustrations relating to the orders Chiroptera, Insectivora, and Carnivora exclusive of the Mustelidæ. The relegation of the latter to the second volume is rather a pity, as it involves the intercalation of the seals and walruses between the bears and the weasels, which somewhat mars the systematic arrangement. The author states, however, that he found it impossible to complete his account of the Mustelidæ in time for it to come in its proper place.

In his introduction the author takes a cursory survey of the history of the British Islands during the prehistoric and later Tertiary periods, and as he is not a professed palæontologist he may perhaps be allowed a little license here, especially as it does not affect the general subject of the work. The statement as to the occurrence of ungulates in the Cretaceous (perhaps due to the author having been misled by a certain South American writer) is, however, open to exception, while the alleged first appearance of marsupials and Insectivora at the same time is perhaps an error in the opposite direction. The assertion that many types of mammals have been but little altered since the (Lower) Eocene might also be modified.

While on the subject of errors, it may be mentioned that the author (and quite justifiably) is very much "down" on other writers on British mammals for their various sins of omission and commission—whether trivial or otherwise. He must therefore take it in good part if similar slips of his own are brought to notice. For example, we fancy Sir Archibald Geikie will feel somewhat surprised to find himself described as a distinguished palæontologist and zoologist. Again, the initials of Dr. Smith Woodward are not A. B., neither is Dr. R. Ball (p. 238) the designation of the late director of the Dublin Museum, while Hermann, and not Herman, is the proper designation of the author of the name *Sorex vulgaris* (p. 141). Lack of classical knowledge seems to be implied in the translation of Chiroptera as "hand-bearers" (p. 12). More serious is the discrepancy between the number of teeth in Rhinolophus as given in the text (p. 23) and in the formula (p. 24), while another error of the same nature occurs on p. 143, where the number of premolars in the shrew is given as 2/4 instead of 4/2. Exception may also be taken to the statement (p. 230) that bears, as a whole, are a more primitive type than dogs, and the fact that the plate of the walrus is lettered *Trichechus rosmarus* while the creature is described in the text as *Odobaenus rosmarus* is another instance of want of care.

Reverting to the merits of the volume before us, attention may be directed to the value of the work accomplished by Mr. Millais in regard to the bats. Although the distinctive features of the various British representatives of the group can be gleaned by a careful study of technical treatises, the nature of the illustrations given in previous works on British mammals rendered it very hard for the amateur (to say

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nothing of the professed) naturalist to identify such specimens as might come under observation. All such difficulties vanish with Mr. Millais's life-sized coloured figures as a standard for comparison, the distinctive features of each species being brought clearly before the reader both in the text and in the plates. Much important work has also been done with regard to the local distribution of several of the species, notably as to the occurrence of the lesser horseshoe bat and the noctule in Wales. Whether Mr. Millais has been well advised, at all events in a work of this nature, in generically separating the noctule and Leisler's bat from the pipistrelle may, however, be open to question. Moreover, seeing that the author refuses to admit "*Myotis myotis*" into the British list, the propriety of assigning a separate heading to this species may perhaps likewise be doubtful.

Among the Carnivora, the account of the wild cat is of special interest, largely owing to the fact that the author does not endorse the views of the late Dr. Hamilton as to the practical extermination of this species in the British Islands. Not that it is anywhere common, even in the wilder parts of Scotland, where in many districts it has long since been killed off. At the present day, owing to a special cause, west Ross-shire appears to be its main stronghold. As to the extermination of the wolf and the bear from our islands, the author has much to say—and all that he says is worth reading. Very interesting, too, is his account of two distinct types of the fox in Scotland, namely, a dark and grey form in the mountains, and a smaller red or pale form in the lowlands. Apparently, however, he does not allude to the "greyhound fox" of the Lake District, which Cumberland sportsmen insist is entitled to be regarded as a distinct local race.

The most original and therefore the most valuable part of the section on the Carnivora is that relating to the British seals, of the characteristics and habits of which Mr. Millais has made himself thoroughly master as the result of personal observation in their native haunts; and no longer will naturalists find any difficulty in distinguishing between the common and the grey seal at all ages. Special interest attaches to the recognition of four distinct colour-phases in the adult male of the grey seal, although, since every intermediate stage between these may occur, and they are found together, they cannot be regarded as local races. Even more interesting is the statement that the young hooded seal is not, as commonly reported, white, but of the same mottled colour as the adult. It is, however, to be wished that the author had given the full reasons for this assertion.

The author has expressed the hope that his work may be found a fitting companion, as regards illustration, to Lord Lilford's volumes on British birds. So far as he has gone at present, he may be congratulated on having attained his ambition, and there is every reason to expect that the second and third volumes will be fully equal in this respect to the one before us. For many years this splendid work will probably remain one of the standard authorities on British mammals, and in the matter of illustration it will most likely be always without a rival. R. L.

FIRE RISKS.

Fire and Explosion Risks. By Dr. von Schwartz. Translated by C. T. C. Salter. Pp. xxi+357. (London: Charles Griffin and Co., Ltd., 1904.) Price 16*s*. net.

IN estimating the risks of fire due to the storage of goods of varying descriptions, the insurance companies are met by the difficulty that the knowledge necessary to gauge the comparative safety or otherwise of the materials present is of so technical a nature that but few possess it, and in many cases substances of apparently the most innocuous character become active sources of danger under conditions likely to escape the notice of any but those who have made a special study of the subject. As a result risks are often taken at far too low a premium, whilst the distrust born of the loss incurred afterwards leads to excessive charges in utterly wrong directions, very few insurance offices being fortunate enough to possess inspectors or assessors with the necessary knowledge to safely guide them in the adjustment of their scale of fees.

In Germany several works by such authorities as Dr. Richter, Prof. Hapke, and Dr. von Schwartz lend valuable aid to the scientific side of the question, but in England, with the exception of some valuable little works compiled by Mr. W. A. Harris, the able secretary to the Phœnix Fire Office in Liverpool, the literature of the subject has been entirely neglected, although the fact that on an average 10,000,000*l*. is annually paid by British fire insurance companies on fire claims alone, whilst the loss probably is nearly double this amount, suggests that the subject is well worth the deepest consideration.

Under these conditions it is a matter for congratulation that Mr. C. T. C. Salter has now given us an excellent translation of Dr. von Schwartz's valuable book on "Fire and Explosion Risks," a handbook which deals in a thoroughly practical way with the investigation, detection, and prevention of dangers arising in the manufacture and storage of the most widely used chemico-technical substances.

The author has had a very wide experience as a consulting chemist and factory inspector, and has brought his almost unique experience in manufacturing methods to bear upon the various risks which they entail, with the result that he has produced a work in which practice is so blended with theory as to make the book of the utmost value, not only to chemists, but also to those who, without much chemical knowledge, yet wish to master the mysteries of a very intricate branch of technical application.

In dealing with the various substances the raw material is fully described in each case, its origin, physical character, and behaviour under all conditions is freely discussed, whilst cautions and suggestions for the safe manipulation and storage of each are clearly stated.

The arrangement by sections of those bodies likely to react on each other is particularly useful, and the works chemist and insurance surveyor can find the information he seeks in relation to the particular class of goods with the minimum of trouble.

Taking the book as a whole, the reader's interest is fully sustained, and although one finds instances of duplication of cautions, this is evidently the result of the sectional arrangement and so unavoidable.

In so excellent a work detailed criticism is a somewhat thankless task, but it might be suggested that in discussing the risks attendant on the use of petroleum lamps, some notice might be taken of the views of Sir James Dewar, Dr. Boverton Redwood, and the late Sir Frederick Abel, as to increase of the flash point not being so complete a solution of the trouble as the author leads one to believe.

It might be well to note in a future edition that barium peroxide, which on p. 117 is said to become dangerous at 800° C., may also give rise to fire at atmospheric temperatures when exposed to friction with organic matter.

On p. 187 it is stated that one pound of calcium carbide furnishes 4 to $4\frac{1}{2}$ cubic feet of acetylene, which is perfectly true of the inferior carbide made on the Continent, but with material of the quality until recently made at Foyers the yield rarely fell below 5 cubic feet per pound.

Occasionally one finds slight discrepancies in the statement of temperatures in different parts of the book, the temperature at which lead fuses being given at p. 291 as 325° C., whilst in the appendix, p. 343, it is stated to be 334° C. Such details as these, however, detract but little from the value of a book which is an important and most valuable addition to the technical literature of the day.

THE DETERMINATION OF MINERALS.

Mineral Tables—for the Identification of Minerals by their Physical Properties. By Arthur S. Eakle, Ph.D. Pp. 73. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 5s. 6d. net.

STUDENTS of mineralogy, miners, prospectors, and others interested in the determination of minerals by methods which do not involve the use of elaborate apparatus, will find this little book a useful addition to the literature of the subject.

The tables, though forming a volume of only 73 pages, include nearly 250 minerals, comprising all the commonly occurring ores, veinstones, and rock-formers, as well as a few species of more restricted occurrence. They are designed for the identification of unknown minerals by the examination of their physical properties alone; blowpipe reactions are not employed at all in the scheme. It is claimed by the author that the determination of minerals by blowpipe analysis is less apt to become merely mechanical if it has been preceded by practice in identification by physical properties. This is no doubt true; and if, as is often the case, the beginner is tempted to rely upon blowpipe analysis alone, that intimate acquaintance with minerals which is only gained as the result of the systematic observation of their physical properties, and which is so valuable for their ready recognition in the field, is either missed entirely or is only very imperfectly acquired. Indeed, in most cases blowpipe reactions are best employed by the determinative mineralogist in confirming conclusions already arrived at from the evidence of physical properties. They are, however, so invaluable for this purpose, and afford such an indispensable aid to identification by physical properties, that any determinative scheme from which they are entirely excluded must be in a sense deficient. The author would have greatly added to the value of the tables by including for each species a brief statement of its distinctive blowpipe reactions, and we venture to suggest this extension of the scope of the work to him for future editions.

As in all tables of this kind, the identification of an unknown mineral is effected by a process of elimination. The minerals dealt with in the book are first divided into categories according to their colour in the powdered condition; these groups are then subdivided into minor groups according to the colour of the mineral in mass; and finally, the species in each of these divisions are arranged in order of hardness.

In general plan the tables are similar to those of Weisbach; but they differ from them in certain respects, notably in their greater simplicity, and in the abandonment of that indefinite and unsatisfactory property lustre, as an important means of discrimination. The tables are preceded by an "analytical key," by reference to which it is possible, after preliminary observations of streak and colour, to see at a glance in which table the mineral under examination will be found; it is then only necessary to determine the hardness and one or two other characters, such as crystalline form, structure, cleavage, specific gravity, and so forth—all of which are described in columnar form in the tables—to complete the identification.

The omission of the great majority of those rare minerals which the ordinary student or prospector is scarcely likely to meet with, and which by their insertion render so many books of this kind dear and unnecessarily complicated, is to be commended. The tables are certainly to be regarded as among the most satisfactory that have yet appeared.

OUR BOOK SHELF.

Die Sinnesorgane der Pflanzen. By G. Haberlandt. Pp. 46. (Leipzig: Barth, 1904.) Price 1 mark.

THIS little book, which is appropriately dedicated to the memory of Darwin, was given as a lecture before the recent Versammlung deutscher Naturforscher und Aertzte at Breslau. The author devotes the chief part of his space to a semi-popular account of the various types of structures, such as bristles, hairs, papillæ, which serve for the perception of mechanical stimulus. This is necessarily, to a large extent, a recapitulation of his own interesting work on the subject, and is followed by an account of the *statolith* theory—the hypothesis independently put forward by himself and Němec as explaining the sensitiveness of plants to the force of gravity. The most interesting part of the lecture is, however, Haberlandt's concise discussion of his recent theory of the mechanism by which the direction of incident light is perceived by plants. He believes that the epidermic cells are, so to speak, the eyes of the plant. Thus, according to his view, when light strikes a leaf at right angles to the surface it results, from the plano-convex form of the epidermic cells, that the inner wall of each cell is illuminated more brightly in the centre than at the periphery. This makes it possible for the leaf to orientate itself in regard to light. Thus, suppose the plant to be moved so that the light now strikes the leaf obliquely, the bright patches of light on the inner cell walls will no longer be central. This change may be believed to constitute a stimulus calling forth a curvature of the leaf stalk by which the leaf is brought again to its normal position at right angles to the incident light. Thus the leaf moves when the bright patch is not central, and comes to rest when each of its epidermic cells is centrally illuminated. This attractive theory cannot be said to be as yet established, and botanists will look with interest to its further development by its author. The appendix of six pages is devoted to the literature of the subject and to short discussions of points which probably seemed too technical for the text of the lecture.

Electricity in the Service of Man. By R. M. Walmsley. Pp. viii + 1208. (London: Cassell and Co., Ltd., 1904.) Price 10s. 6d. net.

WHEN the first edition of this book was published in 1888, it was doubtless a comparatively easy matter to write a treatise covering all the practical applications of electricity to the service of man. As each successive edition appeared the task must have become one of increasing difficulty, and now that the fourth has been reached Dr. Walmsley no longer finds it possible to condense all his material into one volume. He has therefore wisely confined himself to certain branches, and left the others for treatment in a supplementary volume. The book before us is divided into two parts, the first being more or less theoretical, dealing with the principles, and incidentally with the history, of the subject, and the second dealing with the technology of electricity. The first part is clearly written, and forms a good introduction to the study of electricity and magnetism which should be valuable to the beginner or to the amateur interested in scientific progress. The second part is confined in the present volume to generators and motors, with a chapter on measurements. The writer is of opinion that these more advanced subjects are best studied by means of the many very excellent treatises specially devoted to them; but still, there can be no doubt that a general review such as the one before us appeals to a large class of readers and serves a useful purpose. The book is plentifully illustrated with drawings and diagrams, which are for the most part good, though several, especially in the earlier part, are rather crude and out of date. M. S.

The Flora of the Presidency of Bombay. By T. Cooke. Vol. ii. Part i. Compositæ to Boraginaceæ. Pp. 216. (London: Taylor and Francis, 1904.) Price 9s.

THIS volume begins in the middle of the series *inferae* belonging to the gamopetalous division. The indigenous species of Compositæ are numerous, but for the most part are not so important as the introduced composites, of which a list is given. In the series *heteromerae* the cohort Ericales is unrepresented, but the orders Myrsineæ, Sapotaceæ, and Ebenaceæ include several interesting genera. Under Bassia Dr. Cooke explains how the synonym Illipe has been erroneously introduced. Illipe is the Tamil name for *Bassia longifolia*, and is applied commercially to the fatty product obtained from the fruit; this species replaces in southern India the better known mahua tree, *Bassia latifolia*, of which the flowers furnish a favourite food, also a spirit to the natives of Central India. The province is rich in species of Diospyros, amongst them *ebenum*, *melanoxylon*, the calamander-like *oocarpa*, and *crumenata*. The author agrees with Hiern in uniting *D. ebenum* and *D. assimilis*, but separates *D. cordifolia* and *D. montana*. The Apocynaceæ include *Cerbera Odollam* of the salt marshes, an endemic Beaumontia, and a species, also endemic, of Ervatamia, a genus cut off by Dr. Stapf from the original genus Tabernæmontana. Another dominant order is that of the Asclepiadaceæ, which furnishes mostly twining shrubs or climbers, and of which a good many, as, for instance, the four species of Hoya, and seven species of Ceropegia, are confined to the western side of the peninsula. This part gives every indication of the same care and accuracy which distinguished the first volume.

Quadratic Partitions. By Lieut.-Colonel Allan Cunningham, R.E. Pp. xxiv + 266. (London: F. Hodgson, 1904.) Price 12s. net.

THIS contains a complete list of primes p up to 99991, with the factors of $p-1$, and resolutions of

$$p=a^2+b^2=c^2+2d^2=A^2+3B^2=\tfrac{1}{4}(L^2+27M^2);$$

of $p=e^2-2f^2$ up to $p=24977$; together with other resolutions of the type $mp=x^2\pm Dy^2$ for selected values of m, D, and all primes p up to a certain limit. Besides this, there are tables relating to the Pellian equation, and others directly connected therewith. The introduction explains the nature and use of the tables, and gives an account of their preparation. Though some of the contents have already been published (as explained in the introduction), a substantial part appears for the first time in print; the whole forms a varied as well as extensive series of arithmetical records which will be found of great value by those who are interested in the theory of numbers, especially in connection with the theory of residues and of quadratic forms. Great care has been taken to ensure accuracy, and the appendix contains lists of errata detected in various preceding tables. The new part of the work represents a very large amount of labour, which is henceforth spared to those in search of material for induction, and the grants made by the Royal Society towards the expenses of computation and publication have been worthily bestowed. It may be added that the paper and type used are satisfactory; in the case of tables this is a matter of real importance. All serious students of the theory of numbers ought to procure this work, as well as Lieut.-Colonel Cunningham's "Binary Canon," for, independently of their use in solving special problems, these tables may suggest or confirm new theorems of real importance.

Advanced Hand-camera Work. By Walter Kilbey. Pp. xvii + 98. (London: Dawbarn and Ward, Ltd., 1904.) Price 1s. net.

IN this series of photographic books already published the present author is responsible for the popular volume on "Hand Colour Photography," which is now in its second edition. In the issue before us he deals with the higher flights of hand-camera work, more especially in connection with its use with the focal plane shutter. The subject-matter treats of the selection of apparatus, the behaviour and efficiency of the focal plane shutter, and practical work with the camera, the last mentioned consisting of hints on focusing, exposing, and the treatment of moving objects. No less important are the subjects of the last two chapters, which concern the plates and developers suitable for such work, and the employment of hand cameras in telephoto, stereoscopic, and orthochromatic photography. A great number of excellent and appropriate illustrations from the author's own negatives accompany the text.

The easy and clear style of the author, and his thorough acquaintance with the subject he is treating, render the book not only delightful to read, but a valuable guide to those who wish to work successfully with hand cameras.

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 Definition of Entropy.

THERE is, I fear, a difficulty in drafting Prof. Bryan's definition so as to be clear as well as accurate. This arises when the definition is first given with reference to the entropy of the working substance, because the non-available energy is not necessarily a portion of the energy of the substance. The terms available energy, free energy, bound energy, and non-available energy are continually used loosely in thermodynamics as if they referred to portions of the energy of the working substance. I know from experience the difficulty of defining the entropy of the working substance in terms of dissipation or degradation, without reference to the state of things outside the substance, and in a paper on the factors of heat I adopted the notion of reduction of "transfer credit," so that increase of entropy went with lessening of capacity for transforming heat into work with change of volume. In my book on "Entropy" the whole treatment is essentially from the dissipation or degradation point of view, but entropy is first defined in connection with the irreversible increase of entropy in an isolated system. It is thus defined: "Increase of entropy is a quantity which, when multiplied by the lowest available temperature, gives the incurred waste."

May I say that I am exceedingly glad to find Prof. Bryan treating the subject from the same point of view, as it is strong evidence that my treatment is essentially right.

41 Palace Court, W. J. SWINBURNE.

MR. SWINBURNE has directed attention to an obscure point in my letter of November 10 which is calculated to produce quite the contrary impression to what I intended. In defining available energy relative to a given temperature, it was not my intention to exclude work that the system was capable of producing by expansion or otherwise without using the reversible engines, and instead of "maximum amount of energy" I meant maximum amount of *work*. By work I refer to ordinary mechanical energy as opposed to what Mr. Swinburne calls "waste energy." The point to which I wished to direct attention was the desirability of basing a definition of entropy on non-available energy, and the use of the term "relative" in this connection, or at least some equivalent language (as implied in my words, "The definition may be stated *somewhat* as follows").

So far as I am able to judge, both from Mr. Swinburne's book and from some correspondence with the author, it would appear that the conclusions to which I am being led by independent working in regard to entropy agree closely in many substantial points with those at which he has arrived. Since the controversy referred to there have been one or two papers published on the subject by other writers with which I altogether disagree. G. H. BRYAN.

Craniology of Man and the Anthropoid Apes.

IN reading Mr. Macnamara's Hunterian oration of February, 1901, I find these words:—

"Prof. Deniker in his work on the embryology and development of the anthropoid apes has shown that *in consequence of the early closure* of the anterior sutures of the skull of these animals the fore part of their brain does not increase beyond the size it had attained at the end of the first year of life; but in man these sutures do not consolidate until a much later period, so that the anterior lobes of his brain are enabled to expand, and actually become far more perfectly developed than the corresponding lobes among anthropoid apes."

This being so, I ask:—

(1) Has the experiment ever been tried of keeping the sutures of an infant ape open by artificial means? And if it has,

(2) Has the brain been found to expand and become more perfectly developed?

For if so we should expect the ape to manifest an intelligence not far short of that of a man. A. T. MUNDY.

IN answer to Mr. A. T. Mundy's questions, it seems to me that it would be impossible in a young living ape, by artificial means, to prevent his frontal suture from closing, and if we could succeed in keeping it open I question if any marked increase in the size of the animal's frontal lobes would augment his intellectual capacity. It is not only the great size of man's cerebrum as compared with that possessed by anthropoid apes which gives him greater intellectual power, but, as I have stated in the passage quoted by Mr. Mundy from my Hunterian oration, the frontal and parietal lobes of the human brain are "far more perfectly developed than the corresponding lobes among anthropoid apes." This is especially the case with respect to those motor and psychical areas of man's cerebral convolutions which control his power of intelligent speech; these areas of the brain are deficient in the anthropoid apes. It is probable that man's ability to make use of articulate language, and through this means to think, has led to the great development of the psychical elements of his brain. A comparison of the size and conformation of the cranium of Tertiary man with that of existing Englishmen is an indication of the length of time it has taken for the human cerebrum, and therefore intellect, to reach its present stage of evolution. Man and anthropoid apes we hold to be derived from a common ancestral stock; the former, under the action of natural selection and other causes, including, I think, not only an inherent capacity of cerebral but also of cranial growth, have gradually developed, whereas anthropoid apes, from arrest of cranial and cerebral growth, have not reached the standard attained by human beings; the difference between these two orders of beings, however, is one of degree, and not of kind. N. C. MACNAMARA.

November 26.

Pinnipedia a Sub-order of Cetacea!

ONE is so much accustomed to encounter strange assertions in regard to zoology in the non-scientific Press that one takes little notice of them; but when one reads under the head of "Science," as may be read in this day's *Athenaeum* (p. 767), a reviewer of Mr. Millais's "Mammals of Great Britain and Ireland" complaining of that work that "Nowhere is it stated, as it should be, that the Sub-order Pinnipedia belongs to the order Cetacea," one is tempted to ask to what end have writers on classification laboured, if such an assertion as this is to pass unchallenged? If, by a slip of the pen, "Cetacea" was written for "Carnivora," one can sympathise with the reviewer, for all are liable to such unhappy accidents; but the general drift of his remarks seems to forbid that charitable construction, for in the preceding paragraph it is expressly stated that the Carnivora, except the Mustelidæ, are dealt with in the volume. F. Z. S.

December 3.

The Late Mr. Assheton Smith.

THE man of ample means, and who is a lover of living creatures, has a great opportunity. Mr. Assheton Smith had this opportunity, and he used it not only to gratify his own pleasure, but to share it with others. There was nothing that he liked better than to go the round of his park with a guest, and to point out and discuss the characters and habits of the animals which he had gathered together from various quarters of the globe. With the late squire such a ramble was no ordinary treat. One felt, too, that in this man the beasts had a true friend, that he had studied them and knew their ways, and that he would do his utmost to make their lot as happy as possible. To such a man science owes a great debt. Not only does he afford the student an opportunity of studying animals in favourable circumstances, but he is able to place material at the disposal of the laboratory and museum when these animals have paid nature's last demand. For a number of years I have had the good fortune to act, as it were, as prosector to his menagerie, and both my students and I have been able to carry out not a few studies in comparative anatomy. Sometimes, playfully, he would accuse me of possessing the "evil eye," as he said that an animal was not likely to survive long should I express a desire to have it eventually for the college museum. I am grateful that my liking for natural history brought me in touch with him. It is in the small actions of life that one can best read character. A gentleman to the core, he was never fearful of giving himself away by showing the utmost courtesy to the humblest. An unfastened door or gate, a watertap left trickling he would not abide. Everything at the park must be precision and finish to the smallest details. Over his many acts of private charity he ever kept the veil tightly drawn. A few of them have incidentally come to my knowledge, and they reveal the vastness of his sympathy. His many zoological donations, and his gift to the college of a site on the Menai Straits for a biological station for the study of marine life, bear eloquent testimony to his desire to advance science. May the pile to be raised on this fine site—let us hope at no distant date—be at least one grateful tribute to his memory. PHILIP J. WHITE.

University College, Bangor, November 28.

The Leonid Meteors of 1904.

FROM results of observations of this shower as published in NATURE of November 24 it seems that Leonids were found to be somewhat numerous on the night of November 14. It is to be regretted that those observers who were able to count so many shooting stars on this night had not the following night equally clear, as at Dublin both November 14 and 15, though not to the same degree, proved favourable for observations, and it was on the latter night that the maximum occurred. Owing to the unsuitable weather that appears to have prevailed in many places on November 15, some details of the observations made on the successive nights of the epoch at the same place may prove interesting.

The night of November 14 turned out ideally fine here, the temperature also being very mild for the season. During a watch on this date from 10h. 15m. to 13h. 45m. (Dublin time) 16 meteors were counted, of which 7 or 8 were referred to the Leonid radiant. The meteors, especially the Leonids, did not appear very bright, only 1 of the first and 2 or 3 of the second or third stellar magnitudes having been seen. No particulars of their paths were noted, as doing so might have interfered with the observations of other meteors. Shooting stars were more numerous in the early part of the watch than after midnight, 5 having been counted between 10h. 45m. and 11h., of which 2 shot from the direction of Leo. Another, though feebler, maximum occurred about 13h.; but, as it was considered from the declining meteoric rate that the anticipated miniature shower of this night was already over, observations were discontinued shortly before 14h.

The night of November 15 began very inauspiciously; clouds in the early evening covered the heavens, totally concealing both moon and stars. Subsequently, however, the sky partially cleared at intervals, and when observations were begun at 10h. 15m. passing clouds in the east left clear tracts of considerable area. Though the seeing was thus far from good, yet meteors were considered to be rather scarce, only 1 shooting star, a third magnitude Taurid, having been seen during a watch extending over nearly an hour. About 11h. the clouds passed off, leaving the eastern sky clear until nearly 14h. Meteors now began to be more numerous. A fine Taurid at 11h. 25m. passed down straight towards Leo, which, however, was partly invisible in a bank of fog along the horizon. When about twenty minutes later the "Sickle" emerged clear in the heavens, a succession of fine Leonids left no doubt as to the superior character of the coming display.

From 11h. to 13h. 30m. 32 meteors were counted; at 14h. 55m. the number had increased to 50 meteors, the total result at 16h. 45m. amounting to 60 meteors. But owing to clouds observations were greatly hindered from 13h. 45m. to 14h. 15m., and a second interruption of nearly equal length, arising from the same cause, occurred about 15h. During the last hour of the watch the sky was fairly clear, and it was noted that the meteor shower was now rapidly declining. The majority of the meteors were observed to emanate from Leo as soon as the latter had become visible near midnight.

The shower was also observed at the Paris Observatory on the night of November 15 with the following results[1]:—

From 10h. 30m. to 13h. 15m. ... 21 meteors observed
,, 13h. 15m. ,, 16h. 30m. ... 29 ,, ,,
,, 16h. 30m. ,, 17h. 35m. ... No shooting star seen

As no mention is made of the state of the weather, it seems the display terminated very abruptly at Paris, slightly more so than in Dublin or elsewhere, as Mr. T. R. Clapham, on November 15, from 15h. 45m. to 17h. 45m. counted 19 Leonids with 3 three doubtful ones, notwithstanding two brief interruptions from clouds, this result, it may be added, indicating a meteoric rate almost exactly equal to that of the preceding night as given by Mr. Hector Macpherson, who on November 14, from 15h. to 18h., recorded 35 meteors (*English Mechanic*, November 25, p. 365). The rate on the latter night seems, however, to have been even higher than this to judge from some results, but more observations are, no doubt, desirable. JOHN R. HENRY.

Dublin, November 29.

[1] The results are of course given in Paris mean time.

Blue-stained Flints.

Two years ago I found large patches of an intense blue colour, with some black spots, on flints on the quay at Great Yarmouth. I looked for a possible cause, and discovered other patches similar in all respects but colour. The latter patches were black, and had been made by tar spilt by fishermen when tarring their fish skips. I kept some pieces, both black and blue, in a box until some months ago, and no appreciable change had taken place, so I came to the conclusion that the blue colour was produced by the action of the tar on the flint when exposed to sunlight.

This occurrence is interesting in view of the action noticed by Dr. Allen between gas-lime and flint, and points to the action on the flint of some substance common to the tar and gas-lime.

May I suggest to your former correspondent that the blue flints seen at Bournemouth were produced from the black, and not *vice versâ*. THOMAS L. D. PORTER.

County School, Ilford, Essex.

"FIND" OF ROYAL STATUES AT THEBES.

THE "land of surprises and paradoxes," as Egypt has well been called, has once again justified its reputation, and out of the ruins of one of its most ancient cities there has come to light a mass of historical evidence which, if we mistake not, will be found to be of more importance the more it is studied. It will be remembered that for many years past M. G. Legrain has been carrying out a series of repairs of a very far-reaching character on the mass of buildings of various styles and ages which is commonly known as the "Temple of Karnak." In the course of this work he has collected a number of important facts which, when duly arranged, will be of considerable use to the student of ancient Egyptian architecture, and, side by side with these, he has brought together a considerable amount of information of value historically. It is not our purpose even to outline the broad facts of the works of restoration which he has carried out, and we therefore pass on to state briefly the facts which relate to his last "find" of monuments at Karnak.

Early in the present year M. Legrain was continuing the excavation of a portion of the temple precincts near one of the great walls when he accidentally came upon a large pit or well which, it was evident, had been filled up by the ancient Egyptians. Soon after he began to dig out the well the workmen came upon a layer of statues made of hard stone of various kinds, and when the mud was removed from them many of them were found to be inscribed. Beneath this layer of statues was a layer of earth, and beneath the earth was another layer of statues, and the clearing out of the pit showed that it was filled with layers of statues and earth, arranged alternately. The statues were usually found face downwards, and it thus became clear that they had been so placed in order that their faces might be protected by the soft earth and mud in which they were buried. The total yield from the pit or well was about 450 statues.

As soon as the pit was emptied M. Legrain began to examine the objects which he had found, and he saw that many of the statues were royal, and that, speaking generally, the oldest belonged to the second or third dynasty, and the latest to the twenty-sixth dynasty. The greater number of them were, of course, made for high officials, generals, architects, priests, &c., and we may be certain that from first to last they represent the men who, during a period of about 3500 years, were the principal benefactors of the great temple of Amen-Rā, the "king of the gods," at Thebes. The question which naturally arises is, How came these statues to be in the place in which they were found? The answer is not far to seek. We know that it was a custom among the Egyptians for the kings and their nobles to dedicate statues of themselves to the temples of the god or gods whom they loved to worship, and they did so with the idea that, after death, their spirits would come from their graves and inhabit them, and would enjoy in their new existence the worship which had been their delight when upon earth. As the spirits of the gods also dwelt in the statues which were dedicated to them in the temples, the spirits of the kings and their nobles would thus dwell in divine company, and would participate in the happiness which disembodied spirits were believed to derive from the chants and hymns of the faithful, and the offerings and incense which were offered up by the priests. How these statues were arranged is not quite clear, but it is pretty certain that they were placed in niches or on pedestals in the chambers adjoining the sanctuary. As time went on, chamber after chamber would become full, and at length it would be as difficult to find a site for a new statue as it is to find a site for a monument to some illustrious dead person in our own Westminster Abbey.

It has been the custom to say that the temple of Amen-Rā at Karnak was founded by the early kings of the twelfth dynasty, about B.C. 2500, but it is clear from the statues which M. Legrain has brought to light that a temple to Amen must have existed at Karnak at least some 1500 years earlier. Some archæologists, basing their opinion on the evidence derived from religious texts, have always maintained that the twefth dynasty temple of Amen was merely a new foundation, and not the original temple, and this was the view which Sir Norman Lockyer, K.C.B., arrived at in his investigations of the systems of the orientation of Egyptian temples. We now know that so early as B.C. 4000 an important temple of Amen stood at Karnak, and that even in that early period it was already so old that kings held it to be one of the highest honours attainable to have their statues included among the monuments of the "glorious and mighty dead" who were commemorated there. The temple of Amen represented the roll of fame for the Egyptians, and M. Legrain's "find" helps us to understand why Karnak was declared by the priests to be the "throne of the two lands" (*i.e.* Egypt), and the "seat beloved of the heart of the god." Now the fortunes of the god Amen and of his temple varied with those of the king, and the glory of his sanctuary waxed and waned according as the prosperity of the country increased or decreased. During the fourth, fifth, and sixth dynasties the chief centre of power lay between Heliopolis and Memphis; from the twelfth to the twentieth dynasty it rested at Thebes, and the temple of Amen between B.C. 2500 and B.C. 1050 was the greatest in the land, just as Amen himself was the greatest of the gods.

Between B.C. 1000 and B.C. 650 evil times came upon Thebes, and the formerly wealthy capital became poverty-stricken. A serious trouble between the priests and the people resulted in the departure of the former to Nubia, and in consequence the temple of Amen fell into a state of decay. Worse than all, soon after his accession, B.C. 668, Ashur-bani-pal, King of Assyria, invaded Egypt, and, marching up the country, plundered Thebes and its temples. This blow the city seems never to have recovered, and for about 300 years it held a position of no importance in the country. Under the Ptolemies some attempt to rebuild certain portions of the Temple of Amen was made, and it is probable that the work was begun under the wise rule of that astute ruler Ptolemy I. It was, of course, impossible to restore the worship of Amen to its original glory, and the extent of the buildings of the god must have been considerably curtailed.

Whilst the work of restoration was going on, the question of the disposal of the statues which M. Legrain has unearthed came up for decision. It was felt that to destroy the statues would be a sacrilegious and profane act, and therefore an old well was chosen in which to bury them; as we have seen, they were carefully placed in layers of earth or mud, and it is entirely to the religious instinct of the restorers of the temple of Amen that we owe the preservation of such a unique series of statues. In his "Notes prises a Karnak," recently published in the *Recueil*, M. Legrain directs special attention to the statues of three kings, of whom previously no monuments have been known; these are:—Mer-ḥetep-Rā, Mer-sekhemRā Mer-ānkh-Rā. It is early yet to attempt to assign exact places to these kings, but the discovery of their monuments is a striking contradiction of the assertion which has been made recently to the effect that our knowledge of Egyptian history is complete, and that there are no more important discoveries to be made in Egypt. Already M. Legrain's examination of the statues from Karnak enables us to correct our views on Egyptian history, and we must be prepared to admit that the kings of Egypt were considerably more in number than the king-list of Manetho would lead us to suppose, and that some of the dynasties were contemporaneous. M. Legrain's "find" also proves beyond all doubt the futility of limiting dynastic history to a period of 3000 years, as some of the German *savants* have done, and the evidence which is accumulating rapidly all goes to show that the assertions concerning the great antiquity of Egyptian civilisation made by Herodotus and other Greek writers, and the opinions of modern experts like Mariette, Chabas, and our own Hincks, are generally correct.

The statues recently found belong to all the dynasties which are most famed for the production of fine artistic efforts in sculpture and statuary, and many of them may well be considered to represent with great fidelity the features of the men they commemorate. Nearly all the great kings of Egypt took care to have their portrait-statues added to the Karnak collection, and down to the Ptolemaïc period the lover of antiquity in Egypt could look upon contemporaneous portraits in stone of the kings of the Archaic period, of Cheops, the builder of the Great Pyramid, of the great warriors of the eleventh, twelfth, and eighteenth dynasties, of the bombastic Rameses II., and of the Nubian king Tirhakah, who, to his credit be it said, left the shrine of Amen at Karnak uninjured, and humbly worshipped in that great symbol of the solar worship of the ancient Egyptians. It is greatly to be regretted that the Ptolemies did not cause portraits of themselves and their queens to be included among the statues of the great kings and priests of the country over which a strange fate called them to rule.

COMPULSORY GREEK AT OXFORD AND CAMBRIDGE.

THE statute enabling students of mathematics and natural science to proceed to a degree at Oxford, without previously passing in Greek, has been rejected in the larger house by 200 votes to 164. At an earlier stage the proposal was adopted in the smaller assembly by the narrow majority of two votes. The discussion accorded to the statute was brief, for the voters had probably made up their minds; but it revealed the fact that, while the familiar arguments as to culture and the humanities held sway with those who have "learned nothing and forgotten nothing," some condemned the proposal, at least ostensibly, because it was too narrow. It would shut up school boys with a bent for mathematics or science to a "premature specialism," if they alone had to be segregated, years before the university stage, from their happier fellows on the "classical side."

The Cambridge proposals avoid at least this latter objection. They recognise that the examination which admits to the university should be one, in the sense that it allows the student who has passed it to enter any faculty or department of the university. He need not, while still at school, decide finally as to his special subject or subjects; and if he changes his mind as to the course he desires to pursue he need not retrace his steps, and begin to "get up" a new set of "little-go" subjects after he has entered the university. For three days high debate on the new scheme was held in the Cambridge Senate House, and so far as argument goes the impression produced is that the *placets* have the best of it. The official defenders of compulsory Greek spoke, naturally and properly, of the ennobling influence of Greek literature and philosophy. They scornfully derided the lack of culture disclosed by the false quantities of the mere man of science who is Greekless. But they failed to make clear the connection between the paltry rudiments, half grammar and half "crib," by which Greek is now represented in the previous examination, and humanistic culture or literary training of any sort. It was practically admitted that half the boys, even from classical schools of the straitest sect, might spend eight formative years over Greek and be no Hellenists in the end. But the conclusion was that time must be given for the improvement of school-teaching in classics, and that, in order to secure this improvement, the artificial support of the subject afforded by the present regulations is a necessity. The monopolists asked for more protection that they might mend their machinery.

One or two headmasters pleaded their helplessness before the uncultured parent if the shelter of academic compulsion were denied them, and the inconvenience they would suffer if they had to rearrange their time-tables to make room for science and modern languages, with all their complexity. Greek for all who aspire to enter the university is so much simpler than French and German and science for some, mere "modern-siders," and Greek and Latin for others, the "pick of the school." "If compulsion is done away with, schools will soon give up Greek altogether; in ten years it will be as dead as Hebrew," was the cry of these despairing headmasters. There were not wanting others to answer them, no less distinguished as scholars and teachers. The masters of Trinity and Christ's, the president of Queens' and Dr. Jackson, and other Grecians of established fame had such faith in the vitality of Greek—in its undying charm and its unrivalled power over the human spirit—that in their opinion it needed no such paltry prop to hold it upright. To force upon students of another bent the wasteful drudgery of six months' cramming in Greek accidence and the perfunctory conning of a set book with the help of a translation, was not only an educational blunder, but a grave moral wrong. It was bad for the student, it was bad for the master, it was bad for the university, and it was worst of all for the cause of Greek learning itself. It was breeding a race of students who, able and brilliant and influential in other paths, cherished a positive hostility to the distasteful subject that had raised itself as a needless obstacle in their way. But for compulsion they might have remained at worst indifferent, at best distant admirers of Greek. Now their only thought of it was associated with grievance and injustice. Times had changed, were changing fast; new methods of education were afoot in the schools. The bifurcation of studies—classical and non-scientific on the one hand, modern and scientific on the other—had become an accomplished fact. It was for the university frankly to recognise the change, and to give equal opportunity for both curricula. Cambridge had amply provided for the needs of the modern and scientific student once the barrier of the classical previous was passed. Why should the student, whose school and university course alike bore in one and the same direction, say towards natural science, be obliged to deviate during the last months of his school-time in order to pass through a wicket that lay straight in the path of his classical comrade, but far out of his own? True, a great teacher, a Porson or an Arnold or a Gow, might make even "Little-go Greek" a thing of life and light for his pupils; but what of the schools the head of which was a "mere Newton or Darwin"? Must the many be sacrificed for the few?

Then another issue was raised by the clerical members of the Senate, an issue on which, seeing the actual composition of the register, more will ultimately turn than on the educational question. If Greek is not compulsory, it will cease to be taught to and cease to be learned by candidates for ordination. The bishops of the Church of England will no longer be able to require a knowledge of the Greek Testament from the aspirant to holy orders. It is admitted that the Presbyterian Church exacts both Greek and Hebrew as a condition of admission to its theological schools. But the heads of the Anglican Church are weaker than the General Assembly; the university must reinforce them, whatever the consequences to sound learning and unfettered research.

Grave warnings were uttered that the *non possumus* of the Senate on this question would not be the final word. Revolution, in other words a Royal Commission, would be the inevitable Nemesis of reform denied. And there is no doubt that this thought will weigh with some waverers, who love learning and fear for its displacement by modern studies, but who love the university more and dread the changes which a liberal government might impose on it from without.

The report of the syndicate will doubtless be referred back for reconsideration of details in the light of the discussion. But the principle that modern subjects shall be recognised will certainly be retained, and on this principle issue will be joined early next term. The result no man can predict, for it lies with the silent voters who will flock from the country to the poll. But the debate has cleared the air, and the reformers are sanguine that this time something will be done.

PROF. KARL SELIM LEMSTRÖM.

As has already been announced, Prof. Karl Selim Lemström, whose name is known to our readers by his investigations on the aurora borealis and the influence of electricity on plant growth, died on October 2 after a short illness.

He was born in 1838 not far from Helsingfors, and entered the university in 1857, where he devoted himself to studies of physics and mathematics. His first scientific work, published in 1868, was founded on experiments made in Stockholm under the guidance of the late E. Edlund, the celebrated physicist, and dealt with the intensity curve of induction currents in relation to time, the intensity of the inducing current, &c. A summary was published in French in the *Proceedings* of the Swedish Academy of Sciences in 1870.

Lemström joined the late Baron A. E. Nordenskjöld's expedition to Spitsbergen in 1868 as physicist. In the two following years he worked in the laboratory of V. Regnault in Paris; in 1871 he made a journey to Lapland; in 1872 he continued his researches on the induction currents at the St. Petersburg Academy of Sciences. His papers during these years are printed in the *Proceedings* of the Swedish Academy and of the Finland Society of Sciences.

During the journey to Spitsbergen Lemström was engaged in observations on atmospheric electricity, terrestrial magnetism, and the aurora borealis. These observations, continued in Lapland, suggested to him a new theory of the last named phenomenon, so enigmatic even after the investigations of De la Rive, Loomis and others. This theory he expounded in a dissertation entitled "The Electrical Discharge in the Aurora and the Auroral Spectrum" (1873).

His next work, on the causes of terrestrial magnetism, was published in 1877. Starting from Edlund's well known theory on the nature of electricity, he argued that the rotation of the earth in an atmosphere of non-rotating ether causes the electric currents of which the terrestrial magnetism is a manifestation, and he described several experiments in confirmation of these views.

Appointed in 1878 professor of physics at the Helsingfors University, he continued his investigations on the aurora borealis in Lapland in 1882–4, where he organised two stations for taking part in the international polar exploration of these years. The investigations carried on by this expedition were published in a large work, "Exploration internationale des Régions polaires, &c.," of which vol. iii. (1898) contains his auroral researches.

One very interesting work by Lemström is devoted to the study of night frosts and the means to prevent their devastations, so frequent in Finland. Lemström emphasised the nocturnal radiation of heat as the principal cause of the night frosts, and showed that in calm and clear summer nights the air, cooled by the radiating soil and plants, must remain at the surface of the earth, and, flowing like water, gather on lower grounds, which generally are most exposed to frost. He proposed to prevent the radiation by artificial clouds of smoke, and invented for this purpose "torches" or tubes of peat (described in *Acta Societatis Scientiarum Fennicae*, Tome xx.).

Moreover, Lemström made important experiments on the influence of electricity on growing plants, on which subject he read a paper before the British Association at Bristol in 1898. The influence in question was found by exposing the plants to electric tension from a metallic wire net, provided with points and connected with the positive pole of a Holtz machine, the negative pole being conducted to the earth.

His frost experiments directed attention to the prevention of frost damage in several countries, and also gave rise to new scientific investigations (for instance, by Th. Homén). It is to be hoped that further work may be devoted to this important subject as well as to the electrocultural question, which have both but very little advanced from the point to which they were brought by the warm-hearted, indefatigable pioneer, Selim Lemström. Arthur Rindell.

NOTES.

It was announced last week that the Royal Society of Edinburgh has awarded the Gunning Victoria Jubilee prize for 1900–4 to Sir James Dewar, F.R.S. We now learn that the following additional awards have been made:—the Keith prize for 1901–3 to Sir William Turner, K.C.B., F.R.S., for his memoir entitled "A Contribution to the Craniology of the People of Scotland," and for his "Contributions to the Craniology of the People of the Empire of India": the Makdougall-Brisbane prize for 1902–4 to Mr. J. Dougall for his paper on an analytical theory of the equilibrium of an isotropic elastic plate; the Neill prize for 1901–4 to Prof. J. Graham Kerr for his researches on *Lepidosiren paradoxa*.

A valuable collection of specimens illustrative of the fauna of the deep sea has recently been received at the British (Natural History) Museum as a gift from H.M. the King of Portugal. The collection is reported to include a number of deep-sea fishes, among which are sharks of considerable size, captured during His Majesty's recent cruise in Portuguese waters. Several of these may prove to have been previously unrepresented in the British Museum collection. King Carlos, like the Prince of Monaco, is much interested in the fauna of the deep sea, of which he himself has done much to increase our knowledge. The collection sent to the museum is also stated to contain a series of contributions to our knowledge of the deep-sea fauna from the pen of His Majesty.

The sale of Chartley Park, Staffordshire, the hereditary seat of Lord Ferrers, involves also a change of ownership of the remnant of the celebrated herd of white cattle which have been kept there for the last 700 years. It is much to be regretted that the cattle could not have gone with the park, and have been maintained there by the new owner; but as this is not to be, it is to be hoped that they will be given a safe home elsewhere, where they will flourish and increase. It was long considered that the herds of wild cattle in various British parks were direct descendants of the wild aurochs, but it is now generally admitted (largely owing to the writings of Mr. Lydekker) that they are derived from domesticated albino breeds nearly allied to the Pembroke and other black Welsh strains, some of which show a marked tendency to albinism. This view, as pointed out by a writer in the *Times* of November 29, is strongly supported by the fact that the Chartley cattle frequently produce black calves. The theory advocated by a later writer in the same journal that the British park cattle are the descendants of a white sacrificial breed introduced by the Romans rests upon no solid basis. The Chartley cattle, believed to be reduced to nine head, are to be captured by the purchaser—no easy task.

The anniversary dinner of the Royal Society was being held last week as we went to press. In proposing the toast of the Royal Society, Mr. Arnold-Forster said that every day he has lived in a public office he has been more and more impressed with the need for a greater knowledge in our public life of what men of science are thinking, what they are doing, and what they hope and mean to accomplish in all the great departments of scientific life throughout the globe. There is absolutely infinite opportunity for the work of trained minds in that important department of our national life, the public service. Even in his short official life he had lived to see some progress made in the direction in which he wished to see this nation travel. Sir William Huggins responded; and among other speakers were Lord Strathcona, Sir J. W. Swan, Mr. W. Bateson, and Mr. Leonard Courtney.

The annual dinner of the Institution of Electrical Engineers was held on Thursday last, December 1, Mr. Alexander Siemens, the president, being in the chair. In proposing the toast of the institution, Lord Alverstone remarked that its high standing among scientific organisations was due to the fact that it had kept pace with the times, had been the first to promulgate and promote among its members all the information about electrical science that could be obtained, had been willing to welcome electricians from all parts of the world, had kept its students and its members acquainted with every modern development, and had given them the means of cultivating the technical knowledge of their science to the highest extent. In the course of his response to the toast, the president announced that telegrams of congratulation and sympathy had been received from the Belgian and Italian Societies of Electrical Engineers. In their visits to foreign countries the international character of electrical engineering had come out, and it was this which had contributed not a little to the development of electricity throughout the world.

The death is announced of Dr. T. M. Drown, president of Lehigh University, and previously professor of chemistry at Lafayette College and the Massachusetts Institute of Technology.

It is reported in the *Pioneer Mail* that the Secretary of State for India has sanctioned the creation of the appointment of electrical adviser to the Government of India, with headquarters at Calcutta. The present post of electrical engineer to the Government of Bengal will be abolished.

According to the correspondent of the *Daily Chronicle* (November 25) the German Commission that is investigating tuberculosis has come to the conclusion that two distinct forms of tubercle bacilli exist, the human and the bovine. Out of fifty-six cases of human tuberculosis examined fifty showed human bacilli only, five (three being children) showed bovine bacilli, while the remaining one showed both human and bovine bacilli.

A movement has been initiated in Denmark for the erection of a monument to the late Prof. Finsen, the inventor of the light cure for lupus. It has been thought that many outside Denmark would desire to join in doing honour to one who did so much for his fellow-men, and a British committee has been formed for the furtherance of the scheme. The Hon. Sydney Holland, Sir Francis Laking, Sir Frederick Treves, and Mr. Malcolm Morris, members of this committee, announce that subscriptions may be paid to the Finsen Memorial Fund at the National Provincial Bank, 112 Bishopsgate Street, E.C.

The Bradshaw lecture was delivered at the Royal College of Surgeons on December 1 by Mr. Mayo Robson, who took for his subject the treatment of cancer. He pointed out that in many instances, perhaps in all if we only knew it, there was a pre-cancerous stage in which operation ought to be performed, and would be the means of saving many lives. In early operation with complete removal of disease, together with a wide margin of healthy tissue, our hope of cure must depend. Medical treatment could not cure, and could do little to prolong life. There was hardly any situation in the body in which an operation for removal could not be performed provided the disease were recognised sufficiently early, and the results of surgical treatment were by no means so hopeless as generally supposed.

We learn from the *Athenaeum* that M. Paul Tannery, whose death is announced, was born at Mantes on December 20, 1843, was president of the Congrès d'Histoire Générale des Sciences held at Paris in 1900, and had written extensively on philosophical subjects since 1876. His principal works include "Pour l'Histoire de la Science Hellène," 1887, and "Recherches sur l'Histoire de l'Astronomie Ancienne," 1893; he edited with M. Ch. Henry the works of Fermat, and with M. Ch. Adam an edition of Descartes.

Prince Roland Bonaparte has resumed the presidency of the committee of the Aëro Club of Paris, which he had previously to relinquish on account of ill-health. At the meeting of the club on November 28, the report of the St. Petersburg congress was read. The suggestion was made to ask the Government to lend a torpedo-boat for experiments in starting sounding-balloons over the Mediterranean when the scientific congress meets at Algiers next April. In connection with proposed ascents during the solar eclipse of August 30, 1905, it is unfortunate that one of the towns having the best situation on the line of totality—from Philippeville to Sfax—Batna, with a population of 6000 or 7000, is lighted by electricity, and there is no gas reservoir. It will therefore be necessary for the aëronauts to manufacture hydrogen on the spot, or else to bring it from a distance.

The following are among the lecture arrangements at the Royal Institution, before Easter:—a Christmas course of lectures (experimentally illustrated and adapted to a juvenile auditory) on ancient and modern methods of measuring time, by Mr. Henry Cunynghame; Prof. L. C. Miall, adaptation and history in the structure and life of animals; Prof. Karl Pearson, some recent biometric studies; Prof. W. E. Dalby, engineering; Mr. A. H. Savage Landor, exploration in the Philippines; Prof. W. Schlich, forestry in the British Empire; Mr. J. J. H. Teall, recent work of the Geological Survey; Prof. H. H. Turner, recent astronomical progress; Prof. R. Meldola, synthetic chemistry (experimental); Mr. D. G. Hogarth, archæology; Prof. J. J. Thomson, electrical properties of radio-active substances; and Lord Rayleigh, some controverted questions of optics. The Friday evening meetings will begin on January 20, when a discourse will be delivered by Sir James Dewar on new low temperature phenomena; succeeding discourses will probably be given by Dr. E. A. Wilson, Mr. Cecil Smith, Mr. J. W. Gordon, Prof. H. Marshall Ward, Chevalier G. Marconi, Prof. J. J. Thomson, Prof. G. H. Bryan, Prof. J. Wright, Prof. T. Clifford Allbutt, Lord Rayleigh, and other gentlemen.

The new board of anthropological studies in Cambridge is now organised, and commenced work last October with nine courses of lectures. Sir Richard Temple, Bart., C.I.E., delivered an inaugural address at Cambridge in the museum of archæology and ethnology on "The Practical Value of Anthropology." In the course of his most interesting and suggestive address he said:—"Now, when we are started on a new line of research, when we add a new course of studies to a university curriculum, there is a question that we cannot help facing—a question, in fact, that ought to arise—What is the good of it all?" From his long experience as an administrator in the East, Sir Richard Temple drew, from facts that had come under his own observation, examples of the desirability, one would like to add the necessity, of a knowledge of ethnology for those who are brought into contact with alien peoples, and he dealt severally with merchants and planters, administrators and magistrates, and missionaries. He also pointed out that stay-at-home critics require training and information, as by their ignorant criticism they are liable to do a great deal of actual harm. "But mischievous as uninformed criticism is, there is nothing of greater value and assistance than the criticism of the well informed." He alluded to the value of anthropological study to history, and after dealing with the value of an early anthropological training to a man in his work, he pointed out the value it is in his private life, even if it is pursued merely as a hobby. "Not only will it enable the student to do the work of the world and to deal with his neighbours and those with whom he comes in contact, throughout all his active life, better than can be otherwise possible, but it will serve to throw a light upon what goes on around him, and to give an insight into human affairs, past and present, that cannot but be of benefit to him, and it will provide him with intellectual occupation, interest and pleasure, as long as eye can see, or the ear can hear, or the brain can think." The address is printed in full in the *Cambridge Reporter* (vol. xxvi., No. 643).

ACCORDING to "Notes for Visitors to the Gezira Aquarium," issued by the Public Works Department of Cairo in November, the tanks at that establishment contained specimens of no less than twenty-nine species of native fishes, including the Nile perch, the electrical cat-fish, and the elephant-fish (Mormyrus).

WE have received from the author, Dr. W. G. Ridewood, two papers on the osteology of the skull in some of the more generalised families of bony fishes, the one published in the *Proceedings* of the Zoological Society, and the other in the *Journal* of the Linnean Society. Some remarks on the general morphology of the skull are appended to the former paper.

THE *Emu* for October contains reproductions of two very interesting photographs, the first showing the "run" or "play-house" of the great bower-bird (*Chlamydera nuchalis*), and the second a flight of bare-eyed cockatoos (*Cacatua gymnopis*), estimated at between sixty and seventy thousand in number. Considerable interest attaches to a note on bird-sanctuaries in New Zealand, where, it appears, all the surviving flightless species are now protected by Government. The want of such sanctuaries, both for birds and mammals, in Australia forms the subject of comment in another paragraph.

To vol. lxxviii., part ii., of the *Zeitschrift für wissenschaftliche Zoologie*, Mr. A. Voss, of Dusseldorf, contributes the first instalment of an essay on the comparative anatomy and mechanics of insect structure, especially in relation to flight, commencing with the thorax of the house-cricket in relation to the attachment of the wings and their movements. The other articles include one by Dr. P. Dugener on the scent-organ of the butterfly *Phassus schamyl* and the function of the same; a second, by Dr. H. Jordan, on the digestive organs of the sea-mouse (*Aphrodite aculeata*); a third, by Mr. L. von Graff, on the marine turbellarian worms of Orotava and the coast of Europe; and a fourth, by Dr. S. Gross, on the perineal sac and its glands of the guinea-pig.

IN the *Zoologist* for November Mr. O. V. Aplin announces that the black-necked grebe (*Podicipes nigricollis*) should be added to the list of birds nesting in the British Islands. It appears that during the past summer several pairs of these grebes successfully reared their young within our islands, but for obvious reasons neither the locality where this interesting event took place nor the name of the observer by whom it was recorded are revealed to the public. Pennant, it seems, stated that the black-necked grebe nested in the Lincolnshire fens near Stamford in his time, and the late Mr. E. T. Booth had a pair of nestlings brought to him by a marshman; but the observations of this year form the first definite record of the nest having been actually seen. A second article in the same journal is devoted to notes on natural history made during the cruise round the world of Lord Crawford's yacht *Valhalla* in 1902–3 by Mr. M. J. Nicoll. Among new forms obtained during the voyage, the author refers to *Pyroderces crawfordi*, belonging to the Microlepidoptera, and the fish *Corvina crawfordi*. He also records his own observations on the flight of flying fish, and is one of those who believe that they move their "wings."

THE Danish Commission for the Study of the Sea, which is charged with carrying out the Danish portion of the cooperative international investigations, has issued the first memoirs of its report, which is published under the title "Meddelelser fra Kommissionen for Havundersøgelser." The report, which is to be written in English or German, and is issued in quarto form, uniform with the *Bulletin* of the Central Bureau of the International Council, is divided into three series, dealing respectively with fisheries, with hydrography, and with plankton. Of the fisheries series one memoir is now published, viz. C. G. Joh. Petersen, on the larval and post-larval stages of the long rough dab and the genus Pleuronectes (with two plates); of the hydrographic series three memoirs, Martin Knudsen, on the organisation of the Danish hydrographic researches, H. J. Hansen, experimental determination of the relation between the freezing point of sea-water and its specific gravity at 0° C., Niels Bjerrum, on the determination of chlorine in sea-water and examination of the accuracy with which Knudsen's pipette measures a volume of sea-water; and of the plankton series two memoirs, Ove Paulsen, plankton investigations in the waters round Iceland, C. H. Ostenfeld, on two new marine species of Heliozoa occurring in the plankton of the North Sea and the Skager Rak. The memoirs are of interest as being amongst the first fruits of the international scheme of cooperative research. They are, however, all short memoirs, dealing with what may be considered as side issues of the main investigations, the reports upon which must be looked for at a later date. The Danish Commission, which is appointed by the Danish Board of Agriculture, consists of Prof. C. G. Joh. Petersen (chairman), C. F. Drechsel, C. H. Ostenfeld, and Martin Knudsen (secretary).

THE important preliminary results of the National Antarctic Expedition have already been utilised by Mr. W. Krebs in the communication of a useful paper to *Das Weltall* (vol. iv., Heft 24). By comparison of the yearly temperature at the English, German, and Swedish stations during the year 1902–3, he finds that the average decrease of temperature amounted to 0°·5 C. for each degree of latitude; and by applying this value to the results obtained by the five stations established round the Antarctic Pole during the years 1898–1903, he has constructed approximate isotherms between 50° and 80° S. latitude, and thus made an important addition to the valuable yearly isothermal charts published in Dr. Hann's "Handbook of Meteorology." Dr. Hann's southernmost isobar is 4° C., just below Tierra del Fuego; Mr. Krebs continues the isotherms for each 4° C. as far as −16°, which runs near the 70th parallel between longitude 60° E. and 60° W. He also draws portions of the isotherm of −20° C., reaching nearly to the 80th parallel.

THE *Times* of November 29 contains an interesting article on London fogs; although it deals principally with the most elementary physics of the atmosphere, and with the part played by aqueous vapour, the subject is very ably handled and is made both attractive and instructive. The author points out the well known facts that the amount of invisible vapour in the air varies directly with the temperature; by whatever process the cooling of the air takes place, the capacity of the vapour to remain invisible diminishes until the "dew point" or "saturation point" is reached; any further cooling produces cloud or fog. He states that it is more than twenty years since it was shown that the vapour molecules cannot of themselves combine to form cloud or fog particles, but that solid nuclei of dust, or other impurities, are necessary, on which the vapour molecules can condense. Taking this for granted, it is seen at once why fogs in London (or other large towns) are so much denser than in the open country. For instance, at an elevation of 6000 feet, say on the Alps, the number of dust particles per cubic centimetre may amount to less than 200, while in towns the number may reach 100,000 or 200,000. The vapour in the country, condensed on a few particles of dust, will result in a coarse grained form of condensation, whereas in town the same quantity of vapour being distributed over a very large number of dust particles, there results a fine grained fog. The author points out that it is not the large-sized visible dust that does the damage, but the infinitely small, ultra-microscopic particles produced by combustion of fuel and light; that, in fact, experiments have shown that it is possible for cloudy condensation to take place in the absence of dust. In 1897 (*Trans.* Roy. Soc. Edin., vol. xxxix.) Mr. Aitken stated that dust particles are not absolutely essential for the production of fog, but that, as the air is full of dust and condensation takes place on these by preference, therefore practically all our cloud particles have dust nuclei. The author concludes, justly, we are afraid, that London will always be liable to fogs, owing to its situation and meteorological conditions; all that can be hoped for is a reduction in the more disagreeable constituent elements; there seems to be, so far, no way of appreciably reducing their frequency or their bad effects. We hope that the experiments begun by Sir Oliver Lodge, with a view to their possible ultimate dissipation by electricity, will be energetically continued.

THE *Revue Scientifique* (Nos. 20 and 21), in continuing its inquiries as to the existence of the *n*-rays, publishes a letter from M. Blondlot stating that the photographic exposures, the results of which he considers prove the reality of these radiations, were made by a laboratory assistant who was ignorant of the effects he ought to obtain, and was therefore not unconsciously biassed. The obvious rejoinder is made that the results obtained in this way are less to be trusted than if they were due to M. Blondlot himself. M. Lambert claims that his experiments showing that the *n*-rays exist were made in a manner excluding subjective phenomena. On the other hand, MM. Cailletet, Lippmann, Berget, Turpain, and Perrin have all failed to obtain experimental proof of their existence.

PART X. of the *Transactions* of the Royal Dublin Society contains a continuation of the researches of Messrs. W. F. Barrett, W. Brown, and R. A. Hadfield on the physical properties of a series of alloys of iron. It is shown that a remarkable similarity exists between the diminution of the electrical conductivity and the change in the thermal conductivity of iron, which are caused by the addition of other elements. Not only is the general order of the electrical and thermal conductivities the same for all the alloys, but equal increments of any given element appear to produce a corresponding diminution of conductivity for both heat and electricity. It is remarkable that the effect of alloying iron with another element, even a better conductor, is always to reduce both the thermal and the electrical conductivities. The ratio of the two conductivities is, however, not exactly the same for all alloys; on plotting the electrical against the thermal conductivity, a fairly smooth parabolic curve is obtained showing that the ratio increases in magnitude as the conductivity of the alloys increases.

THE October part of the *Physical Review* contains an account by Messrs. C. W. Waidner and G. K. Burgess of a number of measurements which they have made by photometric methods of the temperature of the electric arc. Wien's law of the distribution of energy in the spectrum was assumed as a basis of calculation, and three distinct types of photometers, namely, those of Holborn and Kurlbaum, of Wanner, and of Le Chatelier, were employed. The values obtained for the "black body" temperature of an arc of pure graphite by the three methods agreed within 30° C., the average being about 3700° abs. The true temperature of the arc must be higher than this by an amount depending on the departure of the radiation from true "black body" radiation, and may possibly be between 3900° and 4000° absolute. Contrary to the usually accepted view, the temperature of the arc does not appear to be independent of the current, and it is undoubtedly influenced by the degree of purity of the carbons forming the arc. With impure carbons, the temperature is lower by 40° C. than in an arc of highly purified graphite. Such variations would appear to preclude the suggested use of the brightest part of the positive carbon of the electric arc as a standard source of light.

THE second number of the *Extensionist*, which is a record of the University Extension Guild, has reached us. In addition to numerous descriptive notes on the work of the guild, this issue contains addresses by Sir Arthur Rücker, F.R.S., Mr. Hilaire Belloc, and Mr. Banister Fletcher.

THE Infants' Health Society has published a pamphlet entitled "The Present Conditions of Infant Life, and their Effect on the Nation," which directs attention to the almost complete failure of our present method of rearing the infants of the working class. In the poorer parts of the larger towns and cities it is not uncommon for nearly *half* the children born to die in infancy. The dominating cause of this appalling mortality is the improper feeding of the infant.

MESSRS. A. AND C. BLACK have published the 1905 issues of three useful annuals—"Who's Who," "Who's Who Yearbook," and the "Englishwoman's Yearbook." "Who's Who" has been enlarged again this year, nearly a hundred pages having been added, bringing the total up to 1796. Due prominence is given to men of science and their work, not only of those in this country, but in other parts of the world. There is a want of uniformity in the amount of detail given concerning the careers of the notabilities included, and something might be done with advantage to reduce the lengths of some of the biographies, and thus to keep the volume of a convenient size. The "Who's Who Yearbook" contains the tables which were formerly included in "Who's Who" itself. "The Englishwoman's Yearbook" will in its revised form continue to lighten the labours of women sharing in the useful work of the world.

OUR ASTRONOMICAL COLUMN.

RE-DISCOVERY OF TEMPEL'S SECOND COMET.—A telegram from the Kiel Centralstelle announces that Tempel's second comet was re-discovered by M. Gavelle at Nice on November 30, and that the observation showed the daily ephemeris published in No. 3971 of the *Astronomische Nachrichten* to be nearly correct.

The following is an extract from the above named ephemeris, which was published by M. J. Coniel:—

12h. M.T. Paris.

1904	α (app.) h. m. s.	δ (app.) ° ′	log Δ	$1:r^2\Delta^2$
Dec. 8	20 7 38	−24 19	0·29671	0·126
,, 10	20 15 4	−24 8	0·29913	
,, 12	20 22 26	−23 56	0·30161	0·122
,, 14	20 29 47	−23 42	0·30414	
,, 16	20 37 4	−23 28	0·30672	0·117
,, 18	20 44 19	−23 12	0·30936	
,, 20	20 51 30	−22 55	0·31206	0·113

PARALLAX OF A LOW METEOR.—Whilst exposing on the Andromeda nebula with two Voigtlander objectives on August 12 Herr P. Götz, of Heidelberg, photographed on each plate the trail of a remarkably low Perseid. From measurements of the trail on the two plates it was possible to determine the parallax of the meteor at definite points in its flight where the trail was considerably strengthened. The result showed a mean parallax of 28″·12, whilst for six distinct points on the trail the following parallaxes were determined:—

28″·26, 37″·31, 27″·78, 25″·20, 17″·14, 10″·0.

The base of the triangle Meteor—Voigtlander I.—Voigtlander II. measured 68 cm., and it therefore follows that the distance of the meteor at each of these points was 4·98, 3·78, 5·05, 5·57, 8·27, 14·03 kilometres respectively, the coordinates of the meteor at each point being respectively:—

α = 0h. 28·2m., 0h. 22m., 0h. 19·2m., 0h. 16·8m., 0h. 10·7m., 0h. 7·7m.

δ = +43° 13′, +42° 1′, +41° 28′, +40° 58′, +39° 47′, +38° 59′.

The path of the meteor was apparently rectilinear, but the observations indicated that it described a sharp curve in the third dimension with the convex side towards the observer.

The path of the meteor extended from α = 0h. 33·6m., δ = +44° 17′ to α = 23h. 52·2m., δ = +35° 28′ (*Astronomische Nachrichten*, No. 3975).

DATE OF THE MOST RECENT SUN-SPOT MINIMUM.—From a discussion of the observations of solar phenomena made at the Roman College Observatory during the period November 25, 1900, to January 4, 1902, Signor E. Tringali deduces the date of the latest sun-spot minimum to have been June 15, 1901, or 1901·45.

In Table i. of the communication the relative daily frequencies of spots, &c., are given for the years 1878–9 and 1888–1903, and it is seen that the frequency of days without spots during 1901 was greater than obtained during the previous minimum (1889), but less than in the 1878 minimum. The numbers given for 1878 and 1901 are 0·76 and 0·73 respectively (*Memorie della Società degli Spettroscopisti Italiani*, No. 8, vol. xxxiii.).

OBSERVATIONS OF PERSEIDS, 1904.—In No. 9, vol. xxxiii., of the *Memorie della Società degli Spettroscopisti Italiani*, Prof. S. Zammarchi, director of the meteorological observatory at Brescia, gives in tabular form the results of the observations of Perseids made at that observatory during the nights of August 9–14. 531 Perseids were seen, and the observations are recorded in the order of the appearance of the objects, the time, the points of appearance and disappearance, and the general characteristics of each meteor being given.

THE ORBIT OF SIRIUS.—In No. 3981 of the *Astronomische Nachrichten* Prof. Doberck gives the results of a discussion of the observations of Sirius and its faint companion, and includes a set of elements, an ephemeris for the period 1903·2–1917·2, and a table showing the differences between the observed and calculated values of position angle and distance. Owing to the great difference between the magnitudes of the two components, the systematic errors of observation are unusually large.

The following are the elements determined from the discussion:—

☊ = 225° 49′	P = 49·49 years
λ = 29° 54′	T = 1894·28
γ = 43° 20′	a = 7″·513
e = 0·5871	

The orbit is referred to the equinox of 1900. The motion is retrograde, and the anomalies are considered as positive before and negative after periastron.

The consideration of the errors of observation shows that they are inversely proportional to the aperture of the object glass employed.

HARVARD OBSERVATIONS OF VARIABLE STARS.—Part ii., vol. xlvi., of the Harvard College Observatory *Annals* is devoted to the observations, chiefly of variable stars, made by Prof. E. C. Pickering with the meridian photometer during the years 1892–8.

The first chapter gives the results of the observations of short-period variables, and then discusses the phases of the light-variations and the corrections to their ephemerides. Chapter ii. deals similarly with the observations of variables of the Algol type, chapter iii. collates the observations of various miscellaneous objects, and the fourth chapter gives, and discusses, the observations of planets and asteroids. The early observations of variable stars, at Harvard, are collected into tables in the fifth chapter, whilst the last chapter discusses the observations of long-period variables, and describes the eight light-curves given on the two plates at the end of the volume.

CORRECTION OF THE LONGER TERM IN THE POLAR MOTION.—In a previous communication to the *Astronomische Nachrichten* Mr. Kimura, of the Mizusawa International Latitude Station, showed that the cycle of the polar motion might be approximately represented by two principal terms of 365 and 438 days.

In No. 3981 of the same journal, however, he discusses the latter term more fully, from observations made during the period 1890–1904, and finds that it is probably a day or two too long. Taking the two periods 1890–1896 and 1896–1902, he derived the value 437·1 days, whilst from the periods 1892–1898 and 1898–1904 the value 436·6 days was obtained. The latter value, Mr. Kimura thinks, is likely to be the more correct, and consequently the cycle is not exactly six years as was indicated by the former discussion.

The values given in the paper show that for the years 1890 and 1891 the radius of the circular motion was especially large, but from 1892 to last year it remained nearly constant.

ARC SPECTRA OF THE ALKALI METALS.—In No. 9, vol. xl., of the *Proceedings* of the American Academy of Arts and Sciences Mr. F. A. Saunders, of Syracuse University, gives the results of a series of researches on the arc spectra of lithium, sodium, potassium, rubidium, and cæsium.

The salts were vaporised on nearly pure carbon poles, and the spectra were taken with a grating camera, special arrangements being made to photograph the spectra well up into the red.

Several new lines, which fit into the respective series, were discovered, and in the lithium spectrum Mr. Saunders believes that the dual character of the lines is real and not simply due to reversals as has been supposed by Hagenbach and other spectroscopists.

A comparison of the arc spectra with spark spectra of the same substances showed no relative enhancement of any of the lines in passing from the conditions of the arc to those of the spark.

INVAR AND ITS APPLICATIONS.

Preliminary.

DESCRIPTION of Phenomena.—A new material requires a new name; that of "*invar*" has been adopted, on the suggestion of Prof. Thury, to avoid the periphrase "steel containing about 36 per cent. of nickel, which is characterised by possessing an extremely small coefficient of expansion or by the fact that its specific volume is practically invariable when considered as a function of the temperature." The name has been universally adopted, and the title of this article is thus justified.

The discovery of invar, as is the case with most discoveries, was preceded by observations indicating the direction of the researches from which it had its origin. As early as 1889 the late Dr. John Hopkinson noted the singular fact of the existence of a ferro-nickel containing about 25 per cent. of nickel, the density of which was found to have diminished by about 2 per cent. after cooling to the temperature of solid carbon dioxide; and in 1895 M. J.-R. Benoît, director of the Bureau international des Poids et Mesures, having to determine the length of a metre scale composed of an alloy of iron with 22 per cent. of nickel and 2 per cent. of chromium, was extremely surprised to find that his measurements, made with an extreme range of temperature of about 2 degrees C., gave concordant results only on assuming for the alloy a totally abnormal coefficient of expansion, equal to that of brass, and consequently half as

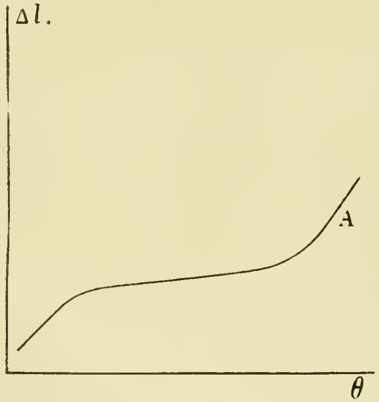

FIG. 1.—General form of the expansion curve for a reversible nickel-steel.

great again as that required by the law of mixtures generally applicable to such cases. This alloy was not magnetic, and thus resembled Hopkinson's alloy before cooling, although the latter after exposure to a low temperature became endowed with magnetism.

It was natural to coordinate these two anomalies and to consider the non-magnetic iron of the second alloy as being very expansible. At the time I considered that the alloy, after being rendered magnetic by cooling, would possess a normal coefficient of expansion; but as the alloy studied by M. Benoît did not become magnetic either in carbon dioxide or in liquid air, I was forced provisionally to renounce this hypothesis. For the liquid air I was indebted to the kindness of Sir James Dewar at a time when liquid air was not obtainable in Paris. I did not, however, abandon this research, and it was in seeking for alloys capable of a transformation similar to that observed by Hopkinson that I was led to examine alloys possessing a negatively abnormal coefficient of expansion. I may add that I was able later perfectly to reproduce Hopkinson's discoveries and to extend them in various directions, but I am unwilling to linger over the details in an article of a practical character, these discoveries having hitherto been fruitless of industrial applications. It will be sufficient to consider later in a brief manner the common cause of the anomaly observed by Hopkinson and of the phenomenon which I have studied.

Reversible Alloys.—The alloys of iron and nickel which contain more than 25 per cent. of the latter metal may or may not be magnetic, according to the temperature at which they are studied. The passage from one state to another is gradual, the magnetism declining continuously as the temperature is raised, whilst on lowering the temperature the reappearance of the magnetism follows the same curve. The temperature at which the magnetism totally disappears depends on the composition of the alloy. For alloys containing from 26 per cent. to 27 per cent. of nickel it is little above 0° C.; as the proportion of nickel increases it rises very rapidly until a maximum, corresponding with 70 per cent. of nickel, is reached at a temperature fixed by M. Osmond at 550° C., when the curve falls to the transformation point of nickel at 340°. This curve of variation is, so to speak, an *indicatrix* of the properties of the alloys; above the curve the expansion is abnormally great, but at the moment of crossing it with descending temperature the rate of the contraction diminishes, and a region is soon reached in which the anomalous negative expansion exists. Subsequently at a much lower temperature the normal state is reached. The curve given in Fig. 1 shows the general character of the variation for alloys of this class; its phases are more or less elongated, the different regions more or less inclined, but the curve always consists of a region of negative abnormality with two confluent curves, one side being characterised by large expansions at high temperatures, the other by a normal expansion. The abnormal region covers generally several hundred degrees.

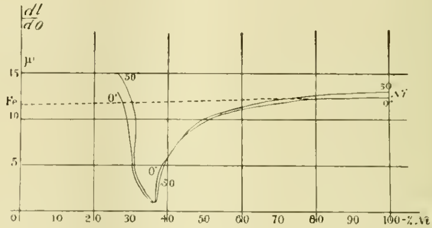

FIG. 2.—Coefficients of expansion at 0° and 50° C. of the various reversible nickel-steels.

The temperature indicated by the abscissa of the point A corresponds sensibly with the ordinate of the indicatrix in question at the point belonging to the same alloy; in other words, it is at this point that the magnetism finally disappears as the temperature rises.

Curve 1 shows that it is impossible to assign a general value to the expansion of a particular nickel-steel; the value chosen must always apply to a definite region and to a more or less extensive range of temperature. If we consider, for instance, the temperatures 0° and 50° C., the two curves of Fig. 2 can be traced, representing at these two temperatures the inclination of the tangent to curve 1 for all the reversible alloys of iron and nickel. It is the minimum of this curve which corresponds with invar, strictly so-called. This minimum will be displaced toward the left for alloys considered at lower temperatures and conversely.

It should be noted that beyond the minimum the curves cross; we are then in the region corresponding to the left-hand side of curve 1, where the true expansion diminishes with rising temperature. This result of the measurements is of interest because, independently of its being observed for the first time, it has given rise to an interesting application.

Theoretical Views.—Without entering into the details of a theory for the development of which I may refer to an article in the *Revue générale des Sciences* (July 15 and 30, 1903), I will indicate at least the source of the phenomena which have been described.

In the two transformations which take place successively in iron in passing from the α condition to the β and γ conditions of Osmond, the metal undergoes different apparent changes, of which the most characteristic are the transitions, in two distinct stages, into the non-magnetic state and a

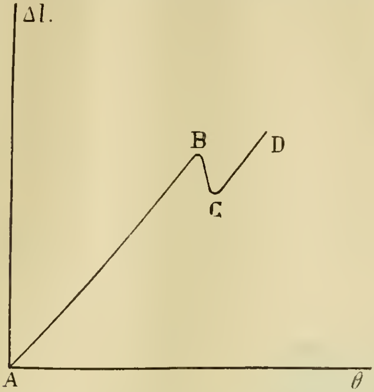

Fig. 3.—Expansion of iron.

sudden diminution of the specific volume of the iron at the moment it reaches the higher condition. The expansion of iron up to high temperatures is indicated by a curve such as ABCD, Fig. 3. The addition of a little carbon modifies this curve considerably, as was observed especially by M. Le Chatelier and MM. Charpy and Grenet. The addition of nickel begins to separate the change more and more into two inverse transformations, which commence at very different temperatures (Hopkinson's phenomenon); as the proportion of nickel increases, the change again becomes simple, but instead of being sudden, as with pure iron, it is spread out over a wide interval of temperatures, at each of which the reciprocal solution of iron in its two extreme states and of nickel strives to attain a stable equilibrium. For the greater part the attainment of equilibrium is practically instantaneous; it is much more rapid, for example, than that which is observed in an aqueous solution in which large crystals are placed, and resembles rather that which would occur in a saturated solution containing an infinite number of crystalline nuclei of the same density as the solution. In a medium thus constituted equilibrium is reached almost instantaneously. The perfect dissemin-

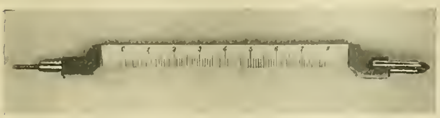

Fig. 4.—Scale at the end of a wire (the divisions are millimetres).

ation of iron throughout the nickel or the converse is evidently a very important factor of the phenomenon. For Hopkinson's phenomenon the same transformation is still produced, but with an enormous thermal hysteresis.

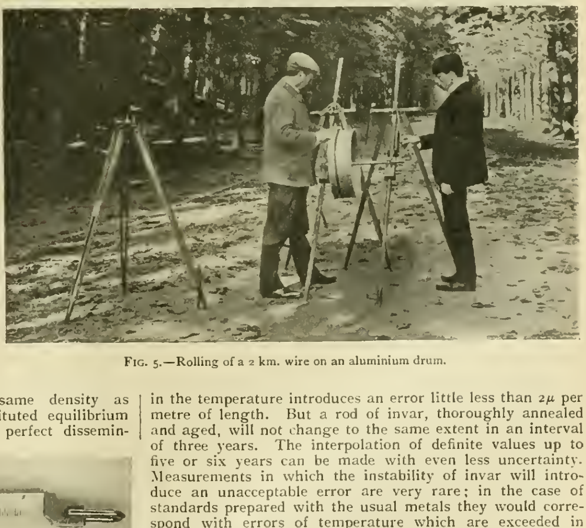

Fig. 5.—Rolling of a 2 km. wire on an aluminium drum.

It is necessary to mention, however, a retardation in a minor part of the change which follows very slowly the principal instantaneous phenomenon. This retardation, due perhaps to a migration of some of the molecules engaged in the change, is rendered visible in the case of invar, strictly so-called, by a gradual elongation with time. It is enormously accelerated by heating the alloy, for example, at 100° C.[1] Nevertheless, when a bar of invar has been heated thus it still increases in length very slightly after several years at the ordinary temperature. At the end of five or six years the total elongation is nearly 1/100 mm. per metre, but the subsequent lengthening each year does not exceed a fraction of a micron.

This phenomenon is of theoretical interest. Practically it restricts the use of invar, and although, by systematic heating, a much smaller limit of variation can be reached than that above indicated, such a change prevents the alloy from being employed in the preparation of *standards of the first order.* It is necessary to point this out before proceeding to consider the apparatus in which invar has introduced decided elements of progress. For a consideration of other qualities which may render it valuable I will refer to information already given in this Journal.[2] I can describe here only a few of the uses of invar, and will choose three of the most typical.[3]

Applications.

Standards of Length.—If the slight defect of stability referred to above prevents the employment of invar in the preparation of fundamental standards, the requirements of which are infinite, a wide field of application still remains in the construction of standards which can be referred from time to time to fundamental units, and during these intervals are employed at temperatures which are not readily ascertained, as is the case with the majority of measuring instruments which cannot be maintained in a liquid bath. With a brass scale, for instance, an uncertainty of 0·1 degree C. in the temperature introduces an error little less than 2μ per metre of length. But a rod of invar, thoroughly annealed and aged, will not change to the same extent in an interval of three years. The interpolation of definite values up to five or six years can be made with even less uncertainty. Measurements in which the instability of invar will introduce an unacceptable error are very rare; in the case of standards prepared with the usual metals they would correspond with errors of temperature which are exceeded in nearly all ordinary measurements.

But the greatest claim that invar can make to utility is in its application to geodesy; working in the open air under extremely variable atmospheric conditions makes the deter-

[1] The variation of the rapidity of the change with temperature seems to follow van 't Hoff's law of geometrical progression.

[2] Nature, No. 1822, September 29, vol. lxx. p. 527.

[3] A more complete description will be found in my recent work, "Les Applications des Aciers au Nickel."

mination of temperature very uncertain, and, on the other hand, a control on returning, by means of a standard of reference in a geodesical or metrological establishment, is always possible. With this idea M. Benoît and myself, at the request of General Bassot, have designed for the use of the Geographical Service of the French Army a scale of 4 metres which is made of invar, and has been found so practical by the surveyors that four other scales of the same type have been constructed for other countries.

This scale has an H-section with a side of 40 mm.; its direction lies in the plane of the neutral fibres, and it has such rigidity that the flexure is quite admissible in an accurate standard supported at only two points. As a consequence, the scale can be placed on a light support which is subjected to no especial conditions of rigidity, since it has not, as in most of the older apparatus, to assure the rigidity of the standard. The support which we have adopted is an aluminium box that completely envelops the scale and protects it from shocks, dust, and accidents of all kinds, as well as from rapid changes of temperature. The complete apparatus weighs 56 kg., whilst the old form of Brunner, consisting of two scales and a rigid support, weighs 72 kg., and affords no protection for the standards.

For direct employment in the field, especially when the apparatus has to be carried to great distances (the scale will, in the near future, be used in the Andes), the facilities introduced, compared with those existing in older apparatus, are considerable, and if they constituted the sole progress in geodesy they would deserve serious consideration. But the use of invar has permitted a more complete transformation in the measurements of bases. Twenty years ago M. Edw. Jäderin made trial of a method which consisted of the use of long wires stretched under a constant load and serving the purpose of fixing between two limits of the base the distance of a series of movable bench-marks, ranged between these limits. The advantage of this method, the rapidity of measurement, lightness of material, and facility in the choice of ground, will be readily appreciated, but it will also be recognised that the uncertainty of the temperature of the wires made the method doubtful in cases where greater accuracy was required than that usual for the ordinary requirements of topography or land-surveying. M. Jäderin has diminished these uncertainties by employing two wires of brass and steel respectively, by means of which each of the ranges was successively measured. The difference observed for the two wires was taken as an indication of their common temperature, whence the temperature of the steel wire, considered as the principal standard, was deduced. Without going into the details of the calculations necessary to the method, it is easy to see that small inevitable errors influence the result; the real difference of temperature of the two wires at the time of the measurements and errors of reading reappear in the result, multiplied by factors of a variable nature, but all greater than unity.

FIG. 6.—Reading the position of the end scale of the wire against a movable mark.

These uncertainties disappear completely with a wire made of invar, especially as the greatest care can be given to the manufacture of comparatively small quantities of the alloy when it is required for particular purposes in which the price, between certain limits, is a secondary consideration; samples may be chosen so as finally to descend below the minimum of the curve in Fig. 2 and cut the axis of the abscissæ. Zero and even negative expansions have thus been realised. The specimens having a minimum expansion are strictly reserved for geodetic purposes, and considerable quantities of wire have thus been obtained of which it is unnecessary to know the temperature within about 10 degrees even for the most precise measurements of base lines. Commonly, a knowledge of the temperature within 5 degrees is sufficient; an error of this magnitude hardly makes a difference of 1 part in 1,000,000.

These advantages could not escape surveyors. As early as 1898, M. Jäderin himself requested me to obtain for him wires[1] made of invar for the purpose of perfecting his method, at a time when M. Benoît and myself were undertaking, at the Bureau international des Poids et Mesures, experiments to ascertain their suitability for such a purpose. The trials were so encouraging that the following year it was decided to equip the Swedish-Russian expedition to Spitsbergen with similar wires, by means of which all its base lines were measured. At this time, however, the experiments were not sufficiently advanced to obviate the need of taking many precautions, and the expedition acted very wisely in not considering the wires as standards of length. The true standards were two iron bars, previously verified at the Bureau international, which served to measure the short bases (the Swedish base was 96 metres long) on which were standardised the wires of 24 metres, which subsequently served to measure the true bases of several kilometres in length. This was the first practical trial of invar in the field, and, according to the reports which I have received from several members of the expedition, notably from M. Jäderin, the success exceeded every hope. Two independent measurements of the Swedish base showed a difference of 19 mm. per 10 kilometres, that is, of 1/500,000 *without introducing any correction for the temperature.*

The same sense of safety in the employment of these wires is felt after reading the report by M. Backlund, of the Russian expedition, and of Commandant Bourgeois, on the measurements of the French Survey in the territory of the Republic of Ecuador. The difference in the measurements of a base made in 1901 with a bimetallic scale and with a wire of invar was 1/3,300,000; the agreement is so good that it must be attributed partly to chance, but such chances are rare when the systematic elimination of errors has not been pushed to extremes.

In any case a more complete study of the wires of invar became necessary, and, on the ground of the studies already commenced by M. Benoît and myself, the International Committee of Weights and Measures entrusted to us, at the end of 1900, on the request of the International Geodetic Association, a detailed investigation of this question.

We therefore erected against a thick basement wall, protected by the building of the laboratory of the bureau, a series of bench-marks spacing out a length of 24 metres at intervals of 4 metres, measured by means of an invar standard. On the outside of the last uprights are two pulleys on ball bearings over which pass two cords that carry weights of 10 kilograms and are attached to the wire on which observations are to be made at the distance of

[1] These wires were manufactured at the steel works of Imphy belonging to the Société de Commentry-Fourchambault and Decazeville, by whose collaboration I was enabled to carry out the work described in this article.

the extreme marks. These wires carry at their extremities scales of invar, having the form represented in Fig. 4, with their edges in the same line as the axis of the wire. This arrangement, somewhat complicated in appearance, is necessary to ensure constancy of length, whatever be the inclination of the scale in a transverse direction.

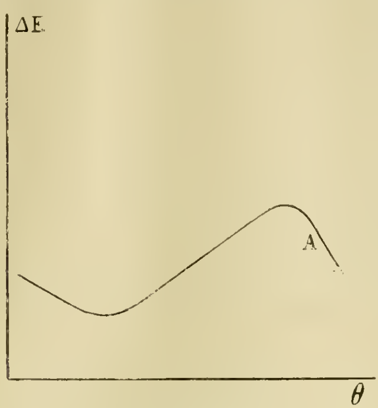

FIG. 7.—General form of the curve of change of Young's modulus for a reversible nickel-steel.

During four years measurements have been made weekly with a great number of wires which have been submitted to different treatment. Owing to the complexity of the subject, more than a hundred thousand comparisons between the wires and the base were necessary to elucidate all the questions relating to the stability of the wires and the precision that they guarantee. After four years, and after the method of treatment of the wires has been gradually modified so as to ensure the greatest possible degree of stability, we can emphatically assert the excellence of the method of measurement by wires constructed of invar. When a wire of the usual diameter of 1·65 mm. is stretched by loads varying from an insignificant weight to that of 20 kilograms, the permanent elongation which it undergoes is not measurable; moreover, it can be rolled as often as desired on a drum (Fig. 5) of sufficient diameter (at least 50 cm.), or kept rolled for months without showing on subsequent measurement a variation greater than that due to errors of observation. Several wires which were measured at the bureau were returned after use in the field; in the beginning, variations in the length of the order 1 in 200,000 were observed in several instances, but recently the constancy of the length has become much more decided. Whilst reserving the results obtained by long trials in severe climates, it may be concluded from the results obtained in the laboratory that a surveying expedition equipped with several wires constructed of invar and subject to mutual control will be able to measure several long bases without fearing a departure from accuracy in the wires greater than that permissible in such measurements, assuming, of course, that the wires are always handled with due care.

The considerable increase in the accuracy of geodetic measurements, caused by the substitution of wires of invar for those of steel or brass, necessitated a corresponding improvement in the apparatus. We have therefore proposed certain new principles which have been realised in instruments constructed with the aid of M. Carpentier, of which a provisional model has been already mentioned in NATURE.[1] A description of the final types which have been adopted would carry me too far; Fig. 6, which indicates one of the measures, may take its place. It will be sufficient to add that, thanks to the new material which has been discovered, the measurement of a base by means of wires answers all the needs of a surveyor; the relative error of the base has fallen below that of the angles; bases can be measured across broken ground, cultivated land, streams and rivers. Above all these advantages, the complete staff, including auxiliaries, need not exceed ten men for a rate of progress of 5 kilometres per day. This arrangement, compared with that by which ten years ago fifty men using rules and microscopes could advance 500 metres a day, exhibits an economy of 98 per cent.! To-day the measurement of a base with all the accuracy required in geodesy costs little more than chaining, and the proof has been so thorough that the French Survey finds its advantageous to measure all its bases by the new method.

The advantages of measurements by wires have been quickly recognised by surveyors. Several departments of survey have requested the Bureau international to standardise wires suitable for base measurements; we have thus had the satisfaction of examining the apparatus for use by the Argentine Republic, Australia, Cape Colony, France, Germany, Japan, Mexico, Roumania, Russia, Servia, and Switzerland.

This simplification in the fundamental measurements of the survey will lead to a reversal in the future of the respective positions of the base and angular measurements. In the old method of surveying measurements of bases were reduced as much as possible and angles multiplied indefinitely; in the new geodesy angles will be controlled by frequent measurement of numerous long bases. This general plan has already been introduced in the United States in the fine work carried out during the determination of the length of the 98° meridian.

Horology and Chronometry.—The possibility of constructing a compensated pendulum with its rod of invar is so obvious that it is hardly necessary to emphasise it. It will be sufficient to observe that the slight change which invar undergoes is not for this purpose a serious defect. As it is necessary to determine the rate of a clock at frequent intervals, variations in the daily rate of the order

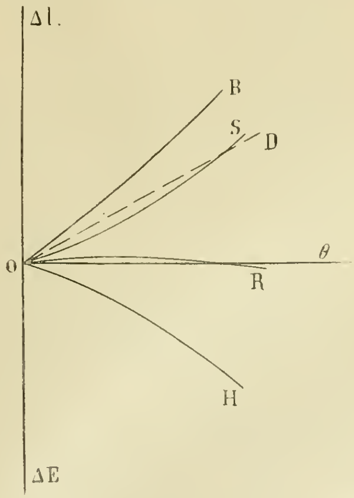

FIG. 8.—Diagram of the compensation of a chronometer with a steel-brass balance.

of a few hundredths of a second in a year will be merged in the variation of the longer period, and will give rise to an error hardly to be feared; but other applications will need some explanation.

In order not to prolong the preliminary part of this article, I omitted to mention a singular property of the nickel-steels,

[1] June 2, 1904, vol. lxx. p. 104.

which for ordinary watch-making is of prime importance. To resume those considerations. At the end of 1896 I found that when an alloy containing 24 per cent. of nickel passes from the non-magnetic to the magnetic state, its modulus of elasticity undergoes a diminution of 10 per cent. This change is the more remarkable inasmuch as the limit of elasticity is simultaneously raised, as was shown by Hopkinson. I was intending to study the same change in invar when M. Thury at Geneva and M. Paul Perret at La Chaux de Fonds, after my first publication, established for the alloy the singular fact of a positive variation of Young's modulus with increasing temperature. A systematic investigation of the change by M. Perret and myself led us to results which, completed by the theoretical views which were developed, permitted me to assign to the total variation of the modulus of a nickel steel endowed with reversible properties a course indicated by the curve in Fig. 7. Point A has the same significance as in the curve of Fig. 1, and two regions of variation in a normal sense are shown, between which lies a region of abnormal variations connected with the first by two confluent curves.

The existence of these confluent curves has a great importance for horology. The necessity of fitting good watches with a bimetallic compensation balance arises

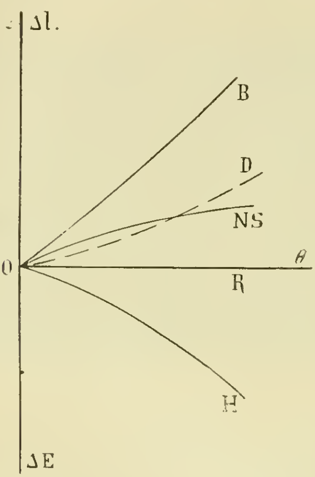

FIG. 9.—Compensation with nickel-steel-brass balance.

almost exclusively from the need of securing comparable rates at different temperatures owing to the variation in the modulus of elasticity of the steel spring. This variation is sufficiently great to cause a retardation of five minutes in the day in a watch fitted with a steel spring and a monometallic balance, the temperature of which undergoes a change from 0° to 30° C. The employment in the spring of a nickel-steel the properties of which are represented by one of the confluent curves (that is, of an alloy having Young's modulus a maximum or minimum at the average temperature to which the watches are submitted) will obviate the need of a costly compensation. The compensation is, of course, not perfect; the difference between the form of the curve and a straight line, and still more, the difficulty of obtaining an alloy passing through a maximum or minimum at ordinary temperatures, limit the application of these springs to ordinary watches, and preclude their use in accurate chronometers. But in their own province they represent a real advance, as they reduce the error of an uncompensated watch by 90 per cent., and the cost of watches which were approximately compensated by a rough balance by 6*d*. in the shilling. The trade of watchmaking gains as much by direct economy as from an increase in quality; the annual saving is certainly 10,000*l*., and is likely to become 20,000*l*. or 30,000*l*. Competition, moreover, is so keen in the trade that a diminution of prices passes at once from the manufacturer to the consumer, so that the public gains the whole advantage of it.

Another application in chronometry, although its advantages from a monetary aspect are insignificant, seems to me of greater interest, because it appeals to a higher range of thought, and represents an advance in a region in which perfection had apparently been reached.

In 1833 the celebrated English watchmaker Dent discovered that a chronometer regulated for two extreme temperatures gains at intermediate ones, and the correction of "*Dent's error*," as it is called, has exercised the ingenuity and invention of the best watchmakers. In England particularly, the country *par excellence* of marine chronometry, great efforts have been made to introduce corrections for this error. The auxiliary systems of Loseby, of Kullberg and others have permitted the attainment of great accuracy, but at the expense of a considerable increase in price and of complications which are not exempt from inconveniences. The cause of Dent's error is almost entirely the non-linear variation of the elasticity of the steel of which the hair spring is composed. The curve OH, Fig. 8, represents this variation. The action of the balance is proportional to the difference of the expansions of the metals composing the bimetallic ring; if we represent the expansions of steel and brass by the curves OS and OB it

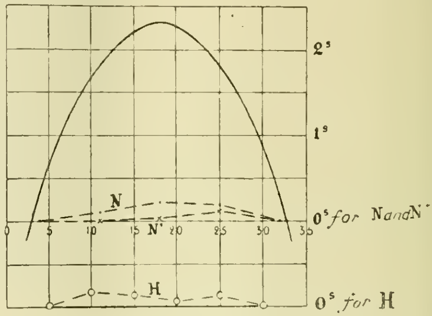

FIG. 10.—Results obtained at Neuchâtel and Hamburg with Nardin chronometers fitted with nickel-steel-brass balances.

will be seen on referring to the numerical formulæ whence these curves are obtained that, whilst their average inclination is very different, the variation of this inclination is nearly the same. The variation of the difference of inclination is therefore nearly zero, and the curve giving the difference of the expansions practically becomes the straight line OD. The rate of the chronometer at different temperatures is given by the algebraical sum of the ordinates of the curves OH (natural variation) and OD (corrective function), that is, by the curve OR. Such is the reason of Dent's error, which has been corrected hitherto by adding to the natural corrective function of the balance a term of great curvature given by an auxiliary system.

But the same result would be attained by substituting for one of the metals of the double ring another metal or alloy of which the increase of expansion is much greater than that of brass, if that metal is rejected, or much less than that of steel, and preferably negative, if the brass is retained. The curve of Fig. 1 offers in this respect numerous possibilities. Practical reasons lead one to retain the brass and to associate with it an alloy having an expansion which is a retarded function of the temperature. Fig. 9, in which the curve OS belonging to steel has been replaced by ONS referring to nickel-steel, shows a curve OD that can be rendered symmetrical with regard to OH; the sum OR of the curves is then always zero, and the problem has a practical solution.

I had established this theory in the year 1899, when two of the principal Swiss watchmakers, M. P. Nardin, of Le Locle, and M. P. Ditisheim, of La Chaux de Fonds, expressed a wish to make a trial of the new balance. The first attempt gave so perfect a result that the balance has not since been modified; its adoption by Swiss watchmakers was very rapid, and to-day it is employed in the majority of their best timepieces. It was with a pocket chronometer fitted with this balance that M. P. Ditisheim beat in 1903 all records at Kew with a total of 94·9 points, the previous best being 92·7. The compensation was awarded 19·7 points, the maximum of ideal perfection being 20. The dark-lined curve of Fig. 10 shows the theoretical variations of a perfect chronometer compensated by the usual method; the curves N, N′, and H represent the average results obtained at Neuchatel with two groups comprising in all sixteen chronometers, and at Hamburg with six chronometers, all made by M. Nardin.

Incandescent Lamps and Crookes's Tubes.—In conclusion, a few words may be given to an application, less scientific in its nature than the preceding, but likely to be welcomed by all who regret the systematic destruction of the world's store of platinum. The curve in Fig. 2 shows that two nickel-steels of definite composition have an expansion equal to that of glass; but only one of these can be practically considered, namely, that containing about 45 per cent. of nickel; the alloy which contains 29 per cent., at a slightly higher temperature passes the point A of Fig. 1 and enters the region of high expansion.

For a metal to fuse in glass it is indispensable, but insufficient, that it should possess the same expansibility as glass; fortunately the alloy containing 45 per cent. of nickel possesses all the other properties which are necessary, provided that it be not unduly oxidised during the softening of the glass. As a matter of fact, several manufacturers of incandescent lamps have adopted, under the name *platinite*, this welcome substitute for platinum, thereby economising several hundred kilograms of the precious metal. If this economy spreads, a ton of platinum may be saved annually for science and those industries in which its use is indispensable.

Conclusions.

It is time to conclude this over-long article. The applications which have been described are not the only ones which might be predicted or have been attempted with these curious alloys, the properties of which for a time seemed so paradoxical that a number of physicists and metallurgists refused to believe in their existence. All the applications which to-day give new resources to science and new economies, representing large sums, to industry arise from a peculiar phenomenon of equilibrium in the mutual solution of two isomorphous metals; that is one interesting side of the question. There is another on which I would insist in concluding; it is that these results have been obtained as a sequel to a long series of delicate measurements in which the thousandth of a millimetre was the ordinary unit, and without which no discovery in this domain would have been possible.

CH. ÉD. GUILLAUME.

SHOWER OF ANDROMEDIDS FROM BIELA'S COMET (?)

WHAT certainly appears to have been a well defined shower of Andromedids occurred on November 21 and following nights to November 28. Yet this display, if it really represented the débris of Biela's comet, like the meteors seen in November 1872, 1885, 1892, and 1899, was not true to its time, for no return was to be expected, in ordinary circumstances, until 1905 or 1906. The period is about 6·7 years, and if the shower displayed itself this year it must mean that the swarm has been much disturbed, or that the meteors are rapidly distributing themselves round the orbit, and will soon form a continuous stream, visible annually as the earth intersects it in the third week of November.

Dr. Schulhof and Prof. Abelman (*Astr. Nach.*, 3516) pointed out some years ago that a convulsion of the orbit-motion of the Andromedids would occur in 1901, as Jupiter would approach the group to within 0·5 of the earth's distance from the sun in March of the year named. The effect would be a displacement of the node to the extent of 6°, which would bring the maximum on November 17, or ten days earlier than in 1872 and 1885.

The Rev. W. F. A. Ellison, of Enniscorthy, Ireland, writes me that the most remarkable meteoric shower he witnessed in November was furnished by the Andromedids. He was extremely surprised to find the radiant of this stream very active on November 21. At 7 p.m. he counted 8 meteors in fifteen seconds, and although this rate was not maintained, he continued to observe numerous Andromedids until midnight. From 7h. to 8h. 24 were seen, from 8h. to 9h. 22, after which the number decreased. Until November 28 meteors continued to fall from this radiant, and many of them were objects of remarkable brilliancy, quite equal to the Leonids, but the motions were slower and the paths shorter. The prevailing colour was pure white, the trains being greenish. The radiant seemed further north than Mr. Ellison expected to find it, the position being at about $21° + 50°$.

The following are some of the larger meteors recorded by Mr. Ellison:—

Nov. 21. 8h. 2m. G.M.T. = Vega. From a point a little above α Cygni exactly across δ and about 15° further, directed precisely from Vega.
,, 21. 8h. 49m. = ♀. Low down in west where no stars could be seen to fix the path, but evidently Andromedid.
,, 21. 9h. 8m. = ♃. From $337° + 7°$ to $329° - 7°$.
,, 21. 9h. 16m. = ♃. From $354° + 30°$ to $348° + 18°$.
,, 26. 7h. 35m. = ♀. From $52° + 27°$ to $64° + 8\frac{1}{2}°$. Duration 2 sec., vivid flash at end.
,, 28. 8h. 50m. > ♀. From about $215° + 50°$ to $215° + 46°$ Very short path, swift and flashing. Impossible to fix path accurately.

It seems desirable to inquire whether any other observers noticed an abundance of meteors on about November 21, and if so whether their paths were directed from the usual radiant point of the Andromedids.

W. F. DENNING.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. J. H. Jeans, of Trinity, has been appointed university lecturer in mathematics in the place of Prof. Macdonald, now of Aberdeen University.

The late Mr. G. T. B. Wigan has bequeathed to the university some 9000*l.*, the interest of which is to be used for the purpose of promoting scientific education and research. It is proposed to divide the fund equally between the board for physics and chemistry and the board for biology and geology. Each board will administer the income of its moiety subject to the condition that no portion is to be applied to one specified purpose for longer than five years at a time.

The name of the late Frank McClean, F.R.S., the founder of the Isaac Newton studentships in astronomy, and a generous donor to the observatory, has been added to the university roll of benefactors.

Dr. Donald MacAlister, the representative of the university on the General Medical Council for the last fifteen years, has been elected president of the council in succession to Sir William Turner, K.C.B., principal of Edinburgh University.

Mr. F. F. Blackman, of St. John's, has been appointed reader in botany in the place of Mr. Francis Darwin.

A university lectureship in botany, stipend 100*l.*, is vacant by the resignation of Mr. F. F. Blackman, recently appointed reader. Application is to be made to the Vice-Chancellor by December 17.

Prof. E. Waymouth Reid, F.R.S., has been approved for the degree of doctor of science.

Prof. Woodhead has obtained from friends resident in or connected with Huddersfield a sum of more than 1600*l.* for the endowment of a Huddersfield lectureship in special pathology. The general board proposes that the gifts be gratefully accepted by the university, and that the lectureship be forthwith established.

The museums and lecture rooms syndicate reports that the zoological collections have outgrown their present accommodation, and suggests that a new zoological museum should be arranged for on the site recently acquired from Downing College, in the neighbourhood of the new Sedgwick Geological Museum.

A new diploma is proposed in mining engineering for students who have resided nine terms and have attained a prescribed standard in certain subjects of the natural sciences and mechanical sciences triposes.

The board of geographical studies has published a report submitting regulations for the special examination in geography for the ordinary B.A. degree, and for the diploma in geography. The range of subjects is comprehensive, and the standard contemplated is obviously high. The regulations are given at length in the *University Reporter*, pp. 301–3. Dr. D. MacAlister and the Right Hon. Sir G. D. T. Goldie, K.C.M.G., have been appointed members of the board.

The memoir of Mr. A. Wood, advanced student of Emmanuel College, on the spontaneous ionisation of air in closed vessels, and its causes, has been approved as qualifying for the certificate of research.

The Rev. Francis Bashforth, second wrangler 1843, formerly fellow of the college, and distinguished for his researches in ballistics, has been elected to an honorary fellowship at St. John's College.

LORD REAY will distribute the prizes to the students of the Northampton Institute, Clerkenwell, on December 9.

PROF. HELE-SHAW has accepted the post of principal organiser under the Transvaal Technical Council for one year, and has in consequence resigned the chair of professor of engineering at Liverpool.

THE registrar of the University of Leeds announced, at a Mansion House meeting held at York on November 30 in support of the university, that 61,825*l*. has been subscribed toward the 100,000*l*. required to make the necessary additions to the buildings and to increase the endowment of the university, so as to satisfy the financial requirements laid down by the Committee of the Privy Council.

LORD LONDONDERRY will receive a deputation from the Association of Chambers of Commerce of the United Kingdom on Monday next, when the following resolution on commercial education will be submitted:—"That in order to retain our industrial positions and to introduce into this country such further industries as may be profitably developed it is absolutely necessary to establish or acquire public secondary schools of the highest standard, and to provide sufficient inducements by bursaries, exhibitions, scholarships, or otherwise to make the efficient boys stay long enough to take full advantage of the provisions made for higher technical and higher commercial education."

THE third annual meeting of the North of England Education Conference will be held in the St. George's Hall, Liverpool, on January 6 and 7, 1905. The subject to be discussed on the first morning is "Leaving Certificates." Lord Stanley of Alderley will preside, and papers will be read by Mr. G. Alexander, Mr. Owen Owen, and the Rev. J. B. Lancelot. The discussion will be opened by Sir Oliver Lodge and Mr. G. Sharples. In the afternoon of the same day there will be three separate conferences dealing respectively with "Manual Training," the "Teaching of Geography," and "Child Study." Principal Reichel will read a paper on the first subject, Mr. Mackinder on the second subject, and Prof. Sherrington on the third. The subject for discussion by the conference as a whole on the morning of the second day is "Scholarships, with Special Reference to the Coordination of Education." Sir William Anson will take the chair, and papers will be read by Miss S. A. Burstall and Dr. T. J. Macnamara. Messrs. Gore and Edwards will open the discussion. In the afternoon the conference will be divided into three parts to discuss the "Teaching of Domestic Science," "School Games, with Special Reference to Day Schools," and the "Teaching of English." Domestic science will be dealt with in papers by Miss Fanny Calder and Miss E. Pycroft, school games by Messrs. J. L. Paton and F. W. Augell, and the teaching of English by Miss E. Drummond and Mr. G. C. Steel. An exhibition of geographical appliances, apparatus, maps, books, &c., will also be held on the days during which the conference meets.

FROM a long list of recent appointments in such journals as the *Physikalische Zeitschrift*, *l'Enseignement mathématique*, and similar sources, we extract the following professorships, mainly mathematical and physical:—Germany, Austria, &c.—S. A. Arrhenius (Stockholm) for meteorology and cosmical physics at Berlin; H. Battermann for astronomy, and directorship of observatory at Königsberg; K. Cranz (Stuttgart) at technical college, Charlottenburg, Berlin; O. Eggert (Berlin) for geodesy at technical college, Danzig; Dr. Furtwangler for mathematics at agricultural college, Bonn-Poppelsdorf; Grassmann (Halle) at Giessen; L. Hefter (Bonn) at technical college, Aachen; G. Landsberg (Heidelberg) extraordinarius for mathematics at Breslau; K. Oertel for astronomy at Munich; R. Prantl (Hanover) extraordinary at Göttingen; Rohn (Dresden) for descriptive geometry at Leipzig; C. Runge (Hanover) at Göttingen; K. Schreber at Greifswald; J. Sommer for mathematics, technical college, Danzig; P. Stäckel (Kiel) at technical college, Aachen, to replace Prof. van Mangoldt, who is transferred to Danzig; Vahlen (Königsberg) at Greifswald; Wellenstein (Giessen) extraordinary for mathematics, Strassburg. France.—Cartan for calculus at Nancy; Cotton for mechanics at Grenoble; Drach for mechanics at Poitiers; Lecornu for mechanics at polytechnic college, Paris, in place of the late M. Sarrau; H. Poincaré for astronomy at polytechnic, Paris; Raffy for analytical geometry, Paris; Jules Tannery for calculus at Paris. Italy.—F. Guardacci (Florence) for geodesy at Bologna; Mich. Rajna for astronomy, and directorship of observatory, Bologna; in addition, F. Amadeo has been appointed recognised teacher for history of mathematics at Naples. America.—G. H. Hallett and C. A. Holden (extraordinary), Pennsylvania; D. N. Lehmer (extraordinary), California; James MacMahon, Cornell; Robert E. Moritz for mathematics, Washington; H. L. Rietz (extraordinary), Illinois; J. H. Tanner, Cornell; A. W. Whitney, California; besides the following instructorships in mathematics:—J. W. Bradshaw, Michigan; A. B. Coble, Baltimore; L. C. Karpinsky, Michigan; E. B. Lytle, Illinois; C. L. F. Moore, Massachusetts; A. Ranum, Wisconsin; F. C. Touton, Illinois.

THE annual dinner of the past and present students of the Queen's Faculty of Medicine in the University of Birmingham was held on November 29. In proposing the toast of "The Medical School," Sir F. Treves said:—"It is very much to be regretted that very little heed is given to science in this country. There was a time when the man of science—Galileo, for example—was cast into prison; now he is simply allowed to starve. There is no kind of encouragement offered to science. In every university throughout the country the same story is told. I think that those men who devote themselves to science in this country deserve rewards infinitely beyond any they have ever received." Mr. Chamberlain, who was present in his capacity of Chancellor of the university, in proposing the toast of "Students, Past and Present," referred to the remarks of Sir F. Treves. Mr. Chamberlain said:—"I am afraid that for all time to come probably science, and the conferring of great benefits upon one's fellow-creatures, must be, to a large extent, its own reward. But the pursuit of research is an impossibility so long as the actual means of existence are wanting, and the professional practitioner when he starts is, in very many cases at any rate, so tied by the necessity of providing an actual subsistence for himself and his family that anything like original and continuous research is in his case impossible. That can only take place when there are in this country schools established where for a year or two, perhaps in their younger time, men of ability and of interest in school subjects can be brought together under capable heads, and can carry out on the most extended scale that series of researches which already, in the hands of some of our most distinguished men of science, have led to such important results." During the course of his remarks Mr. Chamberlain also said that three classes of people are essential to the success of a modern university—students, teachers, pious benefactors. "Unfortunately," he said, "we have fewer pious benefactors in this country than they have in the United States of America, where, by their munificent donations, counting by millions, they have covered the land with a net-work of universities which have brought higher education within the reach of almost every citizen. I hope the time is coming when men who have more than they want, more, perhaps, than is good for them, can find no better opportunity of disposing of the surplus than by benefactions which not only are of present usefulness, but, what is of more importance, are of permanent advantage to the community amongst which they live."

ON Thursday last, December 1, the prizes and certificates gained by students of the Sir John Cass Technical Institute during the session 1903–4 were distributed by Sir William White, K.C.B., F.R.S., when the chair was taken by Sir Owen Roberts, chairman of the governing body. Sir William White, in the course of his address, said that during his recent visit to America he had had the opportunity of studying the methods of technical education in vogue there, and he must certainly confess that both America and Canada can teach us a great deal so far as technical colleges in general, and the interest taken by employers of labour in the future employment of men trained in technical institutions, is concerned. The essential advantage which America and Canada, and also Germany, possess over this country is that they are all imbued with the idea that it is a wise investment on the part of a nation to provide for all kinds of education from the elementary up to the highest. It is almost impossible to make expenditure on education too lavish, provided it is well directed, if the nation is to be well educated. This country, in his opinion, will never reach a truly healthy condition until every man or woman, in whatever position the accident of birth may place them, shall, if they possess the capabilities, have also the opportunities of self-culture. Nevertheless, there is one respect, he thought, in which this country stands supreme. It is in the provision of evening classes for the working man and the working woman who, from the very nature of their circumstances, are compelled to work all day to get a living. Employers should assist these educational classes more than they do at present. The London and South-Western Railway Company are doing what may well be done by other large employers. They grant to the apprentices in their works at Nine Elms the necessary time to attend the early morning classes at the Battersea Polytechnic. The apprentices are allowed to go to these classes twice a week, and are paid for the time that they are away from the company's service, on the condition that they do a certain amount of study at home, thus completing in the evening the training which they receive during the day at the polytechnic. This is not altogether an experiment. The Admiralty has done the same thing for fifty years or more, with the result that the Admiralty, from the apprentices in its own dockyards, has trained not only many of its principal shipbuilding officers and naval architects for the Royal dockyards and the Admiralty service, but has also furnished to the private shipbuilding industry of the country some of its most famous shipbuilders. The leaders and managers in those great private establishments to-day are in no small proportion drawn from men who were trained in the Admiralty service under the system which has been in operation, and by which every apprentice who cares to improve his mind has the opportunity to do so. If employers will give the utmost encouragement to institutions like the Sir John Cass Institute, they will be rewarded by having capable men on their staff who will know the principles of their business.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 17.—"The Electrical Conductivity and other Properties of Sodium Hydroxide in Aqueous Solution, as Elucidating the Mechanism of Conduction." By W. R. **Bousfield,** K.C., M.P., and T. M. **Lowry,** D.Sc.

The original object of the research was to investigate the decay, as the temperature rises, in the "ionising" properties of water, which is manifest in the inflected character of the curves expressing the relation between temperature and conductivity in aqueous solutions of the alkalies.[1] The principal results of the investigation are as follows:—

(1) In the most dilute solutions, in which "ionisation" is nearly complete, and again in the most concentrated solutions, the curves expressing the relation between molecular conductivity and temperature in aqueous solutions of sodium hydroxide are not inflected between 0° C. and 100° C. In each case the form of the curve appears to be determined mainly by the rapid changes of viscosity which accompany changes of temperatures. Moderately dilute solutions give curves that are inflected between 0° C. and 100° C.; the temperature of inflection reaches a minimum, at 48° C., in the case of a normal (4 per cent.) solution, but rises to 100° C. when the concentration is raised to 30 per cent.

(2) The inflected conductivity-temperature curves can be represented by the formula

$$\kappa_t/\kappa_0 = \rho_t/\rho_0 \, (1+bt)^n \, e^{-at}.$$

This formula is applicable to conductivity-temperature curves of all kinds, and gives expression, not only to the inflection now under consideration, but also to the maximum conductivity and the second inflection in the general conductivity-temperature curve.[2]

(3) The maximum conductivity of caustic soda at 18° C. is 0·3490 in a 15 per cent. solution, the value given by Kohlrausch being 0·3462. At higher temperatures the maximum conductivity is considerably greater, rising to more than 1·4 at 100° C., and occurs in solutions of greater concentration.

(4) The viscosity of a 50 per cent. solution of sodium hydroxide is approximately seventy times as great as that of water. The influence of this factor may be to some extent eliminated by dividing the molecular conductivity by the fluidity, and this ratio it is proposed to call the "intrinsic conductivity" of the solution. Whilst the molecular conductivity of sodium hydroxide solutions decreases steadily as the concentration is increased, the intrinsic conductivity falls to a minimum at about 8 per cent. NaOH, and then rises, until at 50 per cent. NaOH, the value is considerably greater than in the most dilute solutions. It is believed that this increase is due to the fact that liquid soda is an electrolyte, *per se*, and that, in concentrated solutions, the current is conveyed partly by the soda alone, as if it were in the fused state.

(5) In re-determining the densities of aqueous solutions of sodium hydroxide, quantities of sodium, amounting to about 150 grams at a time, were weighed, and converted quantitatively into concentrated solutions of sodium hydroxide by the action of steam in a platinum vessel. Eleven determinations, made with six different standard solutions, gave, as the density of a 50 per cent. solution at 18° C., the value 1·5268, with an average error of 0·0001. Solutions of known concentrations having been prepared by dilution, their densities were determined with a probable error of not more than 0·0001; the values recorded by previous observers were derived from solutions standardised by titration only, and appear to contain errors in the third or even in the second place of decimals.

(6) In the formula

$$\rho_t = \rho_0 + \alpha t + \beta t^2 + \gamma t^3,$$

which represents the influence of temperature on the density of water and aqueous solutions of soda, the coefficient of t^3 vanishes when a concentration of 12 per cent. NaOH is reached, whilst the coefficient of t^2 vanishes at 42 per cent. NaOH; at the latter concentration there is a simple linear relationship between density and temperature.

(7) The molecular volume of sodium hydroxide in dilute aqueous solution has a large negative value, a litre of water dissolving 140 grams of sodium hydroxide at 0° C., 100 grams at 18° C., or 60 grams at 50° C., without increasing in volume. The molecular volume does not increase continuously as the temperature rises, but reaches a maximum value at about 70° C. In a 50 per cent. solution the temperature has little effect on the molecular volume, the extreme variation being only about 10 per cent.

[1] Compare Roy. Soc. *Proc.*, 1902, vol. lxxi. pp. 42–54.
[2] *Loc. cit.*, p. 52.

Entomological Society, November 16.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Mr. H. St. J. **Donisthorpe** exhibited the second recorded British specimen of *Orchestes sparsus*, Fahr., taken by him on August 28 in the New Forest.—Mr. H. W. **Andrews** exhibited specimens of *Atherix crassipes*, Mg., from the New Forest, the only previously recorded locality in Britain being near Ticehurst, Sussex.—Mr. G. O. **Sloper** exhibited aberrant forms of *Melitaca athalia* from Luan, Switzerland, and Martigny, in which the tendency of the black markings to supersede the fulvous was particularly noticeable.—The **President** exhibited cases containing Diptera, and a case containing the skins of African Sphingid larvæ, dried in botanical paper, and after seventy years still preserving their colours, from the Burchell collection in the Hope Museum, Oxford.—Mr. C. O. **Waterhouse** exhibited a gall of some lepidopterous insect found on the califate bushes in Patagonia. The gall resembled that of *Cynips kollari*, but was hollow, the walls being about ⅛ inch in thickness. The circular door prepared by the larva was about ⅛ inch in diameter. The pupa was lying free, without any silk cocoon. It was suggested that the insect was perhaps allied to Œcocecis.—Mr. G. H. **Kenrick** communicated a paper entitled "Natural Selection Applied to a Concrete Case."—Mr. J. C. **Kershaw** communicated papers on enemies of butterflies in south China, and a life-history of *Gerydus sinensis*.—Mr. Nelson **Annandale** communicated a paper on the eggs and early stages of a Coreid bug, probably *Dalader acuticosta*, with a note on its hymenopterous parasites.

Royal Microscopical Society, November 16.—Sir Ford North, F.R.S., in the chair.—Mr. Hugh C. **Ross** exhibited and described a new electric warm stage of his invention.—Mr. C. L. **Curties** exhibited two new designs of the Nernst lamp suitable for use with a current of 100 and 200 volts respectively, adapted for use with the microscope, and fitted with ground glass or blue glass fronts and mounted so as to be used at any height or angle required.—A paper on theories of microscopic vision, a vindication of the Abbe theory, which contained some new views on the subject, was read by Mr. **Conrady.**

Linnean Society, November 17.—Prof. W. A. Herdman, F.R.S., president, in the chair.—Mr. H. E. H. **Smedley** exhibited forty-one models of Palæozoic seeds and cones. The models of the seeds show the complexity of their internal structure, whilst the models of the synthetically re-constructed calamitean and other cones display the high organisation of the vascular cryptogams of Palæozoic times.—Note on the shape of the stems of plants: Lord **Avebury.** The author pointed out that while most plants had round stems, in some they were triangular, some quadrangular, &c., but that, so far as he knew, no attempt had been made to explain these differences. He thought they could, however, be accounted for on mechanical principles. In building, when the main object was to meet a strain in one direction, the well known girder was the most economical disposition of material. In a tree-stem it was necessary to resist strain coming from all directions, and the woody tissues acted as a circular series of girders. In herbs with opposite leaves the strains were mainly in two directions, and were met by two opposite girders, thus giving the quadrangular stem. Taking our native flora he showed that all herbs with quadrangular stems had opposite leaves, and as a rule herbs with opposite leaves had quadrangular stems. Sedges had triangular stems and grasses round stems, and while sedges had the leaves in threes, those of grasses were distichous. Pentagonal stems might be accounted for in a similar way, and incidentally this threw light on the petals of so many flowers. Thus plants had adopted, millions of years ago, principles of construction which have gradually been worked out by the skill and science of our architects and engineers.—Observations on some undescribed or little known species of Hemiptera Homoptera of the family Membracidæ: G. Bowdler **Buckton.** Prof. Poulton has explained the significance of the strange forms of some of the Membracidæ by their dependence on environment, and the requirements of mimicry; and the Rev. Canon Fowler has also given information respecting the economics of the species, and their maintenance during the struggle for life. The present paper may be regarded as supplementary to Canon Fowler's work on the Membracidæ in the "Biologia Centrali-Americana," and to Mr. Buckton's monograph, in which latter work an attempt has been made to classify the family so far as at present known. The specific descriptions are chiefly founded on specimens from the museums of Madrid and Brussels. Most of the new species are from Mexico and Central America, six from Africa, and one each from India, Ceylon, Sumatra, and the Philippines. Mr. Buckton then characterises twenty-four new species, five of which are made the types of new genera, and the paper concludes with general observations on the habits, economy, and transformations of the Membracidæ.

Physical Society, November 25.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—The measurement of small differences of phase: Dr. W. E. **Sumpner.** Hitherto, in order to measure the differences of phase between alternating-current quantities, it has been necessary to use some method involving the simultaneous reading of three deflectional instruments, such as the wattmeter method, or the three-voltmeter method either in its original or in some modified form. These methods cannot be successfully applied when the phase-differences to be determined are small. The author describes new voltmeter methods which may be used for the purpose, and gives the results of a number of measurements on alternating-current plant.—Dr. C. V. **Drysdale** exhibited and described apparatus for the direct determination of the curvatures of small lenses, such as the objectives of microscopes. Parallel light from a distant source falls upon a plane unsilvered mirror inclined at an angle of 45°. Some of the light is reflected and brought to a focus by an ordinary convex lens. The surface to be tested is placed at this point, and the reflected rays proceed as if they had come from a point on the surface. They pass through the plate glass into a telescope focused for parallel rays, and an observer sees an image of the distant source. If the surface is convex and is brought nearer to the lens, then, when it reaches such a position that its centre of curvature is at the focus of the rays emerging from the lens, the light will again retrace its former path and a distinct image of the source will be seen in the telescope. In order to obtain the two images the surface has therefore been moved through a distance equal to its radius of curvature. If the surface is concave it must be moved away from the lens. Dr. Drysdale showed how the method could be carried out by means of an auxiliary piece fitted to an ordinary microscope. He also described a method of testing the spherical and chromatic aberration of microscopic objectives. Light from a distant point is partially reflected by means of a piece of plate-glass down the axis of the microscope. In passing out of the objective it is brought to a focus upon a mirror, and retraces its path along the axis of the instrument until it reaches the plate glass. This it passes through, and by means of a telescope an observer can view the distant source. The light having passed twice through the lens to be investigated, the effects of chromatic and spherical aberration are doubled, and at the same time the effect of coma is eliminated.—Prof. S. P. **Thompson** gave an exhibition of specimens of crystals showing the phenomenon of luminous rings. He said it was well known that when a source of light was viewed through certain samples of calc-spar the field of vision contained two luminous rings each of which passed through the image of the luminous point. The subject had been investigated by Dr. Johnstone Stoney, who had attributed the phenomenon to a minute tubular structure in the crystal. There were, however, certain crystals which when cut in the ordinary way across the axis and used to view a distant source of light exhibited a single luminous ring passing through the image of the source. Looking down the axis of the crystals no ring is visible, but on tilting it a ring can be seen in the direction of the tilt which grows in diameter as the tilt is increased. So far as he knew, no explanation of these phenomena had been offered. At the meeting a piece of calc-spar showing the two rings, and pieces of beryl and tourmaline showing the single ring were exhibited.

EDINBURGH.

Royal Society, November 7.—Lord M'Laren in the chair.—In a paper on Prof. Seeliger's theory of temporary stars, Dr. J. **Halm** gave some important extensions bearing especially upon the characteristics of Nova Aurigæ (1892) and Nova Persei (1902). Seeliger's theory, broadly stated, is that a temporary star results from the collision of a dark body with a nebula, the chances of such a collision being much greater than the collision of two dark bodies. A necessary consequence will be an intense superficial heating with an atmospheric expansion in all directions. In whatever direction an observer may be situated, spectroscopic observations will show, (1) a displacement violet-wards of absorption lines or bands due to the absorptive action of the expanding and cooling atmosphere advancing in the direction of the observer with the hotter interior parts of the star as background; and (2) bright bands due to the expanding atmosphere to right and left of the body of the star, there being in this case no brighter background and no spectral shift. Dr. Halm now imagines that the collision is due to the advance of the dark body into a stream of nebulous matter passing obliquely across the dark body's path. This will at once give rise to a circulation of parts of the nebula round the star, and these, of course, will also be highly heated. The portions moving transverse to the line of sight across the face of the star will produce absorption bands in their normal position in the spectrum, while the marginal portions moving on the one side towards the observer and on the other side from him will produce a shift of bright bands both towards the red and towards the violet end of the spectrum. By compounding the effects of these two conditions, namely, the simple expansion of the atmosphere equally in all directions and the swirl of incandescent matter due to oblique collision, Dr. Halm showed that the two types of spectra obtained in the cases of the recent Novæ were at once obtained.—Three papers by Dr. Thomas **Muir** were also communicated, the titles being "The Sum of the Signed Primary Minors of a Determinant," "Continuants Resolved into Linear Factors," and "The Three-line Determinants of a Six-by-Three Array."

November 21.—Lord M'Laren in the chair.—Mr. George **Romanes**, C.E., read a paper on a possible explanation of the formation of the moon. The general idea was that the moon had grown to its present form and size by the gradual agglomeration of what was originally a ring of satellites broadly similar to what we know to exist in the case of Saturn. On this hypothesis it was easily shown that the process of agglomeration of a comparatively small body like the moon could not be accompanied with an evolution of heat sufficient to produce a molten globe, and that in consequence the ordinary assumption of intense volcanic action to explain the so-called craters was difficult to accept. But it seemed possible to account for the rugged mountainous surface of the moon with the "seas," ridges, "craters," and peaks by means of the bombardment of those meteoric masses, large and small, which in virtue of the combined action of moon, earth, and sun were precipitated from time to time upon the lunar surface. In the absence of an atmosphere the masses so precipitated would impinge upon the surface with high enough velocities to render the material in the immediate vicinity liquid, the impinging mass also itself being liquefied wholly or partially according to circumstances. The author entered into a detailed examination of some of the most striking features of the moon's surface, and showed how this hypothesis accounted for them. He also exhibited a mass of lead into which small bullets had been shot at various incidences. The indentations reproduced the leading characteristics of the lunar "craters," even to the small hill in the middle of the main depression. It was also noticed that at the instant of impact the rim of lead thrown up all round was made red hot. The mysterious streaks so characteristic of Tycho in certain aspects were explained as due to great splashes of material which settled down in thin crystalline layers capable of throwing off the reflected sunlight in definite directions.—Prof. **Coker** described a laboratory apparatus for measuring the lateral strains in tension and compression members. By a well designed combination of levers and mirror attachment an apparatus capable of being fixed to the bar itself had been constructed, which was sufficiently rigid and yet sensitive enough to measure a change of 1/20,000th of an inch. Some experiments on steel, iron, and brass bars were described, in which the new apparatus was used in conjunction with Ewing's extensometer, and values of Poisson's ratio were given to three significant figures. The values varied from one-third to one-fourth.

PARIS.

Academy of Sciences, November 28.—M. Mascart in the chair.—On the possibility of chemical reactions: M. **de Forcrand.** The author contends that the rigid application of the thermodynamical condition of the possibility of a chemical reaction is neither practical nor necessary, and that the empirical rule that the disengagement of heat settles the course of a reaction is the only possible experimental criterion of the possibility of chemical reactions.—On the prediction of chemical reactions: M. **de Forcrand.** In general, accurate prediction of the course of a chemical reaction is impossible, but there are two rules or principles, one rigorous the other approximate. The latter, the principle of maximum work, is a simplification of the first, and ought to be considered as the only practical guide.—M. Dastre was elected a member in the section of medicine and surgery in the place of the late M. Marey.—The Leonids in 1904: Lucien **Libert.** Details of observations made at Havre on the nights of November 14, 15, and 15, 16. 111 meteors were observed and the trajectories measured.—On the singularities of uniform analytical functions: D. **Pòmpeiu.**—On a new class of ions: G. **Moureau.** In a previous paper it has been shown that a saline vapour becomes conducting after passing through a porcelain tube heated to about 1000° C., and remains conducting at much lower temperatures, possessing the properties of an ionised gas. In the present paper the mobilities of these new ions have been measured. It was found that in the neighbourhood of the region of ionisation the mobilities of the vapours are of the same order as the ions of the gases issuing from a flame.—On the genesis of temporary radio-activity: Ed. **Sarasin,** Th. **Tommasina,** and F. J. **Micheli.** The authors conclude from the results of their work that a very close relation appears to exist between ionisation and the production of temporary radio-activity. The two phenomena would appear to be reversible, the production of the temporary radio-activity of a body being due to the absorption, or, perhaps, adsorption of an emanation which is formed during the ionisation of a gas. On this view, the radio-activity would consist in the loss by radiation of the emanation adhering to radio-active bodies, this causing, in its turn, the ionisation of a gas.—Stereoscopy without a stereoscope: A. **Berthier.** The author points out that he has already published a description of a method similar in principle to that given by M. Ives in the *Comptes rendus* of October 24 last.—On the colloidal state of matter: G. E. **Malfitano.** The author regards colloidal matter as a system formed of an electrolyte dissociated into ions and insoluble molecules grouped round these ions.—The influence exerted by the removal of the moisture from the air supplied to the blast furnace: A. **Lodin.** The results obtained by Gailey at the Isabella blast furnaces, near Pittsburg, on he effect of drying the air forced into the furnace, have attracted much attention in Europe, not unmixed with scepticism. The author makes a comparison of the heat balances in the two cases, and shows where the economy is effected. One indirect effect of the drying process is to increase the temperature of the ingoing air, and a considerable portion of the economy effected may be attributed to this cause. In Europe, where it is usual to work with the air entering the tuyeres at a much higher temperature than at the Isabella furnaces, the relative economy which would be produced by drying the air would be too small to justify the capital expenditure required to introduce the necessary plant.—On the use of dry air in blast furnaces: Henri **Le Chatelier.** The economy claimed for the use of dry air is ascribed by the inventor of the process to the fact that the moisture of the undried air transforms a certain proportion of the coke into hydrogen and oxide of carbon. From the figures of the amount of water removed it is possible to calculate exactly this loss; it is 5 per cent., or only one-fourth of the amount claimed. It is certain, then, either that the economy claimed is incorrect, or else that the true cause is to be sought for elsewhere. The author shows that the quality of the iron produced, especially as regards its sulphur impurity, is an important factor, and that when the sulphur is to be kept down to a certain percentage the economy of fuel claimed by Gailey may be real.—On wood spirit from *Thuya articulata*, Algeria: Emilien **Grimal.** Carvacrol, thymohydroquinone, and thymoquinone were isolated from the product of the distillation of this wood with steam.—The formation and distribution of the essential oil in an annual plant: Eug. **Charabot** and G. **Laloue.** During the formation of the flower the increase of essential oil by the flower corresponds to a loss of oil by the green parts. After the seed is formed, and there is no longer a flow of nutritive principles towards the flower, the essential oil returns to the green organs.—Floral abnormalities produced by parasites acting at a distance: Marin **Molliard.** The atrophy of the stamens, and the conversion of the sepals, petals, and carpels into green foliaceous leaves, a phenomenon frequently met with in *Trifolium repens*, is shown to be due to the burrowing of a larva (probably of *Hylastinus obscurus*) at the base of the stem of the plant.—*Xylotrechus quadrupes* and its ravages on the coffee plant of Tonkin: L. **Boutan.**—The individuality of the complex particle in a crystal: M. **Wallerant.**—On the lakes of the Grimsel and of the St. Gothard massif: André **Delebecque.**—The degree of saline concentration of the blood serum of the eel in sea water and in fresh water, after its experimental passage from the former to the latter: René **Quinton.** The percentage of salt in the blood serum of the eel varies in accordance with the degree of salinity of the water in which it is placed, and is an example of the fact that the saline concentration of fresh water fishes is that of their marine ancestors, reduced simply by the influence of the new medium in which they live.—The elimination of urea in healthy subjects: H. **Labbé** and E. **Morchoisne.**—Contribution to the study of acid dyscrasia: A. **Desgrez** and J. **Adler.**—On the bleaching of flour: E. **Fleurent.**

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 8.

ROYAL SOCIETY, at 4.30.—Memoir on the Theory of the Partitions of Numbers. Part III: Major P. A. MacMahon, F.R.S.—Note on a Means of Producing a High-voltage Continuous or "Pertinacious" Current: Sir Oliver Lodge, F.R.S.—The Effect of Liquid Air Temperatures on the Mechanical and other Properties of Iron and its Alloys: Sir James Dewar, F.R.S., and R. A. Hadfield.—The *Rôle* of Diffusion during Catalysis by Colloidal Metals and Similar Substances: Dr. H. J. S. Sand.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Notes on Portland Cement: H. E. Bellamy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Hydrodynamical and Electromagnetic Investigations regarding the Magnetic-Flux Distribution in Toothed-Core Armatures: Prof. H. S. Hele-Shaw, F.R.S., Dr. A. Hay, and P. H. Powell. (Conclusion of Discussion).—Studies in Magnetic Testing: G. F. C. Searle.

SOCIETY OF ARTS, at 4.30.—Burma: Sir Frederic Fryer, K.C.S.I.

MATHEMATICAL SOCIETY, at 5.30.—On Groups of Order $p^\alpha q^\beta$: Prof. W. Burnside.—On the Linear Differential Equation of the Second Order: Prof. A. C. Dixon.—On a Deficient Multinomial Expansion: Major P. A. MacMahon.—The Application of Basic Numbers to Bessel's and Legendre's Functions (second paper): Rev. F. H. Jackson.—On the Failure of Convergence of Fourier's Series: Dr. E. W. Hobson.—An Extension of Borel's Exponential Method of Summation of Divergent Series Applied to Linear Differential Equations: E. Cunningham.

FRIDAY, DECEMBER 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.—(1) Dark Nebulosities; (2) Detached Nebula in Cygnus: W. S. Franks.—On the Relative Brightness of Binary Stars: J. E. Gore.—(1) On the Completion of the Main Problem in the New Lunar Theory; (2) The Final Values of the Coefficients in the New Lunar Theory: Prof. E. W. Brown.—On the Relative efficiency of Different Methods of Determining Longitudes on Jupiter: A. Stanley Williams.—On the Temperature of Sun-spots, and on the Spectrum of an Artificial One: W. E. Wilson.—On the Validity of Meteor Radiants deduced from Three Tracks: H. W. Chapman.—*Promised papers*:—Observations of the Leonid Meteors of 1904 November: Royal Observatory, Greenwich.—Radio-activity of Matter the Possible Cause of Heat Energy in Sun and Stars: W. E. Wilson.—Mean Areas and Heliographic Latitudes of Sun-spots in the Year 1903: Royal Observatory, Greenwich.—The Coefficients of 145 Terms in the Moon's Longitude derived from Greenwich Meridian Observations, 1750–1901: P. H. Cowell.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Ticks and Tick-transmitted Diseases: Dr. Nuttall, F.R.S.

MALACOLOGICAL SOCIETY, at 8.—Description of a new species of Trachiopsis from British New Guinea: H. B. Preston.—A Correction in Nomenclature: E. A. Smith.—Notes on the American Cyclostomatidæ and their Opercula: W. H. Dall.—Note on the Dates of Publication of the Various Parts of Moquin-Tandon's "Hist. Moll. terr. fluv. de France": J. W. Taylor.

PHYSICAL SOCIETY, at 8.—On a Rapid Method of Approximate Harmonic Analysis: Prof. S. P. Thompson, F.R.S.—A High-Frequency Alternator: W. Duddell.—Exhibition of Experiments to show the Retardation of the Signalling Current on 3500 miles of the Pacific Cable between Vancouver and Fanning Island.—Exhibit of Ayrton-Mather Galvanometers, Universal Shunts, and Electrostatic Instruments.

MONDAY, DECEMBER 12.

SOCIETY OF ARTS, at 8.—Musical Wind Instruments, Reed Instruments: D. J. Blaikley.

SOCIETY OF DYERS AND COLOURISTS, at 8.—Bleaching Agents: and the Methods of Application: F. W. Walker.—The Application of Sulphide Colours in the Dyeing of Chrome Leather.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Explorations in Bolivia: Dr. H. Hoek.

TUESDAY, DECEMBER 13.

ZOOLOGICAL SOCIETY, at 8.30.—Some Notes on Anthropoid Apes: Hon. Walter Rothschild.—On the Cranial Osteology of the Clupeoid Fishes: Dr. W. G. Ridewood.—The Characters and Synonymy of the British Species of Leucosolenia: Prof. E. A. Minchin.

SOCIOLOGICAL SOCIETY, at 8.—The School in Some of its Relations to Social Organisation and to National Life: Prof. M. E. Sadler.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On the Construction of a Concrete Railway-Viaduct: A. Wood-Hill and E. D. Pain.

WEDNESDAY, DECEMBER 14.

CHEMICAL SOCIETY, at 5.30.—Hydrolysis of Ammonium Salts. V. H. Veley.—The Viscosity of Liquid Mixtures. Part ii.: A. E. Dunstan.—The Diazo-reaction in the Diphenyl Series. Part ii.: Ethoxybenzidine: J. C. Cain.—The Sulphate and the Phosphate of the Dimercurammonium Series: P. C. Rây.—A Method for the Direct Production of certain Aminoazo-compounds: R. Meldola and L. Eynon.

SOCIETY OF ARTS, at 8.—The Patent Laws: C. D. Abel.

THURSDAY, DECEMBER 15.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—An Analysis of the Results from the Falmouth Magnetographs on "Quiet" Days during the Twelve Years 1891 to 1902: Dr. C. Chree, F.R.S.—The Halogen Hydrides as Conducting Solvents. Part iii.: B. D. Steele.—The Halogen Hydrides as Conducting Solvents. Part iv.: B. D. Steele, D. McIntosh, and E. H. Archibald.—Effects of Temperature and Pressure on the Thermal Conductivities of Solids. Part i., The Effect of Temperature on the Thermal Conductivities of some Electrical Insulators: Dr. C. H. Lees.—The Basic Gamma Function and the Elliptic Functions: Rev. F. H. Jackson.—On the Normal Series satisfying Linear Differential Equations: E. Cunningham.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Discussion on Mr. Searle's Paper, Studies in Magnetic Testing; Followed by The Combination of Dust Destructors and Electricity Works, Economically Considered: W. P. Adams.

LINNEAN SOCIETY, at 8.—The Ecology of Woodland Plants: Dr. T. W. Woodhead.—Experimental Studies on Heredity in Rabbits: C. C. Hurst.

FRIDAY, DECEMBER 16.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Heat Treatment Experiments with Chrome-Vanadium Steel: Capt. H. Riall Sankey and J. Kent-Smith.—Messrs. Seaton and Jude's Paper on Impact Tests on the Wrought Steels of Commerce will be further discussed.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Folkestone Harbour: Cylinder-Sinking at the Root of the Old Pier: R. H. Lee Pennell.

CONTENTS.

THURSDAY, DECEMBER 15, 1904.

HUMAN ANATOMY.

(1) *A Treatise on Applied Anatomy.* By Edward H. Taylor, M.D., F.R.C.S.I. Pp. xxvii+738; 178 figures and plates. (London: Charles Griffin and Co., Ltd., 1904.) Price 30s. net.

(2) *The Human Sternum.* By Andrew Melville Paterson, M.D. Pp. 89; 10 plates. (London: Published for the University Press of Liverpool by Williams and Norgate, 1904.) Price 10s. net.

(3) *Der Gang des Menschen.* v. Teil. Die Kinematik des Beinschwingens. By Otto Fischer. Price 5 marks. vi. Teil. Ueber den Einfluss der Schwere und der Muskeln auf die Schwingbewegung des Beins. By Otto Fischer. Price 4 marks. (Leipzig: B. G. Teubner, 1904.)

(1) TO those unfamiliar with the ways of modern medicine the continual appearance of new works on human anatomy must cause some surprise. No subject should be better known, for it has been a matter of almost universal study for centuries. At the best, many will conclude, a new text-book on applied anatomy—the kind of anatomy the surgeon and physician more especially need—can only be a re-setting of old facts, and an examination of Dr. Taylor's work will show that, to a large extent, the conclusion is justified. The steady advance of surgery necessitates a continual rearrangement of anatomical perspective; the areas of the body which were under a surgical taboo to the septic surgeons of former days are open to the clean operator of modern times. The brain and spinal cord, the cavities of the ear and nose, the organs within the thorax and abdomen, and the great joint cavities of the limbs, have come, one after the other, within the field of everyday surgical procedure during the last thirty years. In his treatment of these parts of the body Dr. Taylor is quite up to date; his pages reflect accurately the best opinion that is to be found in modern text-books of anatomy and surgery. Still, modern advances will not altogether explain the rapid appearance of new works on anatomy or on any other subject; every generation demands its books on science or literature wet from the press.

The study of this work, containing more than half a million words, furnished with highly finished figures, written with clearness and accuracy, raises the question: is the modern surgeon, as seen in a text-book such as this, a more scientific man than his predecessor of fifty or a hundred years ago? A consideration of a number of subjects in this work, in the treatment of which Dr. Taylor is neither better nor worse than other rising surgeons, will show that, as thinking men, they compare unfavourably with surgeons of past periods. The subjects referred to deal with (1) the appendix vermiformis, the seat of appendicitis; (2) the prostate, which becomes so frequently enlarged in old men; (3) the epididymis, a structure connected with the testicle and very liable to disease; (4) the gall bladder, interesting in connection with the formation of gall-stones; (5) the antrum of the mastoid, an air space connected with the middle ear; (6) the air spaces opening into the cavity of the nose. These six structures are selected because, during the last twenty or thirty years, they have been the subjects of the keenest inquiry, and surgeons have published their observations concerning them in thousand upon thousand of treatises and articles. One would expect that the basis of their treatment would rest on an intimate knowledge of the normal use of these structures. John Hunter, Everard Home, and John Hilton would certainly have sought a complete knowledge of the functions of these parts to serve as a foundation for a rational treatment. Dr. Taylor adopts the orthodox view as regards these structures; he describes their shape, position, and relationships, and the routes by which they may be reached, but not a word is said of their use. Perhaps it is unfair to blame Dr. Taylor for this omission, because it must be confessed that we know much more of the diseases of these structures than of their normal function. Yet in a text-book written for house and operating surgeons surely it is the duty of the author to point out essential gaps in our knowledge rather than to gloss them over by a multitude of unessential details. This criticism is the more pertinent because the author in this case has not taken a narrow view of applied anatomy; he devotes a very large part of his space to a description of operative procedures, pathological processes, embryological defects, and introduces here and there points in physiology.

A great part of this work consists not of applied, but of purely descriptive anatomy. Some years ago Waldeyer, of Berlin, gave an elaborate description of some ten or twelve areas he distinguished within the human pelvis—all of which have been adopted in this book; yet not a word is said as to what manner of use a surgeon can possibly apply them. Again, as regards a small peritoneal recess, which may occur to the left of the terminal part of the duodenum, all the various forms which have been described by hair-splitting surgeons are reproduced in detail. An elaborate description of the condition known as knock-knee is supplied, yet no mention is made of how bones react in their growth to the forces which are brought to bear on them, nor is there any allusion to the forces which normally act on the knee joint.

Surgeon-anatomists have a fondness for the application of certain proper names to surgical procedures and anatomical structures—such as the "pouch of Prussak," the "fossa of Landzert," "Gosselin's fracture," &c. An examination of the index of this work shows that more than one hundred such terms are used, yet, in comparison with many works, the number is indeed very moderate; but one feels they are still rather many. Many terms introduced by surgeons are not words which may be used easily, such as "cholecystotomy" (opening the gall-bladder), "cholecystectomy" (excision of the gall-bladder), "cholecystenterostomy" (making a communication between gall-bladder and intestine), "choledochotomy" (opening the bile duct).

(2) In this monograph, a companion to one on the human sacrum, published in 1893, Prof. Paterson

gives the facts gathered and the conclusions reached during a prolonged research into the development, comparative anatomy, and nature of the human sternum. Leaving aside the convenience of having our scattered knowledge on this subject summarised, and the value of the mass of evidence collected during the examination of hundreds of individuals, the main importance of the work lies in two conclusions which Prof. Paterson draws concerning the nature of the sternum:—(1) that it is fundamentally part of the shoulder girdle; (2) that it is not a segmental structure. Both these inferences are at variance with accepted opinion.

At the present time it is universally taught that the sternum in mammals, birds and reptiles—that is to say, in all vertebrates which use the body wall for the purposes of inspiration—is a composite bone derived from a fusion of the ventral ends of the ribs. The sternum is thus regarded as a structure of costal origin, and having only a secondary connection with the shoulder girdle. In Amphibia, on the other hand, it is recognised that the sternum is developed in continuity with the shoulder girdle, of which it forms an intrinsic part; it is in them a shoulder-girdle sternum. That the shoulder-girdle sternum represents the more primitive type, and that from such a type the costal sternum of the Reptilia was evolved, are assumptions which comparative anatomists will freely grant. At present, however, there is a distinct break in our knowledge of the history of the sternum; no intermediate forms between those two types are believed to occur, and no one, with perhaps the exception of the late Prof. T. J. Parker, has ever formulated a definite theory as to the manner in which the costal sternum of Reptilia could have arisen from the amphibian shoulder-girdle sternum. Prof. Paterson's investigations help us very materially to trace the origin of the costal or, as it may more truly be named, the "respiratory" sternum of the three higher classes of vertebrates from the simple sternum of Amphibia. He shows that the "respiratory" sternum arises developmentally in continuity with the precoracoid element of the shoulder-girdle, and quite independently of the ribs, and that it is therefore merely a modified form of the amphibian shoulder-girdle sternum. Further, the various forms assumed by the "respiratory" sternum in reptiles, birds, and mammals do not, when rightly interpreted, favour Gegenbaur's conception of its evolution by a fusion of the ventral ends of ribs. The sternum of amphibians is the median ventral element of their shoulder girdle, and when Prof. Paterson states that no corresponding element is developed elsewhere in the median ventral line, he overlooks the cartilage developed as a median ventral element in the pelvic girdle which in every sense exactly corresponds to the sternum.

The origin of the "respiratory" sternum is part of a wide problem, viz. in what manner and under what conditions did the body wall become modified to serve as an active inspiratory agent in higher vertebrates, thus replacing the "pharyngeal pump" of amphibians? Whatever may have been the exact manner in which the one form of respiration was evolved from the other, there can be no doubt that the ribs, the intercostal muscles, and the sternum as we know them in higher vertebrates appeared during this phase of evolution. Their appearance is directly due to the introduction of a new type of respiration; the sternum which serves in the higher forms as an element of the respiratory thorax is totally unlike the bone which merely served as part of the shoulder girdle in the more primitive type. With this evidence clearly in view it is difficult to understand how Prof. Paterson concludes that even in mammals the sternum is still—what it was when it first appeared in vertebrates—functionally and fundamentally an adjunct or element of the shoulder girdle. We are surprisingly ignorant of the part played by the sternum in the movements of respiration, even in man, but a cursory examination of its respiratory movements in various groups of birds, and in several orders of mammals, quickly serves to show that its form and size depend chiefly not on the movements of the forelimbs, but on the part it plays in the respiratory movements of the thorax. In our opinion the key to the morphology of the sternum is an accurate investigation of its function.

Prof. Paterson is undoubtedly right in regarding the sternum as primarily a continuous unsegmented median bar. The conception of the sternum as a segmental structure he characterises as "a nebulous transcendental notion." Yet his own evidence shows that the greater part of the mammalian sternum, at the commencement of the cartilaginous and osseous stages of development, is laid down as a truly segmental structure, each segment corresponding exactly to a body segment. Much more "nebulous and transcendental" appears to us his explanation of the occurrence of bony segments or sternabræ as "due to the traction or pressure on the part of the ribs and costal cartilages." In support of this theory Prof. Paterson cites the fact that centres of ossification appear in bones at points of traction and pressure. In the case of the sternum, however, the centres of ossification appear not opposite such points, but exactly between them.

This monograph is well got up; the figures are numerous and highly finished. There is evidently a slight error in Fig. 35, plate v.; the centre of ossification for the fourth segment (if the term may still be used) of the mesosternum is stated to be present in 71 per cent. of cases, whereas in the text (p. 18) the proportion is given as 26 per cent. A curious misprint occurs on p. 33, where the centre just alluded to is said to appear in 59 per cent. of children before birth, and 15 per cent. *after death*—probably meaning after birth.

(3) The brothers Weber were of opinion that in the forward swing of the leg in walking the lower extremity acted as a pendulum, the chief force in action being that of gravity. Duchenne, on the other hand, as the result of a special investigation, came to a totally different conclusion, viz. that the forward swing was almost wholly due to the direct action of muscle. In the fifth and sixth parts of his research into the mechanics of the human gait, Prof. Fischer concludes, after an elaborate analysis of the force expended during

the movement, that Duchenne comes much nearer the truth than the brothers Weber, muscular action playing a much larger part than the force of gravity. Those who have watched the passive movements of a paralysed leg during attempts at progression will have no difficulty in accepting Prof. Fischer's results.

The problem of estimating theoretically the force necessary to produce the forward swing of the lower extremity in walking is an extremely complicated one. Prof. Fischer regards the lower extremity as a pendulum made up of three segments, each of which undergoes certain secondary movements during the swing of the entire extremity. Further, the hip joint, from which the pendulum is suspended, undergoes an irregular forward movement during the swing of the limb. The resistance and elasticity of the muscles and ligaments and the friction at the various joints are factors which can only be approximately estimated.

By means of photographic records Prof. Fischer was able to subdivide the forward swing into forty and forty-one equal phases of time, and by estimating the amount of force in action during each phase he shows that gravity alone can account for only a minor fraction of the force necessarily expended in the movement. Further, the positions assumed by the foot, leg, and thigh during a forward swing show distinctly that various groups of muscles are then in action. He recognises four periods in the forward movement of the limb, each of which is characterised by the action of a distinct group of muscles. In the commencing phase the ilio-psoas bends the thigh on the body, the rectus femoris extends the leg forwards, the tibialis anticus bends the foot upwards; in the second phase the gluteus maximus and hamstring muscles draw the thigh backwards; in the third phase the knee is flexed by the gastrocnemius and short head of the biceps; in the final phase the muscles in front of the leg are again in action, and remain powerfully contracted until the sole of the foot is again planted on the ground.

These results are certainly much more in keeping with clinical and everyday experience than those of the brothers Weber. Many who only occasionally take long walks must have observed that one of the first groups of muscles to give out are those in front of the leg, and that they feel painful only at the end of the forward swing, when the heel reaches the ground—the period at which Prof. Fischer shows these muscles come most powerfully into action.

A. KEITH.

EARTHQUAKES.

Earthquakes. By Clarence Edward Dutton, Major, U.S.A. Pp. xxxiii + 314; 63 illustrations. (London: John Murray.) Price 6*s.* net.

EPITOMISED and carefully digested accounts of seismological investigations made during the last twenty-five years are few in number. Two have been published in England, a compilation has been "made in Germany," and now we have a volume from the distinguished geologist, Major C. E. Dutton, of the United States. All told, therefore, we have only four books which give the uninitiated some idea of what the new seismology means and what it has accomplished. About the old seismology, volumes, papers, and particularly sermons exist in thousands. But if we except a few, and amongst the few the works of Mallet stand high above the rest, all they give are reiterated narratives of what people saw and heard, now and then enlivened by some wild hypothesis or pious reflection.

Major Dutton's work belongs to another category, and rather than telling us what earthquakes do, his main object has been to tell us what they are, and while doing this he has kept abreast with the work of others which his own inquiries in the domain of seismic and volcanic activities have enabled him to present in a terse and accurate form.

Everything is discussed with a minimum of mathematics from a strictly scientific standpoint, whilst that which is sensational has properly been most carefully put under taboo. A justification for the exclusion of what is of practical importance, which gives not only to the man in the street but to Governments some inkling as to the use of earthquakes, is not so apparent. It is extremely likely that a Prime Minister may not care a twopenny-bit whether the inside of the world on which he lives is red hot or stone cold, while he might be extremely interested to know that seismograms may afford a satisfactory explanation for the interruption of his cablegrams. The importance of earthquake writings to communities who have been alarmed by accounts of disasters in foreign countries is self-evident, while it would at least be consoling to those who were suddenly cut off from the outer world by the failure of their cables to learn whether such failures were the result of an operation of war or of nature. A knowledge of how to construct so that earthquake effects should be minimised means the saving of life and property in countries subject to seismic disturbances. Seismic charts indicate positions where it is dangerous to lay deep-sea cables, whilst they tell the hydrographer where he may expect to find changing depths. In these and in a variety of other directions seismology helps to make communities comfortable, and at the same time acts as incentive to create a popular interest in and to obtain support for a young science. But as Major Dutton defines his standpoint, and as a volume of 300 pages cannot contain everything, our remarks on omissions must only be taken as indications of the hydra-headed nature of seismology.

The first four chapters are chiefly devoted to the cause of an earthquake, which is defined as anything that "calls suddenly into action the elasticity of the earth." Explosions at volcanic foci produce a local trembling, but they are comparatively of rare occurrence and seldom disturb large areas. When a long fault line is produced, and a large territory carrying perhaps mountain ranges drops down along its length, instrumental observations have revealed the fact that the world may be shaken as a whole. Subsequent adjustments along such a line due to intermittent recovery from overstrain and settlements of disjointed materials give rise to numerous after-shocks which are only sensible over areas of small size, and it seems likely that the greater number of earthquakes felt in the world belong to this latter class. All of them represent a relief of stress, and the discussion on the sources of earth stresses, commencing with the contractional hypothesis and concluding with the results of investigations by Prof. George Darwin, are attractive not only to seismologists but to all who wish to learn something about the inside of the world on which they live.

Some fifty pages are given up to descriptions of seismoscopes and seismographs, attention being particularly directed to those which record unfelt teleseismic movements. We cannot say that the concepts relating to seismic wave motion put forward are generally accepted, but such as they are we may say that they represent modern views. About the amplitudes and periods of earthquake waves seismologists have certain definite information, but about the magnitudes of these elements, particularly for waves which have travelled over long paths, much has yet to be learned. For this latter class of movement it is pointed out that discordant results are found in tables showing the speeds at which they were propagated. The author inclines to the view that the differences which have been noted are due to variability in the delicacy of instruments employed to pick up a wave or wave group. In great measure this may be true, but it seems to us that marked errors may also arise in consequence of inaccuracy in determining the time at which waves were generated at their origin.

Then, again, there are those who incline to a belief, which they sustain with arguments deserving close consideration, that within our earth convection currents exist; it would follow from this that along similar paths, or even along the same path, earthquake speeds should vary.

Notwithstanding these uncertainties, the author holds the opinion that remarkable and unexpected results which fit well within errors of observation have been reached.

Two serious difficulties, for the explanation of which we are asked to wait patiently, relate to the lengthening of wave periods and the total duration of a disturbance as it radiates. We will suggest that the former phenomenon may perhaps be at least partially explained by assuming that in the vicinity of an origin the records refer to forced vibrations, while at a distance the motion represents a periodic natural movement of the crust which varies with its heterogeneity. With regard to the second difficulty, now and then we have evidences that a disturbance recorded at a station far removed from an origin may be reinforced and lengthened by a repetition of the first disturbance which has reached the station by travelling in an opposite direction round the world. Generally, however, the record from a horizontal pendulum near to an origin appears to move as long as, if not longer than, a similar instrument at a distant station, which means that in certain instances the author's difficulty is non-existent. Finally, it must be borne in mind that a single impulse at an origin results in the birth of a series of waves which reach a distant station along different paths and with different speeds, with the result that a blow at an epicentre may at a distance from the same be recorded as a long train of waves.

When Major Dutton suggests to his readers that the Seismological Investigation Committee of the British Association carries on its work in consequence of financial aid received from the British Government, we recognise that he shares a widespread misapprehension.

Much is said relating to the elasticity of rocks, in connection with which an elaborate table, the result of investigations made by Prof. Nagaoka, of Tokio, is reproduced. A second long table is that drawn up by M. Montessus de Ballore relating to the distribution of seismicity.

The illustrations, of which there are sixty-three, are for the most part excellent, but there are one or two photomechanical reproductions of instruments which we imagine will give more delight to their authors at the sight of their own shaky caligraphy than to the ordinary reader.

Taken as a whole, the work is one to be read by all who wish to know what is known respecting the propagation of wave motion in our earth since the invention of the seismograph, and it is destined to receive a hearty welcome.

TECHNICAL MECHANICS.

Die technische Mechanik: elementares Lehrbuch für mittlere maschienentechnische Fachschulen und Hilfsbuch für studierende höherer technischer Lehranstalten. By P. Stephan, &c. Erster Teil: Mechanik Starrer Körper. Pp. viii+344. (Leipzig: Teubner, 1904.) Price 7 marks.

IN the very early part of this excellent work there is a certain lack of system, inasmuch as, although the author very properly treats first of the equilibrium of a *particle,* he assumes the nature of the stress exerted in such rigid bodies as the bars of a framework, the crank and connecting rod of an engine, &c. The nature of such forces is never properly appreciated by the student who is truly a beginner in the subject of dynamics—and, indeed, there is no part of statics in which students of even very considerable experience are so apt to go wrong as that relating to the forces exerted by jointed bars. The author treats from the outset the equilibrium of forces acting in space of three dimensions without having previously disposed of the simpler two dimensional case, a course which meets with the approval of many teachers, although it seems to the reviewer to be the less simple method. Herr Stephan enunciates the parallelogram law for the composition of forces (or vectors generally) at the outset, and assumes it as a result of experiment—which, on the whole, is perhaps the wisest plan for a teacher. Near the end of the book, however, he gives the ordinary Newtonian proof of the proposition.

He gives very early and very clearly the method of determining the resultant of a system of coplanar forces acting on a body (other than a particle) by means of the force and funicular polygons—a subject in which English students are, as a rule, extremely weak. There is a section on the determination of the centres of gravity of all the bodies usually figured in our

English books, followed by a discussion of all the ordinary simple machines—with this difference, that Herr Stephan's figures are much better than those of our text-books. Then follows a discussion of friction, in which, although the author almost invariably solves his problems by introducing the normal force N and the friction μN, he does not omit to point out the utility of the *total resistance* and the angle of friction. He underestimates this utility, however, in solving a simple problem by the N and μN method, and in his final results (p. 118) substituting the angle of friction—a process which simply obscures the merit of the second (and much shorter) method—with the remark that the example shows the advantage which the introduction of the angle of friction "occasionally offers." The truth is that in the hands of a skilful student the geometrical method founded on the employment of the angle of friction and the total resistance is almost always more neat, direct, and simple than the analytical, or N and μN, method. It can be conceded, however, that for engineering students, and technical students generally, this analytical method is the safer, although the longer, and requires less of the *esprit mathématique*. The nature of rolling resistance, which seldom finds mention in our English books, is well explained and illustrated by several applications (pp. 147, &c.). Indeed, the whole of Herr Stephan's treatment of the machines (screw presses, cranes, friction band-brakes, &c.) commonly discussed is excellent, and occupies a very large part of the treatise; it is, in fact, the best and most useful portion of the book.

The only kind of catenary treated of in this volume is the parabola of suspension bridges, to which only two pages and two illustrative examples are devoted. Doubtless the subject will receive more consideration in some subsequent volume.

Herr Stephan is very careful to avoid errors in his figures, and to represent the lines of action of three forces when they keep a body in equilibrium as meeting in a point—a very elementary condition not always observed in our text-books. Once, however, he overlooks this necessity, and represents the lines of action of three forces acting on a bar in a framework (Fig. 164) as forming a triangle of very respectable area.

In the section dealing with the equilibrium of frameworks of jointed bars, he directs attention to the obvious fact, which is not usually mentioned in our books, that even if the bars are loaded throughout their lengths (by their own weights or otherwise) the stresses can be calculated by taking any of the bars as unloaded and weightless, and then superposing the calculated results (p. 197). This simple principle he applies in a special case, and it is one which on many occasions might be employed with great advantage.

The last hundred pages are devoted to kinetics of an elementary kind—including the theory of direct collision of spheres, the compound pendulum, &c.—together with a section on the moments of inertia of various figures and solids. There is no mention made of the very simple and useful rule that a triangular area can be replaced by three equal particles placed at the middle points of its sides—a rule which saves an enormous amount of trouble in the calculation of moments of inertia for all plane areas bounded by right lines. In the absence of this simple rule, a ponderous application of the integral calculus is the only refuge of the student. A somewhat similar "particle rule" saves reams of ponderous calculus work in hydrostatics; but these rules are not widely known.

Herr Stephan very properly makes short work of D'Alembert's principle, deducing it directly from Newton's axioms ii. and iii., so that, although he employs the term "centrifugal force," he is careful, except in one instance, to show that it is a force exerted *by*, and not *on*, a moving particle. The exceptional instance occurs at p. 281, where he is calculating the tension in a driving belt which passes over the surfaces of two revolving cylinders. Here he speaks of a small element of the band as "experiencing" a centrifugal force, which is duly represented, in the usual way, by a centre-flying arrow. His subsequent teaching, however, removes the erroneous notion herein contained.

The book is wonderfully well printed and illustrated, as well as free from mistakes. On p. 15 "Punkte" should clearly be "Kräfte," and on p. 187 the reference should be to Fig. 131 and not to Fig. 135. The theory is illustrated by nearly 200 examples.

To all students who desire to attain a real and physical conception of the subject Herr Stephan's work can be very strongly recommended.

GEORGE M. MINCHIN.

OUR BOOK SHELF.

Machine Drawing. By Alfred P. Hill. Pp. 83. (London: P. S. King and Son, 1904.) Price 2*s.* 6*d.* net.

IN this text-book the author presents a course of instruction which he considers suitable for students attending elementary drawing classes who are unable to spare more than one evening per week, and whose technical training is thus confined to the one subject of machine drawing. Three dozen plates are given, affording a choice of examples to be copied to scale from the dimensions figured, some of which are proportional dimensions covering a range of sizes. Accompanying the plates are descriptive accounts of the construction and uses of the machine parts drawn, with sets of questions founded thereon. At intervals, where space is available, formulæ and physical data are introduced and used in making calculations illustrating machine design. This crude attempt to teach applied mechanics along with elementary machine drawing seems to us a mistake, as, in the absence of a knowledge of mechanical principles, such formulæ as are given become mere rules of thumb, and any attempt to apply them independently cannot fail to be disastrous, as, for instance, in the author's method of estimating the limiting speed of a fly-wheel on p. 42. The time wasted on these premature calculations might very profitably be spent with rule, callipers, and squared paper, in measuring and making careful and complete dimensioned sketches of actual machine parts, and so cultivating the habit of closely and accurately observing constructional details.

Errors abound throughout the book. The author is not a safe guide even in such a small detail as the projection of a hexagonal nut, while his statement on p. 44 that "heat and work are mutually controvertible" is a fair index of the scientific value of the work. The volume is somewhat redeemed by a few good plates prepared from working drawings supplied by makers, but in many cases the figures indicating dimensions are, unfortunately, so small as scarcely to be legible.

An Elementary Class-book of Practical Coal-mining. By T. H. Cockin. Pp. xii+428. (London: Crosby Lockwood and Son, 1904.) Price 4s. 6d. net.

In general character this useful volume resembles the text-books already available for students of coal-mining. The work is, however, carried to a rather more advanced stage than has hitherto been considered necessary for an elementary class-book, and chapters are given dealing with allied subjects, such as chemistry, mechanics, the steam-engine, and electricity. The order of treatment differs from that usually adopted, the subjects dealt with being:—(1) geology; (2) structure of stratified rocks; (3) coal and coalfields; (4) search for coal; (5) sinking; (6) opening out; (7) miners' tools; (8) explosives; (9) methods of work; (10) working by long wall; (11) methods of working by pillar and stall; (12) special methods of work; (13) timbering; (14) coal cutting by machinery; (15) mechanics; (16) steam; (17) gases; (18) ventilation; (19) instruments; (20) lighting; (21) winding; (22) haulage; (23) pumping; (24) surface arrangements; (25) coke making; (26) accidents; and (27) electricity. This arrangement is not so logical as that adopted by the late Sir C. Le Neve Foster in his elementary work. For example, sinking with rock-drills is described before mining tools, coal-cutting machinery before the elements of mechanics, and electric signals before electric terms are defined. The brief chapter on coke making is hardly necessary, as this subject is usually dealt with in metallurgical treatises. It is doubtful, too, whether the chapters on chemistry, mechanics, steam, and electricity are sufficiently full to give an insight into the allied subjects, for the study of which excellent text-books are available. The illustrations are clear and diagrammatic, and possess the advantage of having been specially drawn for the book.

Bird Notes from the Nile. By Lady William Cecil. Pp. xii+113; illustrated. (London: Archibald Constable and Co., Ltd., 1904.) Price 2s. 6d. net.

THREE claims to high commendation present themselves on the first glance at this elegant little popular work. In the first place, the numerous illustrations are simply exquisite; secondly, technical names are banished from the text; and, thirdly, in the long list of species forming the appendix such names appear to be correctly spelt, and are thoroughly up to date, even to the adoption of the so-called "Scomber scomber" system of alliteration. In her preface Lady William confesses that the notes were written originally solely for her children, who doubtless were desirous of possessing a memento of their parents' Nile trip, but that friends persuaded her to offer them to the public. The adoption of this advice is, in our opinion, fully justified, and while the book has no doubt been found delightful by the young people of the family, it can scarcely fail to be a pleasant companion to the many bird-lovers who make a winter excursion up the Nile. Although no attempt (and very properly) is made at technical descriptions of the various species encountered during the voyage, such notes as are given are in most cases sufficient to render identification an easy matter, to say nothing of the instances when this is rendered self-evident by the illustrations.

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.*]

Education and National Efficiency in Japan.

THE notice of my book "Dai Nippon, the Britain of the East," which appeared in NATURE of December 1, directed attention to a nation from which much may be learnt at the present time, and it may interest your readers if I supplement your article by a few notes from my personal experience and observation. In the memorandum issued by Sir Norman Lockyer suggesting the formation of a British Science Guild, it is stated that the people of this country do not manifest that interest in and belief in the power of science which are noticeable among the peoples of the Continent or of America, and that, in spite of the efforts of many years, the scientific spirit essential to all true progress is still too rare, and, indeed, is often sadly lacking in some of those who are responsible for the proper conduct of many of the nation's activities. The British Science Guild has been proposed with the view of attempting to remedy this evil, and to bring home to all classes the necessity of applying scientific treatment to affairs of all kinds.

The objects of such a guild have been attained, to a very remarkable degree, in Japan, not so much by the formation of a special organisation for the purpose, as by the awakening of the national consciousness to the necessity of keeping in mind certain definite aims, and by the earnest cooperation of the various departments of Government, of scientific associations, and of private organisations of many different kinds. There is, indeed, a danger at the present time in this country of too much importance being attached to mere organisation and machinery, and too little to the spirit which pervades them. Mr. Matthew Arnold, in one of his last official reports on elementary schools, pointed out that "our existing popular school was far too little formative and humanising, and that much of it to which administrators point as valuable results is in truth mere machinery." This applies with far greater force to a great deal which has been done in recent years in the way of scientific and technical education. Instruction and knowledge are too often confounded with education, and mere machinery and organisation prevent the development of the scientific spirit. Many of the men who are supposed to have had a complete technical education are very poor specimens of humanity, wanting in individuality and character, devoid of all originality, and with a very narrow view of the world. Some of them may manage to pile up fortunes for themselves, but they will do little to make their country great. Even from a practical point of view, success in any trade or profession does not depend so much on the amount of information which may have been crammed into the learners' heads as is often supposed. It depends incomparably more upon their capacity for useful action than upon their acquirements in knowledge. All experience proves that the spiritual is the parent and first cause of the practical, and especially the economic history of the Middle Ages shows us that an ounce of manly pride and enthusiasm is worth more than a pound of technical skill.

The recent history of Japan has emphasised this fact. While attention has been paid to details, the spirit which has animated the leaders of public opinion and action has been the chief cause of the great developments which have taken place. The complete study of this aspect of Japanese national life would take us into many interesting psychological discussions, but it is sufficient for our present purpose to note that the Japanese mind, unlike the British (which is strongly individualistic), is dominated to a very great extent by collective opinion. At the same time, while Japanese philosophy and their former social order were essentially communistic in their nature, still (contradictory as it may seem) their genius is individualistic, and they impress their personal qualities on their work, although they are willing to sacrifice results to a rigid organisation. The outcome of it all is that the national consciousness is directed to the attainment of national objects by men whose individual powers have been trained to make effective use of western science, and the results have been simply wonderful.

These results have been most apparent in the operations of war. It was the sound of the cannon on the Yalu River, in the war with China ten years ago, which awoke Europe and America to a knowledge of the fact that a new nation had been born in the Far East, and which at the same time started many of the political problems which have led up to the present war with Russia. That war, whatever its ultimate results may be, has shown that the Japanese have not only been able to take full advantage of the applications of western science, but that they have been animated by the spirit of old Japan, which has made them regardless of personal sacrifices. The Army and Navy have been organised and worked on scientific methods, and with a completeness of arrangements which has won for them the admiration of all impartial critics. Their intense patriotism has caused them to perform deeds of daring which are unequalled in the history of war, while their skill in strategy and in the applications of the latest scientific methods to all they have done has made them almost uniformly successful in their operations. They have demonstrated the importance of the work of the engineer. The railways which have been built in Japan have been fully utilised to convey men and materials, and the ships to transport them oversea. The telegraphs have been used to communicate instructions and to keep the authorities informed regarding movements and requirements. The dockyards and shipbuilding yards have been ready to undertake repairs, and the arsenals and machine shops to turn out war material of all kinds, as well as appliances which aid operations in the field. Light railways have been laid down on the way to battlefields, and wireless telegraphy and telephones to convey instructions to soldiers; in short, all the latest applications of mechanical, electrical, and chemical science have been freely and intelligently employed.

The ships of the Japanese Navy are probably the best illustrations of the Japanese methods of procedure. In naval matters they accepted all the guidance the western world could give them, but at the same time they struck out a line of their own, and the fleet which they have created is unique in the character of its units. British designs have in many respects been improved upon, with the result that they have obtained in their latest ships many features which have won the admiration of the naval world. The inventions and improvements which have been made by Japanese officers, engineers, and scientific men disprove the charge which is very often made, that the Japanese have no originality. Even in the matter of pure science Japanese investigators have shown that they are able to take their places among those who have extended the borders of knowledge. The memoirs and papers published by Japanese students and teachers, both on scientific and literary subjects, will bear very favourable comparison with those of any other country, and while no Japanese Newton, Darwin, or Kelvin has yet arisen, there are men connected with Japanese universities and colleges of whom any learned institution in the world would have no reason to be ashamed.

I must refer to my book for details of the developments which have taken place in engineering and industry. Suffice it to say that roads and rivers have been improved, railways to the extent of between four and five thousand miles have been constructed, a large mercantile marine has been created, docks and harbours have been made, telegraphs and telephones are in use all over the country, excellent postal arrangements are in operation, and there are few departments of mechanical and chemical industry in which there are not many establishments doing very efficient work. The result of it all has been that commerce has been immensely extended, and the financial resources of the country developed in such a manner as to enable Japan to take her place among the powerful nations of the world.

At the root of all these developments has been the very complete system of education which has been established in the country. Elementary schools are to be found in every district, and secondary and technical schools in populous centres, while the universities of Tokyo and Kyoto supply the highest training required for the national life; but for details of these I must again refer to my book. The motive underlying all the efforts is what I wish chiefly to emphasise. Shortly after the Emperor succeeded to the throne, he issued a proclamation which contained the following sentence:—"Knowledge and learning shall be sought after throughout the whole world, *in order that the status of the Empire of Japan may be raised ever higher and higher.*" The recent history of Japan is the most striking illustration of the influence of a wisely directed system of education on national affairs when those who are responsible for it are infused with high national ideals.

At the same time it should be noted that some of the most thoughtful and influential men in Japan doubt whether the official system of education is likely to lead to the best results. They feel, like Matthew Arnold, that too often the machinery and organisation receive more attention than the real education, and, moreover, they dislike the idea of all educational institutions being of the same type. Probably the most influential educationist in Japan was Yukichi Fukuzawa, and he never failed to point out the possible evils which are likely to arise from a too strictly official routine. His own college, the Keio Gijuku, has been a great school for statesmen, lawyers, and public men, and many of the leading men in Japan have been his pupils. Count Okuma, the distinguished statesman, has also established what is essentially a private university, and there are many other schools of different kinds, all of which supplement the Government institutions. Even in the technical and professional establishments, however, attention is not confined to the subjects required for strictly utilitarian purposes or for examinations; the first object is to train *men* who will be able to serve their country, in the fullest sense of that term. Many discussions are now being carried on with regard to the future of education in Japan, and the general tendency of these was indicated a short time ago by a distinguished Japanese author when he said, "No system of education which is not based on sociological conditions can be thoroughly successful, and therefore a study of ethnology, sociology, and of evolution generally is absolutely essential to a thorough understanding of the educational questions awaiting solution." The Japanese are now face to face with many problems which confront all industrial nations, and it is to be hoped that, having organised their education generally, and in some respects given an example to western nations, they will go a step further and show that it is possible to combine industrial development with the welfare of all classes of the community.

The chief lessons which the British Science Guild has to learn from Japan is that if it is to be of any real influence in the life of the Empire, the term *science* must be used in its broad sense, as including all knowledge required for individual and collective life, and that all efforts must be guided by a consciousness of the real aims of national life.

Glasgow, December 6. HENRY DYER.

The Heating Effect of the γ Rays from Radium.

IN a recent communication to the *Physikalische Zeitschrift* (No. 18, September) Paschen has described some experiments which indicate that the γ rays from radium supply a large proportion of the total heat emission. It is known that the heating effect of radium when surrounded by an envelope of sufficient thickness to absorb both the α and β rays is about 100 gram calories per hour per gram. Paschen, however, found that if the radium was surrounded by a sufficient amount of lead to absorb completely the γ rays the heating effect was increased 2·26 times. This large heating effect of the γ rays was so unexpected, and of such great importance in connection with the nature of these rays, that we decided to verify this result by an independent method. In Paschen's experiments, the heating effect was determined in a special Bunsen ice calorimeter, in the central tube of which the radium, surrounded by a lead cylinder about 4 cm. in diameter, was placed. In order to correct for the natural melting of the ice mantle a differential method was employed. In our experiments we decided to use a differential air calorimeter, similar to the one described in our previous work on the heating effect of radium and its emanation (*Phil. Mag.*, February). In each flask of the differential air calorimeter there was placed a narrow glass tube, closed at the lower end and extending to about the centre of the flask. The radium bromide weighing 23·7 milligrams was enclosed in a small metal capsule supported by a thread, and was inserted alternately in the glass tubes. The flasks, originally at atmospheric pressure, were immersed in a water bath kept in a constant temperature room, and were connected by a xylene tube which served as a manometer. The heating effect was measured by the movement of the xylene column, observed by a telescope with micrometer eye-piece, and the scale was calibrated by a small heating coil of approximately the same dimensions as the radium. Two sets of experiments were carried out, in one of which the ends of the glass tubes were inserted in lead cylinders 3 cm. in diameter and 3 cm. high, and in the other with aluminium cylinders of exactly the same dimensions.

The lead envelope absorbed more than half the γ rays, while the aluminium absorbed only a few per cent. The readings were found to be very steady and consistent, but no appreciable difference in heating effect could be detected in the two experiments. As a check, the heating coil was employed in both experiments to calibrate the readings, the means of which agreed to about 1 per cent.

According to Paschen's results, the heating with the lead cylinders should have been at least 50 per cent. greater than with the aluminium cylinders. In our experiments we could not have failed to detect a difference of 5 per cent. We conclude from this that the γ rays do not supply more than a small percentage of the total heating effect of radium.

E. RUTHERFORD.
H. T. BARNES.

McGill University, December 1

Singularities of Curves.

THE compound singularities of algebraic curves offer a wide field for discussion, but the naming of the simple singularities has not yet been placed on an entirely satisfactory footing. The latter consist of (1) point singularities, which are nodes and cusps; (2) line singularities, which I prefer to call bitangents and inflections. Mr. Basset calls them double and stationary tangents; but if this is done, symmetry requires that the point singularities should be called double points and stationary points, and this is not admissible, because the phrase double points (as now used) includes cusps as well as nodes. If a curve has a double point Mr. Basset calls it *autotomic* (self-cutting); but this term is incorrect when all the double points in the curve are cusps (as in the cardioid), for the curve does not then cut itself. If it is really desirable to have a means of distinguishing curves that have nodes or cusps from those that have none, they may perhaps best be described respectively as curves with or without point singularities.

December 8. T. B. S.

A CHRISTMAS BIRD-BOOK.[1]

THE success which attended his last children's bird-book has induced Mr. Kearton to cater once more for the wants of young people interested in the animal life around them, and the result is the present charming little volume, illustrated, as usual, by reproductions from photographs taken direct from nature by the author and his brother. In the guise of a narrative told by "Cock Robin" to his offspring, the author has contrived to convey in his own inimitable manner a vast store of information concerning bird-life, interspersed with observations relating to other animals. Although, as already said, intended primarily for juvenile readers, the volume contains a certain amount of information which may be new to some of their seniors, including those to whom natural history is not an unknown study. For instance, until we learnt it from Mr. Kearton's pictures, we ourselves were ignorant of the marked and easily recognised difference between the foot-prints of a rabbit and those of a hare, despite the number of times they have come under our notice in the snow.

Generally Mr. Kearton conveys his information in simple language, but he is very prone to speak of a bird picking up food between its two mandibles when it would be "shorter, simpler, and better understood" (to quote from a well known Bar story) if he said beak. Apparently old fables connected with animals die hard, for, according to the author, many young people at the present day believe that a wren is a female robin, and that male robins lose their red breasts in summer.

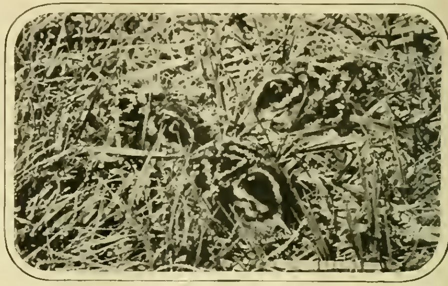

FIG. 1.—Young Dunlins in their natural surroundings. From Kearton's "Cock Robin." (Cassell and Co.).

These and other old wives' legends Mr. Kearton does his best to replace by accurate and interesting accounts of the mysteries of bird-life.

The best (if there can be a best where all is so interesting) of the five chapters are the two on nesting and the clamour of chicks, both being illustrated by a number of photographs of nests and young birds. Very graphically does the author bring out the remarkable difference in development at the date of hatching between a young sparrow, for instance, and that of a woodcock, and he also shows how much this difference depends on habit, a young skylark showing a somewhat intermediate stage. Very striking are the two photographs here reproduced, the one showing young dunlins skulking amid their native covert, and

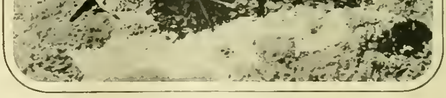

FIG. 2.—The same birds in unnatural surroundings. From Kearton's "Cock Robin." (Cassell and Co.)

the other the same birds removed to an uncongenial environment.

"Nature-teaching" could not be conveyed in a better manner, or in one less free from affectation and faddism, and we trust that the "Kearton annual" will enjoy the extensive patronage that it certainly merits among those on the look-out for suitable Christmas presents for their young friends.

R. L.

[1] "The Adventure of Cock Robin and his Mate." By R. Kearton. Pp. xvi+240; illustrated. (London: Cassell and Co., Ltd., 1904.) Price 6s.

THE PRESENT CONDITION OF THE SEA-FISHING INDUSTRY.[1]

"THE methods employed in the capture and transport of fish, the great combinations of capital, the trade organisations, the disputes between the trade and the railway companies, local upheavals, like those of Newlyn and Grimsby, which temporarily paralysed the industry, the efforts of science to unveil the secrets of the sea, and of Parliament first to encourage such investigation and then to act upon its results; these have in turn been briefly dealt with. Lastly, we visited most of the important fishing ports." Such in the author's words is an outline of the plan of this book.

Historically the work is of interest as being the first popular and general account of the sea-fishing industry which has appeared since Holdsworth's "Deep-Sea Fishing," an admirable treatise of similar scope published thirty years ago. A good idea of the rapid progress of the industry in the interval may be gathered from a comparison of the two. Curiously enough, Holdsworth doubted the probability of any extensive adoption of either steam power or the otter trawl in relation to commercial fishing. Contrary to this forecast these very two factors, together with ice and railway facilities, have effected nothing short of a revolution in the industry. It is possible that the next decade or so may also have surprises in store as the result of trade enterprise on the one hand and scientific investigation on the other.

Mr. Aflalo wisely refrains from pronouncing any strong opinions as to future developments.

After a short sketch on "Life in the Sea," in which the chief of the facts known about the life-histories of the edible fishes are mentioned, the author proceeds to describe the various processes involved in the capture and distribution of fish. These subjects receive adequate if not exhaustive treatment, and are made as interesting as possible by Mr. Aflalo's well-known popular style of writing. Then follow two important chapters on legislation and scientific investigation. The final section consists of interesting notes on the different kinds of fishing practised at each important station along the coast, the condition of the harbours (usually defective), railway facilities, local modifications of the share system of wage-payment, and the general prosperity, or otherwise, of the port in question. The contrasts in some cases are very striking, as, for example, between the mushroom-like development of steam-trawling in the hands of syndicates, as at Grimsby, and the moderate but steady prosperity associated with private enterprise at a typical smack-trawling port like Brixham. The former may be safely described as the busiest and least picturesque port in the kingdom, while Brixham, which three-quarters of a century ago supplied the pioneers of the North Sea fishery, and still breeds a notably hardy and resourceful type of man, remains attractive in the old-fashioned way.

In dealing with such controversial matters as legislation and scientific investigation, Mr. Aflalo represents the two sides of a question with some skill, and, absolutely committing himself to neither, has a good word to say for both. Nevertheless, this attempt to steer a sort of middle course among the different opinions leads to no very definite results. The latest Sea-Fisheries Bill he appears to regard as a measure which might do some good, and cannot, in view of its elastic and unbinding character, do much harm; it has, in fact, its good points. International scientific investigation is strongly advocated, "although effectual investigation of the vast bed of the North Sea is out of the question," and "however faulty the Christiania programme may be when analysed on a purely economic basis."

The continued participation of Britain in the international investigations is recommended for the following reasons:—"As a piece of scientific work on an elaborate scale, the North Sea scheme is not unworthy of a century which opened with the discovery of radium and the *n*-rays. As a measure of high politics it is at least equal to the Anglo-French Agreement of which so much more has been heard."

Apart from purely diplomatic considerations, such as the above, the flat-fish problem, which is understood to be receiving special attention at the hands of the international experts, is surely very largely an international one, if only on account of the well-ascertained fact that by far the most important nurseries of the plaice are on the Continental side. One awaits with interest the full details of these researches, especially of certain experiments on the marking of plaice, as a result of which it has been stated (in a short report recently issued by the council of the Marine Biological Association) that the species performs seasonal migrations of considerable extent and definite direction, and further that 20 per cent. of the English marked plaice have been recovered and returned by the fishermen within a year. The latter result indicates an intensity of fishing such as may conceivably affect the supply of this fish. Still more interesting economic possibilities—standing, perhaps, in relation to the last as the antidote to the evil—are suggested by some reports recently circulated in the newspapers. These speak of the phenomenal growth of small plaice liberated on the Dogger Bank, to which they had been transplanted from certain crowded inshore "nurseries." Investigations such as these bear directly on questions of

FIG. 1.—The *Huxley*, specially commissioned to carry out fishery investigations. From Aflalo's "Sea-fishing Industry of England and Wales."

[1] "The Sea-fishing Industry of England and Wales. A Popular Account of the Sea Fisheries and Fishing Ports of Those Countries." By F. G. Aflalo, F.R.G.S., F.Z.S. With a sea-fisheries map and numerous photographs by the author and others. Pp. xx + 386. (London: Edward Stanford, 1904.) Price 16s. net.

supply, and are evidently inspired by a determination to give something like concrete value for public money.

While awaiting the verdicts of science and the deliberations of legislators, it is useful to have to hand a work such as this, which gives a concise statement and accurate picture of the present condition of the great sea-fishing industry.

The book is abundantly supplied with interesting photographs. There is also a sea-fisheries map, in which, however, is one glaring defect. From this map it would appear that Yarmouth and Lowestoft are given over entirely to the drift-net fishing, and that neither of these places has any connection by rail with the metropolis. This is inconsistent with what is stated in the text, and is opposed to common knowledge.

THE ELEVENTH EROS CIRCULAR.[1]

THE appearance of this volume brings us definitely face to face with a new situation in the derivation of accurate positions of the heavenly bodies from photographs. It will be remembered that in the winter of 1900–1 the recently discovered small planet Eros made a very near approach to the earth, and a large number of photographs were taken with the view of determining the distance of the planet, from a knowledge of which that of the sun, and the dimensions of the solar system generally, could be inferred with (it was hoped) considerably improved accuracy. The measurement of the plates involves enormous labour, and has only been partially accomplished in the intervening four years; and the discussion of the measures has necessarily proceeded even more slowly. But the present publication of more than 400 quarto pages represents a notable addition to the tabular statement of measures, and contains an important contribution to the discussion.

It appears that the plates taken at different observatories are liable to disagreement in a serious manner. Putting aside the planet itself for a moment, when the positions of the stars found from plates taken at the Algiers Observatory are compared with those found from plates taken at Paris, there is a difference varying with the brightness of the individual stars. Such a difference is not altogether new in astronomy; it was pointed out by Sir David Gill a dozen years ago or more that eye observations of stellar positions made by different observers were likely to differ systematically in this manner; but this was attributed to human defects in the observer, and it was hoped that photography would free us from the embarrassment. So it probably will when rightly used; but we have apparently not yet completely realised the necessary precautions. The instruments for taking the photographs at Algiers and at Paris are as precisely similar as the constructor could make them; they were used in the same way; the plates were measured similarly and with careful attention to certain known sources of error, and yet the resulting star places show the following differences in seconds of arc in the mean of 5 groups of 87 stars each:—

Mean magnitude	Difference ″
8·8	−0·27
9·4	−0·42
10·4	−0·57
11·2	−0·72
11·6	−0·83

There is a range of more than half a second, and we want to measure the hundredth of a second! This is probably an exceptional case; but what may occur once may occur again, and in view of this fact it is not too much to say that a very serious addition has been made to the labour of determining the quantity sought—the solar parallax—by this revelation.

It is disappointing to find no satisfactory suggestion of the cause of error in the paper which gives an account of it. A suggestion is indeed made, viz. that in measuring a plate the presence of an adjacent image (for the exposure is repeated on the same plate so as to show all the images more than once) may disturb the eye of the measurer. All our experience hitherto is against such a possibility. It seems more likely to the writer that the cause may be sought in the object glass of the photographic telescope, and, to be more precise, in an error of centreing of the crown lens relatively to the flint. Such an error is well known to opticians, and is easily detected in a visual telescope by the fringe of colour on one side of a star image when slightly out of focus. But the images formed by a photographic telescope are not examined by the eye in the regular course of work, and such an error might therefore escape detection until revealed by such a comparison of measures as is given above. The stray light on one side of the image would not be strong enough to affect the sensitive film in the case of faint stars, but for a bright star it would spread the image in that direction, and so introduce a spurious displacement of the centre. If this explanation be correct, the error can be both detected and eliminated by turning the object glass through 180° (with most forms of telescope mounting it is only necessary to turn the telescope to the other side of the pier), and this can easily be done. Indeed, it ought to have been done before now, under the admirable maxim for physical work, "reverse everything that can be reversed," but, so far as is known to the writer, the point has hitherto escaped notice.

If on examination this explanation will not fit the facts, some other must be found. A few additional details in the volume before us would have made it possible to test this hypothesis; if, for instance, it had been specified which plates were taken on one side of the pier and which on the other, a comparison of the two sets would have given very definite information. Mr. Hinks has already given cogent reasons (see *Observatory* for September, 1903) for regretting the lack of information as to the identity of the individual plates, and we have now to add this further reason. For the systematic difference described is not confined to Algiers-Paris. If we turn to the paper following that in which M. Trépied gives the figures above quoted and arrange the differences found at the Goodsell Observatory (Carleton College, Minnesota) according to stellar magnitude, we find a well marked effect in R.A. and a smaller one in dec.; and probably other cases, when duly examined, will give similar results, though it does not seem to have occurred to astronomers generally to make a properly searching inquiry. For instance, at the end of the volume M. Lœwy tabulates a series of differences between two lists of star places prepared with great care by himself and by Prof. Tucker, of the Lick Observatory, and he comments with satisfaction on the close accordance of the two lists. But a very slight examination suffices to show that the differences are affected with "magnitude-equation," though in this instance the effect may be due to the visual observations.

In fact, while duly admiring the energy and diligence with which this vast mass of material has been collected and published, a result due in great part to the powers of organisation of M. Lœwy, the director of the Paris Observatory, we may well feel some doubts whether it will turn out to be, as he hopes, a "collection of *homogeneous* material, susceptible of being immediately used without the necessity of undertaking,

[1] Conference astrophotographique internationale de Juillet, 1900. Circulaire No. 11. (Paris: Gauthier Villars, 1904.)

as in the past, long and tedious preliminary investigations" (p. 3). Homogeneity for such a purpose cannot be secured by mere similarity in publication of results; indeed, this very process tends to cover up vital differences of detail, and it is to be feared that, unless these can be unearthed again, the work will suffer in accuracy.

There is an appendix at the end of the volume professing to give a bibliography of the already large literature on the Eros campaign, but containing no reference to the *Monthly Notices* or other English work. Is not this rather a strange oversight?

H. H. TURNER.

NOTES.

BRITISH science has been honoured by the award of the Nobel prize for physics to Lord Rayleigh, and the prize for chemistry to Sir William Ramsay, K.C.B., F.R.S. Prof. Pavloff, of the Military Academy of Medicine at St. Petersburg, has been awarded the prize for physiology. The distribution of the prizes took place at Stockholm on December 10 in the presence of King Oscar and the Royal Family, foreign ministers and members of the Cabinet, and many leading representatives of science, art, and literature. After speeches had been delivered by the vice-president and other representatives of the Nobel committee, and of the Academies of Science, Medicine, and Literature, King Oscar personally presented Lord Rayleigh, Sir William Ramsay, and Prof. Pavloff with their prizes, together with diplomas and gold medals. The sum of money attaching to each prize amounts to about 7825*l*. The distribution of the prizes was followed by a banquet, at which the Crown Prince presided; and among the company were Prince and Princess Charles, Lord and Lady Rayleigh, Sir William and Lady Ramsay, and M. and Mme. Pavloff. Count Mörner proposed the health of Prof. Pavloff, Prof. Petterson that of Sir William Ramsay, and Prof. Hasselberg that of Lord Rayleigh. On Monday Sir William Ramsay delivered a lecture on argon and helium at the Academy of Sciences, and King Oscar gave a dinner party to the prize winners. On Tuesday Lord Rayleigh delivered a lecture at the academy on the density of gases. Both lectures were highly appreciated and greatly applauded. It is announced that Lord Rayleigh proposes to present to Cambridge University the value of the Nobel prize for physics awarded to him.

SIR NORMAN LOCKYER, K.C.B., F.R.S., has been elected a corresponding member of the Imperial Academy of Sciences at St. Petersburg.

THE Lavoisier gold medal, which has been awarded by the French Academy of Sciences to Sir James Dewar, F.R.S., for his researches on the liquefaction of gases, was founded in 1900, to be given, without distinction of nationality, at such times as the French Academy should elect in recognition of eminent services rendered to chemistry by scientific men. The present is the first occasion on which the medal has been awarded to a British man of science.

THE Wislicenus memorial lecture will be delivered before the Chemical Society by Prof. W. H. Perkin, F.R.S., on Wednesday, January 25, at 8.30 p.m.

MR. A. SILVA WHITE, formerly secretary to the Royal Scottish Geographical Society, and editor of the *Scottish Geographical Magazine*, has been appointed assistant secretary of the British Association, and has already taken up the duties of the post.

PROF. BOYCE, of Liverpool University, has proposed to the Liverpool Chamber of Commerce a scheme for the establishment of a commercial museum and bureau of scientific information. The object is to correlate the various scientific forces in the city in order to utilise them for commercial advantage. The scheme has been referred to a committee of the Chamber of Commerce.

ON the invitation of the director, Dr. J. J. Dobbie, F.R.S., and Mrs. Dobbie, a large and representative gathering assembled in the Royal Scottish Museum, Edinburgh, on Monday evening, December 12, to celebrate the jubilee of the museum. The museum embraces three departments—natural history, art and ethnography, and technology, under their respective keepers, Dr. Traquair, F.R.S., Mr. D. J. Vallance, and Dr. Alex. Galt. In the natural history department the collection of fossil fish is one of the most important in the world. Other special features of this department are the hall of British zoology and the zoological type collection, the aim of the latter being to illustrate the bearing of comparative anatomy on the classification of the animal kingdom. The ethnographical collection is one of the most extensive of its kind, and contains many specimens brought home by explorers of the end of the eighteenth and early part of the nineteenth centuries. The technological department contains a large and fine collection of machine and engineering models, most of them made in the museum workshops, together with mining and metallurgical specimens and models. There is also a large collection of economic botany attached to this department. The collections of H.M. Geological Survey of Scotland are housed in the museum, and with these is associated the Heddle-Dudgeon collection of Scottish minerals, which has been described as the finest collection of the minerals of any one country in existence. The museum is supported by a Parliamentary grant, and is under the Scotch Education Department, which was represented at the conversazione by Sir Henry Craik, K.C.B., and Mr. Macdonald, assistant secretary.

A MEETING was held in the geological lecture theatre of the Owens College, Manchester, on December 8, at which it was resolved to establish a Manchester University Geologists' Association. The object of the association is to afford a centre of social reunion for the discussion of geological subjects. Prof. Boyd Dawkins was elected president, Mr. B. Hobson and Mr. Winstanley vice-presidents, Mr. W. J. Hall secretary, and Mr. O. B. Leigh treasurer.

A SHORT time ago Dr. Doyen claimed to have discovered the microbe of cancer, and to have prepared with it a curative serum for the disease. A committee was appointed to investigate Dr. Doyen's claims (see NATURE, October 27, p. 631), and, according to the daily Press, has now reported favourably on them. The *Standard's* correspondent telegraphs, however (December 14), that the committee has not yet arrived at any conclusion.

ON the recent retirement of Sir William Macgregor from the Governorship of Lagos, the Liverpool School of Tropical Medicine decided to mark its appreciation of his valuable services to the cause of health and sanitation by raising a fund, to which Sir Alfred Jones contributed 500*l*. and Mr. John Holt 200*l*. It has been decided to expend this fund on two medical expeditions to the west coast of Africa, one in charge of Prof. Boyce, who, with Dr. A. Evans and Dr. H. H. Clarke, sailed from the Mersey on Wednesday, the other under Colonel Giles. These expeditions will study the various health problems presented by the districts they visit, the distribution of biting insects, and related matters.

A DEMONSTRATION of the Pollak-Virag high-speed writing telegraph was given on December 9 at the Carlton Hotel in the presence of the Austro-Hungarian Ambassador. The Pollak-Virag high-speed telegraphic system was described upwards of three years ago in a detailed article published in NATURE for May 2, 1901, and readers may be referred to that account for particulars of the instruments used. Very high speeds—reaching 100,000 words an hour—were reported as having been attained in America in 1901 by this system, using several perforating machines to prepare the message being sent; but it now appears that these estimates were too high. The postal authorities in Hungary in recent experiments carried out between Budapest and Pozsony, a distance of some 218 kilometres, with two copper telephone wires of 3 mm. diameter, secured the transmission of 45,000 words an hour. In another series of experiments, conducted between Berlin and Königsberg, a maximum transmission of 40,000 words an hour was attained over a distance of 710 kilometres with wires 4·5 mm. in diameter. It is stated that our Post Office department is about to carry out some trials of the Pollak-Virag system.

THE performances of an intelligent horse—"Clever Hans"—at Berlin two or three months ago attracted much attention. In a letter which appeared in NATURE of October 20 (vol. lxx. p. 602) the Rev. J. Meehan pointed out that the performances of the horse were much the same as those of the horse "Mahomet" shown at the Royal Aquarium twelve or thirteen years ago, and depended entirely upon the animal's observation of movements of the trainer or the tones of his voice. Much the same opinion has been reached by a commission of psychological experts, headed by Prof. Stumpf, of Berlin University, that has subjected "Clever Hans" to a scientific examination. The conclusion arrived at is that the horse is not capable of independent thought. According to the Berlin correspondent of the *Daily Chronicle*, Prof. Stumpf found that this horse is gifted with remarkable powers of observation, which four years of patient and skilful treatment have developed. When asked a question "Hans" knows he has to beat with his hoof in reply, but he does not know when to cease beating until he detects some movement on the part of the person questioning him. The commission expresses the opinion that, so far as Herr von Osten, the owner, is concerned, these movements are given involuntarily, and are sometimes of so imperceptible a nature as to be undetected, save by highly trained human observers. There has been no trickery, says Prof. Stumpf, but, on the other hand, there have been no reasoning powers on the horse's part. The whole secret is in von Osten's skill, patience, and judicious reward, and, on "Hans's" part, in keen powers of observation.

VISITORS to the Zoological Gardens in the Regent's Park will miss the old Indian rhinoceros "Jim," which had been a denizen of the menagerie since July 25, 1864, on which date it was presented to the society by the late Mr. A. Grote. It died on December 7, after having been out of health for many months. Such a long sojourn in captivity in this country is probably unparalleled for an animal of this kind. As a statement has appeared in the Press that the skin might perhaps be mounted in the British (Natural History) Museum, it may be well to state that His Highness the Maharaja of Kuch-Behar recently presented the skin of a wild specimen of the great Indian rhinoceros to the museum, which has been set up, and is exhibited. The "Zoo" specimen will therefore not find a home in the national collection.

THE December number of the *Century Magazine* contains a most interesting account, by Mr. G. H. Grosvenor, of the new method of purifying water—both in small quantities and when stored in large reservoirs—by means of blue vitriol (copper-sulphate). It has long been known that copper is fatal to bacteria, but the fear has hitherto been that the amount required to effect the destruction of such organisms would likewise be injurious to man. Dr. G. T. Moore has, however, announced in an American official publication that he can employ copper in such a diluted form as to be quite harmless to the higher forms of animal, and yet sufficiently potent to destroy the germs of cholera and typhoid, as well as mosquito larvæ, in a few hours. The method of introducing the copper-salt into the water is fully explained in the article. It may be added that the treatment is stated to be equally efficacious and safe for sterilising milk. As an illustration of the effects of copper in destroying bacteria, it is mentioned that such organisms are never found on copper coins, although abundant on those of silver, and it is mentioned that artisans in copper-works are immune to bacterial diseases. Whether we have been wise in abolishing the old-fashioned copper tea-kettle is one of the questions raised by the new operations.

THE discovery of the existence of an anterior rudimentary pair of gills in the Continental fresh-water crayfish *Astacus fluviatilis*, which is not present in the common *A. pallipes* of the Thames, was described by Prof. Lankester in NATURE of January 21 (vol. lxix. p. 270), and is recorded in the November issue of the *Quarterly Journal of Microscopical Science* by Miss M. Moseley, who appears to have inherited her father's love for biological studies. The other four papers in the same number are of a very technical nature, the longest and perhaps the most important being a detailed account by Mr. J. W. Jenkinson of the maturation and fertilisation of the egg of the axolotl (*Amblystoma tigrinum*). More general interest attaches, however, to the article by Prof. L. Rogers on the development of flagellated organisms or trypanosomes from the protozoic parasites found in the spleen in cases of cachexial fevers and certain other diseases. Of the two remaining articles, the one by Dr. J. Rennie discusses the so-called epithelial islets in the pancreas of bony fishes, while the second, by Dr. H. G. Fowler, is devoted to the description of the anatomy of a radiolarian of the genus Gazeletta.

IN an article entitled "A Flamingo City," which appears in the December number of the *Century Magazine*, Mr. F. M. Chapman, of the American Museum of Natural History, gives a graphic and well illustrated account of one of the great breeding-places of the American flamingo in the Bahamas. Although previous observers, both in those islands and in Europe, have published descriptions of flamingo colonies, and have refuted the old error that the birds sat straddle-wise on their nests, the author claims to be the first to have seen nestling flamingoes in their native haunts, and likewise to have brought the camera to bear on one of the breeding-places of these birds. Flamingoes, as Mr. Chapman remarks, are more brightly coloured than any other large bird, and their gregarious habits and the open nature of their resorts are admirably suited to bring their gorgeous hues into prominence. The visit to the nesting-grounds was made at the latter end of May, when both eggs and young birds were to be found in the nests.

At first the birds—estimated at 2000 in number—rose in a flock, and fears were entertained that they would permanently forsake their nests, but after a time—despite the erection of a "blind" for the camera—they returned in a body. The sight of such an army of large birds, both in flight and when marching, is described as magnificent and imposing, if not, indeed, appalling. The young remain in the nest for about three days, and for the first three weeks after leaving it feed like ordinary birds. By that time, however, the beak has attained its characteristic flexure, and the young birds then search for their food with the lower mandible upwards. Molluscs of the genus Cerithium form almost the sole food of the Barbados species. It is sincerely to be hoped that a movement to prevent these "rookeries" from being raided by the plumage-hunter will be attended with success.

In vol. iv. of the *Bulletin* of the Imperial Botanic Garden at St. Petersburg, Mr. J. Palibin describes the plankton which he collected in Barents Sea, and also gives a historical *résumé* of other collections made in the Arctic Ocean. In a series of letters Mr. Boris Fedtschenko communicates the botanical observations made during a journey through the Sir Daria region of Turkestan.

In a pamphlet entitled "Notes on the Commercial Timbers of New South Wales," Mr. J. H. Maiden describes the principal woods, their characters, and uses. The information is primarily suited to practical men who supply or use timber in the colony. The majority of the timbers are hard woods, and different species of Eucalyptus give ironbarks, stringy barks, varieties of box, mahogany, and gum. The timbers recommended in lieu of pine are white beech, *Gmelina Leichhardtii*, a genus of the order Verbenaceæ, and red cedar, *Cedrela australis*, and rosewood, *Dysoxylon Lessertianum*, both included in the Meliaceæ.

The establishment of "biologic forms" of species of Erysiphaceæ and Uredineæ is based upon the restricted powers of infection of the spores upon allied species of the host plant. But the immunity of a species of the host plant is not absolute, because, as pointed out by Mr. E. S. Salmon in No. 3 of vol. ii. of the *Annales Mycologici*, another host plant may act as a bridging species. Thus the form of *Erysiphe graminis* which grows on *Bromus racemosus* will infect *Bromus hordeaceus*, but will not infect *Bromus commutatus*, although the spores found on *Bromus hordeaceus* will infect *Bromus commutatus*. If spores from *Bromus racemosus* are sown on *Bromus hordeaceus*, then the spores produced on *Bromus hordeaceus* as a result of that sowing are found to be capable of infecting *Bromus commutatus*.

The daily weather report issued by the Meteorological Office on Tuesday, December 6, showed that on the morning of that day the winds and sea in the Channel were still very heavy, and, further, that a rapid fall of the barometer at Scilly pointed to the approach of a fresh disturbance. This storm developed very rapidly, and by 2h. p.m. a deep disturbance lay over Dorsetshire, and another to the north of the Helder. These disturbances were accompanied by very heavy rainfall, amounting in twenty-four hours to 2·25 inches at Cuxhaven, 1·25 inch at St. Aubins (Jersey), and 0·94 inch in London, while severe thunderstorms occurred generally in Devon and Cornwall. Much damage to property is reported from various districts, and in parts of Dorsetshire a veritable tornado occurred; rain and hail fell in torrents, accompanied by heavy thunder and lightning. At Beaminster roofs and trees suffered severely; the path of the storm was well defined, and, as is usually the case in these local whirlwinds, was limited to a very small area. The region of heavy rainfall over the country generally was sharply defined on its northern side; at Nottingham and Spurn Head no rain was reported to the Meteorological Office on the morning of December 7.

A volume of monthly wind charts for the South Atlantic Ocean, prepared by the marine branch of the Meteorological Office, has just been published by the Hydrographic Department of the Admiralty. The region covered extends from the equator southward to the 65th parallel, and from the 20th meridian of east longitude to the 90th of west longitude, so that a portion of the Pacific is included. Nearly a million sets of observations, extending over a period of forty-five years, have been used. The winds have been discussed in areas of 5° of latitude by 5° of longitude, and the results are exhibited by means of roses showing the relative frequency and strength at the sixteen even points of the compass. The distribution of mean atmospheric pressure is shown by means of isobaric lines, and the mean air temperature by isotherms, while along the African and American coasts are numerous notes bearing upon the characteristic climatic features of the various months. A striking feature on every chart is the area of high barometric pressure covering the whole of the area between Africa and the east coast of America, its central space being usually more on the western side of the ocean, as is the case with the anticyclone of the North Atlantic. The wind circulation of the South Atlantic is associated with its dominating high pressure system. On the eastern and northern portions of the ocean the south-east trade is very constant, is never interrupted by storms, nor attains the force of a gale. On the western side the winds are more variable, but gales are very rarely experienced northward of the 35th parallel. Except near the land fogs seldom occur northward of the 30th parallel, and the south-western part of the ocean is the only region where ice is ordinarily met with. Statistics of the rainfall at a number of places within the area of the charts show that the annual amount ranges from 0·31 inch at Walfisch Bay and 1·54 inches at Serena (Coquimbo) to 93·41 inches at Pernambuco and 100·63 inches at Valdivia. It may be recalled that at the Cambridge meeting of the British Association Commander Hepworth read a paper on the results of the discussion of the observations for these charts.

In No. 22 of the *Physikalische Zeitschrift* Messrs. Elster and Geitel reply to Mr. J. R. Ashworth's recent letter to Nature (vol. lxx., p. 454) suggesting that the human breath may be considered as a source of the ionisation of the atmosphere. Their measurements of the conductivity of air charged with ordinary human breath show that such air is not more conducting than ordinary air. On the other hand, the breath of a person who has been working continually with radium preparations has decided ionising power, and the nature of the ionisation shows that it is due to the emanation of radium.

Nearly all the physicists who have been approached hitherto by the *Revue Scientifique* in the course of its inquiries as to the existence of the *n*-rays have unequivocally stated their inability to observe the effects which these rays are alleged to produce. It is therefore particularly interesting to note in the *Revue* for November 26 that M. D'Arsonval has been able to reproduce these effects in many instances, and to show that they are not due merely to thermal causes. M. Mascart is stated jointly to have observed with him the same phenomena. M. Poincaré, although himself unable to verify the existence of the radiations, adversely criticises Prof. Wood's objections. M. Weiss, from his failure to observe the rays, simply concludes that he was physically unfitted for such observations.

PART xii. of the *Transactions* of the Royal Dublin Society consists of an investigation by Mr. Richard J. Moss of the state in which helium exists in pitchblende. The total quantity of helium in a sample of pitchblende was 0·107 c.c. per gram, and of this 1·17 per cent. was liberated by simply grinding the mineral in a vacuum. The quantity of carbon dioxide separated by completely decomposing the mineral was 4·686 c.c. per gram, of which only 0·0085 per cent. was obtainable by grinding. As a similar proportion of the total occluded carbon dioxide can be separated from calcite, in which the gas is undoubtedly present in minute cavities, by simply pulverising the crystals, it is probable that the whole of the carbon dioxide of pitchblende, and possibly the helium also, are present similarly occluded. It is evident that the proportion of the gases liberated by roughly grinding must necessarily be only a small proportion of the total volume.

THE Christmas number of *Photography*, published by Messrs. Iliffe and Sons, Ltd. (1*s*. net), is restricted to many kinds of work with the camera which can be accomplished indoors during the winter months. It might be said further to deal with the lighter side of photography as well, as will be judged by reading the second portion of this number. Part i., by Mr. C. J. Harrison, deals with the working up of negatives and prints for the removal of mechanical and other defects from negatives. The methods and dodges employed are, as the author states, the outcome of his own experience, but nevertheless they are interesting reading, and may prove serviceable to many photographers. The illustrations accompanying the text and chosen to represent various stages of these methods are also well worth examination. In part ii. Mr. W. L. F. Wastell discourses on bye-paths of photography. Here the reader is made acquainted with methods for producing what may be termed "freak" photographs. Thus we have illustrated examples of the so-called "spirit" photograph, distortions due to the object being too near to the camera, two images of the same person in one picture, combination portraits, silhouettes, and many others of a similar character. The supplement to this number consists of designs, covering sixteen pages, of photographic mounts to serve as Christmas cards.

THE articles in the October number of the Johns Hopkins Hospital *Bulletin* (xv., No. 163) are mainly of medical interest. Dr. Packard, however, writes an interesting account of some famous quacks, including Valentine Greatrakes, who claimed the healing touch for the King's evil in the seventeenth century, no other than Robert Boyle testifying to his powers; Joshua ("Spot") Ward, who discovered a cheap way of making oil of vitriol; and John St. John Long, who devised a famous liniment which possessed not only curative powers, but also revealed hidden disease, and from his practice is said to have derived 13,000*l*. a year.

MR. W. B. CLIVE has published a revised and enlarged edition of "First Stage Building Construction," by Mr. Brysson Cunningham.

MESSRS. DAWBARN AND WARD, LTD., have published in their "Home Worker's" series a booklet by Mr. R. H. S. Williams with the title "How to Build a Bicycle," and one on "How to Build a Petrol Motor," by Mr. J. F. Gill.

THE separate parts (parts i.–vi.) of "A School Geometry," by Messrs. H. S. Hall and F. H. Stevens, which have been reviewed in these columns from time to time, have been published together in one volume by Messrs. Macmillan and Co., Ltd., at 4*s*. 6*d*.

A FOURTH edition of Prof. Olof Hammarsten's "Textbook of Physiological Chemistry" has been published by Messrs. John Wiley and Sons, New York (London: Messrs. Chapman and Hall, Ltd.). This issue is an authorised translation by Prof. John A. Mandel from the author's enlarged and revised fifth German edition.

THE 1904 issue of the "Year-book of the Scientific and Learned Societies of Great Britain and Ireland" has now been published by Messrs. Charles Griffin and Co., Ltd. This is the twenty-first annual issue of a useful list of organisations for the advancement of science, literature, and art, and of work done year by year. Comprehensive as the compilation is, it is not quite complete, for there appears to be no reference either to the Sociological Society or to the Geographical Association.

Erratum.—In the inscription of Fig. 5 (p. 135) of the article on "Invar" in last week's NATURE, "a 2 km. wire" should read "a 24 m. wire."

OUR ASTRONOMICAL COLUMN.

RELATIONS BETWEEN SOLAR AND TERRESTRIAL PHENOMENA.—In a paper communicated to the Royal Society of New South Wales, Mr. H. I. Jensen, of Sydney University, discusses the more recent data concerning sun-spot frequencies and the occurrence of volcanic outbursts, earthquakes and climatic variations, with the view of illustrating further the dependence of the terrestrial upon the solar phenomena.

In a previous paper communicated to the same society in June, 1902, he arrived at the conclusion that the maxima of volcanic and seismic activity coincided, in point of time, with the sun-spot minima, but the discussion of the later data has led him to a confirmation of the views expressed by Sir Norman Lockyer, viz. that the maximum activity of the terrestrial takes place at both the minima *and the maxima* of the solar phenomena. His observations show, however, that the action at sun-spot maxima is less marked than, and of a different character to, that which takes place at the minima.

The differential action of lunar attraction is also discussed, and although the author concludes that this cause is only one of secondary importance, he shows that volcanic outbursts and earthquakes seem to occur most frequently at those times when the moon is in perigee.

In discussing the connection existing between solar and meteorological variations, Mr. Jensen refers to the work performed in this direction by Sir Norman and Dr. Lockyer, and in general agrees with their results, although he inclines to the belief that the epochs of sun-spot *maxima* are generally the epochs of excessive rainfall. Further, he strongly insists upon the necessity of attaching more importance to geographical position when considering the prevailing meteorological conditions of any place (*Proc.* Roy. Soc. New South Wales, vol. xxxviii.).

SUN-SPOT SPECTRA.—In No. 4, vol. xx., of the *Astrophysical Journal* Father Cortie brings together the results of all the sun-spot spectra observations made at the Stonyhurst College Observatory during the period 1883–1901.

Using a Browning automatic spectroscope containing twelve 60° prisms, the widened lines in the region B–D of the solar spectrum were picked out, and the intensity of their relative widening recorded on an arbitrary numerical scale. The present catalogue results from 5486 individual observations of 349 lines, and the results generally confirm the observations made at South Kensington as recorded by Sir Norman Lockyer in a paper ("On the Relation between the Spectra of Sun-spots and Stars") recently communicated to the Royal Society, viz. that vanadium and titanium are the elements chiefly affected in sun-spot spectra.

Father Cortie states that the widening of some oxygen lines in sun-spot spectra, particularly in the α band, seems to be a real phenomenon.

ECLIPSE OBSERVATIONS.—Vol. iii. of the *Annalen* of the Royal University Observatory of Strassburg, edited by Dr. E. Becker, the director, contains the results of the heliometer observations of the total solar eclipse of May 28, 1900, and of the lunar eclipses which took place on January 28, 1888, May 11, 1902 (partial eclipse), and April 11, 1903, respectively.

In the first part Prof. Kobold gives the results of a number of observations made in order to determine the reduction elements of the heliometer, and then applies them to the observational results obtained during the solar eclipse of 1900. Finally, he gives the corrections to the previously determined positions. In part ii. the same observer discusses the observations of the 1888 and 1892 eclipses of the moon, and gives the values obtained for the radius of the earth's shadow, &c., finally comparing them with the calculated values.

In the third part Herr C. W. Wirtz discusses the observations of the lunar eclipse of April 11, 1903, including the corrections to the moon's place, the figure and size of the earth's shadow, and the variations of the diameter of the crater Linné during the eclipse. The curve on which are plotted the values of the last named quantity shows a considerable increase in the diameter during the approach of the earth's shadow to the crater, the maximum value evidently occurring during the actual eclipse of Linné.

THE APPEARANCE OF SPARK LINES IN ARC SPECTRA.—An interesting discussion of the conditions which lead to the appearance of "spark" lines in arc spectra is published in No. 4, vol. xx., of the *Astrophysical Journal* by Dr. Henry Crew, of the North-western University, Ill. Dr. Crew made a number of experiments in which the Mg line at λ 4481 appeared in the arc spectrum, and examined the arc, simultaneously, with a Rowland grating spectrograph and a Duddell high-frequency oscillograph.

The various conditions under which the arc was produced were as follow:—(1 and 2) current with negligible and with large amount of inductance respectively; (3) arc broken by air blast; (4) arc in atmosphere of coal gas.

The reproductions of the oscillograph curves show the current conditions during each experiment, and from a discussion of the results Dr. Crew arrives at the following conclusions:—(1) A rapidly changing, high E.M.F. is a probable *conditio sine qua non* for the appearance of spark lines in arc spectra. (2) The effect of hydrogen and other atmospheres in introducing spark lines is explained by the fact that these atmospheres produce a more rapid break, and this, in turn, introduces an extra E.M.F., which in some way, as yet unknown, is responsible for the radiation of the spark line. A possible explanation of the stellar conditions which produce spark lines in the spectra of stars is also discussed.

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA.—Founded as the Astronomical and Physical Society of Toronto, the name of this society was changed in 1900 to that of the Toronto Astronomical Society. In 1903 it was decided to change its name to the Astronomical Society of Canada, and in response to a petition the privilege of prefixing the word "Royal" to its name was granted, so that the full title of the society is now the above heading. We hope that this now national society will be a stimulus to the promotion and diffusion of astronomical science, and that its influence will be greatly extended. We have before us the volume containing the selected papers and proceedings for the years 1902 and 1903, edited by A. Harvey; the varied topics there dealt with bid fair for the future of the society. Among some of the papers may be mentioned the address of the president, R. F. Stupart, director of the Magnetic and Meteorological Observatory of Toronto, in which is an account of the history and work of the institution. W. H. S. Monck gives a catalogue of aërolites, arranged in order of the months in which they fell. There is a brief account of the present astronomical equipment of Canada as a whole, and a discussion on papers dealing with solar phenomena and terrestrial effects. The volume concludes with an account of women's work in astronomy, by Miss E. A. Dent.

THE FIRST TRUE MAPS.

IN the history of cartography, in the development of maps and map-making, there is perhaps nothing quite comparable to the first appearance of the "portolani" or "handy charts" at the close of the thirteenth and the beginning of the fourteenth century. For the portolani, the first true sea-charts, are also the first true maps of any kind—the earliest designs in which any part of the earth-surface is laid down from actual observation of close and continuous character.

By the term "portolani" we intend, of course, to refer to that great series of coast-plans of which the earliest known examples belong to the first decade of the fourteenth century (A.D. 1300–1310); which are traceable to a very few, perhaps to two or three (now lost), originals; which may be extended to cover at least 500 designs (reaching down to the end of the sixteenth century); and were primarily intended to serve as practical guides to mariners and merchants in the seaports of the Mediterranean and Black Sea.

These plans of practical navigators—of men whose livelihood largely depended on their knowledge of nature and their close observation of natural features—are a remarkable contrast, in their almost modern accuracy, to the results of the older literary or theological geography as we have them in the Hereford or Ebstorf maps (both of the very same period as the oldest existing portolans, *c.* A.D. 1300). They have never yet received adequate attention from English geographers (as from Nordenskjöld the Swede, Fischer the German, or Uzielli the Italian), and the problem of their sudden appearance in such comparative perfection is surely deserving of more study, and capable of fuller explanation, than it has yet received. Certain assumptions may perhaps be made without danger. The portolano type was not the invention of one man, of one year, of one decade. It did not spring from any school or any example of mediæval student-map. It was the final result of centuries' experience—the outcome of the notes, plans, and oral tradition of generations of pilots and captains. Skipper-charts of certain important and much-frequented sections of the coast trade-routes were probably combined, by slow degrees, into a coast-chart of the Mediterranean basin as a whole. It may be that the sketches of small portions of shore-line which we have in fifteenth century manuscripts of Leonardo Dati's poem "La Sfera" are really copies, but slightly modified, of such old skipper-charts—reaching back, perhaps, to the eleventh century, and forming the very earliest indications of that new scientific geography in which the compass played so great a part. If this surmise is correct, the opening of the mediæval Renaissance, in the generations immediately preceding the Crusades, was accompanied by the oldest embryonic forms of modern cartography.

Once more, it may be that the sea-chart which is mentioned in connection with the Seventh Crusade (of A.D. 1270), and which St. Louis apparently employed to aid his attack on Tunis, was a portolan, or a sectional chart of the North African coast of portolan type. It may be that the *charta* noticed in Raymond Lulli's "Arbor Scientiæ" (about A.D. 1300) as necessary for sailors—along with the compass, needle, and "star of the sea"—was a work of the same kind. It may be that Andrea Bianco's planisphere of 1436 is a re-edition of a "handy-map" of the thirteenth century. But the oldest certain examples of the type we are concerned with, which have been discovered up to the present, are the *Carte pisane* and the first design of Giovanni de Carignano, both belonging to the opening years of the fourteenth century, while the oldest dated portolan is the first of Pietro Vesconte (or Visconti), executed in 1311.

And when, with these and the next few examples, we get at last our full coast-chart of the Mediterranean basin, what is its character?

It is a map without graduation, embracing only the coast lines and the towns and natural features in the immediate neighbourhood of the coast. But though it is restricted, it has extraordinary merits in its own field. Its delineation of the shores of the *Mare Internum*, from the Straits of Gibraltar to the extreme east of the Black Sea, is markedly superior to anything of earlier date—even to the Madaba mosaic of the sixth century or to Matthew Paris's thirteenth century "England." The chief errors which Ptolemy had imparted to the shape of the Mediterranean are corrected. The main features of the great inland sea are presented with a correctness and a minute detail which, at the most casual glance, immediately distinguish portolan work from any preceding variety of cartography. No attempt is made to fill up the interior of the lands—continental or insular—of which the coasts are portrayed; such attempts are made later, it is true, but they are obvious and confessed additions to the primitive, normal, or typical portolan. But, along the shores in question, all points important for navigation are drawn with great care; small islands, bays, cliffs, and headlands—of no great general importance, but vital to the coaster—are often depicted in disproportionate size; all the ports especially suitable for calling, watering, and revictualling are indicated with the especial honour of *red* colouring; even shallows are frequently marked, denoted by a sign still used at the present day; the very large number of shore-names testifies to the minute knowledge underlying the work. Thus along the north coast of the Mediterranean we have (by A.D. 1320) about 620 names; on the coasts of the Black Sea and Sea of Marmora about 260; on the coasts of Asia Minor and Syria about 160; on the north coast of Africa about 240; in all some 1280, without counting island names—which are very numerous—or the names which fringe the western coast of Europe to the mouth of the Elbe, and the western coast of Africa to Cape Nun, or Non, at the extreme south-west of Morocco. In respect to these shores—let us say from Hamburg almost to the Wady Draa, and from Gibraltar to Azov, Poti, Batum, Alexandretta, Jaffa, and the Nile—the portolani soon become fixed in the pattern they permanently retained, a pattern which gradually triumphs over every other—even the revived Ptolemaic, to which scholars clung so desperately and so unhappily. We may therefore regard the great mass of these works as mere copies of a few normal or typical designs which were completed (at least in all their essential parts) before the outbreak of the Hundred Years' War, and a good twenty years before the battle of Crecy. How closely the original type was followed may be guessed from the fact that the portolan *colours*—used according to certain definite rules—are unaltered for long periods of years, and through scores of examples. Thus red or reddish-brown is always kept for the Red Sea, and long after the Turkish conquest of Rhodes that island regularly appears in white with a black cross.

Instead of lines of latitude and longitude (or substitutes for such lines, as we find in the "Palestine" of Marino Sanuto, *c.* A.D. 1310), a net of loxodromes is employed on (or has, at any rate, been added to) the portolani even of the earliest time. These loxodromes are straight lines in the direction of the various winds, proceeding from a number of crossing-points regularly distributed over the map. But in this loxodrome net-work, in sharp contrast to all other features of the portolan map-type, there is almost infinite variation; one seldom comes across two designs of exactly similar character in this respect.

A distance-scale, with the same unit of length, occurs on all the portolani; this unit (which has been called the *portolan mile*) is estimated with much care by Nordenskjöld at 5830 metres; while of all known mediæval measures, that which corresponded most nearly with the "portolan mile" seems to have been the Catalan *legua*. A Catalan league therefore, it is suggested, may have furnished the basis of the portolan measure, and the portolan type of map may have originated (in part at least) among Catalan mariners.

Baron Nordenskjöld, indeed, does not hesitate to ascribe to the portolani an entirely Catalan parentage. But, admitting that one germ of the first true maps may have existed at Barcelona or some other centre of Catalonian trade and seamanship, I cannot but think that another germ still more active and important was to be found in Italy, and above all in the north-west—in Genoa and Pisa. For, remembering the indications in Dati's "Sfera," we may agree with Theobald Fischer that map sketches of portolan type, and with the practical object of helping navigation, were almost certainly drawn *in Italy, and by Italians,* before 1300. Remembering, also, that of the existing portolani all the earliest examples are unquestionably Italian—and that, of some 500 known, 413 were executed by the countrymen of Carignano and Vesconte—we shall not be ready to deprive Italy of the first place in the creation of the oldest scientific maps. Even if that creation was, as seems probable, an "Homeric" feat—the piecing together (with additions and improvements) of a great number of small sectional coast-surveys—yet this earlier stage, only recorded in Italian manuscripts, seems no less due to the seamen of the peninsula.

Can we throw any other light upon the origin of the portolani?

In 1881 Fiorini suggested that West-European mariners, such as those of Italy, learnt from the Byzantines the art of making and using maps founded on careful draughtsmanship and close study of distance (*i.e.* portolani of a kind) as early as the eleventh century. This idea has been accepted by Theobald Fischer, and has been treated with great respect by other scholars. Yet it is surrounded by difficulties. For no Greek portolan has yet been found, nor is Greek influence anywhere to be detected in the language, legend-allusions, contours, or other details of the early portolani. Fragments of Latin, fragments of Italian and Catalan dialects, fragments of a *lingua franca* composed of various Romance tongues—these are the media through which the early portolan draughtsmen convey information. But of Greek they make no use, and of Byzantine geography, history, harbours, or coast routes they show no *special* knowledge. We may give weight to the fact that the Byzantine navy was one of the chief Christian weapons in the ninth, tenth, and early eleventh centuries; that Constantinople was then the greatest trade centre in Christendom; and that the seamen of the Greek islands were very prominent in Mediterranean navigation in the age of the Byzantine revival (*c.* 860–1060 A.D.). But all this is far from proving a Byzantine right to the "invention" of the portolan coast-chart,[1] even in the primitive form of sectional pilot-maps of limited areas.

It only remains to say that all genuine progress in geographical delineation followed the lines of the portolani; that the accurate methods employed by them for coast-work were gradually applied to the interior of countries; that in spite of the contempt shown for them by most of the learned in the so-called Renaissance period, they were at last known by their fruits and vindicated by the success of their type.

Ancient classical or pre-Christian maps were not without certain merits, though we can only judge of them by the two remaining examples, the Peutinger table, originally a road-map of Augustus's Empire, and the designs illustrating the "Geography" of Claudius Ptolemy of Alexandria—both surviving only in manuscripts of the central mediæval period. After the modern age of oceanic discovery had passed through its earliest and most difficult stages, the Renaissance editions of Ptolemy (from 1474) played a very important part in delaying geographical progress and retarding the history of civilisation. But in the time of the early portolani (say from 1300 to 1400) neither the work of the Alexandrian astronomer nor the road-maps of the Roman Empire were adequately known in western Europe. The sixteenth and seventeenth centuries were not so innocent.

Designs of the portolan type do not seem to have existed even in the best ages of classical geography and exploring activity; the old *peripli* were sailing directions, not drawn, but written; and the only Arabic scheme of the sort which has yet been found is certainly copied from a Christian—and Italian—original.

It is in the portolani, and especially in such a work as the Laurentian design of 1351, with its revelations of the Azores and the Madeira group, and its still more startling suggestion of the true shape of Africa, that we may find, perhaps, the chief geographical teachers of Henry the Navigator and his Portuguese. Never better than in these long-neglected charts does the history of civilisation illustrate man's change from empirical to scientific, from traditional book-learning to the investigation of nature. The portolani long

[1] To Nordenskjöld's wild theory, "Facsimile Atlas," p. 48, that Marinus of Tyre is the real original portolan draughtsman, and that the Marinus maps which Masudi saw before A.D. 956 were really portolani, we need not pay attention.

suffered, in general appreciation, from the fact that—in their essential features—they never attempted to gratify popular taste; that they did not, with rare exceptions, illustrate[1] the works of fashionable writers, whether classical philosophers or mediæval prelates; that they had no connection with the legends and dreams of chivalry and romance; that they were not the work of schools or courts; and that they owed nothing to Ptolemy or Strabo. But we know their worth better now.

They first record for us the new discoveries among the Atlantic islands and along the African mainland; they guide and accompany the faltering steps of our race in the outward, oceanic, movement of European life; in them true cartography, the map-making of the civilised world, begins.

C. RAYMOND BEAZLEY.

[1] Some of the atlases founded on portolani, such as the *Carte Catalane* of 1375, really illustrate the travels of the thirteenth and fourteenth centuries, *e.g.* Marco Polo's. But this is strictly in the way of explanation of a great eographic text.

GEOLOGICAL NOTES.

STATISTICS of mineral production in India in the ten years 1894 to 1903 have been issued by the Government of India (Department of Revenue and Agriculture, 1904). In the report for 1903 satisfactory progress in the mining industry is recorded. There has been a remarkable development in the production of petroleum and manganese ore, and a continuation of the progress previously recorded for coal and gold.

From the Geological Survey of India we have received part ii. of the newly re-issued *Records*. Mr. T. H. Holland, director, contributes a short appreciative memoir of the late General C. A. McMahon, and among other articles there is a well illustrated report by Mr. J. Malcolm Maclaren on the auriferous occurrences of Chota Nagpur, in Bengal. The conclusion is that there is little scope for the legitimate investment of capital in the recovery of gold, whether from the quartz veins or from the superficial deposits, but that the greater portion of the gold must be left to the native washer, "forming for him a reserve that, though it will never raise him to affluence, will always lift him beyond the grasp of famine." Two minerals, thenardite and cancrinite, are recorded for the first time from India. We have also received a report on the geology of Spiti, by Mr. H. H. Hayden (*Mem.* Geol. Surv. India, vol. xxxvi., part i.). Hitherto no systematic survey had been made of the region, and the results of this work, which was carried out by Mr. Hayden with the assistance of the late Dr. von Krafft, are depicted on a map to the scale of one inch to four miles, and further illustrated by some striking pictorial views and sections. The formations represented are Cambrian, Silurian, Carboniferous and Permian, Trias, Jurassic, and Cretaceous, with also intrusive rocks. The oldest sedimentary rocks belong to the Middle Haimanta division of Mr. Griesbach; they are unfossiliferous, and are overlain presumably by the Upper Haimantas, in which Lingulella and Olenus have been found. Lower and Upper Silurian rocks are recognised, and from these and the later formations many fossils are recorded.

The ammonite fauna of the Spiti shales forms the subject of a monograph by Dr. Victor Uhlig (*Mem.* Geol. Survey, India, ser. xv., vol. iv.). Only the first portion of this work has at present been issued, and in it the author deals with the genera and species of Ammonoidea. With regard to the classification, the author remarks that as no universally satisfactory agreement has yet been reached, he gives the descriptions of the various forms in unclassified sequence, while indicating their approximate position. In the course of his work he has studied as far as possible all the old as well as new material, and he has found it necessary to re-figure and describe many of the species previously published.

In mineralogical notes contributed by Mr. A. K. Coomaraswamy (*Spolia Zeylanica,* August), reference is made to the occurrence in Ceylon of thorium-bearing minerals, of corundum-sillimanite rocks, kyanite, serendibite, &c. The same author, in dealing with the geology of Ceylon (*Geol. Mag.*, August), proposes the name Balangoda group for a series of granitic and pegmatitic rocks intrusive in the Charnockite series. The group includes granites with zircon, allanite, magnetite, &c.

The summary of progress of the Geological Survey for the year 1903 contains the usual particulars of the field work which has been carried on in Cornwall, Derbyshire and Nottinghamshire, Carmarthenshire and Pembrokeshire, in various parts of Ross-shire and the western highlands, in the Edinburgh coal-field, and in the neighbourhood of Cork in Ireland. Special attention is directed to the discovery in Ross-shire of a rock essentially composed of magnetite and cassiterite—the occurrence of tin-ore being new; but it is stated that at present there is no reason to believe that the tin-bearing rock occurs in any large masses. In an appendix Dr. J. S. Flett contributes first notes on the petrography of western Cornwall, dealing with some of the garnetiferous greenstones, the granites and greisen veins, and the phenomena of contact alteration; Mr. H. B. Woodward writes on the Geological Survey in reference to Agriculture, with report on the soils and subsoils of the Rothamsted estate; and Mr. H. A. Allen continues the important catalogue of types and figured specimens of fossils in the Museum of Practical Geology, with a record of Oolitic Gasteropoda and Scaphopoda.

The general report and statistics on mines and quarries for 1903, part iii. (output), has been issued by the Home Office. The total value of the minerals raised during the year showed a decrease of $5\frac{1}{4}$ million pounds as compared with 1902—a decrease arising from the fall in price of coal. The total output of coal was the highest hitherto recorded. The outputs of ores of iron, copper, and lead show increase, while those of manganese, tin, and uranium ores show decrease.

In the *Proceedings* of the Bristol Naturalists' Society (n.s., vol. x., part iii.) Prof. Lloyd Morgan and Prof. S. H. Reynolds give particulars of the field relations of the Carboniferous volcanic rocks of Somerset. There is also an interesting article by Mr. W. H. Wickes on the Rhætic bone-beds, the author pointing out that there is no regular and persistent bed, but thin layers of varying extent occur on different horizons, due to the former presence and destruction of shoals of carnivorous fishes and saurians, while the occurrence of small pebbles in the bone-beds is attributed to the fact that large sea fish often have stones in their stomachs. Mr. H. B. Woodward contributes a memoir on the late Robert Etheridge, dealing more especially with his work in the Bristol area.

In the *Proceedings* of the Cotteswold Naturalists' Field Club (vol. xv., part i.) Messrs. J. W. Gray and G. W. S. Brewer direct attention to the evidence of a Celtic settlement on Cleeve Hill, prior to the Roman occupation of that part of the country; among the domestic animals were the horse, ox, sheep, pig, dog, and fowl. Mr. L. Richardson contributes an article on the Rhætic beds of Worcestershire.

A study of sands and sediments has been commenced by Mr. T. Mellard Reade and Mr. Philip Holland (*Proc.* Liverpool Geol. Soc., 1904). So far as their investigations have proceeded, they are led to believe that purely mechanical micro-sediments may constitute a much larger proportion of the rocks than has been hitherto suspected. Moreover, their experiments show the persistent retention of detrital carbonate of lime in extremely fine subsidence-matter, and suggest that deep-sea limestones may sometimes be formed as detrital accumulations.

The twenty-eighth annual report of the Department of Geology and Natural Resources, Indiana, under the direction of Mr. W. S. Blatchley, State geologist, is accompanied by an excellent geological map of the State on the scale of an inch to four miles, with explanatory descriptions by Dr. T. C. Hopkins and Dr. A. F. Foerste. The formations represented are Ordovician, Silurian, Devonian, Lower Carboniferous, and Coal-measures. The petroleum producing areas are specially marked, that industry having become one of the greatest in the State. Special reports are contributed on this and on the lime industry, and there is also an article on the stratigraphy and palæontology of the Niagara formation by Mr. E. M. Kindle, with twenty-five plates of fossils.

A comprehensive memoir on the geology and ore-deposits of the Bisbee Quadrangle, Arizona, by Mr. F. L. Ransome, appears as one of the "professional papers" of the United States Geological Survey (1904). This district became famous for its production of copper-ore in 1880, and was connected with the railway system as recently as 1902. Hence Mr. Ransome has found himself obliged to invent names—and pleasing ones of Spanish origin—for several topographic features. His plates show how the geological structure of the country can be read on many of the hill-sides with the clearness of a diagram; in several respects they remind one of the bare dry landscapes in the Mesozoic areas of the Basses Alpes. The fossiliferous beds include Middle Cambrian, Devonian (apparently conformable on these), Lower and Upper Carboniferous (both marine), and Cretaceous, resting unconformably on the preceding beds. The affinities of the strata are with those of Texas. The paper concludes with a discussion of the origin of the copper-ores, in which stress is laid on their concentration from cupriferous iron-pyrites, deposited in metamorphosed limestone.

In the *Proceedings* of the Royal Society of Victoria (vol. xvii., n.s., part i.) Messrs. F. Chapman and G. B. Pritchard commence an article on the fossil fish-remains from the Tertiaries of Australia. They deal with the description, range in time, and distribution of the sharks, and they observe that Asteracanthus, hitherto known only from Secondary strata, extended beyond question into the Tertiary seas round southern Australia. In other articles the Silurian Ostracoda and Phyllocarida, and the Tertiary Polyzoa and Mollusca of Victoria receive attention. Prof. J. W. Gregory contributes a paper on the antiquity of man in Victoria, and concludes (contrary to his previously expressed opinion) that, however ancient the Australian aborigines may be, there is no evidence of the long occupation of Victoria by man.

We have received the annual report of the Geological Survey of Canada for the year 1900, issued in 1903; it is accompanied by geological maps, dated 1904, of parts of British Columbia (Atlin Gold-fields), Labrador, Saskatchewan, and Quebec.

A revision of the Palæozoic Palæechinoidea, with a synopsis of all known species, has been contributed by Mary J. Klem (*Trans.* Acad. Science, St. Louis, vol. xiv., No. 1). She remarks that the prevailing characters which may be taken as a basis for classification are:—(1) number of columns in the ambulacra; (2) position and number of the ambulacral pores; (3) ornamentation of the plates; (4) imbrication of the plates; (5) apical system; (6) general shape of the body; and (7) geological position.

An interesting article on the occurrence and distribution of copper in the United States, by Mr. W. H. Weed, appears in the *Mining Magazine* (New York, September). Nearly 700 million pounds of metallic copper were produced in the States during 1903, and in the previous year nearly 300 million pounds were obtained from an area a mile long and half a mile wide at Butte, in Montana, where the Anaconda Mine produces more copper than any other mine in the world. The ores occur in well defined veins in quartz-monzonite, associated with white granite or aplite, which forms dykes and small masses. Dykes of quartz-porphyry also occur, and seem to have some genetic association with the ore-bodies. Several mines are 2200 feet deep.

The Geological Survey of Queensland has commenced the issue of *Records*. In No. 1 Mr. B. Dunstan, the acting Government geologist, contributes notes on the occurrence of gold nuggets near Mount Morgan, on phosphate-bearing rocks, asbestos, oriental rubies, &c. Mr. R. Etheridge records the occurrence of Halysites in the Chillagoe limestones. We have received also *Publications* Nos. 191 and 192, on the tin, copper, and silver mining in the Stanthorpe district, by Lionel C. Ball, and on the Herberton tin field, by Mr. W. E. Cameron.

Some Upper Devonian fish-remains, obtained by Dr. Whitman Cross from Colorado, are described by Mr. C. R. Eastman (*Amer. Journ. Sci.*, October). The remains belong to the genera Bothriolepis and Holoptychius. In the same journal a number of fossil turtles belonging to the Marsh collection in Yale University Museum are described and figured by Mr. O. P. Hay. Many of the specimens are from the Laramie deposits of Wyoming.

SCIENTIFIC RESEARCH IN THE PHILIPPINE ISLANDS.

THE occupation of the Philippine Islands by the United States has been quickly followed by the establishment of laboratories, and already a large amount of scientific work has been done, and several valuable reports have been issued.

The report[1] under review deals with the year ending September, 1903. The permanent buildings of the Government laboratory at Manila were completed last April, and comprise a serum laboratory for the preparation of therapeutic sera and vaccine lymph with attached paddocks and animal houses, a chemical laboratory, a biological department for the prosecution of pathological, entomological, and botanical research, a marine biological station, a bureau of weights and measures, and a library.

About one-third of the volume is occupied with a report on trypanosomiasis by Dr. Musgrave and Mr. Clegg, with special reference to the existence of surra among the horses in the Philippines. At the same time a very complete review of our present knowledge of trypanosomiasis is given, the various species are described, and the symptomatology and prophylaxis are discussed. The report, which is a very valuable one, is copiously illustrated with excellent photographs, temperature charts, &c. Several other papers of pathological interest are included in the volume; also an account of rinderpest inoculation.

Another valuable report is on the gutta-percha industry and the various gutta-percha-producing trees, and is illustrated with a number of photographs of species of Palaquium and Payena, methods of collection of the gutta-percha, maps of geographical distribution, &c.

The final third of the volume contains the report of Mr. Charles Banks, the Government entomologist, and gives an account of the insect pests attacking the cacao. This, like the rest of the papers, is copiously illustrated with excellent photographs.

The volume reflects the greatest credit on the staff of the laboratory, but the complete omission of a table of contents and an index should be remedied in future issues.

R. T. HEWLETT.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—A chair of music has been established by an endowment of 10,000*l.* given for that purpose by Mr. Richard Peyton, of Birmingham. The chair has been accepted by Sir Edward Elgar; but the intention of the university authorities is by no means to interfere in any way with his work as composer, and he will be left free to develop the chair gradually and on such lines as he, in consultation with other members of the Senate, may think fit.

Dr. Arthur Robinson, of King's College, London, has been elected to the chair of anatomy, vacated by the appointment of Dr. Windle to the presidency of Queen's College, Cork. The new professor will assume office in January.

A new chair of electrical engineering has been established as a supplement to the lectureship in the same subject held by Dr. D. K. Morris. The first occupant of the chair will be Mr. Gisbert Kapp, now lecturer at Charlottenburg. He is not expected, however, to return to this country until the autumn of next year, and his appointment will not take effect until October, 1905. Meanwhile, and subsequently, Dr. Morris and his staff will continue their work as before. The new and large buildings for the department will be ready by that time. A competent assistant will have to be elected to assist Prof. Kapp in the drawing office for dynamo and central station design.

Prof. Burstall will continue to occupy his chair, the title of which will be changed to "Mechanical Engineering," and he will have control over a great engineering block and the power station.

It is not improbable that a special chair of civil engineering in the narrower sense will be established.

[1] Report of the Superintendent of Government Laboratories in the Philippine Islands for the Year ended September 1, 1903.

EDINBURGH.—Sir Donald Currie has subscribed the sum of 25,000*l.* toward the fund which is being raised by the university to enable a site to be purchased on which laboratories and other educational buildings could be erected, and for making further financial provision for an extension of the teaching staff and for the promotion of research in the university. To the principal, Sir William Turner, Sir Donald Currie stated that he wished the revenue from this money to be applied by the university court to the remuneration of a staff of lecturers, such as the authorities of the university might find it advisable from time to time to appoint. An option was also given to the university court to apply 5000*l.* of the amount towards the purchase of a site for the new laboratories, should it be necessary to use a portion of his gift for that purpose. In addition to this gift, subscriptions amounting to 15,000*l.* have been promised by other friends of the university.

ACCORDING to a report mentioned in *Science*, it is proposed to move the Western University of Pennsylvania from the suburbs of Allegheny to Pittsburg proper, near the new Carnegie Technical School. About fifty acres of ground, sufficient for twenty large university buildings, are being secured at a cost of about 400,000*l.*, and the work of construction will be begun before long. Fifty citizens of Pittsburg have agreed to give each from 8000*l.* to 20,000*l.* for the school. From the same source we learn that the general assembly of the State of Vermont has appropriated 12,000*l.* for the use of the agricultural department of the university. The money is to be expended in the erection and equipment of a building to be known as Morrill Agricultural Hall, in memory of the father of the agricultural colleges of the country, the late Senator Justin S. Morrill.

IT may be remembered that the authorities of University College, Sheffield, were informed by the committee of the Privy Council that, subject to a substantial realisation of the hopes entertained in connection with the movement for the establishment of a Sheffield University, their Lordships would be prepared in due course to recommend to His Majesty the grant of a charter. We learn from the calendar of the University College for 1904–5 that of the sum of 170,000*l.*, which efforts are being made to raise, 54,134*l.* has been promised since 1903. In addition, 52,908*l.* was promised in 1902 to the new buildings fund, so that some 107,042*l.* has been raised for higher education in Sheffield within a short period. It is to be hoped that little difficulty will be experienced in securing the amount which must be provided still before the University of Sheffield can be incorporated.

Two technical State scholarships have been just placed at the disposal of the local government of the Punjab, says the *Pioneer Mail*. These scholarships will enable natives of India to pursue a course of study in Great Britain or other western countries with the object of qualifying them to assist in promoting the improvement of existing native industries and the development of new industries wherever this may be possible. In the case of the Punjab the industries allowed to be taken up are tanning, metal-work, and pottery, and the local government has decided to confine its efforts to the first two, at any rate for the present. The value of each scholarship has been fixed at 150*l.* a year, and it will be tenable for two years, but it will be open to the Government of India to increase the value of any scholarship, and to extend the period during which it will be tenable. Commissioners and superintendents of divisions have been asked to make the scheme publicly known, and to enlist in its behalf the interest of the commercial classes.

THE annual prize distribution and students' conversazione at the Northampton Institute, E.C., was held last week, when the prizes and certificates were distributed by Lord Reay. The principal's report showed that the work of the institute has in several important departments overtaken the accommodation, and that there is urgent necessity for extension. A special note was made of the recent recognition of the work of the institute by the Board of Education; and the necessity for a "British Institute of Technical Optics" was pointed out. Lord Reay, in his address, dwelt upon the desirability of reviving, so far as modern conditions would allow, the old system of apprenticeship, and pointed out how the polytechnics and technical institutes could be made useful in connection therewith. The vote of thanks to Lord Reay was moved by Mr. Alexander Siemens. After the distribution the various laboratories and workshops were thrown open, and a series of lecturettes, exhibits, and demonstrations was given. The most interesting demonstration was perhaps that of a new submersible boat in the swimming bath. These boats, invented by Mr. Middleton, of Brighton, are propelled, directed, controlled, and governed by fins actuated by prime movers, in such a fashion that they can move any way in tri-dimensional space in the fluid in which they are immersed. By altering the inclination of the plane of the fins, these can be made to propel the boat forwards or backwards, to sink it below the surface, to raise it again, and, in fact, to direct it along any course, whether inclined to the horizontal or otherwise.

THE proceedings of the Institute of Chemistry of Great Britain and Ireland for 1904, which have now been published, show that the council of the institute has had under consideration the recommendations of the Consultative Committee to the Board of Education for a scheme of examinations for school certificates. It will be remembered that it is proposed that these school certificates should take the place of the many professional preliminary examinations now held; that a central board should be constituted for England, consisting of representatives of the Board of Education and of the different examining bodies, to control the standard of the examinations for school certificates; and that the proposed examinations should be under the control of independent external examiners, although conducted by internal and external examiners jointly. The council of the Institute of Chemistry has informed the Board of Education (*a*) that the council considers it desirable to substitute some such system as is proposed in lieu of the various professional preliminary examinations now held; (*b*) that if such a system be established, the council will be prepared to accept the proposed senior certificate examination, passed in the subjects required by the regulations of the institute; and (*c*) that the council will be pleased to be represented on the proposed central board. A scheme for school certificates submitted by the University of Birmingham has also met with the approval of the council of the institute, and it has also been decided to accept the matriculation examination held jointly by the Victoria University, the University of Liverpool, and the University of Leeds, as an approved preliminary examination, provided the certificate include the subjects required by the regulations of the institute.

A DEPUTATION from the Association of Chambers of Commerce of the United Kingdom waited upon Lord Londonderry, President of the Board of Education, on Monday to urge that increased Government aid should be given to higher technical and higher commercial education. The views of the deputation were expressed in the following resolution, which was passed at the meeting of the association on September 28, and was now laid before Lord Londonderry:—"That, in order to retain our industrial position and to introduce into this country such further industries as may be profitably developed, this association is of opinion that it is absolutely necessary to establish or acquire public secondary schools of the highest standard, where efficient means of such education do not exist, with fees low enough to make them accessible to all grades, and to provide sufficient inducements by bursaries, exhibitions, scholarships, or otherwise to make the efficient boys stay long enough in these schools in order to thoroughly train and adequately prepare a very much larger number than is at present available for taking full advantage of the provisions made for higher technical and higher commercial education, the facilities for which ought also to be largely extended and the standard considerably raised." In introducing the deputation, Sir W. H. Holland, M.P., said the chambers of commerce might be fairly taken to represent the organised commercial opinion of the country, and they were convinced that the Board of Education would encourage them to take a keen interest in secondary and technical education. Mr. Ivan Levinstein said the want of secondary education was the cause of our present most deplorable position. What we wanted, in the first instance, was a far larger number of high-class public secondary schools. We must be prepared to face a great financial sacrifice, for some years at any rate, if we were to put secondary education in this country on anything like the level it had reached in America, Switzerland, and Germany. After other speakers had put forward similar claims for consideration of the subject, Lord Londonderry, in reply, said that he felt the weight of the arguments put forward, but the opinions of his colleagues of the Board of Education and himself on this vitally important matter were expressed in such detail and so definitely in the reply forwarded by Mr. Morant to the chamber on September 26 (see NATURE, October 13, p. 595) that on the present occasion he proposed to devote attention rather to the question of commercial education than to that of technical education. The whole matter was one to which the Board were fully alive, and he was very glad to learn from the representations which they had made that day that there was on the part of the chambers of commerce a keen appreciation of the value of that special advanced instruction in the several sections of mercantile practice which the Board had felt it their duty to encourage in the evening schools serving the more important commercial communities.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 11.—"On Certain Properties of the Alloys of Silver and Cadmium." By Dr. T. K. **Rose.**

Attention was directed to these alloys on account of the advantages of using them as the material for trial plates for testing the fineness of silver coin and plate. An examination of the curves of equilibrium between the liquid and solid states of the alloys proved the existence of several compounds of silver and cadmium, some of which have already been recognised in other ways. Horizontal branches of the curve mark the solidification of the compounds Ag_3Cd_2, AgCd, and $AgCd_3$, and the solidification of Ag_2Cd_3 corresponds to a cusp on the curve of initial freezing points.

There is a strong tendency for mixtures of the compounds to form solid solutions. This is strikingly shown in the case of alloys containing more than 80 per cent. of silver. At temperatures in the short range of a few degrees between the initial and final freezing points of these alloys, two bodies exist side by side, but at a lower temperature they coalesce to form a single solid solution provided that sufficient time is allowed for complete mixing by diffusion. For example, in the standard alloy, which contains 7·5 per cent. of cadmium, solidification begins at about 945°, and is completed at about 913°. If the alloy is maintained at some temperature between these points a network of a silver-poor body is gradually formed surrounding crystals of a silver-rich body. If the alloy is subjected for some hours to a temperature a little below 913°, large crystals with regular boundaries are formed occupying the whole area of the field. These alloys are remarkably ductile.

The alloy corresponding to the formula Ag_2Cd is fine-grained and apparently homogeneous. If heated for some time to a temperature of 750°, somewhat below its point of solidification, the cadmium from the surface is volatilised, leaving a layer of pure silver. On removing this during the operation of polishing a black layer is met with, coloured by oxide of cadmium, and underneath this the original alloy is found to exist. The layers are not everywhere of the same thickness, so that in the course of polishing alternate rings of black and white are produced, resembling the well known Japanese decorative metal-work called Mokumé, which is used in jewellery.

The alloy containing about 50 per cent. of silver consists of crystals of a silver-rich body, often pinkish in colour, set in a white matrix composed of $AgCd_3$. The 40 per cent. alloy is a hard, brittle substance, the compound Ag_2Cd_3. As the percentage of silver decreases, a matrix, consisting mainly of $AgCd_3$, makes its appearance surrounding the crystals of Ag_2Cd_3, and specimens containing less than 25 per cent. of silver consist of crystals of $AgCd_3$ set in a matrix of cadmium.

Several similarities to the silver-zinc series of alloys have been noted.

November 24.—"The Refractive Indices of the Elements." By Clive **Cuthbertson.**

In a letter addressed to NATURE in October, 1902, attention was directed to the fact that the refractivities of the five inert gases of the atmosphere, He, Ne, A, Kr, and X, as determined by Ramsay and Travers, were, within narrow limits of accuracy, in the proportion of 1, 2, 8, 12 and 20; or, more simply, of $\frac{1}{4}$, $\frac{1}{2}$, 2, 3, and 5.

In a second letter it was shown that the refractivities of the halogens, Cl, Br, and I, stand also in the relation of 2, 3, and 5 to the same degree of accuracy; but it was pointed out that the figures for P, As, and S, as measured by M. Le Roux in 1861, did not show any similar relation; and it was observed that a re-determination of them would be interesting.

With a Jamin's refractometer, adapted for use with high temperatures, results have now been obtained for Hg, P, and S, which differ widely from those of M. Le Roux. The index of mercury, calculated for a molecule containing two atoms, is placed at 1·001857, a number which agrees closely with the value given by the refractive equivalent of Gladstone. The index of P_2 is found to be 1·001197, and that of S_2 is 1·001101.

In all three cases it is estimated that the margin of error does not exceed $1\frac{1}{2}$ per cent. Comparing these values for P_2 and S_2 with those of N_2 and O_2, it is shown that the simple relations found in the case of the inert gases and the halogens also hold in the case of nitrogen and phosphorus, oxygen and sulphur; and that an atom of phosphorus retards light four times as much as an atom of nitrogen, an atom of sulphur four times as much as an atom of oxygen.

Efforts have also been made to measure the index of fluorine in the gaseous state, but, owing to the experimental difficulties, success has not yet been attained.

It appears then, that, out of fourteen elements the index of refraction of which has been measured in the gaseous state, twelve conform to the rule that in each chemical group the refractivities of the elements are in the ratios of small integers. The other two, Hg and H, have no allied elements with which they can be compared.

It is pointed out that N, O, and Ne are each followed, in their respective families, by an element the refractivity of which is four times as great, and that, consequently, there are reasons for believing that the elements composing the series N, O, F, and Ne, and P, S, Cl, and A are, in some sense, homologous. Comparing the refractivities of the latter series we see that the power to retard light appears to be closely connected with the valency, increasing as it increases, in spite of the decrease in atomic weight, as shown in the following table:—

	Element			
	P	S	Cl	A
Atomic weight ...	31	32	35·5	40
Refractivity ...	299 × 4	275 × 4	192 × 4	141 × 4

The series Ne, O, N, show the same relation, and it is probable that the refractivity of C is even higher than that of N.

The refractivity of B, estimated from BCl_3 and BBr_3, is certainly very great; but whether it exceeds that of C there is not sufficient evidence to determine.

December 1.—"On the Structure and Affinities of Fossil Plants from the Palæozoic Rocks.—V. On a New Type of Sphenophyllaceous Cone (*Sphenophyllum fertile*) from the Lower Coal-measures." By Dr. D. H. **Scott,** F.R.S.

The class Sphenophyllales, of which the fossil described is a new representative, shows on the one hand clear affinities with the Equisetales, while on the other it approaches the Lycopods; some botanists have endeavoured to trace a relation to the ferns. The nearest allies among recent plants are probably the Psilotaceæ, which some writers have even proposed to include in the Sphenophyllales.

The new strobilus appears to find its natural place in the type-genus Sphenophyllum, as at present constituted, but it possesses peculiar features of considerable importance, which may probably ultimately justify generic separation. The specimen, of which a number of transverse and longitudinal sections have been prepared by Mr. Lomax, is from one of the calcareous nodules of the Lower Coal-measures of Lancashire, and was found at Shore Littleborough, a locality rich in petrified remains, now being opened up by the enterprise of the owner, Mr. W. H. Sutcliffe.

The close affinity of the strobilus with Sphenophyllum is shown by the anatomy of the axis, which has the solid triarch wood characteristic of that genus, and by the fact that the whorled sporophylls are divided into dorsal and ventral lobes, as in all other known fructifications of this class. But whereas, in all the forms hitherto described, the lower or dorsal lobes are sterile, forming a system of protective bracts, while the ventral lobes alone bear the sporangia; in the new cone, dorsal and ventral lobes are alike fertile, and no sterile bracts are differentiated. On this ground the name *Sphenophyllum fertile* is proposed for the new species.

Each lobe of the sporophyll divided palmately into several segments, the sporangiophores, each of which consisted of a slender pedicel, terminating in a large peltate lamina, on which two pendulous sporangia were borne. In the bi-sporangite character of the sporangiophores, and in other details of structure, *Sphenophyllum fertile* approaches the *Bowmanites Römeri* of Count Solms-Laubach, while in the form and segmentation of the sporophylls there is a considerable resemblance to the Lower Carboniferous genus Cheirostrobus.

The wall of the sporangium has a rather complex structure, the most interesting feature in which is the well defined small-celled stomium, marking the line of longitudinal dehiscence.

The spores, so far as observed, are all of one kind; they are ellipsoidal in form, with longitudinal crests or ridges; their dimensions are 90–96μ in length by 65–70μ in width.

The most characteristic point in the structure of the new cone—the fertility of both dorsal and ventral lobes of the sporophyll—is regarded as more probably due to special modification than to the retention of a primitive condition.

"On the Presence of Tyrosinases in the Skins of some Pigmented Vertebrates.—Preliminary Note." By Florence M. **Durham.**

An extract can be made from the skins of certain pigmented animals (rabbits, rats, guinea-pigs and chickens) which will act upon tyrosin and produce a pigmented substance. This action suggests the presence of a tyrosinase in the skins of these animals.

The action of the tyrosinase is destroyed by boiling, does not take place in the cold, is delayed by time, requires a temperature of about 37° C., and also the presence of an activating substance such as ferrous sulphate to start it.

The coloured substances produced are in accordance with the colour of the animals used. Black substances are obtained, when animals with black pigment in their skins are used, and yellow substance, when the skin contains the orange pigment. The coloured substances are soluble in alkalis, but insoluble in acids.

Anthropological Institute, November 22.—Mr. H. Balfour, president, in the chair.—Dr. Ed. **Westermarck** read a paper on the magic origin of Moorish designs. The designs are largely derived from charms against the evil eye. A Moor protects himself against the evil eye of another person by stretching out the five fingers of his right hand, saying, "five in your eye." The object of this gesture is to throw back the evil power, *l-bas*, which has emanated from the other person's eye. The number five by itself has thus come to be regarded as a charm against the evil look. This was illustrated by a number of lantern slides, showing charms, and designs grown out of charms. Silver amulets containing a double five grouped in the form of a cross, with a piece of blue glass as a common centre, are in frequent use. Magic efficacy is attributed to the cross, not only because it represents a five, but also, as it seems, because it is regarded as a conductor for baneful energy, which is dispersed by it in all the quarters of the wind. The double five is often represented as an eight-petalled rosette, or a double cross, with or without a well marked centre. By joining the extremities of the lines which form each of the two crosses, two intersecting squares are produced; they are probably intended to represent a pair of eyes. By painting over all the lines which fall within the two intersecting squares, or by hollowing the two squares, the artist produces an empty octagon. The two crosses may also be of different lengths, and then the joining of the extremities of each cross gives rise to two squares, of which the one is inscribed in the other. The tendency to produce the number five double as double five, an eight petalled rosette, a double cross, or a double square seems to be due to the fact that the protective gesture is sometimes performed both with the right and left hand. By doubling each petal in the eight-petalled rosette, the sixteen-petalled rosette has been produced. The image of an eye or a pair of eyes is also used to throw back the baneful energy emanating from an evil eye. The eye is sometimes represented as round, sometimes as a triangle (the two intersecting triangles seem to represent a pair of eyes), sometimes with a triangular eyebrow. A row of triangular eyes and eyebrows, or of eyebrows alone, is a common design on carpets.

Geological Society, November 23.—Dr. J. E. Marr, F.R.S., president, in the chair.—On an ossiferous cavern of Pleistocene age at Hoe-Grange Quarry, Longcliffe, near Brassington (Derbyshire): H. H. **Arnold-Bemrose** and E. T. **Newton,** F.R.S. The quarry is situated near the top of the plateau, at about 1100 feet above Ordnance-datum. The cave is evidently a master-joint in the limestone, enlarged by water, and, besides being a swallow-hole, has served as a hyæna-den. The large number of mammalian remains found includes lion, hyæna, rhinoceros, Elephas, and other Pleistocene forms; but, besides these, there were numerous bones and teeth of fallow-deer, mixed with the Pleistocene remains at all horizons in the cave. The physical conditions are such as to preclude, as the authors think, any idea of a re-deposition of the bones at any date subsequent to the Pleistocene period; and it is concluded, therefore, that the fallow-deer (*Cervus dama*) was a Pleistocene species, although hitherto supposed to be a much later introduction.—The superficial deposits and pre-Glacial valleys of the Northumberland and Durham Coalfield: D. **Woolacott.** Six volumes, published by the North-of-England Institute of Mining and Mechanical Engineers, contain a large number of borings made in the northern coalfield. A considerable proportion of these are most valuable in showing the nature and distribution of the superficial deposits. From them and from field-mapping it is possible to form a fairly accurate conception of the pre-Glacial floor of the district and its drainage, and also of the relative changes of level before, during, and after the Glacial period.

Zoological Society, November 29.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—Observations on the field natural history of the lion made during seventeen years of travel and residence in Central Africa: Captain Richard **Crawshay.**—Some nudibranchs from East Africa and Zanzibar, part vi.: Sir Charles **Eliot.** The paper contained an account of thirty species and varieties, of which eight of the former and one of the latter were described as new.—Some photographs of giraffes and a zebra taken from pictures in the art collection at Windsor Castle, and an old print of a zebra dated 1762: R. **Lydekker.** Mr. Lydekker was of opinion that the picture and print of the zebra had been taken from the same animal.—Two specimens of lorises, one a slow loris (Nycticebus) and the other a slender loris (Loris), recently acquired by the British Museum: R. **Lydekker.** The latter specimen was pointed out to be sufficiently different from the typical *L. gracilis* to be entitled to subspecific rank.—The morphology and classification of the Asellota group of crustaceans, with descriptions of the genus Stenetrium and its species: Dr. H. J. **Hansen.**—The lizard *Lacerta depressa* of Camerano and its varieties: G. A. **Boulenger,** F.R.S. A small collection of fresh-water Entomostraca from South Africa: R. **Gurney.** The collection comprised examples of five species, three of which were described as new.—The cranial osteology of the Egyptian mastigure (*Uromastix spinipes*): F. E. **Beddard,** F.R.S.

Chemical Society, December 1.—Prof. W. A. Tilden, F.R.S., in the chair.—The nitrites of the alkali and alkaline earth metals and their decomposition by heat: P. C. **Rây.** These nitrites are shown to be comparatively stable, and their aqueous solutions can be evaporated to dryness without decomposition or oxidation taking place. When barium nitrite is heated it is first converted into barium oxide and barium nitrate, the latter finally also being decomposed into baryta.—Metallic derivatives of nitrogen iodide and their bearing on its constitution: O. **Silberrad.** Guyard's supposed copper derivative of nitrogen iodide is shown to be a cuprosamine periodide. The silver derivative described by Szuhay is found to be a true nitrogen iodide derivative of the formula NI_3,NH_2Ag.—Synthesis of 1:1-dimethylhexahydrobenzene: A. W. **Crossley** and Nora **Renouf.**—The formation and reactions of imino-compounds, (i.) condensation of ethyl cyanoacetate with its sodium derivative: H. **Baron,** F. G. P. **Remfry,** and J. F. **Thorpe.** This is a preliminary communication regarding the properties of compounds containing the group —C(=NH)—, which in some respects closely resembles the =CO group in reaction.—The affinity constants of aniline and its derivatives: R. C. **Farmer** and F. J. **Warth.** These constants are best measured in such cases by determining the distribution of the salts between two immiscible solvents applied simultaneously. The following substituents exert a decreasing electronegative action, in the order in which they are given, on the affinity constant of aniline:—NO_2,COOH,—N=NPh,Br,Cl,Me,OMe. — The attractive force of crystals for like molecules in saturated solutions: E. **Sonstadt.** Crystals of a salt were placed in saturated solutions of the same salt, and the amount of the latter withdrawn from the solution by the attractive force of the crystals was determined periodically.—The Grignard reaction applied to the esters of hydroxy-acids: P. F. **Frankland** and D. F. **Twiss.** A substance which is probably $\alpha\alpha\delta\delta$-tetraphenylerythritol was obtained by the action of magnesium phenyl bromide on dimethyltartrate.—Note on the addition of hydrogen cyanide to unsaturated compounds: A. **Lapworth.** It is shown that in spite of Knoevenagel's assertion to the contrary, there is no experimental evidence that mesityl oxide unites directly with hydrogen cyanide except in the presence of alkalis. The author is now engaged in the examination of a number of products obtained by the interaction of aldehydes with chloroacetates in presence of potassium cyanide.

Mathematical Society, December 8.—Prof. Forsyth, president, in the chair.—The following papers were communicated:—On a deficient multinomial expansion: Major **MacMahon.** A generalisation of the binomial theorem, made by Abel and restated by Cayley, leads to the consideration of the series that is obtained from an ordinary multinomial expansion by restricting the indices of the terms to obey certain Diophantine inequalities. The paper contains investigations of the number of terms in such a series, the sum of the coefficients, and a syzygetic theory of the distinct terms.—The application of basic numbers to Bessel's and Legendre's functions: Rev. F. H. **Jackson.** The author generalises various functions that are expressed by power series by replacing n in the coefficient of x^n by $(p^n-1)/(p-1)$. Two generalisations are obtained of Bessel's functions, one being derived from the other by inversion of the "base" p. In the present paper the author shows that these two functions are connected by a relation containing basic exponential functions. He obtains also generalisations of a number of results which bear on the relations between Legendre's functions and Bessel's functions, and he connects the theory of the generalised Legendre's functions with that of the Theta functions.—On groups of order $p^\alpha q^\beta$: Prof. W. **Burnside.** In a previous paper the author had proved that these groups are soluble. In the present paper it is shown that, subject to certain specified exceptions when the order is even, a group of the specified order in which $p^\alpha > q^\beta$ must have a characteristic subgroup of order p^a, where a is such that p^a is greater than $p^\alpha q^{-\beta}$.—On the failure of convergence of Fourier's series: Dr. E. W. **Hobson.** Fourier's series formed for a continuous function may not converge at a point, and then it does not represent the function at the point. In the paper attention is directed to a class of series which fail to converge, but can be made to converge to any assigned value by enclosing suitable sets of terms in brackets and treating the terms in a bracket as a single term. No example has ever been found of a non-convergent Fourier's series which cannot be included in this class. The nature of the set of points in the periodic interval at which a Fourier's series fails to converge is discussed, and it is shown that, when the function to be represented by the series is continuous, this set has the "measure" zero.—An extension of Borel's exponential method of summation of divergent series applied to linear differential equations: E. **Cunningham.** The object of the paper is to make more precise the connection between Laplace's solution of linear differential equations in terms of definite integrals and the asymptotic expansion of the solution as the product of an exponential function and a descending power series. The latter series, with the exponential factor omitted, is shown to be "summable" in a sense analogous to that of Borel's theory; and it is proved that the fundamental properties of summable divergent series, such as differentiation term by term, addition and multiplication term by term, are valid for the series in question.—On the linear differential equation of the second order: Prof. A. C. **Dixon.**

CAMBRIDGE.

Philosophical Society, November 14.—Prof. Marshall Ward, president, in the chair.—The charge of the α rays from polonium: Prof. **Thomson,** F.R.S. A bismuth disc covered with polonium (or radio-tellurium), as supplied by Sthamer, was mounted on pivots in a vacuum tube. In front of the disc and about 3 cm. from it was a very carefully insulated gold-leaf electroscope which could be charged with either positive or negative electricity. The vacuum tube was exhausted by first pumping out as much air as possible by a mercury pump, and then using Dewar's method of extracting the remainder of the air by dense charcoal cooled by liquid air. In this way vacua were obtained very much superior to those got by pumping alone. It was found that at these very low vacua the electroscope in front of the polonium if negatively charged leaks so slowly that it is hardly possible to measure the leak with accuracy; while if the electroscope is positively charged its leak is very rapid, certainly more than 100 times the leak when charged negatively. Thus the polonium gives out large quantities of negative electricity, but not enough positive to be detected; this is very remarkable, as polonium is generally supposed to give out nothing but α rays. In order to see that the positive electricity had not been swamped by the negative the instrument was placed in a strong magnetic field; this stopped the negative corpuscles coming out of the polonium from reaching the electroscope, and it was found that now the latter no longer leaked when charged with positive electricity; but though the negative particles had been stopped no positive ones could be detected, for there was no leak from the electroscope when negatively electrified. The author was never able to be sure of any *increase* in the charge of a negatively electrified body placed near the polonium; this he thinks is due to the negative particles from the polonium moving so slowly that they are unable to make headway against the repulsion exerted by a negatively electrified body. The α rays of polonium are deflected by a magnet, hence they must be positively charged at some part, at any rate, of their course, yet no trace can be found of this charge when the rays strike against an electroscope. The question is discussed whether the α particles lose their charge when they pass through the cloud of negative ones near the polonium, or whether they are alternately charged and discharged, the time during which they are uncharged being much longer than the time they are charged.—On the dynamical significance of Kundt's law of selective dispersion in connection with the transmission of the energy of trains of dispersive waves: Prof. **Larmor,** F.R.S.—The chlorination of α picoline: W. J. **Sell,** F.R.S.—An attempted synthesis of uric acid: H. J. H. **Fenton,** F.R.S.—The diffusion of hydrogen through palladium: O. W. **Richardson.** The paper is chiefly a criticism of the conclusions drawn by Mr. G. N. St. Schmidt (*Drude's Ann.*, vol. xiii. p. 747) from his experiments on this subject. The author shows that the known facts can be explained on the hypothesis that the hydrogen inside the metal is dissociated, in the same way as for platinum.—Optically active nitrogen compounds: Miss M. B. **Thomas** and H. O. **Jones.** The work was undertaken in order to find out what connection exists between the constitution of optically active nitrogen compounds and the numerical value of their rotatory power. The rotation for a basic ion may be determined by preparing the salt with an acid of known rotatory power, and subtracting the rotation due to the acidic ion from the total rotation of the salt in aqueous solution. The series of substituted ammonium salts under investigation contain the phenyl, benzyl, and methyl radicals with ethyl, *iso*propyl, *iso*butyl or *iso*amyl. The paper contains a brief account of the resolution of the *iso*propyl compound by means of its dextro-brom-camphor-sulphonate.

DUBLIN.

Royal Dublin Society, November 15.—Dr. R. F. Scharff in the chair.—Prof. T. **Johnson** gave an account of a disease of swedes which has caused considerable loss in different parts of Ireland, especially in the west. The small leaves become "spotted," turn yellow, and fall off. The attack is due to *Cercospora Bloxami*, Berk. and Br., which causes disease in swedes in Germany and Switzerland. Associated with the Cercospora from different localities, the author found a Phoma-stage, suggestive of *Phoma Brassicae*, Thüm., and in one locality, associated also with Cercospora, *Pleospora herbarum*, *β Brassicae* (Lasch), Sacc. The swede disease shows a curious parallelism with the disease of the sweet chestnut investigated by Berlese in Italy, where Cercosporella, Phoma or Phyllosticta, and Sphærella stages are associated.—Prof. W. F. **Barrett**, F.R.S., read a paper on a method of protecting the hands of the operator from X-ray burns. The author stated that in taking some radiographs of surgical cases during the first three months of 1896 (shortly after Röntgen's discovery) he noticed the extreme opacity to the X-rays of any bandages which contained a dressing of iodoform. This led to a series of experiments on the relative transparency of bodies to the X-rays, and it was discovered, early in March, 1896, that all bodies of high molecular weight, such as iodoform, were opaque to these rays. If, then, the burns produced by the X-rays be due to those rays which cannot penetrate a layer of iodoform, it is easy to construct gauntlets with an inner lining filled with iodoform which would entirely protect the hands of the operator. Such gloves would be far more flexible and far lighter than gloves with a lead lining. The author added to his paper an historical note on the relative transparency of bodies to the X-rays, giving a brief summary of the work done.

MANCHESTER.

Literary and Philosophical Society, November 15.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—Dr. W. E. **Hoyle** exhibited specimens of certain rare Cephalopoda:—(1) *Ancistrochirus lichtensteini* from the Maldive Archipelago, the type specimen in the Paris Museums being the only one previously known. (2) A species of Cirroteuthis from the neighbourhood of the Cape of Good Hope, beautifully preserved in formol, and exhibiting the gelatinous appearance and rounded stumpy form of the animal in a way never seen in examples preserved in alcohol. (3) Section of an octopod embryo from Zanzibar showing a number of peculiar chitinous rods in the epithelium.—Mr. F. **Nicholson** communicated a note on the mistaken idea that birds are seed-carriers, in which the author stated that he had found no evidence from his own observations, extending over many years, that entire seed can pass through a healthy bird. In confirmation of this view Mr. Nicholson quoted two passages from Macgillivray's "A History of British Birds," in which the author states that of many hundreds of berry-eating and seed-eating birds which he had opened there were only two which showed the presence of whole seed in their intestines, and these two were in all probability cases of diseased action.—Mr. R. W. **Ellison** exhibited a number of birds' eggs, including specimens of the following:—the great black-backed, the lesser black-backed, the herring, and black-headed gulls, the Sandwich and lesser terns, the ring sand plover, and the guillemot. The selection was made with the view of demonstrating certain facts as to the coloration of the eggs and its relation to that of their surroundings.

PARIS.

Academy of Sciences, December 5.—M. Mascart in the chair.—On the general formula giving the number of double integrals of the second species in the theory of algebraic surfaces: Émile **Picard**.—On the nepheline rocks of Tahiti: M. **Lacroix**. A detailed examination of a series of rocks from Tahiti constitutes a continuous series from a petrographical point of view, in which the mineralogical variations are essentially the result of an increase in the amount of lime, iron, and manganese, accompanied with a corresponding reduction in the amount of silica and alkalis.—On differential equations of a parabolic type: Vito **Volterra**.—Observations on the Perseids for 1904, and the determination of their heights above the ground: V. **Fournier**, A. **Chaudot**, and G. **Fournier**. The observations were carried out on the nights between August 9 and 16. 274 meteors were registered, 180 of which were Perseids. Only 27 of these were of the first magnitude, the greater part being of the third or fourth order. With the view of determining the heights of some of the meteors simultaneous observations were carried out on the night of August 16 at Rouvray and at Morvan (Côte d'Or), two stations 10·1 kilometres apart. 32 shooting stars were noted at the first station, and 52 at the second, 13 of these being common to both, and of these 4 have been reduced. The height at the first appearance varied from 107 to 283 kilometres, at disappearance from 35 to 66 kilometres, and the length of the trajectory from 56 to 245 kilometres. The average height for the first appearance was 168 kilometres, and of disappearance 53 kilometres, these figures being greater than those obtained by M. Chrétien in 1901.—On groups of the order p^m(p prime, $m>4$) of which all the divisors of the order p^{m-2} are Abelian: M. **Potron**.—The design of high-speed vessels: Vice-Admiral **Fournier**.—On telestereoscopy: Paul **Helbronner**. The object of the experiments was, whilst preserving the strong magnification of the telescope objective, to get the details standing out in clear relief. The arrangement described has been used in geodesic work in the French Alps, and has been found very useful.—Researches on dielectric solids: V. **Crémieu** and L. **Malclès**. By means of a quantitative study of the phenomena described qualitatively in a previous note, the diminution of electrical influence through solid dielectrics by the production in the dielectric of a reactive charge is clearly established.—Experiments permitting of the demonstration of the n-rays: H. **Bordier**. With the view of removing objections to the purely subjective experiments which are used for the detection of the n-rays, the author has applied with success a photographic method, very long exposures being employed on account of the feeble intensity of the light emitted.—On the composition of colloidal granules: Victor **Henri** and André **Mayer**. The composition of the colloidal granules of copper ferrocyanide studied by J. Duclaux may be considered as a particular case of the phenomenon of adsorption. The granules may be looked upon as formed by copper ferrocyanide which has adsorbed a certain quantity of potassium ferrocyanide. It is not necessary that compounds of indefinite chemical composition should be assumed.—The action of methylene chloride upon toluene in the presence of aluminium chloride: James **Lavaux**. It is shown that the ditolylmethane and dimethylanthracene isolated by previous workers on this reaction are mixtures. From the former the author has isolated dimeta- and dipara-ditolylmethane, and β-methylanthracene, and from the latter three isomeric dimethylanthracenes.—On the retrogradation of some cyclic secondary amines: P. **Lemoult**. Amines of the type R—NHR′ on heating with PCl_5 give some of the primary amine RNH_2, together with R′Cl. The reaction was best marked with the methylanilines.—On the organic combinations of metals in plants: MM. **Schlagdenhauffen** and **Reeb**.—On the synthesis and chemical nature of sorbierite: Gabriel **Bertrand**. It is shown synthetically that the sorbierite described by the author in a previous paper is identical with the d-idite of Fischer and Fay.—The biological *rôle* of the diffusion of liquids: Stéphane **Leduc**.—Researches on the germination of the spores of some yeasts: A. **Guilliermond**.—On the anatomical modifications which are produced in the course of the evolution of certain rhizomes: André **Dauphiné**.—Biospeleology: Armand **Viré**. A discussion of the bearing of the evidence of the animals found in caves on the theory of evolution.—Osmotic communication between the vital and exterior media in certain marine Selacian fishes: René **Quinton**.—*Lernaeenicus Sprattae*, a parasite of the sardine on the coasts of Vendée: Marcel **Baudouin**.—The action of calcium permanganate on alkaloids, and in particular on strychnine: G. **Baudran**.—The nutritive value of cows' milk, sterilised at 108° C., for artificial feeding: G. **Variot**. As the result of work carried on over a period of twelve years, on an average of 150 to 200 infants daily, the conclusions are drawn that milk sterilised at 108° C. preserves all its nutritive value, and is in no way inferior to milk pasteurised at 80° C. or simply heated to 100° C. No appreciable decrease in the readiness with which the milk was assimilated could be noticed, and not a single case of infantile scurvy occurred. The percentage of infants incapable of utilising sterilised milk was between 3 per cent. and 4 per cent.

NEW SOUTH WALES.

Royal Society, October 5.—Mr. C. O. Burge, president, in the chair.—Ethnological notes on the aboriginal tribes of New South Wales and Victoria: R. H. **Mathews**.—Preliminary observations on radio-activity and the occurrence of radium in Australian minerals: D. **Mawson** and T. H. **Laby**. A brief summary of observations on the radio-activity of minerals and occurrence of radium is given, showing that comparatively intense activity is only found associated in minerals with thorium and uranium. A torbernite and euxenite were found highly active, but the specimens were too small to examine for radium. A Western Australian gadolinite, found by Prof. Norman Collie to contain one bubble of helium in ten grams, was expected to contain radium, but none could be detected. Twelve monazites were found radio-active; one, with double the average activity of the others, from Pilbarra, Western Australia, gave on heating the radium emanation; five monazite and zircon sands were also active. No relation between thoria contents and activity was found, which points to the presence of uranium.—The flood deposits of the Hunter and Hawkesbury Rivers: Prof. F. B. **Guthrie** and Prof. T. W. Edgeworth **David**.

CAPE TOWN.

South African Philosophical Society, September 28.—Dr. J. D. F. Gilchrist, president, in the chair.—A new South African cypress, *Callitris schwarzii*, Marl.: Dr. R. **Marloth**. The two species of cypress hitherto known from South Africa belong to the genus Widdringtonia, which, however, is now mostly merged into the genus Callitris. Until recently only one other species of Widdringtonia was known, viz. *W. Commersoni* from Madagascar, but lately a fourth species has been found by Whyte on the Shire Highlands, called by Sir H. H. Johnston the Malanje cedar. The South African species are *C. juniperoides*, the so-called Cape cedar, and *C. cupressoides*, the saprechout. The former is a tree from 30 to 40 feet high, and occurs only on the Cedar Mountains, while the latter is only 10 to 12 feet or rarely 15 feet high, but is common on all the mountains of the south-western districts. When recently the author heard that some "Sapree" trees in the Baviaanskloof Mountains were 50 to 60 feet high, he suspected at once that this must be a different species, and an examination of some ripe cones proved that this tree is quite distinct from the common *C. cupressoides*.—The Glacial conglomerate in the Table Mountain series near Clanwilliam: A. W. **Rogers**. This communication is an extension of one read before the society in 1901. The conglomerate with glaciated pebbles has now been traced through a distance of about 23 miles near Clanwilliam.—South African Verbenaceæ, supplementary note: H. H. W. **Pearson**.—Further note on factorisable continuants: Thos. **Muir**.—South African Hymenoptera: P. **Cameron**.—On the structure of the endothiodont reptiles: R. **Broom**.

October 26.—Sir David Gill, K.C.B., F.R.S., vice-president, in the chair.—The rocks of Tristan d'Acunha, brought back by H.M.S. *Odin*, Commander Pearce, R.N., and their bearing on the question of the permanence of ocean basins: E. H. L. **Schwarz**. Through the courtesy of Commander Pearce, of H.M.S. *Odin*, a number of specimens were recently obtained for the South African Museum from the island group of Tristan d'Acunha. The islands are described in the *Challenger* reports, and from the accounts published in them it is evident that while Inaccessible Island and Tristan d'Acunha itself are ordinary volcanic islands, Nightingale Island is a gigantic agglomerate neck like those that the author has described from Griqualand East, on the flanks of the Drakensberg Mountains. Two rocks of a type unusual to volcanic islands were brought back by the expedition; one was a white mica and biotite gneiss from Tristan d'Acunha, the other a lava containing foreign fragments from Nightingale Island.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 15.

ROYAL SOCIETY, at 4.30.—On the Ultra-violet Spectrum of Gadolinium: Sir William Crookes, F.R.S.—An Analysis of the Results from the Falmouth Magnetographs on "Quiet" Days during the Twelve Years 1891 to 1902: Dr. C. Chree, F.R.S.—The Halogen Hydrides as Conducting Solvents. Part iii. Preliminary Note: B. D. Steele.—The Halogen Hydrides as Conducting Solvents. Part iv. Preliminary Note: B. D. Steele, D. McIntosh, and E. H. Archibald.—Effects of Temperature and Pressure on the Thermal Conductivities of Solids. Part i. The Effect of Temperature on the Thermal Conductivities of some Electrical Insulators: Dr. C. H. Lees.—The Basic Gamma Function and the Elliptic Functions: Rev. F. H. Jackson, R.N.—On the Normal Series satisfying Linear Differential Equations: E. Cunningham.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Discussion on Mr. Searle's Paper, Studies in Magnetic Testing; Followed by The Combination of Dust Destructors and Electricity Works, Economically Considered: W. P. Adams.

LINNEAN SOCIETY, at 8.—The Ecology of Woodland Plants: Dr. T. W. Woodhead.—Experimental Studies on Heredity in Rabbits: C. C. Hurst.

FRIDAY, DECEMBER 16.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Heat Treatment Experiments with Chrome-Vanadium Steel: Capt. H. Riall Sankey and J. Kent-Smith.—Messrs. Seaton and Jude's Paper on Impact Tests on the Wrought Steels of Commerce will be discussed.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Folkestone Harbour: Cylinder-Sinking at the Root of the Old Pier: R. H. Lee Pennell.

MONDAY, DECEMBER 19.

SOCIETY OF ARTS, at 8.—Musical Wind Instruments, Flutes: D. J. Blaikley.

INSTITUTE OF ACTUARIES, at 5.—On the Retrospective Method of Valuation: Frederick Bell.

FARADAY SOCIETY, at 8.—The Electric Furnace; its Origin, Transformation, and Applications. Part ii.: A. Minet.—Electrolytic Analysis of Cobalt and Nickel: F. Mollwo Perkin and W. C. Prebble.—(1) The Electrolytic Preparation of Tin Paste. (2) Note on the Electrolytic Recovery of Tin: F. Gelstharp.

TUESDAY, DECEMBER 20.

ROYAL STATISTICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion* on the Construction of a Concrete Railway-Viaduct: A. Wood-Hill and E. D. Pain.

WEDNESDAY, DECEMBER 21.

GEOLOGICAL SOCIETY, at 8.—Certain Genera and Species of Lytoceratidæ: S. S. Buckman.—(1) The Leicester Earthquakes of August 4, 1893, and June 21, 1904. (2) The Derby Earthquakes of July 3, 1904. (3) Twin-Earthquakes: Dr. C. Davison.

ROYAL MICROSCOPICAL SOCIETY, at 8.—The Theory of Highly Magnified Images: J. W. Gordon.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Discussion of Mr. F. J. Brodie's paper, Decrease of Fog in London during Recent Years. Followed by The Study of the Minor Fluctuations of Atmospheric Pressure: Dr. W. N. Shaw, F.R.S., and W. H. Dines.

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THURSDAY, DECEMBER 22, 1904.

A ZOOLOGICAL TRIBUTE.

Mark Anniversary Volume. To Edward Laurens Mark, Hersey Professor of Anatomy and Director of the Zoological Laboratory at Harvard University, in Celebration of Twenty-five Years of Successful Work for the Advancement of Zoology, from his former Students, 1877–1902. Pp. xix+513; 36 plates and portrait. (New York: Holt and Co., 1903.)

THIS stately volume is a tribute to a notable personality in the history of American zoology. It has been inspired by the affection and loyalty of about one hundred and fifty of his former students, twenty-six of whom contribute the memoirs which fill its 500 quarto pages. To their esteemed master, these students—now themselves in many cases well known teachers and investigators—express their gratitude for his rigorous discipline in methods of work, for his critical skill, and for his stimulating sympathy. They recall with pride the service that was done to science by the publication of Mark's work on the maturation, fecundation, and segmentation of the egg of Limax—

"a work that introduced into America the then new cytological methods in the application of which this country has since reached an elevated position. It likewise introduced into zoology a proper fulness and accuracy of citation and a convenient and uniform method of referring from text to bibliography. It marked a step forward, also, in thoroughness and detail, and in the full recognition that, even in zoology, as in physics and chemistry, method is hardly less important than matter."

The tribute of twenty-five memoirs is one to make a teacher proud, especially as they exhibit many of the features which have distinguished his own work.

Seitaro Goto leads off with a description of a new Craspedote medusa—*Olindioides formosa*, n.g. et sp., from Misaki, like Haeckel's Olindias in some ways, yet strikingly different, *e.g.* in having six radial canals instead of four. Along with Gonionema and Halicalyx, Olindiopsis and Olindias represent the subfamily Olindiadæ, which must rest meanwhile under the Eucopidæ among the Leptomedusæ. H. S. Pratt describes four new Distomes—a new genus (Ostiolum) from the frog, related to Hæmatotœchus of Looss, and three new species of Renifer (=Styphlodera) from the mouth and air passages of common North American snakes. W. A. Locy takes us into a different domain in elaborating his discovery (1899) of a "new nerve" in Selachians, which arises on the dorsal summit of the fore-brain, before and apart from all other olfactory radices, and runs to the olfactory epithelium. A similar nerve has been recorded in Protopterus by Pinkus, and in Amia by Allis; elsewhere it has remained undetected. Jacob Reighard takes us into the open air in his fascinating and most instructively careful study of the breeding habits of *Amia calva*. The sexes differ obviously in colour, but spawning is usually at night; there are about three times as many males as females on the spawning ground; the male builds the nest, guards and defends it; he excites the female by biting and rubbing; he may induce two females at different times to spawn in the same nest; he leads the young black larvæ forth, re-unites the school when it loses scent, and guards them until they begin to assume orange and green hues; he is a model of paternal care.

Charles A. Kofoid describes an interesting Opalinid, *Protophrya ovicola*, the least specialised member of the family, which he found in the brood-sac of *Littorina rudis*. An interesting item is the presence of a micronucleus, which has only been observed in one other Opalinid, *Anoplophrya branchiarum*. It is obvious that the question of the micronucleus in Opalinids should be looked into, and that this new genus should be searched for in other localities. The next memoir brings us back to "new-fangled" methods, for C. B. Davenport compares a lot of Pectens from Tampa, Florida (*Pecten gibbus*, var. *dislocatus*), with another lot from San Diego, California (*Pecten ventricosus*). These are closely analogous species, and if environmental facts are similar, the variability should be the same. But in all the proportions measured, the San Diego Pectens show themselves from 50 per cent. to 100 per cent. more variable than those of Tampa. The San Diego forms represent a plastic race in a varied present environment. It seems to us that the concepts of variability and modifiability must be analysed out before such statistics as those offered in this memoir can be of much value in ætiological discussion. Observed differences have to be recorded, but it is only when demonstrable modificational differences are subtracted from the observed differences that we can draw secure conclusions as to variability in the strict sense. Gertrude Crotty Davenport discusses the longitudinal division and fragmentation of the sea-anemone *Sagartia luciae*, and shows that numerous intermediate forms may occur while the individuals are always tending by means of regeneration in the direction of twelve stripes and forty-eight mesenteries. Again, we must emphasise the desirability of distinguishing between modificational and variational divergences from the norm of the species.

Frank W. Bancroft describes an interesting seasonal modification of the compound Ascidian *Botrylloides gascoi*; the colony died down and the zooids degenerated, but with the assistance of a "yellow lobe" containing no zooids recuperation was effected. Carl H. Eigenmann discusses another mode of degeneration in telling the whole history of the eyes of the blind Amblyopsid fishes. The foundations of the eye in the embryos, which develop in the gill-cavity of the adult, are normally laid, but the stages beyond the foundations are cœnogenetic or direct; in fact, there is a developmental degeneration corresponding to the degeneration of the eye in the adult. Somewhat surprising is H. P. Johnston's account of three fresh-water Nereids—*Nereis limnicola*, n.sp., *Lycastis hawaiiensis*, n.sp., and *Lycastroides alticola*, n.g. et sp.—from indubitably fresh-water habitats. The author discusses the conditions which will admit of marine forms becoming denizens of fresh water, and gives a useful synopsis of recorded cases of fresh-water Polychæta. Then follows an interesting study in ethology, H. R. Linville's account of the tube-formation in *Amphitrite ornata* and *Diopatra cuprea*, the particular point of which is the minute adaptations of structure to function, an illustration of a kind of research which is always welcome and valuable.

W. E. Ritter discusses the structure and affinities of a new type of Ascidian from the Californian coast, which he calls Herdmania after a well known ascidiologist. The colony is composed of crowded but entirely free zooids arising by budding from short, much branched, closely interwoven stolons. The zooid is long and narrow, with three regions—thoracic, digestive, and cardiogenital. It is quite unique in having two epicardiac tubes, separate throughout their length; the oviduct serves as a uterus in which the embryos go through their development to nearly the period of metamorphosis; there is a peculiar grouping of the numerous branchial tentacles. It seems to be a divergent offshoot from the Polyclinid branch. R. M. Strong brings us back to a familiar subject and an old problem; he analyses the iridescence or metallic coloration of the dorsal surfaces of the distal portions of the feathers from the sides of the neck of grey domestic pigeons. The coloration is not due to diffraction, and Gadow's refraction-prism hypothesis will not work. The colours are probably thin-plate interference colours or Newton's rings, effects which are produced where spherical pigment granules come in contact with the outer transparent layer. C. R. Eastman takes us back to Palæozoic sharks, showing that the much-debated Edestus fossils are genuine teeth, and represent a stage in an interesting evolution series from Campodus to Helicoprion. We can hardly do more than refer to H. V. Neal's careful study of the development of the ventral spinal nerves in Selachians, but we may note that while the neuraxones of these nerves develop like those of Amniota as processes of neuroblast cells, there is a migration of medullary cells in early stages of development, which, though they take no part in the formation of the neuraxones or ganglia of the ventral nerves, participate in the formation of the nerve-sheaths, which have usually been regarded as of mesenchymatous origin.

H. S. Jennings elaborates his interesting thesis that the asymmetry of most flagellate and ciliate Infusorians, as also of the Rattulid Rotifera, is correlated with the habit of swimming in spirals. The spiral course is the simplest device for permitting an unequally balanced organism to progress in a given direction through the free water, and the method of reaction to most stimuli is closely correlated with the unsymmetrical or spiral type of structure. Rolfe Yorke contributes a study of the nerve cells of the cockroach and of the substance within these that seems to correspond to the chromophilous material in the nerve cells of higher animals. R. M. Yerkes shows by elaborate experiments that *Daphnia pulex* is strongly positively phototactic to all intensities from 0 to 100 candle-power, and is negatively thermotactic at a temperature of about 28° C.

In a very interesting paper on Mendel's law and the heredity of albinism, W. E. Castle and G. M. Allen show that complete albinism, without a recorded exception, behaves as a recessive character in inheritance, and that the facts are in general accord with Mendelian principles. P. E. Sargent discusses the structure and functions, development and phylogeny of that archaic portion of the mesencephalic roof known as the torus longitudinalis which is characteristic of Teleosts. T. G. Lee attacks a not less difficult problem —the implantation of the ovum in the gopher, which he finds to be quite unique as regards the nature and history of the pre-placental "fixation-mass" formed by the trophoblast. J. H. Gerould makes a comparison of the early stages of Sipunculus and Phascolosoma, and seeks to show that the "serosa" of the former represents the remains of a degenerating prototroch equivalent to that of the latter, which is in turn homologous with the primitive condition seen in mesotrochal Annelids.

G. H. Parker takes us once more into the open air in his study of the positive and negative phototropism of the mourning-cloak butterfly (*Vanessa antiopa*). It is interesting that the negative phototropism is only seen in intense sunlight and after the butterfly has established a certain state of metabolism by flying about for a while, and that the position assumed in negative phototropism exposes the colour patterns of the wings to fullest illumination, and has probably something to do with bringing the sexes together during the breeding season. Ida H. Hyde presents a new interpretation of the structure of the eye of Pecten, supplementing and correcting previous descriptions. The long series of memoirs ends with one by H. B. Ward on the larvæ of *Dermatobia hominis* —an Oestrid or bot-fly, widely distributed in America, though not in the States, which occurs commonly in the skin of cattle, pigs, and dogs, and less frequently in some other creatures, including—unfortunately—man.

We cannot conclude our rapid review of this huge volume without directing attention to the great range of zoological territory which the memoirs cover, to the high standard of workmanship which they exhibit, and to the unanimity with which the various authors recognise their indebtedness to their master, Edward Laurens Mark.

J. A. T.

SYNTHESIS OF VITAL PRODUCTS.

The Chemical Synthesis of Vital Products, and the Inter-relations between Organic Compounds. By Prof. Raphael Meldola, F.R.S. Vol. i. Hydrocarbons, Alcohols and Phenols, Aldehydes, Ketones, Carbohydrates and Glucosides, Sulphur and Cyanogen Compounds, Camphor and Terpenes, Colouring-matters of the Flavone Group. Pp. xvi + 338. (London: E. Arnold, 1904.) Price 21s. net.

IN spite of the long and daily increasing list of successful chemical syntheses of substances which are primarily produced as the result of processes occurring in living organisms, one constantly hears from physiologists the complaint that the synthetic work of chemists, wonderful as it may be in itself, throws no light on the biochemical problem of how the same substances are generated in the bodies of plants or animals. The points of view of the organic chemist and the physiologist are entirely distinct. The chemist, in studying a biochemical product, starts by dissecting it into a number of known atomic groups, and when this analytic work is complete, he seeks to confirm his conclusions as to the constitution of the substance by piecing these atomic groups together again, so as to reproduce the substance synthetically. In accomplishing the latter part of his task, the question of imitating biochemical conditions never even occurs to him, inasmuch as for his purpose the simplest and most efficient laboratory processes are the best; and when he has solved the problem from his point of view he is satisfied. That alizarin and indigo can not only be synthesised, but that they can be synthesised so cheaply that the natural products cannot compete with them in the market, is doubtless a triumph both for the chemist and for the technologist; but so long as each step of these syntheses is effected either by means of such chemical agents or under such conditions of temperature as would be fatal to life in any form, it is evident that the results are devoid of any biochemical bearing, and that the physiologist is justified in disregarding them. Meanwhile, therefore, so far as the important subject of the synthesis of vital products is concerned, there is no helpful interaction between chemistry and physiology. Each goes its own way.

It is with the object of endeavouring to remove this reproach from these sciences and of bringing about a better understanding between them that Prof. Meldola has written the present work, of which the first volume is now before us. The work is, as the author states, "a record of the synthetical achievements of generations of workers arranged with a distinct biochemical bias." In fact, the title of one of the introductory chapters, "Organic Chemistry from the Bio-centric Standpoint," might have served as a subtitle for the entire work.

This biocentric standpoint has, as the author indicates, necessitated an arrangement of the subject-matter differing materially from that usually followed in works on organic chemistry. In these the derivatives are arranged under the parent compound, or chemical type, from which in many cases they can be produced by processes of laboratory synthesis. But,

"According to the present scheme each vital product is in itself a biochemical type quite independently of the chemical type to which it may be referred, and the synthesis of each product, instead of being mentioned incidentally in connexion with the group to which it belongs as a point of minor interest, is here brought into the first rank of importance. In other words, the chemical type is in this work subordinated to the individual compound—a mode of treatment for which every justification will be conceded when it is pointed out that in vital syntheses there are unquestionable genetic relationships between compounds of quite different types" (p. 12).

Another necessity arising from the biocentric standpoint has been the recognition of "down-grade synthesis" as well as of "up-grade synthesis"—of the synthetic products obtained from complex generators by fission as well as of those obtained from simpler generators by union. Thus a number of substances generally recognised as vital products do not occur as such in the living organism, but are produced by hydrolytic fission, sometimes during the process of isolating them: thus alizarin from the glucoside ruberythric acid. The justification for registering these as vital products lies in the fact that their atomic complexes are pre-existent in the glucosides and similar compounds from which they are obtained.

The details of these classifications are worked out by the author with very great skill and with exhaustive knowledge of the subject. References are everywhere given, no fewer than forty-five periodicals, not to mention the patent literature, being quoted from. Among the syntheses enumerated we have not succeeded in detecting any omissions. The author does not claim to have sifted critically the enormous mass of experimental records which he has brought together; he leaves to the investigators themselves the responsibility for their statements. His object is "to bring practical workers, whether chemists, physiologists, or technologists, into communication with the various authorities quoted."

The author admits that we are at present profoundly ignorant of the modes of synthetic action which go on within the living organism, and he points to the necessity for a more systematic study of the chemical stages in which such action occurs—a branch of investigation for which plant life offers especial facilities. He points to Charabot's researches on the development of the terpene alcohols and ketones as examples of the pioneering work required. He is firm in his belief that such work will not only increase our knowledge of biochemistry, but will place us in a position to imitate the conditions of biochemical synthesis. He writes:—

"If, some decades hence, a work on similar lines to the present should ever be compiled, it may be anticipated with confidence that the laboratory methods for synthesising vital products will have approximated more closely to the physiological processes" (p. 9).

This confidence in the future powers of the chemist is closely connected with the author's attitude towards Neovitalism. He says:—

"I think it advisable to place on record the opinion that the present achievements in the domain of chemical synthesis furnish no warrant for the belief that the chemical processes of the living organism are in any sense transcendental, or that they must be regarded as belonging to a class of special material transformations which human science will never be able to reproduce. Such an admission as the latter would be tantamount to a proclamation of Neo-vitalism. . . . There is no warrant for the belief that the physics or chemistry of animals and plants is ultra-scientific" (Preface, p. vi).

To the present reviewer the terms "transcendental" and "ultra-scientific" seem to beg the question. It is surely a matter for legitimate and entirely "scientific" inquiry, whether our present laws of chemistry and physics, which have been deduced solely from the study of dead matter, apply without qualification to living matter. Possibly, when the conditions of the biochemical problem are more thoroughly understood, it may be, contrary to Prof. Meldola's belief, just as easy to show that we can never, in our beakers and retorts, imitate the biochemical conditions of vital synthesis as it is for a mathematician to prove the transcendence of π.

This view, like its opposite, is, however, in the present state of our knowledge, rather a matter of opinion than of proof.

In conclusion we congratulate the author on having produced a most useful work—a work of almost ultra-German thoroughness—and one which will be an immense boon to all interested in the subject with which it deals.

IONISATION AND ABSORPTION.

The Becquerel Rays and the Properties of Radium. By the Hon. R. J. Strutt. Pp. vii + 214. (London: Edward Arnold, 1904.) Price 8s. 6*d*. net.

A NUMBER of books dealing with radio-activity and the kindred phenomena have already appeared; and it is a bold thing on the part of an author to place another before the public. However, with the exception of Prof. Rutherford's inimitable treatise on the subject, none of the previous works have been characterised by any striking individuality, so that there is, or rather was, still room for a vigorous statement of the general features of the subject from a popular point of view. This the author of the present work has accomplished in a manner that leaves little room for criticism. He possesses to a remarkable degree the faculty of stating difficult questions in a simple way, and of expressing the answers in a language which is easily understood.

In a book of this kind there is usually a good deal of treatment which appears somewhat slipshod when regarded from a strictly scientific standpoint; but such a charge cannot with justice be maintained against the present volume. Naturally some of the most intricate points, such as the effect of a magnet on a moving electric charge, have to be treated analogically to make them represent anything real to a mind inexpert in dealing with this class of phenomena; but here the author has not only been fortunate in choosing familiar instances, but those chosen have been true analogies, and accurately represent the physical features of the case. The whole treatment is characterised by vigour and interest, and is such as we should have every reason to expect from the pen of so well-known an investigator in this branch of physical science as the author.

It is scarcely necessary to analyse in detail the contents of the book, but the whole forms a clear and concise presentation of the great question of the relationship between electricity and matter, which is of overpowering interest to physicists at the present time. In the first chapter we are made familiar with the various phenomena accompanying electric discharge in rarefied gases, and are thus placed in a position to understand the working of what may be regarded as a miniature discharge tube, viz. a radio-active atom. After describing the various manifestations of radio-activity and the properties of the radiations, the author considers the various products of radio-active change. We are thus led to a probable view of the mode of origin of the chemical elements, in the evolution of which the inert gases seem to form the final stage. The last chapter forms a very lucid account of the electrical theory of mass and the various views of atomic structure based thereon.

Unfortunately there is one serious blot on the general excellence of the book, and that is the treatment of absorption in chapter iv. Almost at the outset (p. 87), the author contradicts himself owing to the word "greater" having crept in where he doubtless intended to say "less." This uncorrected error is not likely to cause much trouble to those who are familiar with the subject, but we imagine the beginner will be greatly perplexed by trying to reconcile this statement with what follows.

Apart from this, it seems a great pity that so much stress should be laid on Madame Curie's experiments on the absorption of the α-rays from polonium, as it is doubtful what conclusion can be drawn from them except that practically all the rays are stopped by about four centimetres of air. In the experiments referred to a quantity of polonium was placed at a variable distance below two parallel plates three centimetres apart. A hole in the lower plate covered by wire gauze allowed the α-rays from the polonium to penetrate the region between the two plates, and the ionisation it produced there was taken to measure its "intensity." Madame Curie then investigated the diminution in the ionisation produced by placing a sheet of aluminium foil 0·001 cm. thick (equivalent to 2 cm. of air) over the lower plate, when the polonium was at different distances below it. When the polonium was 0·5 cm. away the aluminium cut down the radiation to one-quarter its previous value, whilst when the distance was 1·9 cm. the ionisation was reduced to one-twentieth. This shows clearly, as Madame Curie pointed out, that the α-rays which have passed through a certain thickness of matter are less penetrating than those which have not. The question, however, which is of most interest in the present state of the subject is how the ionisation per centimetre of path varies with the amount of matter previously passed through. These experiments furnish no very certain answer to this question, since when the aluminium foil is inserted the whole of the radiation is absorbed long before it reaches the upper plate, so that the different experiments are not strictly comparable. The whole question of absorption is very intricate, and it is undesirable to dwell further upon it here. There is still plenty of room for experimental investigation on this subject. For instance, Townsend's experiments on ionisation by collision and Durack's on that produced by the Lenard and Becquerel rays show that the number of ions produced per cm. by a moving corpuscle increases with the velocity up to a certain point, and then decreases. It would be of interest to see whether, as is probably the case, this holds for the positively charged α-rays as well.

The book contains three useful appendices. The first describes a number of simple experiments illustrating the essential features of radio-activity; the second gives the simple theory of the deflection of kathode rays, for the benefit of those not entirely unacquainted with mathematics; while the third describes the chemical processes involved in the extraction of the radio-active products from pitchblende residues.

The general arrangement is good, but there appears to be more than the usual allowance of uncorrected errors in spelling and composition. We hope that a second edition will give the author an opportunity of correcting these.

On the whole the book may be thoroughly recommended to the general reader as an accurate and attractive account of the latest aspect of scientific thought on the structure of matter; whilst the specialist will find numerous passages which are suggestive and stimulating.

O. W. Richardson.

LABORATORY EXERCISES IN BREWING.

Laboratory Studies for Brewing Students. By A. J. Brown, M.Sc., &c. Pp. xviii+193. (London: Longmans, Green and Co.) Price 7s. 6d. net.

THE brewing school at Birmingham is fortunate in possessing Prof. Brown as its head, and we hail the appearance of his book as extending its advantages to students of brewing generally.

These Laboratory Studies describe a systematic series of experiments illustrating the scientific principles underlying brewing. The author is careful to point out that he does not aim at dispensing with a teacher. Assuming a knowledge of chemical manipulation, he gives the detail necessary for the successful performance of each experiment, and draws the appropriate conclusion. He frequently connects the conclusions with others from allied experiments, and even to some extent with brewing practice, but at each step more and more scope is left for the teacher to discuss the bearing of the results on one another and on large scale work. If the author published his own lectures we should doubtless find them an exceedingly valuable complement to the work before us.

The book is divided into four sections:—(1) barley and malting; (2) principles of the mashing process; (3) fermentation; (4) hops. These sections are further subdivided into parts and paragraphs, the latter corresponding to each experiment.

The first section follows the changes in outward appearance from the flowering stage to the ripe barley corn, and thence passes on to the anatomy of the corn and to its conversion into malt.

Under the heading dealing with the varieties, we find one of the many instances of the way in which the author equips his men for taking their part in the controversies of present day brewing but avoids all dogmatising on points still *sub judice*. The experiments are planned so that the student will know all the characteristics of, *e.g.*, Chevallier (we adopt Mr. Beaven's spelling of the rev. gentleman's name) and Goldthorpe, but he is left with an open mind as to the vexed question of their rival merits.

Dealing with the technical examination of malt (and, indeed, also of barley and hops), we are glad to find due recognition given to expert knowledge—the student being specially commended to the teacher for instruction in it. For we are apt nowadays to underrate the knowledge accumulated by the practical man—what corresponds to the "farmer's eye" is still of immense value to the brewer.

Section i., part v., devoted to the chemical examination of malt, is as good as any in the book. Heron's method of determining the yield of extract is very fairly criticised, and we leave the subject with a full appreciation of its value and difficulties. The footnote of p. 46, that "a thoroughly satisfactory malt mill is yet to be introduced," should appeal to all interested in brewing.

Section ii., the principles of the mashing process, deals with the changes which take place when malt and water are brought together at various temperatures and sketches the analysis of wort as far as the carbohydrates (much the largest constituents) are concerned. We were sorry that, in giving the experiment showing that the influence of heat in restricting starch transformation is due to modification of the diastase, no reference is given to Kjeldahl's "Recherches sur les ferments producteurs de sucre" (*Résumé du Compte rendu des Travaux du Laboratoire de Carlsberg*, i, 109), but this is perhaps on account of its being in a foreign language and so unsuitable for students.

Section iii. is devoted to fermentation, but, as there are already books, chiefly by the Hansen school, dealing with this important subject, this section is a good deal curtailed. We are, however, glad to see (even if they are in small print) experiments on the author's important discovery that the maximum number to which yeast cells multiply in a nutritive solution depends, not on the number of cells with which the solution is seeded, but on the volume of the solution, granted, of course, a sufficiency of food.

Section iv., on hops, concludes the volume. We wish an experiment had been included to show the restrictive action of hops on the acid-forming bacteria, but such an experiment is not a very easy one for students.

It will have been noticed that the book adheres to the usual plan of beginning with barley and ending with beer. This seems inconsistent with the custom of passing from the well known to the less well known, and we should like to see tried the opposite plan of starting with beer and tracing it back into its constituents.

In training men for technical work the course should be; first, a general grounding in science; secondly, practical experience of the art in question; thirdly, a study of the scientific principles involved. If this be so the work before us should not only be of service to students but also to those brewers who desire to look into the experiments on which the principles of their art are founded.

OUR BOOK SHELF.

Morphologie und Biologie der Zelle. By Dr. Alexander Gurwitsch. Pp. xix+437. (Jena: Gustav Fischer, 1904.)

We are told in the preface that this book is intended for the use of beginners. The author must, however, have had Macaulay's omniscient schoolboy looming large in his imagination when he thus appraised the character of his completed work. Many of the topics discussed are quite the reverse of elementary, and the general treatment adopted throughout is lacking in that quality of lucidity which is essential to success, especially in a work that is written for the use of beginners. The fact is the author has attempted too much, and although his book may be serviceable to readers already tolerably familiar with cytology, it can, we imagine, hardly hope to appeal to the class for which it is stated to have been designed.

The general plan of the work is somewhat novel and has much to recommend it, whatever one may think of the manner in which Dr. Gurwitsch has actually executed his task. Thus, whilst a considerable description of cell-structure is naturally included, it is on the physical and physiological aspects of the problems that attention is mainly concentrated. Some of the sections, in particular those dealing with metabolism, are suggestive and well worth reading, although one not seldom misses expected allusion to recent work. Indeed, it almost seems at times that the author is rather needlessly attacking positions which have already ceased to possess any real importance.

A considerable number of pages are devoted to the subject of nuclear and cell division, as well as to a discussion of conflicting theoretical explanations of the process of mitosis. The advanced student will here find much to interest him if he will take pains to dig it out. But the whole question of reduction is omitted, on the ground that the author regards it as foreign to the main purpose of his book. We cannot but regret his decision, since the processes therein concerned serve to throw light on many difficulties connected with an ordinary mitosis that are not otherwise easily cleared up.

The last portion of the book is given up to a discussion as to whether the cell is to be regarded as an elementary organism or as the unit of organisation, and the question is treated both from the view of the Protozoa and Metazoa. The discussion is difficult to follow, and the answer really depends on what meaning is attached to the somewhat elusive definitions employed. It is, of course, obvious that the significance attaching to the unit will not always be the same, for this will have a different value for the morphologist and the physiologist respectively.

We confess that, whilst the book as a whole possesses undoubted merits, it nevertheless strikes us as the result of a premature effort. There is much evidence of undue haste, for example in the amazing number of glaring typographical errors; the names of authorities quoted, no less than ordinary words, repeatedly assume an unfamiliar appearance. But however irritating this may be to the reader, it would after all be a trifling matter if the subject as a whole had been presented in a well digested fashion. J. B. F.

A New Geometry for Senior Forms. By S. Barnard, M.A., and J. M. Child, B.A. Pp. xv+331. (London: Macmillan and Co., Ltd., 1904.) Price 3s. 6d.

This text-book is intended primarily for the use of students who are reading for the Oxford and Cambridge local examinations; the London intermediate examinations; mathematics, stages iii. and iv., South Kensington, and examinations of like nature. The first half of the book is a very happy combination of practical work and deductive reasoning. Much scale drawing is done, it is to be hoped with proper appliances in a proper manner, and teachers and students can select from a large number of graphical exercises appearing at short intervals, many of which have been taken by permission from recent examination papers. Trigonometrical ratios for acute angles are introduced and formulæ established relating to triangles, a short table of sines, cosines, and tangents being employed for numerical calculations. This section also deals with the geometry and mensuration of the simple solids, the formulæ used being all proved. The prismoidal formulæ and suggestions for the treatment of irregularly shaped figures seem unfortunately to have been overlooked. There are a few pages on the geometry of plane motion where the idea of a vector might have been appropriately and very usefully introduced.

The second or "theoretical" half of the book is mainly concerned with the formal establishment of theorems relating, amongst other matters, to the connection between algebra and geometry (after Euclid ii.), to circles, to ratio, proportion, and similar figures, and to solid geometry as in Euclid xi. A little modern geometry is given, but there is no description of how form and position in space are defined and exhibited by scale drawings.

The authors have produced one of the best of the new text-books which are following closely the progress of reform rather than leading the way. The volume can be heartily recommended to students who are preparing for mathematical examinations under recently revised schedules.

Studien über die Albuminoide mit besonderer Berücksichtigung des Spongin und der Keratine. (Studies on Albuminoids, with Special Reference to Spongin and the Keratins.) By Dr. Eduard Strauss. Pp. 128. (Heidelberg: C. Winter, 1904.) Price 3·20 marks.

This little book does not treat, as its title might lead some to suppose, of the albuminous substances in general, but of that limited group of them to which the term albuminoid is usually restricted by physiologists. This group includes spongin, cornein, gorgonine, onuphine, conchiolin, spirographin, and silk, which are products (mainly skeletal in function) of the invertebrate world; and collagen, reticulin, elastin, and the keratins, which are found among the vertebrata. One notes in this list the absence of chitin among the invertebrate products, the reason being that this material has now been shown not to be a member of the proteid group at all. Reticulin, also, which is mentioned, and was originally described by Siegfried, does not really exist. Miss Tebb conclusively proved it to be an artifact from collagen, and this view is accepted by Dr. Strauss.

The first seventy pages deal with a general account of these substances taken one by one. The remainder of the book deals with some original work on the digestion products of spongin and the keratins. The proteoses so formed were separated by Pick's method, and their properties differ somewhat from, though in the main resemble, the similar products of proteolysis derived from other and better known sources. Among them two gluco-albumoses are described. Iodine occurs not only in gorgonine, the organic substratum in certain corals, but also in spongin.

This contribution to science is interesting, but deals with such a small corner of biochemistry that it will appeal to very few. We doubt whether it is wise to magnify its importance by making it the subject of a special book. The first part of the work is dealt with, though perhaps not quite so fully, in all text-books of physiological chemistry, and the second part might quite well have formed the subject of a brief paper in one of the numerous journals devoted to such subjects.

W. D. H.

Pages from a Country Diary. By P. Somers. Pp. vi+280; illustrated. (London: Edward Arnold, 1904.) Price 7s. 6d.

THIS is one of those delightful books written in the form of a discursive diary, somewhat after the style of Sir Herbert Maxwell's "Memories of the Months," which may be taken up and read during every spare half-hour until the reader finds with regret that he has come to the last page. Almost every kind of topic and pursuit connected with country life receives a share of attention, among them, to a brief extent, the habits and ways of birds and other animals. Among statements connected with natural history is one (on the authority of a well known taxidermist) that albino pheasants always have diseased liver; this, however, if true, can scarcely be cause and effect, since such birds have white plumage from the first, and they surely cannot be hatched with liver-disease. Special interest attaches to the statement that a hen grouse of normal colouring produced an entire brood of cream-coloured chicks, since this seems to afford an instance of how a new colour-phase might be produced by discontinuous variation. The subsequent history of the brood is not recorded—probably its members were all shot.

Several references are made to otters and their habits, and, although he is a thorough sportsman, the author cannot refrain from uttering a word of sympathy with these beautiful animals when surrounded in the water by a pack of hungry otter-hounds. On the other hand he has nothing but scorn for the sickly sentimentality of those who would forbid such manly sports as hare-hunting and stag-hunting, even when the deer is a so-called tame animal.

A Scheme for the Detection of the more common Classes of Carbon Compounds. By Frank E. Weston, B.Sc. Pp. viii+56. (London: Longmans, Green and Co., Ltd., 1904.) Price 2s.

THIS little book is intended for students who are preparing in chemistry for the final B.Sc. examination of the University of London. The author, who is lecturer on chemistry at the polytechnic in Regent Street, has elaborated the scheme now offered as the result of many years' experience with his own classes. There certainly has been a dearth of "systematic schemes" for the detection of carbon compounds, and from this point of view the book should be useful. Whether it will have any real educational value will depend very much upon the manner in which it is used. If, as in the case of the "systematic schemes" for the detection of inorganic substances, the identification of organic compounds is to be reduced to a purely mechanical series of operations involving no real scientific knowledge on the part of the student, the present book will do more harm than good to the cause of education, although it may help candidates through the final B.Sc. as intended. On the other hand, if used intelligently in connection with the scientific treatment of organic chemistry, it may be made of some educational use. The selection of compounds has on the whole been judiciously made, and we have no fault to find with the treatment excepting to point out that certain crudities of style and inconsistencies of spelling seem to indicate either imperfect knowledge or imperfect revision. What quantity, for example, is meant by "a pinch"? Why should the word "monohydricphenols" appear on one page and "trihydric phenols" on another? There are too many slips of this kind in such a small book to enable us to recommend it unhesitatingly to students in its present form.

Photograms of the Year 1904. By the Editors and Staff of the *Photogram*, assisted by A. C. R. Carter. Pp. xlviii+176. (London: Dawbarn and Ward, Ltd., 1904.) Price 2s. net.

IN these pages we have typical photographic pictures of the year reproduced and criticised. This statement does not apply simply to British productions, but extends to those made in many lands where pictorial photography is practised. Robert Demachy discourses on the pictures exhibited at the annual series of photographic events in France. British Columbian progress is recorded by H. Mortimer Lamb. The editor of the Australian *Photographic Journal* gives some notes of the advances made in his country, while "A new Departure in American Pictorialism" is written by Savakichi Hartmann. These are followed by articles on the work of the year, suggestions to would-be picture-makers by H. Snowden Ward, and "Royal and Ring." The two great exhibitions, the Photographic Salon and the Royal, are dealt with by A. C. R. Carter. The "American Salon" and "Western Workers in the United States" conclude the volume. It may be mentioned that this publication is the tenth annual issue, and equals, if it does not exceed, both in quality and number of illustrations, those that preceded it. Most of the reproductions are the work of Messrs. Carl Hentschel, Ltd.

It seems scarcely necessary to add that those of our readers who follow this special branch of photography will find in this volume material which should prove of great value to them.

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.]*

Heterogenetic Fungus-germs.

THE development of brown fungus cells in connection with Zooglœa, as described in NATURE, November 24, by Dr. Bastian, is very familiar to me, and probably to all who attempt pure cultures of fungi.

Various species of microscopic fungi belonging to the genus Cladosporium are everywhere present on fading and dead leaves. The spores, and also the vegetable portions of these fungi, constantly assume the form called *Dematium pullulans* by De Bary. Such forms produce exceedingly minute colourless conidia, which can pass through thick filter paper. Under normal conditions these minute conidia on germination form delicate hyaline hyphæ which give origin to a Cladosporium. If cultures of these conidia become infested with bacteria that form Zooglœa the hyphæ become invested with a comparatively thick, brown cell-wall, and form either compact masses of cells or irregular hyphæ consisting of short cells, constricted at the septa, exactly as shown in Dr. Bastian's Fig. 12. In a disease of *Prunus japonica*, caused by a Cladosporium, large masses of gum, just sufficiently dense to prevent dripping, issued from the wounds. The mycelium of the fungus spread into this gum, and produced myriads of brown cells arranged in chains.

The semi-liquid gum caused the same abnormal development as that produced by Zooglœa. A plate showing the entire course of development of the fungus in the gum is contained in the *Kew Bulletin*, December, 1898. As these fungi only develop on fading leaves, it was not to be expected that they would appear in infusions of young grass.

Herbarium, Kew. GEORGE MASSEE.

Note on Radio-activity.

In the course of some experiments on the chemical behaviour of the β and γ rays from radium (Ramsay and Cooke, NATURE, August 11) solutions were obtained containing a radio-active substance which could sometimes be removed from the solution by the formation in it of a suitable precipitate. Sometimes when such a solution, containing ammonium salts, and in which several precipitations had already taken place, was evaporated to dryness on the lid of a porcelain crucible the residue was found to be capable of lessening the rate of leak of the electroscope, *i.e.* it behaved in the opposite way to an active residue, which would increase the rate of leak. This "anti-activity" has been observed on several occasions, and seems to be a specific property of the matter examined, and not to be due to any variable condition of the electroscope; thus the natural leak taken before is the same as that taken immediately after such an experiment.

I have not found any mention of a similar phenomenon in the literature on radio-activity, but should be glad to know if like results have been noticed by other observers. An explanation of the "anti-activity" would seem to be either that the leaf of the electroscope, which was always negatively charged, receives particles carrying a similar charge, which particles cause little ionisation of the air, or that the rays exert a de-ionising power on the air, if one can conceive of such an action. W. TERNENT COOKE.

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Gower Street, W.C.

Blue Flints at Bournemouth.

THERE is an old man living here, in Bournemouth, who years ago was employed in re-laying a part of the Poole Road, some little distance within the western boundary of the borough. He says that he helped to put down a quantity of refuse from the gas-works mixed up with flints, &c.—for this was before the days when the Poole Road began to be mended with granite. Now it so happened that this very man was employed to dig up and remove the surface of the road in preparation for the laying down of the tram lines, and of the wood pavement with which the whole road is now covered; and he says that he helped to dig up the very stuff which years ago he had helped to put down, and that this old road material was carted off to the new road then in course of construction upon the common and along the top of the cliff close by this part of the Poole Road. The flints, he says, came out blue, and are the blue flints now to be seen in patches upon this new road along the west sea-front. J. W. SHARPE.

Bournemouth.

Intelligence of Animals.

As some stray remarks of mine seem to have set this discussion agoing, I should be glad if you would kindly allow me to supplement your correspondents' interesting letters by two or three further stories which have come directly under my own observation. They are intended to be illustrative of methods of *reasoning about reason* in animals, particularly dogs. It will be observed that each story has its own distinctive shade of inaccuracy, and that the shade grows deeper as you proceed.

I trust, however, I shall by no means be taken as doubting the correctness of the facts sent you by your scientific readers, though I admit I might plead guilty to an indictment for suspecting seriously their interpretation. In the case of one or two of them I should not be surprised if some much more simple explanation than the one put forward might have been overlooked.

(1) Some years ago I had a favourite Irish terrier, Tim. Tim was a brave little chap, and would not quail before a lion. Like all of his strain, he had, I may say in passing, the rather human habit of grinning when amused, and would smile back at you in quite a comical fashion. This not too common trait is, I think, noteworthy.

When a mere puppy, Tim, in one bound, leaped into the household's good graces, and by no less meritorious an action than by saving us all from being burned alive. It was this way. Some newspapers thrown carelessly near the library grate caught fire; but Tim, who was snoozing on the hearthrug, bounded up and rushed to the cook, making such a row that that good lady dashed upstairs and tramped out the budding conflagration.

I am loth to point out that the young terrier could have had no more idea of a conflagration than Juno's geese when they cackled had of the Gallic invasion, from which by so doing they are said to have saved the Roman Capitol, and, further, I am greatly afraid that on the occasion showed not the foresight set down to his credit, but for once in his life—cowardice. The results, indeed, as not rarely happens from that species of wisdom, were satisfactory, and the appropriation of the praise on Tim's part quite after the manner of fully acknowledged rationals.

(2) In adult life Tim used to earn his breakfast of mornings by carrying my boots up to my room. Where his astuteness and "reasoning power" came in was by always fetching up polished boots, though he might have three or four pairs to pick and choose from. Of polished pairs he would invariably seize my light ones if they were at hand—a hint, the housekeeper used to insist, that he wished that I should "go off with myself" and visit friends.

When "doggie" stories are circling I seldom fail to extract this from my budget, and I am always tempted to add little flourishes. At all events, I never feel called upon to explain that Tim possessed no acquired taste for bog-mud, and accordingly he discarded soiled shoes. Further, though Tim was by no means lazy, he set store by Helmholtz's great principle of the conservation of energy. He had experimented and discovered for himself that there was far less using up of brawn and muscle in bearing along and aloft a thin than a heavy, thick-soled boot. All this by no means appeared on the surface, and so his superlative judiciousness was a source of delight to the cook, and of bewilderment to her visitors, all the year round.

(3) A farmer residing near me has a strong, useful mongrel, Major by name. Though Major is a cur of low degree, his wisdom is great and "uncanny." Like every other dog around here he would almost know your thinking—to use the pet phrase—and certainly would understand your talking. The latter statement can be proved, and I beg to undertake the demonstration.

For agriculturists in these parts fairs are the grand monthly carnivals. Some months ago, on the eve of one, our farmer said to his wife as they sat by the fireside, "Jane, I think I must chain up Major to-night and not have him follow us to-morrow as he did on the last occasion." "Would you believe it," so the farmer relates it, "on hearing his sentence out marched Major, most indignant." Next morning at an early hour, as Jane and himself proceeded to the fair, there he was sitting on his tail on a fence looking out for them more than a mile from home! And so he was at the fun of the fair as well as another.

Our farmer never conjectured there might have been in the meantime for the mongrel an attraction of his own in the direction of the town, though the torn ear was there to set him thinking. *Qui vult decipi, decipiatur.*

(4) Another neighbour possesses a spotted dog which he calls a water spaniel. Though he, no less than every other puppy, whelp, and hound in the country, may be distinguished for intelligence, he and they are certainly not noted for good looks or long pedigrees. This particular thoroughbred, amongst many things, (*a*) can go on a message to any house he is directed to within a radius of three miles! (*b*) can catch any hare he sets his eyes upon! and yet (*c*) will be fifteen years old to a day if he lives until January 2 next!

Explanation:—His owner sometimes gives a loose rein to a splendidly vivid imagination.

I yield to no one both in my respect and liking for our canine friends and in my admiration for their affection, their highest developed quality. But I am inclined to think their good points and "thinking powers" are often vastly exaggerated by friendly and carelessly observing eyes. Much that surprises may be of the type of one or other of the four stories above given. Imperfect, ill-trained observation, reading into actions motives and purposes which were never dreamt of, setting aside the simple for the marvellous, assisted by a heavier or lighter dash of Munchausenism, would turn folly into wisdom and wisdom into folly. By the help of any one of these principles one is quite capable of seeing in the most aimless action the profundity of the gods.

Creevelea, co. Leitrim. JOSEPH MEEHAN.

SOME SCIENTIFIC CENTRES.

VI.—The Physical Laboratory at the Museum d'Histoire naturelle.

The Museums d'Histoire naturelle, in the beautiful surroundings of the Jardin des Plantes in Paris, founded in 1793, form an institution of acknowledged eminence; whilst the lectures delivered there are by the most renowned professors, and on most, if not all, branches of the natural sciences. It was Cardinal Richelieu, as we know, who founded the Jardin des Plantes somewhere about 1626, not long before the establishment of the French Academy by the same great Minister of State.

The physical laboratory in particular of these museums has been the seat of many discoveries and the centre from which has radiated some of the best thought, as well as some of the best work, that has animated the academy and through it the scientific world for three-quarters of a century. It is not often the case with science, nor, indeed, with other branches of learning, that in a single family there should be found for three generations a series of distinguished men of the highest order of intellect who have devoted their lives and best energies to its pursuit and attained to universal fame. More seldom is it, then, that when the lineage is thus preserved unbroken, the members thereof should all be devoted to the one and to the self-same calling. For three generations the Becquerels have occupied in succession the same chair at the same institution, namely, the Museum d'Histoire naturelle in Paris. The number of papers which have been read before the Academie des Sciences by the Becquerels extends to seven or eight hundred.

Henri Becquerel, whose portrait in his laboratory at the Museum d'Histoire naturelle is here reproduced, is, we venture to think, perhaps the most distinguished of his race. His father, Alexander Edmond, is known as the inventor of the phosphoroscope and the author of "La Lumière," a work of great value in its day, whilst his grandfather, Antoine César, was likewise famous for a long series of researches, chiefly on chemical dynamics and electrocapillary phenomena. His electromagnetic balance is of historic interest in the development of the galvanometer, although long since abandoned for practical purposes.

Thus the history of the physical laboratory at the Museum d'Histoire naturelle may be said to run parallel with the history of the Becquerels, and the two to be so closely interwoven that to describe the part played by one and the influence exerted by it in the development and advancement of knowledge is perhaps equivalent to writing that of the other in detail. It was not so with other scientific centres of this series; there there were many discontinuities, here the continuity is one.

The technical process of gilding due to de la Rive was based upon Becquerel's observation in 1834 of the deposition of metals on the negative electrode when the poles of a pile are immersed in solutions of various metallic salts; that the two solutions needed could be kept apart by the use of animal membranes without preventing the passage of the current, and that with very feeble currents the deposition of metal is even

Fig. 1.—Prof. Henri Becquerel in his Laboratory at the Paris Museum d'Histoire naturelle.

and uniform on the surface of the electrode. Although rivalled by many others in the application of these principles, many were the facts and many the methods which he announced with rapid succession in laying the foundations of the art of electro-plating.

It was to the study of electrocapillary phenomena, which he was the first to observe in 1867, that his later years were devoted. The discovery was a curious one, the result, if we mistake not, of the deposition of metallic copper on a crack in a test-tube containing a solution of cupric sulphate, and immersed in another solution of sodic sulphide. The investigation of this phenomenon was full of interest, and not the least was the suggestion that the deposition of metals in veins in rocks is due to the same cause as that which he observed in the broken test-tube.

A member of the French Academy from 1829, eight years before being called to the chair which he filled to the end of his life, he was also a corresponding member of the Royal Society, and received from it its greatest honour, the Copley medal, and from the Emperor Napoleon III. the Cross of Commander of the Legion of Honour. Thus with him there closed a chapter, a long, an interesting, and an eventful chapter, in the history of the Museums d'Histoire naturelle.

Edmond Becquerel, although a pupil of his father and for a considerable time his assistant at the museums, did not teach there, and, indeed, as Sir William Crookes has said in his obituary notice of him in the *Proceedings* of the Royal Society, of which he was a foreign member, it may "be remarked that though he had early distinguished himself by scientific works of high value, and as the son of an eminent and much respected Academician he was not without influence, yet none of the great scientific establishments of his country offered him an appointment." He finally, however, secured a permanent position at the Conservatoire des Arts et Métiers, and there the abilities so long latent had full play, and manifested themselves by the success of his subsequent career.

At the death of his father, in 1878, he succeeded to the chair of physics at the museum, and this important position he continued to hold until his death in 1892. Brought up as he was in a scientific atmosphere, he evidently inherited from his father his "acute power of observation," and that "infinite capacity of taking pains which seems to be the essential characteristic of the Newtons, the Faradays, and the Darwins, and, in short, of all the great leaders of science."

Since 1892 Henri Becquerel has been professor at the Museum d'Histoire naturelle, and has continued those studies which his ancestors in days gone by pursued with ardour and with success, not the less marked, although perhaps, on the whole, notwithstanding their brilliant achievements, less fruitful in revealing that knowledge which was to come; for by his memoirs on the radio-activity of matter Henri Becquerel has given to the world of science the results of a very remarkable series of researches.

There are four methods of studying the infra-red parts of the spectrum: the thermopile, as employed by Tyndall and others, the radiomicrometer of Boys, the bolometer as used by Langley, and the phosphorescent screen of Becquerel. After exposure to the violet rays, and if the screen is subjected to the action of the infra-red, the phosphorescence becomes so intense that the energy accumulated is radiated so rapidly that the parts thus acted upon become quite dark relatively to the other parts of the screen. Thus a map of the infra-red can be produced and studied at leisure so long as the phosphorescence of the screen lasts, or, indeed, photographs of the screen thus affected may be taken. The effect is due most probably to heat, and is therefore a case of thermoluminescence. Under the influence of heat the collisions between molecules become more frequent and more violent, and the energy absorbed from the more refrangible rays, and stored up in the substance, by some means at present not very clearly understood, is once more yielded up to the æther and radiated away. The energy is stored up in unstable molecular aggregates which gradually disintegrate, as radio-active molecules have been found to do,[1] the change of absorption which accompanies fluorescence being due to the formation of these molecular groups.

The absorption spectrum of crystals exhibits many anomalies, from which Becquerel has extracted a most important principle. If a crystal is composed of two isomorphous substances the molecular elasticity of which varies in different directions, so that the absorption varies too, the absorption spectrum will likewise vary in different directions, so that it is thus possible to detect the presence of different substances, since in two isomorphous substances the directions of molecular elasticity do not correspond, and therefore the directions of absorption would likewise differ. Each chemical substance, therefore, affects the direction of propagation and of absorption.

If the directions of absorption do not coincide with the optic axes, it is due to the presence of different isomorphous substances in the crystal. The absorption spectrum of each substance remains different and in its own particular direction, whilst that of refraction is the resultant effect. By this contrivance the composition of crystals has been examined and afterwards confirmed by chemical means, whilst in many instances the presence of substances in quantities too minute for the chemist to notice has been detected by this elegant method of analysis.

But the most striking work that has issued from Becquerel's laboratory relates to the radio-activity of matter. Of this great discovery, separating as it does the ideas of this century from those of the last, so much has been written, upon their far-reaching importance, so many ideas have been discussed in these columns, that to discourse upon them here would be but vain repetition of all that has been said before; yet, paradoxical though it may seem, it is unquestionably the work of all works that most definitely separates, and at the same time most closely unites, the two sciences of physics and chemistry, whilst it brings into prominence what may appropriately be called a new science—that of radio-activity—a science which neither physics nor chemistry can claim within its old province, and yet neither can disclaim, nor would it very readily do so if it could.

What is the influence which these laboratories have exerted and exert? We may ask, what is the influence of the Royal Institution? Is it not to be measured by the work which has been done there and by the ideas which have been scattered from those great fountains of thought—if they can be measured? How many youthful imaginations, how many enthusiastic aspirations have been aroused within those venerable halls, of the Becquerels as of the Davys, the Faradays, and the Tyndalls? Parisian lecturers are *savants*, philosophers, and orators. For although the Teuton regards the gift of eloquence (we hope it is his own) as the gift to be designated as "gab," the southerner or the Celt thinks it indispensable in the expression of a clear mind and of a great soul, at once saturated with thoughts and the grandeur of its subject; and in France this counts for more than it usually does among us.

These lectures are a source of inspiration to the multitude as well as to the grave, and their importance cannot be overrated.

Having said thus much of the laboratories of the Museum d'Histoire naturelle, we may perhaps be permitted to add a word as to the central figure in this centre of scientific thought, of M. Henri Becquerel; from none need we expect greater freedom, greater ease, or kindlier consideration. The brief summary

[1] British Association and *Electrician*, 1900-02; and *Phil. Mag.*, 1901 *Phil. Trans.*, 1897[5]

of his researches and of that of his predecessors is the record of this branch of the museums, and also of the debt which knowledge owes, and must ever owe, to the influence of one of the most remarkable of the pioneer laboratories and great European centres of scientific work.

JOHN BUTLER BURKE.

THE "NATURE-STUDY" OF BIRDS.[1]

THIS book fulfils the chief conditions we have previously insisted upon as being essential in all new works relating to the birds of the British Isles, in that it is original, interesting, exquisitely illustrated from living subjects, and not burdened with technical names. Indeed, the latter are conspicuous by their complete absence, thereby, no doubt, rendering the volume much more acceptable to readers of all classes than it would have been had it included the usual superfluous intercalations in bracketed italics. Mr. Boraston, it appears, took to the "nature-study" of birds comparatively late in life, and in his case it may be truly said "better late than never," for had he never done so lovers of nature in general, and of birds in particular, would have been deprived of a very charming volume containing a number of fresh ideas and suggestive observations. Having once decided to take up the outdoor study of bird-life, the author entered on his task with characteristic energy, and at once saw how essential it was for him to follow in the steps of the Messrs. Kearton and to employ the camera to perpetuate the scenes that he so much enjoyed if his work was to be one that would appeal successfully to the public.

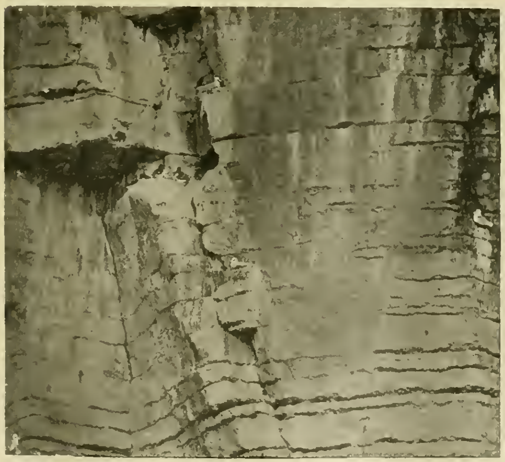

FIG. 1.—Kittiwakes on an Anglesea Cliff. From "Birds by Land and Sea."

How successful have been the results, both from the literary and the artistic point of view, readers of his book will not, we venture to think, be long in deciding. To whet their appetites, we herewith reproduce a couple of the illustrations, all of which, by the way, are taken from the author's own photographs.

FIG. 2.—Young Ringed Plovers crouching. From "Birds by Land and Sea."

The volume opens with the latter of what the author terms the two critical periods of bird-life, namely, March and September, when the migratory species are in the thick of their departure from or arrival at the British Islands. From September until May the seasonal observations of the year forming the subject of the volume relate to the bird-life of the neighbourhood of the author's home at Stretford, near Manchester, but during June the scene is transferred to the wild coast of Anglesea and Puffin Island, while in July and August we once more return to the home district. Perhaps the Anglesea interlude forms the most interesting part of the volume; but whether on a holiday or whether at home, the author seems to be endowed with a marvellous capacity for work, both in the matter of making and recording observations and in taking photographs.

On the wild cliffs of Anglesea, as we are told on p. 210, "stalking" birds for the purpose of taking their portraits by a well planned snap-shot demands a considerable amount of coolness and steadiness on the part of the observer, as if he becomes too much absorbed in the object of his pursuit awkward accidents are likely to occur; and even if such undesirable contingencies are successfully avoided, disappointments from unsuspected or unavoidable causes are only too likely in many instances to annul the results of all the toil and trouble. Who, for instance, will fail to commiserate the author on having lost the chance of "snapping" a sitting nightjar (p. 202), from the fact that he actually did not see the bird for some seconds, and then, when "his eyes were opened," the camera slipped?

[1] "Birds by Land and Sea: the Record of a Year's Work with Field glass and Camera." By J. M. Boraston. Pp. xiv+282; illustrated. (London: John Lane, 1905.) Price 10s. 6d. net.

As an example of the successful accomplishment of a difficult task, we reproduce (Fig. 1) the photograph of kittiwake gulls nesting on the precipitous face of a cliff, approach to which was effected by climbing down a narrow gulley and then scrambling over seaweed-clad boulders, to the imminent peril of the camera.

As a specimen of really excellent bird-photography, we present to our readers the picture of a group of young ringed plovers (Fig. 2), the mottled down of which harmonises so admirably at a short distance with their surroundings.

If it be said that this notice is purely commendatory, and contains nothing in the way of criticism, the reply is that we have found nothing to criticise or to condemn. It is real nature-study. R. L.

THE ARTIFICIAL PRODUCTION OF RUBIES BY FUSION.[1]

THIS memoir opens with a short historical account of the attempts previously made to produce rubies by fusion, starting with the researches undertaken by Gaudin with the view of obtaining fused alumina in a transparent state. He obtained by fusing potassium or ammonium alum, together with a little chrome alum, small globules, which became opaque on solidification, but had the composition of the ruby. These were shown by Becquerel to have the cleavage of corundum, and contained small cavities lined with crystals of ruby. Gaudin concluded that alumina could not exist in the vitreous state, and this view was supported by C. Sainte-Claire Deville, on account of the uniform density of the oxide before and after fusion. The facts at present known are in support of this view, for the transparent alumina obtained by fusion is a completely crystalline mass. The problem was not further investigated until, in 1886, Charles Friedel described an experiment by which corundum was obtained by fusion, presenting most of the properties of the ruby, but differing from the natural product by the presence of certain included bubbles, and by a rather low density.

As the production of the so-called "Geneva rubies" remained a trade secret, M. Verneuil started a series of investigations, following up the work of Gaudin. He found that to obtain the fused material in a transparent state certain conditions must be rigorously fulfilled. He compares the solidification of alumina to that of water, which forms according to the method of cooling transparent or opaque ice. An important observation which appears to have escaped Gaudin is that it is only the portions of alumina which are fused in the cooler parts of the flame which remain transparent on solidification. One of the greatest experimental difficulties is that, however carefully the cooling is conducted, the fused mass is excessively brittle. This brittleness is least marked when a very small supporting surface is employed. The apparatus devised by M. Verneuil is very ingenious. The blow-pipe and furnace tube must be absolutely vertical. The finely powdered alumina, containing the requisite quantity of chromic oxide, and specially purified, is admitted by means of a fine sieve, which is given a series of regular taps, controlled by an electromagnet, so that the material falls down the tube intermittently in a series of thin layers. It forms a cone at the bottom, and as soon as this cone reaches a hot enough part of the tube the apex fuses, and the fused material then extends gradually upwards in a long filament. This eventually reaches a still hotter part of the furnace, and develops a spherical mass instead of growing further; this spherical globule when solidified forms the ruby. The cooling has to be very gradual, so that the crystalline particles have time to become regularly arranged, or an opaque product is obtained. If the ovoid mass is carefully detached when cold, it splits up into two nearly equal portions, but not along a cleavage-plane. The product so obtained is an individual crystal, and the direction of its principal optic axis is never very different from that of the major axis of the ovoid.

The product when cut cannot be distinguished by its chemical, physical, or optical properties from a stone cut from a natural ruby. The operation may be considered successful when the clear product weighs 12 to 15 carats, and has a real diameter of 5 or 6 millimetres. It is, however, impossible to obtain stones larger than $\frac{1}{4}$ carat free from included bubbles and cracks, and experts can therefore readily distinguish the artificial gems from natural ones. These flaws do not in any way detract from the beauty of the stones; they are often clearer than many natural rubies, which are seldom found perfect.

The paper is illustrated by diagrams of the very ingenious apparatus devised by the author.

[1] "Memoire sur la Reproduction artificielle du Rubis par Fusion." By A. Verneuil. (*Annales de Chimie et de Physique*, 8e série, t. ii., September.)

CALCIUM METAL.

ELECTROMETALLURGY has at last succeeded in producing metallic calcium in commercial quantities, and at what must be considered a relatively low price. Until within a few weeks ago this metal had only been available in very small amounts, and remained a rare laboratory specimen; it is now obtainable at a price per kilogram less than that charged by most chemical dealers for a small one-gram sample. Humphry Davy first formed the amalgam by electrolysing lime, mixed with mercuric oxide and slightly moistened, with a mercury kathode; he isolated the metal in small quantities by distilling off the mercury. Since then many chemists have tried in vain to find a method suitable for its preparation on a larger scale. Matthiesen, making use of Bunsen's suggestion of applying high current density at the kathode, only succeeded in obtaining a few grams at a time by electrolysis of the fused chloride, or of mixtures of calcium and other chlorides having a lower fusing point. Henri Moissan, as the result of a critical study of the numerous proposed methods, was able to prepare somewhat larger quantities of the metal. His method was essentially a modification of that proposed by Liès-Bodart and Jobin in 1858, which consisted in reducing fused calcium iodide with metallic sodium. Moissan found that molten sodium forms an excellent solvent for calcium, and by heating calcium iodide with a large excess of sodium obtained on cooling a cake of the sodium-calcium alloy resting on the sodium iodide. Small quantities of the alloy were thrown into well cooled absolute alcohol, which reacts with the sodium leaving the calcium pure, but in the state of a fine crystalline powder. This powder can be agglomerated by pressure and fusion, and thus Moissan prepared the fine specimen ingots of this metal which so greatly interested visitors to the Paris Exhibition of 1900. It is largely to him that we are indebted for a knowledge of the properties of the pure metal, of which he prepared some 1 kilos. by this process. Contrary to the earlier descriptions, calcium is a white metal, the yellow coloration being due to a film of nitride; its melting point is about 760° C., and its density 1.85. The definite compounds which it forms directly with hydrogen and nitrogen promise useful applications in the laboratory in cases where it is necessary to remove these gases.

The next advance was made almost simultaneously by Borchers and Stockem at Aix-la-Chapelle, and

Ruff and Plato at Berlin. The method employed by these workers was in principle that of Matthiesen, but by suitable construction of apparatus and regulation of temperature much better yields were obtained, and the metal was thus prepared in larger quantities. Borchers and Stockem electrolysed molten calcium chloride, which was maintained at a temperature below the fusing point of calcium; they ascribe the low yields at higher temperatures to the reaction of fused calcium with calcium chloride to form a subchloride. Using an iron rod as kathode, they obtained a metal sponge which was pressed with tongs before removing from the electrolyte. The raw material prepared in this way contained some 10 per cent. of calcium chloride, which could, however, be almost entirely removed by subsequent fusion of the metal.

The final step in the evolution of the commercial process was taken by Suter and Redlich, of the Elektrochemische-Werke, Bitterfeld. By the ingenious employment of a kathode which only just touches the surface of the fused calcium chloride, they obtain a small layer of fused calcium under the kathode; before the calcium has collected in sufficient amount to flow away the electrode is very slightly raised; the metal thus comes into a cooler zone and solidifies. By continuing the process a rather irregular rod of calcium is built up, which itself forms the kathode. The metal is supplied in these rough rods, which in outward appearance strongly resemble cabbage stalks, but show a white metallic surface when cut through.

The present price quoted in Germany is about 20*s.* a kilogram retail, or 12*s.* a kilo. in 100 kilogram lots, which quotation alone proves the feasibility of the process. The technical product is said to contain about 97·11 per cent. pure calcium, 1·64 per cent. calcium chloride, and 0·4 per cent. sodium. If one may judge by the case of metallic sodium, there will doubtless be difficulties in finding any large demand for the metal, but it will obviously be much appreciated for experimental purposes in many chemical and physical laboratories.

R. S. Hutton.

NOTES.

We regret to announce that Sir Lowthian Bell, Bart., F.R.S., died on Tuesday, at eighty-eight years of age.

The death of Mr. Norman Maccoll, late editor of the *Athenaeum*, at sixty-one years of age, will be deeply regretted by many men of science. Mr. Maccoll did much to further the interests of science, and to cultivate sympathy with the pursuit of natural knowledge among readers not actively engaged in scientific work.

On Saturday last, direct telegraphic communication was established between Liverpool and Teheran, in Persia, a distance of four thousand miles. The line belongs to the Indo-European Telegraph Company.

On Tuesday next, December 27, Mr. Henry Cunynghame will deliver at the Royal Institution the first of a Christmas course of six lectures adapted to a juvenile auditory on ancient and modern methods of measuring time, experimentally illustrated.

At the December meeting of the Astronomical Society of France an address was given by Mr. de Watteville on the temperatures of stars. The lecturer described a series of experiments made by him in the Count de Labaume Pluvinel laboratory, and exhibited a series of photographs of spectra obtained by him, reproducing the principal types described by Sir Norman Lockyer. The president congratulated the speaker on having obtained such brilliant results, on the subject of which he has already delivered a thesis at the Sorbonne.

It is announced by the *Athenaeum* that the Circolo Matematico di Palermo intends to offer an international prize for geometry at the fourth International Mathematical Congress, which will meet at Rome in 1908. The prize will consist of a small gold medal, to be called the Guiccia medal, after its founder, and of 3000 francs, and will be given by preference, though not necessarily, to an essay which advances the knowledge of the theory of algebraical curves of space. The treatises may be written in Italian, French, German, or English, and must be sent to the president of the Circolo Matematico before July 1, 1907.

We learn from the *Times* that on Friday last President Loubet received Dr. Otto Nordenskjöld, who was presented by the Minister for Sweden and Norway in Paris. On the evening of the same day Dr. Nordenskjöld delivered a lecture on his Antarctic explorations before the French Geographical Society. Prince Gustav Adolph and Prince William of Sweden were present, and several Ministers were represented. Dr. Nordenskjöld was the guest on Saturday afternoon of the Paris Municipal Council at the Hôtel de Ville. He was welcomed by the president of the council, who presented him with a silver medal commemorating his visit to the city. On Saturday evening Dr. Nordenskjöld delivered a lecture before a large and distinguished audience at the Sorbonne.

The death is announced of Mr. C. G. Barrett, one of the editors of the *Entomologist's Monthly Magazine*, at the age of sixty-eight years.

It is stated that at a meeting of the French Surgical Society held on December 14 a report of the committee appointed to investigate Dr. Doyen's researches on cancer and its microbe was read, and that some of the conclusions support Dr. Doyen's claims. No authentic details have, however, as yet been published.

The following recent deaths are announced in the *Bulletin* of the French Physical Society and the *Popular Science Monthly*:—M. Jeunet, late professor of physics; Prof. Lespiault, of the University of Bordeaux; Prof. Joseph Thimont, of the École Ste.-Geneviève and other institutions; Prof. Clemens A. Winckler, professor of chemistry at Dresden; Prof. Max Berbels, of Berlin, noted for his publications on ethnology; Major Henry F. Alvord, chief of the dairy division of the U.S. Department of Agriculture.

In the *Bulletin* of the French Physical Society, No. 219, the death is announced of Prof. Macé de Lépinay, of Marseilles, a former member of the council of the society. Prof. Macé de Lépinay's researches were mostly connected with optics, and had special reference to the determination of wave-lengths by means of interference phenomena, on the lines first laid down by Fizeau. The methods used were interference due to double refraction, interference of a direct ray with one passing through a lamina of the crystal, and interference of two rays, one passing once and the other twice through the lamina. A further series of researches dealt with the inverse problem of determining the specific mass of water. Most of the experiments were performed with sodium light. Prof. Macé de Lépinay's latest researches were conducted conjointly with M. Buisson, who proposes to complete them.

Glass hives for the observation of bees at work have been in use for many years, and latterly ants' nests have been on view at the Crystal Palace; but it may be new to many of our readers to learn that Messrs. A. W. Gamage, Ltd., of Holborn, have actually put on sale a contrivance called "The Lubbock Formicarium," which is really a portable ants' nest, which can be moved anywhere without trouble or inconvenience, and which, it is claimed, will last for upwards of six years with ordinary care. The species selected is the small yellow ant, *Formica flava*, and the nest is enclosed in a frame 10 inches square, resembling a picture frame, except that it must, of course, be laid flat, and the cover must be kept over it except when the ants are under observation. The nest contains ants in their various stages, and some of the other insects which are associated with them; and it is supplied with or without a queen, and accompanied by full directions as to management. This novelty has attracted considerable attention already, and the visitors, many of whom are children, show much interest in this novel exhibition.

Dr. Charles Waldstein gave a lecture on "Herculaneum and the Proposed International Excavation" at the Royal Academy on December 14. He remarked that from Herculaneum many beautiful works might be expected. The city and district of Herculaneum were overwhelmed with volcanic material, but this is not the impenetrably hard lava commonly supposed. Geologists have shown that, apart from actual contact with air, the material is perfectly friable and manageable for the excavator. The beautiful works from the city which are to be seen at Naples show that the disaster was not destructive of the beauty of the works of art at Herculaneum. Manuscripts which can be unrolled and read, as well as glass and marble, with no trace of fire on them, give good hope of what may be expected from thorough excavation. The catastrophe was a marvellous preservation of a provincial city's life at the moment of arrest. The King has expressed approval of the proposed international excavation, and the King of Italy, as well as his Prime Minister, promise support. The President of the United States, the German Emperor, the President and Government of the French Republic, the Emperor of Austria, and the King of Sweden encourage the undertaking. There is already a committee in Vienna, and it is hoped to secure the cooperation of many other national committees. Mr. Neville Rolfe, our Consul at Naples, has told Dr. Waldstein that there is ample work for many years without infringement of private rights.

Our Norwegian namesake—*Naturen*—for November contains an illustrated account of the mammoth discovered in the Kolyma district in 1901, and now mounted in the St. Petersburg Museum. The monster has been set up in the position in which it was found, namely, endeavouring to struggle out of a quicksand or crevasse.

In the issue of the *Sitzungsberichte* of the Vienna Academy for November 10 Dr. F. Werner gives an account of the zoological results of his recent expedition to Egypt and Nubia. The most important part of the collection appears to consist of orthopterous insects—a group hitherto very imperfectly known from the countries in question, and of which a large series of specimens was obtained. Very noteworthy is the discovery of certain Central Asian species of the group in the heart of this part of Africa. A fish and a fresh-water mussel previously supposed to be confined to the Upper Nile are recorded from the delta, and some interesting observations with regard to certain reptiles have also been made.

We are indebted to the publisher—G. Freytag, of Leipzig—for copies of the two issues of the new (twenty-sixth) edition of Pokorny's "Naturgeschichte des Tierreiches," a well known zoological text-book for schools. The present enlarged edition has been supervised by Mr. M. Fischer, of Mülhausen. The book is issued in two forms, one more expensive than the other. In the cheaper issue (of which the price is 3*s*. 6*d*.) there are only five coloured plates, whereas in the more expensive one (price 4*s*. 6*d*.) the number of illustrations of this description is twenty-nine. Some difference in the arrangement and number of the cuts distinguishes the two issues. Considering the price of the volume, the coloured illustrations are all that could be desired. The fact of the work reaching its twenty-sixth edition is a sufficient guarantee of its fitness for its special purpose.

We have received a copy of a new monthly publication, *Indian Public Health* (No. 4, vol. i.), which is to be devoted to the discussion of public health questions in our Indian Empire. We cannot help expressing the opinion that it is undesirable to multiply small journals, of which there are already too many. It would be better to enlarge the scope of the existing journals.

In the *Journal* of the Quekett Microscopical Club (ix., No. 55) Mr. T. B. Rosseter gives a good description of the anatomy of *Taenia sinuosa*, a tapeworm of geese, and proves by feeding experiments that the cysticercoids inhabit certain copepods and ostracods; and Mr. Wesché investigates some new sense-organs of Diptera, concluding that where the antennæ are not particularly sensitive, the palpi have structures to compensate, and may bear organs of touch, taste, and smell, but not more than two of these at the same time. He also describes certain organs, probably of sense, on the legs of many species, the function of which is doubtful.

We have received "Researches in Helminthology and Parasitology," by Prof. Joseph Leidy, edited by his son, Dr. Joseph Leidy (*Smithsonian Miscellaneous Collections*, part of vol. xlvi.). It gives a summary of Prof. Leidy's contributions to science, with bibliography, and should prove of considerable value to those engaged in these branches of research. Commencing in 1849, Prof. Leidy's contributions were continued without intermission down to 1889, and are no less than 578 in number, many being of considerable importance, and embracing parasites of all kinds, as well as some papers on comparative anatomy.

In the report for the year 1903–4 on the administration of the Government Museum and Connemara Public Library, Madras, amongst other interesting matter the following paragraph appears:—"A prolonged tour was made in the Mysore province in connection with the ethnographic survey, with the primary object of continuing my researches into the character of the Canarese cranium (*vide* Museum *Bulletin*, iv., 2, 1901). The work was carried out under conditions of considerable difficulty, caused by the terror of the natives, who mistook me for a recruiting sergeant bent on seizing them for employment in South Africa or for the Somali war, and fled before my approach from town to town. The little spot, which I am in the habit of making with Aspinall's paint to indicate the position of the fronto-nasal suture when measuring the nose, was supposed to possess blistering properties, and to turn into a number on the forehead, which would serve as a means of identification. The untimely death of a Korava outside a town where I was halting was attributed to my evil eye. Villages were denuded of all save senile men, women and children. The vendors of food-stuffs in one bazaar finding business slack owing to the flight of their customers, raised their prices, and a missionary complained that the price of butter had gone up. My arrival at one important town was coincident with a temple festival, whereat there were not sufficient men left to drag the temple car in procession. The headman of another town, when he came to take leave of me, apologised for the scrubby appearance of his chin, as the local barber had fled. One man, who had volunteered to be tested with the tintometer, was suddenly seized with fear, and, throwing his body-cloth at my feet, ran away and was no more seen. An elderly municipal peon wept bitterly when undergoing the process of measurement. Such are a few examples of the results which attend the progress of the Government anthropologist." Mr. Edgar Thurston finds that the average cephalic index of various groups of natives in the southern (Tamil and Malayalam) districts of the Madras Presidency ranges from 72·6 to 76·5, while that in the Canarese and Maratha area ranges from 77·1 to 81·8. The significance of this brachycephalic element is not yet elucidated.

In the *Transactions* of the Academy of Science of St. Louis, vol. xiii., No. 8, Mr. J. A. Harris gives some details of polygamy and floral abnormalities in species of Solanum. A collection of flowers of *Solanum carolinense* showed about twenty staminate to eighty perfect flowers. A second paper by the same writer describes the germination of seedlings with unequal cotyledons of *Pachira campestris*, a genus sometimes allied with Bombax.

The formation of a botanic garden in sandhills does not perhaps suggest utility or success, but in the *Gardener's Chronicle* (November 19) Dr. Masters gives an account of the practical results obtained by experiments carried out in the garden, or, as it may be called, the experimental station established in the Belgian dunes at Coxyde. As an instance of the way in which experimental results are sometimes opposed to theoretical supposition, the writer describes the successful formation of a forest of dwarf poplars in the sandhills, and even suggests that they would act as nurses to seedling pines.

It is characteristic of the scattered groups of islands which lie between the parallels of 45° and 60° south that in their flora they all contain a proportion of what has been termed a Fuegian element. Amongst these are the so-called Southern Islands of New Zealand, of which the latest account is that given by Dr. Cockayne in the *Transactions* of the New Zealand Institute, vol. xxxvi. The plant associations of the Auckland Isles include a forest formation, with *Olearia lyallii* as the dominant tree, which Dr. Cockayne regards as the primitive forest, and one that was previously more extensive, but which has been curtailed by the spread of a *rata* forest similar to the rata forests found in New Zealand. This fact, and the existence of a well marked New Zealand element in the flora are points of evidence in favour of a former extension of New Zealand to the south.

Mr. A. Tingle, of the Imperial Provincial College, Chinanfu, Shantung, has sent a further communication upon the flowering of the bamboo, in which he supplements—in view of the letters of Prof. J. B. Farmer, F.R.S., in our issue for August 11, and of Mr. J. S. Gamble, F.R.S., in Nature for September 1—the information supplied in his previous letter. Mr. Tingle is unable to tell the species of the bamboos that flowered, but he reports that they were small, growing to a height of about 4 metres, and that the stems averaged about 4 cm. in circumference near the ground. All the bamboos have died since flowering. Mr. Tingle points out that the bamboo will grow in Shantung only if carefully cultivated in a garden. The seasons, he remarks, have been in no way exceptional in Shantung.

Among the interesting collection of models of Palæozoic seeds and cones exhibited by Mr. H. E. H. Smedley at a recent meeting of the Linnean Society, a few are of special interest to palæobotanists. The example selected for illustration here is that of the group of three models of the sporophylls of the lycopodiaceous cone, Lepidocarpon, from the Carboniferous formation. The model on the left shows the general morphology of a single sporophyll, from which will be seen the peculiar shape of the integument and micropyle, much resembling a hand-bag. The centre model demonstrates the general anatomy as seen in the

Fig. 1.—Palæozoic cones.

transverse section, and shows the complete lamina of the sporophyll, while that on the right clearly exhibits the complex internal structure of the sporangium containing four megaspores, one of which has developed a seed-like formation filling nearly the whole of the sporangium, the other three being abortive. In urging an affinity between the lycopodiaceous cones and the gymnosperms, the author submitted the following points of agreement :—Integument and micropyle, the single functional megaspore in the sporangium, and the detachment of the seed-like organ as a whole.

The report of the Meteorological Council for the year ending March 31, 1904, shows increased activity, and is somewhat more bulky than its predecessors, extending to more than 200 pages; the report proper embraces only some 30 pages; the remainder is composed of appendices which contain details of the operations of the office. No change has taken place in the constitution of the council during the year, nor is any clue given to the future of the office resulting from the deliberations of the Meteorological Grant Committee; their report, however, was not issued until after the period to which the council's report refers. While the work of a former Government department is arduously performed, the Meteorological Office continues to hold a very anomalous position compared with similar establishments in other countries; it performs valuable public duties, but has not the status of a Government office, although supported by a Government grant. The operations may be summarised under four principal heads :—(1) ocean meteorology, the collection, tabulation, and discussion of meteorological data for all parts of the ocean, and the preparation and issue of charts and the supply of instruments to the Royal Navy and mercantile marine; (2) the issue of storm warnings to all seaports willing to receive them, of daily weather forecasts, and of forecasts for agriculturists during harvest seasons; (3) the climatology of the British Isles, statistics relating to British colonies and dependencies, and replies to numerous meteorological inquiries from all sources; (4) the discussion of automatic registers received from the observatories and other stations in connection with the office. The library contains weather maps and other publications received from all parts of the world, and these are available to all persons wishing to consult them.

PART X. of the *Bulletin* of the Department of Agriculture of Jamaica contains an interesting article by Mr. H. H. Cousins, the Government chemist, on the possibility of manufacturing starch from cassava on such a scale as to undersell German potato starch in the English market. The high proportion of starch in cassava makes the latter twice as valuable as the potato as a raw material, and cassava has the additional advantage that it is not liable to fungoid diseases such as produce extraordinary variations in the annual potato crop in Germany. The seasons of its growth and harvest are, moreover, perfectly unrestricted.

SOME apparatus left by the late M. Félix Worms de Romilly has been offered by the French Physical Society for distribution to its members.

THE Association of Engineers of the School of Liège is organising, under Government patronage, a congress of mining, metallurgy, applied mechanics and geology, to be held at Liège from June 26 to July 1, 1905, on the occasion of the Universal Exhibition.

IN the *Physikalische Zeitschrift* for December 1 Mr. Hermann Bonin contributes an interesting report on steam turbines, based on the writings of Stodola, Feldmann, Gutermuth, and Boveri. In it the Laval, Curtis, Rateau, Zölly, and Parsons turbines are figured, and their peculiar features discussed.

PROF. R. W. WOOD contributes a paper on *n*-rays to the *Physikalische Zeitschrift* for December, and suggests that those experimenters who obtain positive and those who obtain negative results should arrange to make a series of joint experiments in the way that has been done in a similar case by Crémieu and Pender.

WE have received a thesis by Messrs. H. C. Crowell and G. C. D. Lenth on the "Doble" needle-regulating nozzle for fire hoses and other jets. This nozzle is furnished with a convergent mouth-piece in the centre of which is a peculiarly shaped "needle," the effect of which on the stream lines is to obviate the spraying noticeable with ordinary jets, and thus to increase the efficiency. The paper is printed by permission of the Massachusetts Institute of Technology.

PROF. N. UMOW contributes to *Terrestrial Magnetism and Applied Electricity* an ingenious method of constructing magnetic charts. It consists in developing the magnetic potential in a series of spherical harmonics, and representing on a Mercator's chart the poles of the various harmonics and curves showing their zeros and so forth. The advantage of this system is that instead of drawing a large number of magnetic curves, it is possible to convey more exact information by drawing a comparatively small number of curves indicating the various terms in Gauss's expansion.

IN a paper read before the Institution of Mechanical Engineers on November 18 Messrs. A. E. Seaton and A. Jude emphasise the need of testing materials which are to be subjected to rapidly repeated or to alternating loads by other methods than by merely determining the tensile strength and elastic limit. A form of apparatus is described by means of which the ability of a notched bar of the material to withstand impact can be measured, and it is shown that although a high tensile strength may be accompanied by a small resistance to shock, a bar which responds satisfactorily to the impact test always has sufficient tensile strength and elasticity. The best results as regards resistance to shock are obtained with those steels which contain only a small proportion of carbon, an extraordinarily rapid increase of brittleness occurring with an increase in the percentage of carbon. The line of fracture of the metal follows the direction of the ferrite and avoids the perlite. Oil quenching has the effect of increasing the shock strength of steel to a value which is 500 per cent. to 600 per cent. greater than that of the natural steel in its best condition.

A NEW and revised edition of stage iii. of Mr. Vincent T. Murché's "Object Lessons in Elementary Science based on the Scheme issued by the London School Board" has been issued by Messrs. Macmillan and Co., Ltd.

IN the November, 1904, issue of the *Central*, the magazine of the Central Technical College Old Students' Association, Prof. H. E. Armstrong, F.R.S., continues his papers on the mechanism of combustion, and there is an illustrated description of the Manhattan railway power station of New York, contributed by Mr. W. A. Del Mar.

IN addition to the enumeration of classes and other administrative matter, the *Johns Hopkins University Circular* for November, 1904, contains one or two original papers. Among these may be mentioned one by Prof. W. B. Clark on the Matawan formation of Maryland, Delaware, and New Jersey, and its relations to overlying and underlying formations.

THE Department of Agriculture and Technical Instruction for Ireland has issued a pamphlet entitled "Notes for Manual Instructors." Manual instruction is comparatively new in Ireland; the conditions are different from those in other countries, and there are initial difficulties to be overcome. For these reasons the notes here brought together should be of real assistance to teachers of the subject.

A COPY of an almanac for the year 1905, compiled at the offices of the Egyptian Survey Department, and published by the National Printing Department at Cairo, has been received. The almanac provides full particulars of the dates of all the important meetings of the various Government departments, and gives information on points in connection with the Government regulations which should be of service to tourists and residents.

IN view of the largely increased facilities provided within the past few years by the publication departments of various institutions, and more especially by the Carnegie Institution, for the promotion of original research with its incident publications, the Wagner Free Institute of Science, Philadelphia, has decided to discontinue for the present its work in this department, and to devote its energies more exclusively to other purposes indicated by its founder.

WE have received a copy of the "Guide to the Archives of the Government of the United States in Washington," just published by the Carnegie Institution of Washington. The guide was begun by Mr. C. H. Van Tyne and Mr. W. G. Leland, and completed by the newly organised Bureau of Historical Research. The original purpose of the guide was to gather information of the whereabouts of important historical materials, but as the work proceeded it was found desirable carefully to deal with all administrative records. The work, in fact, developed into a survey of all the branches, bureaus, and divisions of the Federal Government in Washington.

Two new volumes have been added to Ostwald's series of scientific classics, published by Mr. W. Engelmann, Leipzig (London: Williams and Norgate), bringing the number of reprints and translations in the collection up to 145. One of the volumes is a translation, by Herr F. Plehn, of Kepler's "Dioptrice," with an introduction, notes, and sketch of Kepler's life and work. The second volume (No. 145) contains reprints of two papers by Kekulé, edited with notes by Herr A. Ladenburg; the papers are:—"Über die Constitution und die Metamorphosen der chemischen Verbindungen und über die chemische Natur des Kohlenstoffs" and "Untersuchungen über aromatische Verbindungen."

THE annual report of the Smithsonian Institution for the year ending June 30, 1903, has been received. As usual, the general appendix makes up the greater part of the volume. The excellent and varied selection of beautifully illustrated papers by men of science of all nationalities, constituting the general appendix, provides a trustworthy indication of the extent and nature of the progress in science during the twelve months with which the report deals. It is impossible here to give even the titles of the fifty-three papers included. Some of the papers have been reprinted from NATURE and other periodicals, some are addresses delivered before scientific bodies, and a few are new contributions. In addition to these works there are a number of translations of papers originally published in other languages. The first place is given to a reprint of the general description of the moon included by Prof. N. S. Shaler in the introductory chapter of his memoir on "A Comparison of the Features of the Earth and the Moon." This paper is illustrated by ten magnificent plates. The work done on radium and radio-activity is chronicled in papers by M. E. Curie, Prof. J. J. Thomson, Sir William Ramsay, Mr. Soddy, Sir Oliver Lodge, Sir William Crookes—the names being mentioned in the order in which the papers are printed. Geographical research is represented by contributions by Captain E. W. Creak, Mr. Alfred H. Brooks, Commander Peary, Sir Clements R. Markham, Dr. Otto Nordenskjöld, M. G. Ts. Tsybikoff, and others. The articles on geographical and zoological subjects are illustrated very profusely, and the volume will make a valuable addition to reference libraries fortunate enough to secure copies of it.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A NEW COMET (1904 *d*).—A telegram from the Kiel Centralstelle announces that a new comet was discovered by M. Giacobini at Nice on December 17·11. Its position at 17h. 41·3m. (M.T. Nice) was

R.A. = 16h. 14m. 40s., dec. = $+27°\ 28'$,

and its movement was in a north-easterly direction.

This position is situated on the western boundary of the constellation Hercules, about 44m. east of α Coronæ, which has approximately the same declination (27° 2′), and is favourably situated for observation during the three or four hours preceding dawn.

A second telegram from Kiel informs us that the comet was again observed at Nice on December 18. Its position at 16h. 44m. (M.T. Nice) was as follows:—

R.A. = 16h. 17m. 3·4s., dec. = $+27°\ 54'\ 8''$.

TEMPEL'S COMET (1904 *c*).—The following details of M. St. Javelle's re-discovery of Tempel's second comet are given in No. 3984 of the *Astronomische Nachrichten*:—

	M.T. Nice h. m. s.	R.A. (app.) h. m. s.	Dec. (app.) ° ′ ″
Nov. 30	... 6 7 48	... 19 36 39·89	... −24 48 37·3
Dec. 1	... 5 55 10	... 19 40 23·58	... −24 46 17·5

The comet was a feeble and ill-defined object as seen in the Nice equatorial of 0·76 m. aperture, and had the appearance of a whitish spot 1′·5 to 2′·0 in extent; no nucleus was visible.

A continued abstract of M. Coniel's daily ephemeris (*Astronomische Nachrichten*, No. 3971) is given below:—

12*h*. *M.T. Paris.*

1904	α (app.) h. m. s.	δ (app.) ° ′	log Δ	$1 : r^2\Delta^2$
Dec. 20 ...	20 51 30 ...	−22 55 ...	0·31206 ...	0·113
,, 22 ...	20 58 39 ...	−22 36 ...	0·31480	
,, 24 ...	21 5 43 ...	−22 17 ...	0·31760 ...	0·108
,, 26 ...	21 12 44 ...	−21 57 ...	0·32044	
,, 28 ...	21 19 41 ...	−21 35 ...	0·32333 ...	0·103
,, 30 ...	21 26 35 ...	−21 13 ...	0·32626	
1905 Jan. 1 ...	21 33 24 ...	−20 50 ..	0·32924 ...	0·c98

ENCKE'S COMET (1904 *b*).—An observation of Encke's comet was made by Herr van d Bilt at Utrecht on December 8. At 8h. 3m. 46s. (M.T. Utrecht) the position of the comet was

α (app.) = 20h. 46m. 22·11s., δ (app.) = $+5°\ 12'\ 29''\cdot5$,

and its magnitude was estimated as 7·5. This observation indicated that a correction of +41s., +1′·2 was necessary to the ephemeris published by Messrs. Kaminsky and Ocoulitsch in *Astronomische Nachrichten*, No. 3981 (*Astronomische Nachrichten*, No. 3985).

OBSERVATIONS OF OCCULTATIONS BY PLANETS.—Dr. T. J. J. See, writing to the *Astronomische Nachrichten* (No. 3984), explains the futility of making observations of occultations by planets for the purpose of determining the extent of the planetary atmospheres. He points out that the extent of the irradiation about a planet's disc, at night time, in every case exceeds the probable extent of the planet's atmosphere, so that the star is lost in the irradiation zone before the interposition of the atmosphere between it and the observer.

Thus observations of this character, made during the hours of darkness when the irradiation affects the observation, can never succeed in determining the amount of refraction suffered by the star light in passing through the planet's atmosphere, because the star is always hidden before it reaches even the outer limit of that atmosphere.

RELATIVE DRIFT OF THE HYADES STARS.—In a paper communicated to the British Astronomical Association Dr. Downing, F.R.S., discusses the resulting values obtained by Herr Weersma, and published in No. 13 of the Groningen Astronomical Laboratory *Publications*, in order to determine the relative drift of the sixty-six Hyades stars dealt with by the latter observer.

The results of the discussion show that these stars may be arranged in three chief groups as regards the amount and direction of their annual motion. The first group contains thirty-eight stars, including most of the bright ones except Aldebaran, having a mean motion of 0″·096 per year in the mean direction 106° from north towards east. In the second group Aldebaran and three faint stars are included, and the annual mean motion is as much as 0″·160 in the mean direction 160°. In both these groups the magnitudes are in no way related to the amounts of movement, some of the fainter stars, in fact, having a greater apparent motion than the brighter ones in the same group. The values for the third group are 0″·036 and 254° respectively, and it is reasonably conjectured that this group is at a greater distance from our system than the others (*Journal* British Astronomical Association, No. 1, vol. xv.).

DESIGNATIONS OF THE VARIABLE STARS DISCOVERED DURING 1904.—In No. 3984 of the *Astronomische Nachrichten* the Variable Star Commission of the Astronomischen Gesellschaft publish a catalogue of fifty-eight new variables, discovered by various observers during the present year. They give for each star the number by which it will in future be known, the temporary designation which this replaces, its coordinates and the amount of precession in each coordinate, for 1900, and the magnitude. The catalogue is followed by a detailed account of the discovery, variations, and general characteristics of each variable.

THE "COMPANION TO THE OBSERVATORY."—The 1905 edition of the well known "Companion to the Observatory," published at 1s. 6d. by Messrs. Taylor and Francis, contains its usual complement of useful data for all kinds of astronomical observations. Ephemerides for the planets and their satellites, the Greenwich magnetic elements, the times of maxima and minima and the periods of numerous variable stars and data relating to a number of double stars are given amongst the mass of information contained.

As in previous years, Mr. Denning gives the dates and radiant points of the principal meteor showers and Mr. Maw has supplied the double-star tables, whilst the ephemerides of an ever-increasing number of variable stars have been taken from advance proofs generously contributed by M. Lœwy.

GLACIATION IN NORTH AMERICA.[1]

THIS volume, which has only recently reached us, is by no means of merely local interest. The first 226 pages form a treatise on glacial geology in general, and represent the author's views after some twelve years of study of drift deposits in the field. No one who examines plates i. to vi. can mistake the character of these deposits; these excellent photographic pictures would meet, indeed, with international acceptance. On p. 30 we have some suggestive figures given as to the area of existing glaciers, from which it appears that the whole drift-covered country in North America is only ten times as large as that still covered by ice in Greenland. The Antarctic ice-sheet, moreover, is as extensive as that postulated for North America in "Glacial" times, a fact that effectually "removes the element of incredibility which, at first thought, attaches to so striking a theory as that of the glacial origin of the drift." The northern ice, however, as Mr. Salisbury immediately points out, extended into temperate latitudes, and special explanations must thus be sought. New Jersey, we may observe, lies on the latitude of Lisbon and Sicily in the northern hemisphere, and corresponds with Cape Town and Melbourne in the southern and more glacial hemisphere. Mr. Salisbury at present seeks the cause of older widespread glaciations (p. 192) in Chamberlin's hypothesis of variations in the amount of carbon dioxide in the atmosphere. Elevation accelerates rock-decay, and this process promotes refrigeration by withdrawing carbon dioxide from the air. The possibility of variation in the constitution of the atmosphere, owing to the emanations of volcanoes, is also touched on as one of many other causes controlling the supply of carbon dioxide.

FIG. 1.—Side of a glacier in Greenland, showing the moraine-débris in the lower part, while the upper ice is almost free from it.

Plates xviii. and xix. are valuable for the comparison they afford between the landscapes formed by the uniform ice-cap of Greenland and the protrusion of peaks through a dwindling ice-area in the familiar scenes of Switzerland. Other interesting photographs from Greenland occur on plates xxv. and xxvi., and one of them is here reproduced (Fig. 1).

The general propositions stated by the author are illustrated by examples of moraine-material, striated surfaces, &c., from New Jersey, so that dwellers in that State may now acquire a new insight into the topographic features round them. Mr. Salisbury restricts the word *kame* to material washed out from and left against the irregular margin of a glacier (p. 116), while *eskers* represent the channels of subglacial streams. Seeing how these two terms have been interchanged, as the author's references show (p. 136), it might have been well to invent a new word for the special type of water-formed terminal moraine which the author describes here as a kame. Chapter v., on changes in drainage resulting from glaciation, contains a very suggestive study of the former glacial lakes in the flat basin west of Newark. The concluding 550 pages are concerned with "local details," the meaning of which becomes clear after so excellent an introduction. One of the most striking illustrations is that facing p. 537 (Fig. 2), where the "plucking" away of blocks along the joint-planes of a glaciated surface is clearly shown by the step-like structure and abrupt details of the lee side of a *roche moutonnée*. This term, by the by, does not seem to be defined in the earlier portion of the book.

FIG. 2.—Glaciated surface of "trap" at Weehawken, New Jersey.

In conclusion, we could wish that some "State Survey" would give us a similarly comprehensive memoir for the glacial provinces of the British Isles. G. A. J. C.

[1] "The Glacial Geology of New Jersey." By Rollin D. Salisbury. Vol. v. of the Final Report of the State Geologist. Pp. xxviii+802; plates and folding maps. (Trenton, N.J.: MacCrellish and Quigley, 1902.)

THE PEOPLE OF THE NORTH-EAST OF SCOTLAND.[1]

IT is to the credit of the Anatomical and Anthropological Society of the University of Aberdeen that it can issue *Proceedings* in a form far superior to those of the Anatomical Society of Great Britain and Ireland—the only other anatomical society in this country. Even in the contents of its *Proceedings* the younger society, founded and fostered by the professor of anatomy in the university, compares not unfavourably with the older society.

Naturally one turns first to those papers which deal with the people in the north-east of Scotland. By common repute they are a shrewd, "hard-headed" race. In a well written paper on the contents of short cists found in Aberdeenshire and neighbouring counties, Dr. Alexander Low tells all that can at present be known of their ancestors, the prehistoric inhabitants of this part. The picture drawn by Dr. Low is founded on the broken skeletons of eight men and

[1] *Proceedings* of the Anatomical and Anthropological Society of Aberdeen University, 1902–04. Pp. 155, 28 plates, 22 figs. in text. (Aberdeen: University Press, 1904.)

two women which, owing to the foresight of the late Prof. Struthers and of Prof. Reid, have been slowly accumulated and safely preserved in the anatomical museum of the university. These prehistoric Aberdonians were of low stature (5 feet 2 inches to 5 feet 4 inches), with rounded heads which measured in breadth from 82 per cent. to 85 per cent. of their length. One can see, by referring to "An Analysis of Anthropometric Statistics," a contribution made to this volume of the *Proceedings* by Mr. John Gray, that only about 12 per cent. of the present inhabitants of Aberdeenshire possess heads which, in the proportion of their diameters, resemble those of the prehistoric race. Further, it is evident that the present inhabitants of Aberdeenshire stand, as regards the diameter of the head—the only racial characteristic that can be dealt with—in an intermediate position between the long-headed highlanders of the west of Scotland and the short-headed prehistoric people of the east coast. The natural inference appears to be that the present race of the north-east of Scotland is the result of a fusion of the east and west types—but the west has exerted the stronger influence. One of the two female skulls described by Dr. Low is that of a woman who, in shape of head, belonged to the west rather than to the east type. She may have been an exceptional member of the "short-cyst" race, but it is more probable that she was a western woman captured by the eastern invaders. Those who seek to discover the factors which determine the shape of the head will find most valuable material in the fourteen plates contributed by Prof. Reid. They represent serial sections of the heads of two subjects which had been very successfully prepared.

In these *Proceedings* one can recognise the influence that the Anatomical Society exerts on the medical graduates of Aberdeen. A skeleton of a Chinese coolie sent from Singapore, a Boxer's skull brought from north China, five Wa Kamba skulls and ten Wasoga crania collected in Uganda, provide material for the junior members to examine and report on. A paper contributed by Dr. F. W. Moir contains the results of a prolonged study of the people of Ashanti. Is it not strange that the University of London, in the very centre of the Empire, offers no such stimulus to its medical graduates as is given in Aberdeen? When the board of studies for human anatomy and morphology was recently constituted in the University of London the study of human races was, for all practical purposes, completely excluded.

The eyesight of the people in the north-east of Scotland is remarkably good. Drs. Usher and Stoddart found, from the examination of 400 students, that 15 per cent. were myopic or short sighted; Fuchs found in Germany that 60 per cent. of students at a corresponding age were myopic; Norris and Oliver give 28 per cent. as the corresponding figure for American students. About three in every hundred of the Aberdeen school children are myopic; the proportion in Edinburgh is almost twice that number. Seven per cent. of the Aberdeen police are short-sighted.

In conclusion, it is to be hoped that the oblivion which so frequently overtakes the *Proceedings* of local societies, because of their inaccessibility to other workers, will spare the *Proceedings* of which this volume is but one of a series.

HYDROLOGY IN THE UNITED STATES.

THE Geological Survey Department of the United States embraces much wider duties than those covered by the similar department in this country, and the following notes upon some of the various matters with which it deals, and of the trouble taken to afford information as to the mineral resources and water supply of America, may be of interest.

The United States Geological Survey Department was created by an Act of Congress in 1879. From time to time its duties, as originally set out, have been considerably extended. For administrative purposes the survey is now divided into branches and divisions, comprising geology, topography, hydrography, with offices charged with administration and the publication of maps and reports.

The department of the Geological Survey has charge and classification of all public lands; the examination of the geological structure, mineral resources, and the products of the national domains; the survey of forest reserves and the preparation of topographic and geologic maps. The hydrographic and hydrological branch has charge of all investigations relating to the occurrence of water as a mineral and as a source of wealth to the country. It is engaged in making systematic measurements of the rivers and streams throughout the States, and of the flow of water and the supply available, whether for domestic use or as a source of power. It also, through the Reclamation Service, prepares plans for the construction of reservoirs, canals, and other works for the irrigation of arid lands, of which there are very large areas in America, and superintends the carrying out of works that have been decided on for reclamation.

To show the thorough way in which the work of the department is carried out and the pains taken to ensure efficiency, recently a conference was called by the chief engineer for the purpose of enabling the heads of the engineering staff of the Reclamation Service (twenty-five in number) to become acquainted with their work, and of exchanging views and information as to the works in hand and those planned for the future, and so secure uniformity of method in carrying out their work. At this conference an address was given by the chief engineer on the duties of the officers engaged in the work, and papers were read by the engineers having charge of the various works in execution. A record of these proceedings, with copies of the papers and other information, is given in one of the State papers issued by the department.[1]

Nearly two hundred engineers, hydrographers, and topographers are in the employ of the Reclamation Department alone, and comprehensive instructions are issued as to the management of the works, rates of pay for assistants and workmen, and other matters. One condition laid down by the State is that in all constructive work eight hours shall constitute a day's work for all labourers and mechanics.

For the use of the staff engaged in the hydrological department a manual[2] has been issued containing instructions as to the proper method of taking observations and the best form of float and current meters to be used under different conditions, with illustrations of the different kinds of meters in use and the method of using the same from bridge, cable, and boat stations; forms of reports, diagrams of discharge and current observations; with formulæ and tables to be used in computations.

From time to time the reports sent in by the staff as to the results of the various surveys and works going on are issued by the department, some of which, relating to water supply and irrigation, the relation of rainfall to run off and the floods in the Mississippi, have been noticed in NATURE of January 7, July 28, and November 3, the last reports, Nos. 89, 90, 91, being on the water resources of the Salinas Valley, the geology and water resources of the lower James River Valley, and on the natural features and economic development of drainage areas in Ohio.[3]

[1] "Proceedings of the First Conference of Engineers of the Reclamation Service, with accompanying Papers" Compiled by F. H. Newell. Water Supply and Irrigation Paper, No. 93. (Washington: Government Printing Office, 1904.)

[2] "Hydrographic Manual of the U.S. Geological Survey." Water Supply Papers, No. 94.

[3] "On Destructive Floods in the United States in 1903"; "On the Progress of Stream Measurements for 1903"; "Underground Waters in Southern Louisiana"; "Contributions to the Hydrology of the Eastern United States in 1903"; "The Underground Waters of Arizona."

"Water Resources of the Salinas Valley, California." Paper No. 89.

"Geology and Water Resources of the Lower James River Valley." Water Supply and Irrigation Paper, No. 90.

"The Natural Features and Economic Development of the Sandusky, Maumee, Muskingum, and Miami Drainage Areas in Ohio." Water Supply and Irrigation Paper, No. 91.

"Destructive Floods in the United States in 1903." By E. C. Murphy Paper No. 96.

"Report on the Progress of Stream Measurements for the Calendar Year 1903." By J. C. Hayt. Paper No. 97.

"Report on the Progress of Stream Measurements for the Calendar Year 1903." By J. C. Hayt. Paper No. 98.

"Underground Waters of Southern Louisiana." By G. D. Harris. Paper No. 101.

"Contributions to the Hydrology of Eastern United States." By M. L. Fuller. Paper No. 102.

"The Underground Waters of Gila Valley, Arizona." By W. T. Lee. Paper No. 104. (Washington: Government Printing Office, 1904.)

A BIBLIOGRAPHY OF AGRICULTURAL SCIENCE.[1]

THE yearly increasing output of scientific workers, like the fleas that have "lesser fleas to bite 'em," has called into being another class of workers who have to abstract the papers into Jahresberichte, Centralblatter, records, and the like, the next step in the *ad infinitum* process being represented by the indexes which appear every decade or so to the abstracts themselves. By no other means would the investigator be able to "read up the literature" before attacking a new problem, and though there may be two opinions as to the wisdom of so doing, there can be none as to the desirability of having the power if need be. The present volume consists of a subject index to the first twelve volumes of the *Experiment Station Record*, the well known series of abstracts of both American and European papers in agricultural science which is issued monthly by the United States Department of Agriculture, and distributed so liberally to all foreign workers. The *Experiment Station Record* is, indeed, something more than a journal of abstracts; it contains from time to time special articles resuming the current state of knowledge about particular subjects, and written by some acknowledged expert; for example, in this index we find mentioned special articles by Kühn, Stohmann, Kellner, Zuntz, and Hagemann on nutrition investigations alone.

The abstracts proper in the *Experiment Station Record* are generally very full; like all abstracts, they vary much in value, but generally they fulfil their real purpose of telling one whether it is worth while to read the original paper or not. Naturally, with a subject like agriculture, touching on so many sciences, the abstracts cover a very wide field; chemistry, botany, zoology, geology, all have their special journals which must be looked through lest any article bearing on agriculture escape; meteorology, bacteriology, veterinary science, horticulture also contribute, in addition to the great volume of journals in every country which are devoted solely to agricultural topics. The present index only adds to the debt of gratitude which all British workers in this field have long owed to the United States Department of Agriculture; in fact, if one wants to find the reference to some English experiment, by far the best if not the only way of tracing it is to hunt up its abstract in the *Experiment Station Record*. Such a pursuit will now be greatly facilitated by the present general index, which represents a putting together of the very full indexes to each of the annual volumes. A further feature of value is a complete list of *Bulletins* issued by the various divisions of the U.S. Department of Agriculture, with references to the abstracts in the *Record*. When we add that the department has also published card indexes to the more important foreign agricultural publications, as, for example, to the well known *Landw. Versuchsstationen*, we get a further idea of the completeness with which the United States Department of Agriculture is pursuing its self-imposed task of bibliography.

[1] "General Index to Experiment Station Record." Vols. i. to xii., 1889–1901. Pp. 671. U.S. Department of Agriculture. (Washington, 1903.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

AT the Darmstadt Technical College Mr. Clarence Feldmann has been appointed professor of electrotechnics.

PROF. W. NERNST, director of the departments of physical chemistry and electrochemistry at Göttingen, has accepted the chair at Berlin previously occupied by Prof. Landolt.

PROF. ARRHENIUS has declined the appointment offered him at Berlin, the Swedish Academy of Sciences having founded a Nobel Institute of Physical Chemistry with Prof. Arrhenius as director.

DUBLIN University has conferred the degrees of Master in Surgery and Doctor in Medicine *honoris causa* on Sir Frederick Treves, C.B., and the degree of Doctor in Science *honoris causa* on Major Ronald Ross, C.B., F.R.S.

DR. E. W. SKEATS, demonstrator in geology at the Royal College of Science, has been appointed to the chair of geology and mineralogy in the University of Melbourne in succession to Prof. J. W. Gregory, F.R.S., now professor of geology at Glasgow University.

CHAIRS for research and teaching in protozoology and in helminthology are about to be established at the London School of Tropical Medicine, the funds being provided by certain colonial Governments. The importance of these branches of research in tropical medicine is unquestionable, and it is gratifying to know that this is appreciated by the Governments which have thus assisted the study of the subjects.

DR. JOLY has been appointed ordinary professor of mathematics at Lausanne; Dr. Heinrich Liebmann, hitherto recognised teacher in mathematics, has been appointed assistant professor of philosophy at Leipzig; Dr. Roland Scholl, assistant professor of chemistry at the technical college, Carlsruhe; Dr. Arthur Wehnelt assistant professor of theoretical and applied physics at Erlangen; Dr. Georg Edler von Georgievics, hitherto professor of chemical technology at Bielitz, is to succeed Prof. Karl Zulkowski at the German Technical College at Prague.

THE annual conference of teachers, arranged by the London County Council, will be held on January 5–7 next at the Medical Examination Hall, Victoria Embankment. At the first meeting, addresses on the teaching of arithmetic will be given by Mr. C. T. Millis and Mr. S. O. Andrew, and the discussion will be opened by Mr. A. W. Siddons. Other subjects to be brought forward at subsequent meetings are:—the psychology of dictation, the teaching of reading, art teaching in Japan, the influence on handicraft of art teaching in elementary and secondary schools, the art training of the artisan, and true and false applications of Froebel's principles.

THE promoters of the movement for providing the University College of North Wales with new buildings on the site presented by the Corporation of Bangor have within the last few days been greatly encouraged in the task by an announcement that Mr. Owen Owen will contribute 1000*l*. to the building fund. This donation, taken in conjunction with the recent bequest to the college by the late Dr. Isaac Roberts of the sum which is expected to reach about 15,000*l*., and by the late Mr. John Hughes, of Liverpool, and Mr. Richard Hughes, of Llanfwrog, Anglesey, of 5000*l*. and 1500*l*. respectively for the purpose of establishing scholarships, affords a welcome indication of the interest which is now being taken in the fortunes of the college by Welshmen having the like means and wish to benefit the cause of higher education.

AT a recent meeting with reference to Swanley Horticultural College, presided over by Lady Brassey, Mr. J. C. Medd urged the claims of the college to recognition by the Board of Agriculture, and showed how the institution now fulfilled the conditions which it ought to do, if it were to expect an annual grant from that Government department. He also alluded to the nature-study course for teachers which was held at Swanley during the summer holidays. Sir John Cockburn pointed out that all educational establishments that did their duty were in need of funds, and that Swanley College was no exception. Mr. Buckmaster, chief inspector to the Board of Education, spoke of the efficiency of Swanley College at the present time, and thought that all energy should be directed towards maintaining and improving the position which Swanley had attained rather than to inaugurating similar undertakings.

ADDRESSING the boys at St. Clement Danes' Holborn Estate Grammar School on Monday, Lord Alverstone remarked that it was the knowledge acquired in youth which lasted longest. The effort to retain impressions in later life was in marked contrast to that made when the brain was younger. Modern languages, therefore, should be earnestly and carefully studied at school. He was glad to see a considerable number of pupils had gained honours in English literature. In the hurry and race of modern life there was a tendency to advocate education which would be of immediate assistance to professional life; but he was strongly of opinion that up to the age of sixteen or seventeen a boy's education should be general, and the temptation to specialise too much should be resisted. A boy would be a better student and would make a better man of the world if up to seventeen he received a liberal education rather than one directed to any special object. Most educationists would agree with Lord Alverstone in his objection to specialisation at school; but in connection with this subject it is pertinent to ask whether the study of Greek is not specialisation to a boy who is taught English and Latin properly.

At the annual speech day of Scarborough Municipal School on Tuesday, the Right Hon. A. H. Dyke Acland, chairman of the governing body of the school, remarked that if he were asked what the secondary schools of the country needed most he would say more money, fewer examinations, and a more effective instruction in English language and literature. They wanted the means which would enable them to try to follow the example of other countries in the matter of secondary education. The culprit in this case was not the Board of Education but the Treasury. If it had to put down ten millions for elementary education it tried to take it out of secondary education, and at this present moment of our country's history there was nothing which needed more assistance than secondary education. With regard to examinations, Mr. Acland strongly contended that the old system of paper examinations was not a true test of the efficiency of a school, and was often altogether deceptive. The true test was when half a dozen inspectors spent four days and watched the work of the pupils, as was done at Scarborough. In America there were almost no examinations, and in Germany the ordinary paper examination of which we thought so much was unknown.

SOCIETIES AND ACADEMIES.

London.

Royal Society, October 27.—"Some Physical Characters of the Sodium Borates, with a New and Rapid Method for the Determination of Melting Points." By C. H. **Burgess** and A. **Holt**, jun.

The glasses obtained by fusing sodium carbonate with boric anhydride can be transformed either wholly or in part on prolonged heating into stable, crystalline varieties, which invariably melt at higher temperatures than the glasses from which they were derived.

A study of the melting points of the crystalline and vitreous forms of mixtures of different compositions leads to the conclusion that only two sodium borates can be obtained by fusion—$Na_2O.4B_2O_3$ and $Na_2O.B_2O_3$.

The addition of Na_2O to boric anhydride produces in the first place a solution of the borate $Na_2O.4B_2O_3$ in boric anhydride. This then becomes supersaturated, and the borate in excess separates on heating for some time. The amount which separates continues to increase until the mixture has the composition of nearly pure $Na_2O.4B_2O_3$, when complete crystallisation occurs. Between this point and the compound $Na_2O.B_2O_3$, the crystalline forms appear to be solid solutions of the two above mentioned borates, anhydrous borax itself being almost the eutectic point. In mixtures containing more sodium than $Na_2O.B_2O_3$, the crystals seem to be solid solutions of this compound with sodium carbonate. The glasses appear to be the superfused and metastable forms of the crystals.

Analyses of glasses and crystals of various composition confirm the observations derived from the melting points. The melting point method employed consisted essentially of a platinum wire which was heated electrically, to which a small bead of the substance under investigation was hung. A light weight was attached to the bead. When the wire was heated to the melting point of the substance the bead and weight fell off. The resistance of the wire was determined at this moment, and thence the temperature. The method proved good for substances like glass, which have hitherto not been supposed to melt at any definite temperature.

November 17.—"On the Group IV. Lines of Silicium." By Sir Norman **Lockyer**, K.C.B., LL.D., Sc.D., F.R.S., and F. E. **Baxandall**, A.R.C.Sc.

In previous communications to the Royal Society an account has been given of the behaviour of the lines of silicium under varying experimental conditions, and as a result of the inquiry the lines were divided into four distinctive groups. The genuineness of the lines of group iv., as silicium lines, has recently been questioned by M. de Gramont, of Paris. He concludes that, as the lines of group iv. always disappear from his spectra with the air lines, they are really due to oxygen or nitrogen. This is so much at variance with the Kensington conclusions that it has been considered necessary to give, in the present paper, the photographic evidence on which those conclusions were based. Reproductions of photographs of silicium spectra under various electrical conditions are given, and from the behaviour of the Si iv. lines in the different photographs it is claimed that they cannot be due to anything other than silicium.

In the vacuum-tube spectrum of SiF_4 the Si iv. lines are seen to be stronger than even the strongest of Neovius's air lines, which appear in the same spectrum.

In one of the reproductions, the spark spectrum of sodium-silico-fluoride, volatilised between platinum poles, is compared with the spark spectrum of air, also made incandescent between platinum poles. In each spectrum the ordinary lines of nitrogen and oxygen are well seen. The silicium lines in question are shown in the former spectrum, but have no corresponding lines in the air spectrum. It is also mentioned that these lines do not occur in the Kensington spark spectrum of any element other than silicium.

There are, according to Neovius, very weak lines of oxygen or nitrogen near the positions of the silicium lines (4089·1 and 4116·4). These faint air lines are possibly the lines which Gramont gets in his spectra, but from the evidence adduced in the present paper they are not the lines which appear so strongly in the Kensington silicium spectra.

In another reproduction the SiF_4 spectrum is given alongside that of ϵ Orionis, and the identity of position of the Si iv. lines and strong lines in the stellar spectrum is shown.

Linnean Society, December 1.—Prof. W. A. Herdman, F.R.S., president, in the chair.—Proteid digestion in animals and plants: Prof. S. H. **Vines**, F.R.S. In this discourse Prof. Vines first remarked that the foundation of our knowledge of gastric digestion in animals was laid by van Helmont so long ago as early in the seventeenth century ("Ortus Medicinæ," 1648), who held that it was effected by an "acid ferment." But in spite of continued research by Réaumur, Stevens, Spallanzani and others, it was not until two hundred years later that the ferment was actually detected. This important discovery was made in 1836 by the celebrated Schwann, who gave to the ferment the name "pepsin." In the course of subsequent investigation, it came to be recognised that the digestion of the food is not by any means completed in the stomach, but that the greater part of the digestive process is carried on in the small intestine (duodenum) by the pancreatic secretion. Claude Bernard ascertained in 1856 that the pancreatic juice contains a ferment that digests proteids; to this ferment the name "trypsin" was given by Kühne in 1876. These two were the only proteases known until quite recently (1901) a new protease, termed "erepsin" by Cohnheim, its discoverer, was added to the list. Like trypsin, this protease peptolyses peptones, and is active in alkaline liquids; but its peptonising power is much less marked, as it is without action on albumin and fibrin, though it can peptonise casein. The discovery of erepsin suggested the possibility that trypsin might be, not a single enzyme, as had hitherto been thought, but a mixture of enzymes, possibly of peptonising with peptolysing enzymes. Research in this direction has, in the hands of Dr. Vernon, already (1903) shown that what is generally known as trypsin is a mixture of erepsin (pancreato-erepsin) with what may be termed trypsin proper. It is not inconceivable that analysis may be carried still further, and that trypsin proper may itself be found to be a mixture of a peptonising with a peptolysing enzyme. Prof. Vines next turned to proteid-digestion in plants. His own contribution, made within the last three years, consists of a number of observations on many different plants or parts of plants, showing that a protease of some kind is probably to be found in all parts of all plants at one stage or other of their development. It appears that whilst all plants that have been investigated can effect peptolysis, only a limited number have been found capable of digesting fibrin. Prof. Vines has ascertained that in certain cases (yeast, mushroom) the tissues contain a mixture of erepsin with a fibrin-digesting enzyme, a result which finds its analogue in Vernon's researches on pancreatic trypsin.

Entomological Society, December 7.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Mr. H. St. J. **Donisthorpe** exhibited *Quedius nigrocoeruleus*, taken by Mr. H. C. Dollman in a rabbit-hole at Ditchling, Sussex, this being the fourth recorded British specimen.—Prof. T. Hudson **Beare** exhibited a specimen of the rare Longicorn *Tetropium castaneum*, taken about two years ago in the vicinity of the quays at Hartlepool, and probably introduced from abroad.—Mr. G. J. **Arrow** exhibited a series of the Lamellicorn beetles from the Burchell collection, and remarked that Burchell had at the time of their capture, some seventy years ago, already noted their powers of producing musical sound.—Mr. C. O. **Waterhouse** exhibited drawings illustrating the development of the front wing in the pupa of the Tusser silk moth, showing the relation of the tracheæ to the veins, prepared for exhibition in the Natural History Museum. He also exhibited some coffee berries from Uganda injured by a small beetle belonging to the Scolytidiæ, and two coleopterous larvæ from the Burchell collection from Brazil, submitted to him for determination by Prof. Poulton. One was a heteromerous larva two inches long, much resembling the larva of Helops. The more interesting one was noted by Burchell to be luminous, and appeared to be the larva of an Elaterid.—Mr. J. J. **Walker** exhibited the type-specimen of *Haplothorax burchelli*, G. R. Waterhouse, from the Hope collection, a remarkable Carabid discovered by Burchell in St. Helena. It is now exceedingly rare, if not entirely extinct, in its sole locality, the late Mr. Wollaston, during his visit to the island in 1875–6, having entirely failed to find the beetle alive, though its dead and mutilated remains were often met with.—The **President** exhibited cases showing the results of breeding experiments upon *Papilio cenea* conducted by Mr. G. F. Leigh, who had for the first time bred the *trophonius* form from *trophonius* itself. He also exhibited a photograph, taken by Mr. Alfred Robinson, of the Oxford University Museum, showing the Xylocopid model and its Asilid mimic, exhibited by Mr. E. E. Green at a recent meeting. The example was particularly interesting, inasmuch as Mr. Green's record of the mimic circling round its model tended to support the view that the bee is the prey of the fly.—*Erebia palarica*, n.sp., and *Erebia stygne*, chiefly in regard to its association with *E. evias*, in Spain: Dr. T. A. **Chapman**. The author described *Erebia palarica*, a new species from the Cantabrian range; he said it was phylogenetically a recent offshoot of *E. stygne*, and the largest and most brilliant in colouring of all the known members of the family.—Entomological experiences during a tour through India and Ceylon, October 10, 1903, to March 26, 1904: Dr. G. B. **Longstaff**.

Geological Society, December 7.—Dr. J. E. Marr, F.R.S., president, in the chair.—The chemical and mineralogical evidence as to the origin of the dolomites of southern Tyrol: Prof. E. W. **Skeats**. Recent work on modern coral-reefs has shown that these limestones contain very little, if any, insoluble residue. The study of the relative proportions of the organisms composing these reefs, and the alterations that they undergo, has further shown that corals play a subordinate part in them, and that calcareous algæ, foraminifera, and other organisms form the bulk of the rocks of the reefs. The author has applied this information in the examination of collections from the much debated area of the dolomites of southern Tyrol. The chemical examination of numerous specimens from the Schlern dolomites of the Schlern, the Langkofl, the Marmolata, the Sella, the St. Cassian district, the Richthofen Reef, and numerous other localities is described, so far as relates to the proportions of lime and magnesia and of insoluble residue. These results are compared with similar analyses of limestones from lower and higher horizons.

Physical Society, December 8.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—On a rapid method of approximate harmonic analysis: Prof. S. P. **Thompson**. For the study of alternating electric currents and for several other applications, harmonic analysis is simplified by the consideration that all the even terms in the Fourier expansion are absent. In this case the second half-period is similar to the first half-period, but with the ordinates of the corresponding angles reversed in sign. Given a complicated harmonic curve containing constituents of the odd orders only, the zero-line can always be drawn so that the constant term vanishes from the Fourier series, the mean ordinate being zero; and it is then always possible to choose as origin a point for which the ordinates at 0° and 180° are zero. The paper gives a *résumé* of the various methods which have been employed for harmonic analysis by reduction from simultaneous equations, graphical means, and by harmonic analysers. The method adopted by the author is a simplification of a general method of analysis published by Prof. Runge.—A high frequency alternator: W. **Duddell**. The author described and showed in action a high-frequency alternator which he had constructed in 1900 for some experiments on the resistance of the electric arc, and with which frequencies up to 120,000 ~ per second had been obtained. An illustration will perhaps convey some idea of how high a frequency of 120,000 ~ per second really is. In plotting curves for ordinary frequencies of 50 to 100 ~ per second, a scale often adopted is 10 inches for 100 ~. If it were attempted to plot a curve up to 120,000 ~ per second to this scale, the curve paper would require to be 12,000 inches, or nearly *one-fifth of a mile long*.—Exhibition of experiments to show the retardation of the signalling current on 3500 miles of the Pacific cable between Vancouver and Fanning Island: Prof. W. E. **Ayrton**. The experiments were performed upon a cable electrically equivalent to the portion of the Pacific cable between Vancouver and Fanning Island, the product of the capacity (in mfds.) and the resistance (in ohms) being nine millions. Three dead-beat galvanometers were employed to indicate the current at the beginning, in the middle, and at the end of the cable. It was shown that upon applying an E.M.F. at one end of the cable the current at that end was enormously greater than its steady value, and that one-fifth of a second elapsed before any indications of current were shown at the far end of the cable. By that time the current at the sending end was 3·7 times its steady value, and after two-fifths of a second it had fallen to 2·3 times its steady value. In about five seconds the current became steady.

Royal Astronomical Society, December 9.—Prof. H. H. Turner in the chair.—On a very sensitive method of determining the irregularities of a pivot, and on the influence of the pivot errors of the Radcliffe transit circle upon the right ascensions of the Radcliffe catalogue: Dr. **Rambaut**. The method is a modification of that of M. Hamy, a small steel pin being inserted in each pivot; by means of a lever arrangement horizontal as well as vertical displacements, due to pivot irregularities, can be observed. The apparatus, which had been found entirely satisfactory, was fully described and illustrated.—On the validity of meteor radiants as determined from three observed tracks: Mr. **Chapman**.—A note accompanying a photograph of the detached nebula in Cygnus: W. S. **Franks**. The nebula was the one recently photographed by Dr. Max Wolf; the present plate, taken with the late Dr. Isaac Roberts's 20-inch reflector, showed the details of the nebula on a larger scale. A second note by Mr. Franks upon dark nebulosities was also read; it was illustrated by four photographs of long lenticular nebulæ, each of which was sharply divided longitudinally throughout its entire length by a dark line. The author suggested that these nebulæ, probably spirals seen edgeways, were cooler at their extreme edges, and that this band of cooler matter absorbed their light and caused the appearance of the dark bands seen in the photographs.—Two papers on the lunar theory, one being a note on the completion of the solution of the main problem: Prof. Ernest W. **Brown**.—An analysis of 145 terms in the moon's longitude: P. H. **Cowell**.—On the decline in the magnitude of the variable 159, 1904 Pegasi: Mr. **Wickham**.

Zoological Society, December 13.—Mr. Herbert Druce, vice-president, in the chair.—Some specimens of a gazelle from Palestine: a new species: Oldfield **Thomas**, F.R.S.—The anthropoid apes, illustrated by a large collection of mounted skins, skeletons, and skulls: the Hon. Walter

Rothschild. The gorilla from South Cameroon and the white-faced chimpanzee of the Gaboon were characterised as new.—The cranial osteology of the clupeoid fishes: Dr. W. G. **Ridewood.**—Characters and synonymy of the British species of sponges of the genus Leucosolenia: Prof. E. A. **Minchin.**—Descriptions of eighteen species of land-shells belonging to the genus Macrochlamys and its allies: Dr. W. T. **Blanford,** F.R.S.—Descriptions of a new genus and thirty-two new species of phytophagous Coleoptera of the family Halticidæ from South and Central America: M. **Jacoby.**

Cambridge

Philosophical Society, November 28.—Prof. Marshall Ward, president, in the chair.—Remarks on Piroplasmosis with exhibition of specimens: G. H. F. **Nuttall.**—Note on some peculiar features in seedlings of Peperomia: A. W. **Hill.** The seedlings of *Peperomia umbilicata* were found in the Andes of Bolivia at about 13,500 feet above sea-level. The species is a geophilous one with small bulbs and peltate leaves. The peculiarity of the seedlings lies in the fact that, though they are dicotyledonous in structure, only one of the two cotyledons leaves the seed to function as an assimilating organ; the other remains permanently in the seed as an absorbent organ. The other bulbous species from the Andes apparently show the same features of germination, and several other species from Central America, preserved in the herbaria of Kew and South Kensington, whilst differing in their vegetative habits, show a similar type of germination.—Exhibition of new and rare Arachnids taken near Cambridge: C. **Warburton** and N. D. F. **Pearce.**—The inheritance of tortoiseshell and related colours in cats: L. **Doncaster.** Tortoiseshell cats are heterozygotes, containing the two colours black and orange. They can be produced by mating orange with black, but a tortoiseshell paired with either orange or black may throw all three colours. Male tortoiseshells are exceedingly rare, and the normal colour of the black-orange heterozygote in the male is orange, the black in this case being completely recessive. When a male tortoiseshell is paired with a female, all three colours may be produced in the kittens. Cream and blue are dilute forms of orange and black, and behave similarly when crossed, the females being "blue tortoiseshells," the males creams. Creams may be obtained by pairing blue with orange, the dilution being transferred from one colour to the other. Blue is recessive to black, and so probably is cream to orange; it appears also that blue may be completely recessive to orange in the female, although black by orange in the female gives tortoiseshell.

Manchester.

Literary and Philosophical Society, November 29.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—Determination of wave-lengths in the extreme ultra-violet part of the spectrum: H. **Morris-Airey.** After a brief historical sketch of the work of earlier investigators, the classical experiments of Schumann were described. Schumann was not able to measure the wave-lengths of the new lines beyond $185\mu\mu$, which he photographed, on account of our defective knowledge of the dispersion of the material of which his prism was constructed. The author attempted to do this by producing the spectra by means of a concave grating *in vacuo*, but without success. However, using a plane transmission grating ruled on a plate of white fluorspar, to resolve the light from a powerful induction coil discharge between aluminium electrodes four new standard wave-lengths were measured extending to the wave-length $169\mu\mu$. The experiments were carried out, after Schumann, *in vacuo*, and the spectra recorded on photographic plates specially designed for the work.

Paris.

Academy of Sciences, December 12.—M. Mascart in the chair.—Remarks on some thermochemical rules relating to the possibility and the prediction of chemical reactions: M. **Berthelot.** The author discusses the statement that a chemical reaction must always be accompanied with an evolution of heat, and refers to his earlier works to show the exact meaning to be attributed to the words chemical reaction.—The determination of the difference in longitude between Greenwich and Paris made in 1902: M. **Lœwy.** A detailed account is given of the precautions necessary for the accurate determination of this constant. Particular care was given to the study of the personal equation of each observer, and to reduce still further the errors due to this source, the English and French observers changed stations. The mean result obtained by the latter for the difference of longitude between Paris and Greenwich was 9m. 20·974s.—On the element Z_δ: Lecoq **de Boisbaudran.** In discussing the presence of a band $\lambda = 488$, M. Urbain regards the existence of a new element corresponding to this band as hypothetical. The author gives reasons for his statement that this band is really due to a new element, and maintains the accuracy of his work published in 1895.—Observations of the sun made at the Observatory of Lyons with the 16 cm. Brunner equatorial during the third quarter of 1904: L. **Guillaume.** The results are summarised in three tables giving the numbers of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—On the approximation of incommensurables and of trigonometric series: M. **Fatou.**—On continuous space groups, finite and infinite: M. **Le Vavasseur.**—Remarks on a method for the study of the convergence of certain continuous fractions: H. **Padé.**—The detonation of explosive substances under water: M. **Jacob.**—An electrically driven nickel-steel pendulum: Jean **Mascart.** A preliminary account of the results obtained with a pendulum of invar, driven by the electrical arrangement devised by M. Lippmann. Its rate was about two seconds per day. The author regards it as preferable to use several pendulums of this kind, which can be set up with ease, to attempt an absolute compensation.—On the registration of the *n*-rays by photography: G. **Weiss** and L. **Bull.** A description of the arrangement adopted is given in detail, the object being to produce three squares in contact with each other, the centre one corresponding to the effect produced by the phosphorescent surface when not exposed to the rays. The two outer squares should have been darker if an increase of the light intensity had been produced under the action of the rays. The experiment was repeated a great number of times, varying the nature of the plates, the time of exposure, and the intensity of lighting. The shortest exposure was twenty seconds, and the longest five minutes. In no case was a positive result obtained, there being no difference between the intensity of the squares corresponding to the time of action of the rays.—On some new derivatives of tetrahydrobenzene: Léon **Brunel.** By the simultaneous action of iodine (in the presence of mercury oxide) and acetic anhydride upon tetrahydrobenzene an iodoacetate is formed, $CH_3.CO_2.C_6H_{10}I$.—The synthesis and study of cyclic substituted thio-hydantoins: Emm. **Pozzi-Escot.** The method of preparation adopted consisted in acting upon the *a-b*-disubstituted thio-ureas with a monoalkyl fatty acid.—On the possibility of producing a non-brittle steel, tempered blue: Ch. **Frémont.** It is generally supposed that all irons and steels, whatever their quality, become brittle under shock at temperatures between 200° C. and 450° C. An example is given showing that this is not necessarily the case.—On a method of decomposition of complex statistical curves into irreducible curves: Charles **Henry.**—On the accessory glands of the larvæ of the Lepidoptera: L. **Bordas.**—The development of the tentacles of the Campanulariidæ and the Plumulariidæ: Armand **Billard.**—The resistance to desiccation of some fungi: Mme. Z. **Gatin-Gruzewska.** It has been found that certain fungi, including three species of Polyporus, are not killed by a prolonged drying at 37° C., as the dried fungi, when moistened, possess the same respiratory coefficient as the undried plant. The amount of carbon dioxide given off per hour is, however, less in the former case than in the latter.—On the constitution of arable earth: A. **Delage** and H. **Lagatu.** By the application of the methods of petrography to the smallest particles of arable earth, the authors come to the conclusion that instead of the earth being, as is usually represented in classical works on the subject, the result of a disaggregation followed by a decomposition of the mineral constituents of rocks, it simply consists of the various minerals of the rocks from which it is derived in a very fine state of division. The mica, quartz, felspar, calcite, tourmaline, apatite, &c., are perfectly normal, and show no signs of decomposition or of localised corrosion. The advantages of this method of examining arable earths, when used to supplement the results of a chemical examination, are pointed out.—On a new potato suitable for cultivation in damp soils: M. **Labergerie.** *Solanum Commersoni*, which up to the present has been regarded as only good for forage, has been found to give an excellent edible tuber, and it possesses the great advantage of preferring a damp soil for its growth.—On the gasification of vegetable combustibles and the generation of an economical motive power in agriculture: L. **Bordenave.** An account of the production of gaseous fuel from agricultural refuse, used in conjunction with a gas engine designed for gas of low calorific value.—The Coal-measures in French Lorraine: Francis **Laur.** The views of the author regarding the prolongation of the Saarbruck basin into France, following an axial line Neukirchen-Pont-à-Mousson, have been confirmed by two borings 700 metres deep. Further borings are in progress for the thorough exploration of the coal field. The coal contains 2 per cent. of moisture, 36 per cent. of volatile matter, 49 per cent. of coke, and 13 per cent. of ash.—Glacial growth at the end of the nineteenth century, and the different factors which have determined the anomalies of this growth in the massif of Pelvoux: Ch. **Jacob** and G. **Flusin.** The observations put forward furnish an explanation of the anomalies of glacier growth in this region indicated in 1900 by Kilian.—On subterranean corrosion at Wells (England), and the chronometry of subterranean erosion: E. A. **Martel.**

NEW SOUTH WALES.

Linnean Society, October 26.—Dr. T. Storie Dixson, president, in the chair.—Notes on Australian Lycænidæ, part iv.: G. A. **Waterhouse** and R. E. **Turner.**—Revisional notes on Australian Carabidæ, part i., tribes Carabini, Pamborini, Pseudozænini, Clivinini, and the genus Nebriosoma: T. G. **Sloane.**—Notes on the native flora of New South Wales, part ii.: R. H. **Cambage.** The route traversed—Boggabri to Tingha, *via* Narrabri, Moree, Warialda, and Inverell—offers sufficient variations in altitude and geological formation (including portion of the black soil plains) to provide interesting examples of the results traceable to these factors in the distribution of species under Australian conditions. Thus the effect of climatic influence is exhibited by such species as *Eucalyptus sideroxylon* (ironbark or mugga), *E. conica* (a box-tree), and *E. melanophloia* (silver-leaved ironbark), which in the south grow at lower elevations than is the case towards the north, where they are able to ascend the mountains owing to the warmth of northern latitudes being tempered by the increased elevation. The same influence also allows certain eastern and western species to mingle on the northern highlands, while in the south the Great Dividing Range serves as a cold barrier to keep them apart. As an instance of the influence of geological formation, the case of a sandstone area between Boggabri and Narrabri was mentioned; here *Angophora lanceolata* is a conspicuous feature of the flora.—Notes from the Botanic Gardens, Sydney, No. 10: J. H. **Maiden** and E. **Betche.**—Miscellaneous notes (chiefly taxonomic) on Eucalyptus, part i.: J. H. **Maiden.** The author deals with some plants formerly included under *E. amygdalina*, Labill. The confusion which has gathered around *E. radiata*, Hook. f. (non Sieb.), is finally cleared up. That "white gum" included under *radiata* by Bentham and others is described as a new variety or species under the name *E. numerosa*, from the number of fruits in an umbel.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part v. for 1904, contains the following memoirs communicated to the society:—

July 23.—A. **Sommerfeld**: Contributions to the theory of electrons; (2) bases of a general dynamic of the electron. G. v. d. **Borne**: Seismic records in Göttingen, July–December, 1903. W. **Voigt**: The action of electric vibrations upon optically active bodies. M. **Laue**: On the propagation of radiation in dispersive and absorptive media.

September 10.—J. **Thomae**: On a Gaussian series in various parts of its region of convergence.

INDIA.

Asiatic Society of Bengal, November 2.—Some archæological remains in Bishnath: W. N. **Edwards.** The old earthworks round Bishnath and Pertabghur are described, as well as the Buroi Fortification.—Noviciæ Indicæ, xxiii., four orchids new to the Indian flora: D. **Prain.** Descriptions of two new species, *Microstylis Cardoni* from Chota Nagpur, and *Eulophia Campbellii* from Manbhum and Singbhum; and also of *Lecanorchis japonica*, Bl., and *L. malaccensis*, Ridl., orchids now first added to the Indian flora.—Noviciæ Indicæ, xxiv., some new Indian plants: D. **Prain.** Some notes on species of the orders Anonaceæ, Sterculiaceæ, Celastraceæ, Leguminosæ, Rosaceæ, Combretaceæ, Orobanchaceæ, Labiatæ, and Monotropeæ, together with descriptions of new species.—A language map of west Tibet with notes: A. H. **Francke.** The distribution is given of the Rong, Leth, Sham, Purig, and Balti dialects in the Indus and Shayog valleys, and in Zangskhar and Rubshu.—Additions to the collection of oriental snakes in the Indian Museum, Calcutta: Nelson **Annandale.** A paper adding to our knowledge of the distribution of Typhlopidæ, Uropeltidæ, Colubridæ, and Viperidæ in India.—On *Dioscorea deltoidea*, Wall., *D. quinqueloba*, Thunb., and their allies: D. **Prain** and I. H. **Burkill.**

CONTENTS.

THURSDAY, DECEMBER 29, 1904.

THE FUTURE OF THE HUMAN RACE.

(1) *Mankind in the Making.* Pp. viii+429. Price 7s. 6d. (2) *Anticipations.* Pp. 122. Price 6d. (London: Chapman and Hall, Ltd., 1903.) (3) *The Food of the Gods.* Pp. 317. (London: Macmillan and Co., Ltd., 1904.) Price 6s. By H. G. Wells.

MR. WELLS is a man of imagination, and he has let his imaginative faculty play about the great problems that obtrude themselves when we contemplate the new conditions under which civilised man is now living, conditions which must inevitably undergo further change as science advances. Three books of his more especially claim to forecast the future of our race, and to lay down the lines on which education should proceed. These three are "Anticipations," a very bold attempt to peer into the future; "The Food of the Gods," a lively romance full of humour that does not pall from beginning to end of the book; and "Mankind in the Making," a series of essays dealing mainly with education, and advocating radical changes in our methods.

As to style, Mr. Wells is a hard hitter. He pounds at all classes or professions or trades which fall below his standard of efficiency, or who represent, as he thinks, mouldering ideas and systems. He cannot talk patiently of bishops, schoolmasters, army men or plumbers. His philosophy has had its origin in the theory of evolution. He looks at the race of men in the past, the present, and the future, and he sees a long series of births. The individual is trustee for the race of the principle of life. The idea of this trusteeship is to Mr. Wells a great and ennobling one. A man must not look upon his individual life as the all-important thing, but must find his true happiness in the propagation and education of offspring. Nevertheless, we find in "Anticipations" that this ideal will be shared only by a limited number of people. In the world he pictures are many childless *ménages*, and Mr. Wells himself is prepared to tolerate relaxation of the marriage law and even "sterile gratification." But in this new world there will be also many men of strenuous earnestness and of religious purpose, though not professing a definitely Christian faith, who will be the leading spirits. As a rule they will be fathers of families, for the childless *ménages* will not fit in with their theory of things.

These men of energy—men of science, engineers, doctors, and so forth—will shape policy and administration. The result will be marvellous efficiency, such as is rarely if ever seen now. There will be no king. Monarchy will have given place to the New Republic. Royalty is connected with all things out of date, with aristocratic privileges, ridiculous costumes and decorations. Therefore it must go. In the New Republic, though so efficiently managed, there will be many idlers. There will be an enormous development of irresponsible wealth, great numbers of people living on invested money, having no cares of management and no duties in connection with their property. It is among this class mainly that will be found the childless *ménages*. The class that supplies unskilled labour, the old servile class, will tend to disappear. The invention of machines capable of performing more cheaply all the work that has hitherto fallen to the unskilled will make such men unnecessary. Peasant proprietors and all small land-holders must pass away. They represent stagnation, and there is room only for go-ahead, adaptable people. Those who fail to adapt themselves will fall into the abyss, the great sink in which wallow all those who are unfitted for the new conditions. The people of the abyss are to be encouraged to extinguish themselves, to practise what would commonly be called vice without offspring resulting.

Mr. Wells is quite alive to the need of an antiseptic in a wealthy society such as he foresees. To keep down excessive accumulations of wealth he proposes heavy death duties, and heavy graduated duties upon irresponsible incomes, "with, perhaps, in addition, a system of terminable liability for borrowers." But besides this there will be at work for many years to come "that most stern and educational of all masters —war." In its methods war will be very unlike anything of which we have as yet had experience. There will be marksmen few in number, but possessed of skill altogether beyond that of the marksmen of to-day. The army will no longer be officered by men too stupid and indifferent to use properly the inventions of science. No masses of raw, unskilled lads will be driven on to the slaughter.

Some greater synthesis will emerge. Mr. Wells reviews the various large groups of peoples which make up the greater part of the population of the earth. There is the Russian group, the German, Latin, and English groups, and there are the Yellow Races. Mr. Wells does not think the Russian or the German likely to predominate. In the French he has a great belief, though they do not "breed like rabbits." The richness and power of their literature make him think their language will extend itself far. He laments the comparative poverty and meagreness of our literature. Still, he inclines to the belief that a great dominant synthesis of the English-speaking peoples may be formed. Germany will be cowed by the combined English and American Navies, and Anglo-Saxonism will eventually triumph.

There remain the Yellow Races. Their star, too, will pale before that of the Anglo-Saxons. But all syntheses, however great, will eventually fuse into one. There will be a World State, and rival nationalities will be a thing of the past. "Against these old isolations, these obsolescent particularisms, the forces of mechanical and scientific development fight and fight irresistibly."

All these speculations are very interesting reading, but we cannot help regretting that Mr. Wells did not study and reflect a little longer before writing. His imagination, unclogged by knowledge, is apt to run away with him. Though he expresses the greatest reverence for Darwin and his successors, he does not show a very thorough grip of the principles of evolution. To begin with, he seems unaware of the part in the national life that is played by the lower stratum of society, the "stagnant" masses as he would call them. From this stratum emerge the men of energy so dear to Mr. Wells's heart. Occasionally the son of a poor man, say in Scotland or Yorkshire, rises to eminence. Far more often it takes more than one generation to climb the ladder. But this does not alter the fact that this substratum is an absolute necessity. For the upper strata do not keep up their numbers, and society has been truly described as an organism that is perpetually renewing itself from its base. But Mr. Wells knows only of the abyss into which tumble all the failures of modern life. Such a valuable national asset as peasant land-holders he despises and wishes to abolish. Yet from such "stagnant" classes spring the families that work upward and produce the men of energy that do the highest work of the nation. The downward movement of which Mr. Wells talks so much is comparatively but a puny stream. No doubt there is an abyss, no doubt there are in our big towns not a few degraded families which are tending to die out. Yet even the most degraded produce here and there a man of grit, a man, for instance, who enlists and rises to be a non-commissioned officer. The pick of the slum-bred men make fine fighters.

Mr. Wells wishes all citizens to be energetic and up to date. The unadaptable masses must be got rid of. They must be instructed so that the indulgence of their sexual instincts may not lead to their having offspring. Reckless parentage must be in every way discouraged. And yet Mr. Wells declares that he cannot devise any system of selection by which it would be possible to breed good citizens; the qualities demanded are too diverse. So we are to get rid of the reckless classes and depend solely on the careful classes. We are to introduce careful parentage, that is, put a stop to natural selection; but there is to be no scientific selection to take its place. The result would indeed be disastrous. As it is, our national physique may be poor, but what there is in the nation of physical vigour is due to the great amount of elimination, probably not far short of 50 per cent., that still goes on.

Here is another strange forecast. War is "the most educational of all masters," and yet after many years a great world state will arise and there will be a kind of millennium. If war the great educator, the great antiseptic, is no more, surely the world is likely to be the worse for its absence. What is to make the world better? No doubt Mr. Wells would say, "The advance of science." Science is his sheet anchor. It is to ennoble the national life so that even the idle holders of irresponsible wealth will be powerless to degrade it. But will this be so? No doubt the inventor is ennobled by his brain labour, by his striving to make his dream a reality. And the men of energy who find practical applications of his discoveries are doing work of a kind that often, though not always, elevates the character. But what of the people who merely make use of the discoveries and inventions of others? The man who invents a locomotive engine is likely, at the lowest, to be above the pettiest meannesses. But the mere travelling in railway trains leaves men morally no better and no worse. The striving after knowledge is the ennobling thing, and not the knowledge itself, the making of discoveries, not the enjoyment of them.

This being so, there is a fallacy running all through that very humorous romance "The Food of the Gods"; in the story those who are fed on this food in their infancy and youth grow to a height of some forty feet. The inventors do not add to their inches. In its application this is not true. The mass of mankind remain small in brain and character—they grow, but do not grow much, when their youth is nurtured on the clearest and noblest ideas. The few thinkers, discoverers, inventors are the giants. As to education, Mr. Wells has much to say that is worth pondering. He wishes boys to make a real study of the English language and literature. On our success in teaching English and producing good literature depends the answer to the question: Will English retreat before the tongue of some rival synthesis, or will it become the language of the world? For educational purposes, the dead languages, as we might expect, are tried and found wanting. Those who teach them are "fumbling with the keys at the door of a room that was ransacked long ago." F. W. H.

BRITISH FRESHWATER ALGÆ.

A Treatise on the British Freshwater Algae. By Prof. G. S. West. Pp. xv+372. (Cambridge: At the University Press, 1904.) Price 10*s.* 6*d.* net.

A Monograph of the British Desmidiaceae. Vol. i. By W. West and Prof. G. S. West. Pp. xxxvi+224. (London: Printed for the Ray Society, 1904.) Price 25*s.* net.

WHOEVER has sought to gain a practical knowledge of the British freshwater Algæ has in the past been often checked by the impossibility of determining, by the aid of English works, many of the forms met with. During the twenty years that have elapsed since the issue of the latest large English work on the group (Cooke's "British Freshwater Algæ") very great progress has been made in most countries of Europe, in North America, and to some extent in other countries also, in the study of these plants. Very many species previously unknown have been detected, and much light has been thrown on obscure life-histories, on the effects of environment, and on the relationships of the various Algæ to one another, and to other organisms of simple structure. But while so much new knowledge has been gained, it is dispersed in various languages and in numerous volumes; and there has been, in English, no trustworthy guide even to the published results of these years dealing with the British freshwater Algæ. Thus it has become more and more difficult to pursue the study with success, and the need of adequate presentation of the subject has been felt to be very urgent. The works just issued by the Messrs. West are most welcome, and mark a very great advance on earlier books in English dealing with these Algæ. The authors possess a unique knowledge of the species and of their distribution in Britain, the result of personal investigations carried on unweariedly in many and varied districts of the British Islands. They have added largely to previous records in species new to science, in others new to British lists, and in the fuller knowledge of the life-histories of species already known. The task was no easy one, but none more competent could have undertaken it, and it has been accomplished in a way to deserve the gratitude of all interested in the freshwater Algæ of Great Britain and Ireland.

The "Treatise" is one of the well known and excellent Cambridge Biological Series. Its aim is stated as "to give the student a concise account of the structure, habits and life-histories of Freshwater Algæ, and also to enable him to place within the prescribed limits of a genus any Alga he may find in the freshwaters of the British Islands." To do this within the limits of an octavo volume of less than 400 pages, in which are numerous illustrations, is a task possible of accomplishment only by one very familiar with the subject and skilled in concise expression; but that it has been successfully done will, we think, be the verdict after testing the book thoroughly. The views and labours of others receive due attention, and footnotes direct the student to the original publications; but Prof. West is no mere follower of the views of others, and much of the excellence of his book is due to his personal researches and to the conclusions he has drawn from them. In the preface we read that "there is no single book, or accessible set of books, by means of which a student can hope to accurately identify one-third of the freshwater Algæ he may find in a single day's ramble through a reasonably productive part of the country." With the aid of this guide he may hope to determine the genus of all save the more critical forms, and even the species in some of the genera. But the book is much more than a guide to the identification of genera and species. The introduction gives a very readable and interesting general account of freshwater Algæ in respect of their habitats, distribution, relations to and associations with certain other plants, and even with the lower animals, some of these correlations being of very curious kinds. Their relations to temperature (some thriving on ice and snow, while others can live around hot springs at 94°.5 C.), to surface conditions and exposure, and to geological strata are discussed; and the author's wide experience in field work gives much interest to the discussion. Mountainous districts are the richer, especially in Myxophyceæ and Conjugatæ, of which latter the desmids and Mougeotia are peculiarly numerous in species in these regions. The older Palæozoic and Igneous regions are preeminent in this respect, and the richest localities in Britain, "and perhaps in the whole of Europe," are tarns and peat-bogs in hollows of the Lewisian gneiss of north-west Scotland, while the fen district of eastern England is the poorest in Britain in freshwater species of Algæ.

The methods of collection, of cultivation (so important as a means of study), and of preservation for future use are described. The structure, cell-contents, nutrition and growth of the cells and plant-bodies, the methods of multiplication by division and of reproduction (asexual and sexual), the alternation of generations, the range of polymorphism observed in some species, and alleged to occur in others, are considered, and the belief is stated that the higher types have originated by gradual evolution from the more lowly types, but that the latter still persist, and must not be confounded with stages in the life-histories of the higher forms, as the author believes has been done by some. The phylogeny and scheme of classification take full note of the discoveries and views of Blackman, Bohlin, Borzi, Chodat, Wille and others, combined with the author's own discoveries.

Six great classes are recognised, of which four (Rhodophyceæ, Phæophyceæ, Bacillariaceæ or diatoms, and Myxophyceæ) are of the usual compass, the two former including few species in fresh waters. The Heterokontæ, a group proposed a few years ago by Luther for a few families characterised by yellowish-green chromatophores and the production of oil as a reserve of food, are separated off from the other green Algæ; but all the remaining green types are included in the class Chlorophyceæ, the methods of reproduction not being accepted as justifying their separation into different classes. Chlamydomonas is regarded as nearest to the origin from which all have sprung, scarcely different from the Flagellata, and the divergent lines of increasing complexity are traced, three chief tendencies, as pointed out by Blackman, showing themselves, and resulting in three types of structure, viz. the motile cœnobium, the multinucleate unicellular cœnocyte, and the multicellular aggregate, the cells of which become more and more intimately related and specialised to form the definite organism. This last type has resulted in the most complex structures among Algæ, and is regarded as having given origin through them to the archegoniate plants.

All grades of classification of the British freshwater Algæ down to genera are defined in this "Treatise," and each genus is well illustrated by drawings from the plants themselves, with few exceptions original. The number of British species is stated under each genus, and information is often added regarding the more representative species. For each genus also the synonymy is given, along with references to the literature.

Prof. West's treatment of his subject is instructive and stimulating, and the book will do much to extend the study of these plants. But it also excites the hope that he will supplement this work by giving us one descriptive of all the species and varieties of these Algæ that have been found in Britain, with, if practicable, indications of those likely to be added to the flora. He has pointed out the need of such a guide, and has proved that it could be attempted by none more fit to make it a success.

The volume on "British Desmidiaceæ" also illustrates the extraordinary advance in the study of British freshwater Algæ in recent years, due to the researches of but a few workers, among whom the authors are in the front rank. In this monograph will be brought together not only much information that, though published, was often scarcely accessible, but also much acquired through researches in many regions, from Shetland to Cornwall, in Wales and Ireland, and not yet published. Nearly 700 species and 450 varieties are now known from the British Islands (being rather more than one-third of all named species). Of these many have been discovered and made known by the authors. Cooke's "British Desmids," issued in 1886–7 as a compilation of all the forms then known, included less than 300 species and less than 50 varieties. In this first volume rather more than one-fifth of the British species and varieties are included, so that the "Monograph" will probably extend to five volumes.

Each form is described, with references to its synonyms and its bibliography; and its distribution in the British Islands is detailed, the authority for each locality being stated. The figures are original, except where it was not possible to procure specimens. When borrowed the sources are always acknowledged. A very full list of books and papers on desmids adds to the value of the work.

The "Monograph of British Desmidiaceæ" is worthy of a place among the numerous valuable works issued by the Ray Society, and will be indispensable in the study of these plants.

THEORY OF RAPID MOTION IN A COMPRESSIBLE FLUID.

Leçons sur la Propagation des Ondes et les Équations de l'Hydrodynamique. By Jacques Hadamard. Pp. xiii+375. (Paris: Hermann, 1903.) Price 18 francs.

THE theory of fluid motion, as ordinarily worked out, presents several *lacunae*. One notable omission is the absence of any detailed discussion of the effects of compression and rarefaction of air owing to the rapid motion of bodies through it. An artillerist, seeking by the aid of the theory for principles that would help him to understand the resistance of the air to the motion of projectiles, would be likely to be disappointed. He would find an explanation of the effect of rifling in keeping the points of projectiles forward; but, while he might admire the ingenuity displayed in the development of the theory, he would feel that, with this exception, it shed but little light upon his business. The present book represents the outcome of efforts made in recent years by some French mathematicians, and especially by Hugoniot and P. Duhem, to widen the scope of the traditional hydrodynamics so as to include rapid motions in compressible fluids.

Our hypothetical artillerist would need to exercise much patience in order to get on with the book. He would probably soon give it up as too intensely mathematical. The first chapter is devoted to an account of an existence theorem in the theory of potential. It is to be proved that, provided a certain condition is satisfied, there exists a function which is harmonic in a given region and has a given normal rate of variation at the boundary of the region, in other words, that irrotational motion of incompressible fluid is possible within a closed surface which changes its form in a prescribed manner without changing its volume. The author gives a proof which is very interesting from the point of view of analysis. He also expresses the required function by means of a subsidiary function which he calls "Fonction de Franz Neumann," and of another which he calls "Fonction de Klein." The latter is the velocity potential due to a source and a sink within the given surface, and the former also can be interpreted physically, but the interpretations are not recorded. In the case of a spherical boundary, which is worked out, the results are attributed to Bjerknes and Beltrami. It would seem that these writers, therefore, virtually anticipated Hicks's discovery of the image of a source with respect to a sphere. One misses the interpretation in terms of images. The mathematics is there, but the author does not tell us what it means. Nevertheless the mathematics is excellent.

In chapters ii. and iii. we have so much of the ordinary theory as is requisite for the purpose of setting out the equations and conditions which govern the motions of fluids, and we have also an extension to discontinuous motions. The fact that was emphasised by Hugoniot is that the motion is not necessarily continuous. He paid especial attention to the case in which the velocity is everywhere continuous, but the differential coefficients of the components of velocity are discontinuous at a moving surface. The discontinuities at such a surface are not arbitrary, but are subject to three sorts of conditions. The surface moves through the fluid like a wave. One set of conditions connects the discontinuities with the direction of the normal to the surface. A second set connects them with the velocity of propagation. These two sets of conditions are kinematical. To determine the velocity of propagation the dynamical equations must be introduced. The kinematical conditions are called "conditions d'identité" and "conditions de compatibilité," and they are expressed by means of some elegant geometry. The necessity for such conditions has been recognised by other writers in the case of discontinuities that affect the velocity. The latter are here called "waves of the first order." The origin of Hugoniot's discontinuities, called "waves of the second order," is found in an analytical paradox. If the pressure is a function of the density, the equations of motion determine the acceleration of every particle; but, if the motion of a boundary is prescribed, the normal component of the acceleration of the particles that are in contact with the boundary is prescribed also. The two values thus obtained for this acceleration are in general different. Waves of the second order originate at the boundary, and are propagated through the fluid.

Chapter iv. deals with rectilinear motion in a gas, and is mainly occupied with the problem, first attacked by Riemann, of discontinuities that affect the velocity. Riemann's theory was condemned by Lord Rayleigh on the ground that it violated the principle of energy, and the problem remained in an unsatisfactory state for many years. It was taken up again by Hugoniot in 1887 without knowledge of Riemann's work. Hugoniot introduced expressly the condition that the increment of energy—kinetic and internal—of the portion of fluid which undergoes a sudden change of state is equal to the work done upon it by the pressures of neighbouring portions, and he concluded that the law connecting pressure and density ($p=\kappa\rho^{\gamma}$) cannot be maintained during the passage of the discontinuity. This conclusion is opposed to Riemann's theory. H. Weber, in his recent edition of Riemann's "Vorlesungen über die partiellen Differentialgleichungen der mathematischen Physik," has contended that a complete calculation of the energy supports Riemann's theory against Lord Rayleigh's objection, but he did not refer to Hugoniot. In the book under review no mention is made of Lord Rayleigh's objection or of H. Weber's contention, but Riemann's theory and Hugoniot's are developed side by side, and the results are compared both with each other and with the results of certain experiments by Vieille. Much of the analysis is worked out and interpreted by the aid of geometrical constructions, but the reader wishes often for a more physical interpretation.

Chapters v. and vi. contain extensions of the theories of the preceding chapters to motion in three dimensions and to waves in elastic solid media. The physical value of a theory of rapid motions, accompanied by strains that are not "small," in an elastic solid, supposed to have a strain-energy function, is extremely doubtful; but no exception can be taken to the analytical methods by which the theory is developed. Chapter vii. brings the theory of waves that do not involve discontinuities of velocity or strain into relation with the theory of characteristics of partial differential equations. The discovery of the relations between these two theories has attracted a good deal of attention recently, and we may be grateful to M. Hadamard for his masterly exposition of the subject. A few notes are appended to the volume. Of these the most interesting is the one in which it is shown that discontinuities of the first order may give rise to vortex motion, even when the pressure and density in the undisturbed state are uniform throughout the fluid.

It is a sign of the healthy state of mathematics in France that the ablest analysts are bringing their powerful methods to bear upon recondite physical questions. The book under notice is a very valuable contribution to a most important and, at the same time, a most difficult subject. It breaks fresh ground, and it cannot fail to stimulate inquiry. It may be expected to conduce to the further advance of our knowledge of aërodynamics A. E. H. L.

THE GREAT ST. BERNARD PASS.

Across the Great St. Bernard. The Modes of Nature and the Manners of Man. By A. R. Sennett. Pp. xvi+444 and 111; illustrated. (London: Bemrose and Sons, 1904.)

A FLUENT but not too accurate pen, and a general knowledge of the more frequented districts of the Alps appear to be Mr. A. R. Sennett's chief qualifications for writing this book. It has a comprehensive title, and needs it, for the St. Bernard Pass is hardly more than a thread to connect, if possible, quotations in prose and verse, scraps of science and history, descriptions of scenery, and moralisings on things in general. The author has nothing new to tell us about the St. Bernard, which is not surprising, for the pass has been often described, and a carriage road now goes the whole way from Martigny to Aosta. Mr. Sennett, however, informs us that Hannibal crossed it "with his vast army," of which he proceeds to describe the sufferings. Notwithstanding what has been written by Law, Ellis, Freshfield and others, we are well aware that it is not easy to determine what route Hannibal did follow, but thought that the Great St. Bernard was no longer advocated by anyone who had studied the question.

Other statements are disputable. We are told the soldanella flower protrudes through the edge of the *névé* (which does not mean the winter snow); that the edelweiss dwells "in snow, owning a habitat where no other flowering plant may survive," and as "its haunt is far removed from all verdant vegetation and in the most craggy and inaccessible positions," we cannot expect to see it growing at the botanical station in Bourg St. Pierre, and so forth. This village is rather more than 5300 feet above sea-level, and the plant is often found between this and 6000 feet; indeed, it can be cultivated in England. As for the craggy and inaccessible positions, we had thought newspaper correspondents now enjoyed a monopoly of this fiction. Like any other Alpine plant, it may grow in a breakneck place, but its favourite habitat is a rough slope of grass and stone. It used to grow profusely on a place of this kind, where it could be gathered in perfect safety, on a mountain ridge about a thousand feet above San Bernardino.

But Mr. Sennett, though prone to discuss scientific questions, does not always win our confidence. The "Tertiary period of the London Clay" is an odd phrase, and adamantine an inappropriate epithet for the *firn* or upper basin of a glacier; and in what respect the Lago di Garda resembles a diadem we fail to perceive. To his vision of a Europe the glacier fields of which only just failed in reaching the Alps we are perhaps accustomed, but think that most geologists at the present day would speak less confidently of glaciers having scooped out the Alpine lake basins, or having "cut out gorges for themselves through the solid mountain, divided enormous peaks in twain, planed down and levelled great asperities." The Märjelen See does not lie in a lake basin, but simply at the head of a glen, blocked by the great Aletsch Glacier, and after seeing it one day full and the next empty, we utterly disbelieve Mr. Sennett's explanation that it is emptied on the principle of a syphon. The name Mörjelen, which he prefers, may be patois, but the other form is more usual; so also is Gondo for Gonda, Guttannen for Guttenen, Meiringen for Meyrengen, and, notwithstanding Baedeker, Penninus for Pœninus (the title of the Alpine Jupiter). The science is discursive and commonplace, where not enriched by extracts from Tyndall or Ruskin, or yet more ornamental writing. Mr. Sennett may think in English, but is so prone to translate into journalese that we suspect he was trained in a certain Fleet Street haunt of young lions. We cannot welcome the verb "resurrect," the adjective "riverian" (of or belonging to a river), or "lithic" (a favourite one) when plain folks would say stony or rocky. The book, however, contains numerous illustrations, often pretty, but it is tiresome to have them (except in the appendix) only numbered, and to be obliged to consult a list to see what they are, especially when we are sometimes greeted with fanciful titles instead of place-names. "Dame Nature's Painters" does not much enlighten us, but it looks very like a view down the lower part of the Via Mala. But the author has tried the dangerous experiment of mingling poetry and science, and we cannot honestly congratulate him on his success.

T. G. B.

TRACHOMA.

Trachoma. By Dr. J. Boldt. Translated by J. Herbert Parsons, D.Sc., F.R.C.S., and Thomas Snowball, M.B., C.M. With an introductory chapter by E. Treacher Collins, F.R.C.S. Pp. lii + 232. (London: Hodder and Stoughton, 1904.)

DR. BOLDT'S monograph on "Trachoma," published at the end of last year, deals with a subject presenting many problems to which no satisfactory solutions can at present be offered. It is therefore a matter for congratulation that an English translation of such an excellent *résumé* of the subject has been prepared. Dr. Boldt has been working for many years in one of the trachoma infested centres of Germany, and has been constantly faced during that time with these unsolved problems, and in the book before us he clears the ground of all the lumber which gathers round any subject of discussion, and states clearly the present condition of our knowledge and the lines on which future investigation must go.

The first and most important difficulty met in dealing with trachoma is that at present the ætiological factor is unknown. The discussion of this question in chapter iv. particularly, and incidentally in chapters iii. and v., will be, to ophthalmic surgeons, the most interesting part of the book. The author distinctly inclines to the view that there is a specific organism, the primary cause of trachoma, as yet undiscovered, but that also an individual predisposition and a number of subsidiary causes, such as climate, soil and race, overcrowding, uncleanliness, and other social evils, are also contributing causes.

Many workers at the present time are inclining to lay much greater stress on the importance of the individual predisposition and to hold the view that the disease may be set up by any bacterium which is pathogenic for the conjunctiva. The large number of cases in which some scrofulous taint can be traced is distinctly in favour of this view. It has been frequently shown that in such people any infection will give rise to a lymphoid hypertrophy, and the essential pathology of trachoma is primarily a hypertrophy of lymphoid follicles with subsequent degeneration of the lymphoid tissue and formation of scar tissue. Dr. Boldt, with absolute fairness, gives both hypotheses and the arguments which have been advanced by various writers in support of them.

It would be of undoubted benefit to the community if this book were to get into the hands of two classes in particular, the men who are concerned in the administration of the Poor Laws of the country, and those concerned in the medical and sanitary administration of the Army. The excellent introductory chapter by Mr. Treacher Collins gives details of the most useful work which is being carried on at Swanley, and of the influence that proper hygienic measures have had generally in checking the disease. Dr. Boldt gives similar details of the progress and subsequent checking of trachoma throughout the various countries of Europe. It would indeed be well if the last chapter were separately printed and distributed as a pamphlet to the various boards of guardians and health officers throughout the Empire.

We have nothing but praise for the way in which the translators have carried out their work. We could nowhere detect a trace of German origin in the style.

OUR BOOK SHELF.

The Cyclones of the Far East. By Rev. José Algué, S.J. Second (Revised) Edition. Pp. 283. (Manila: Bureau of Public Printing, 1904.)

IN the present edition the author has extended the area dealt with in the earlier editions, and as abundant additional data have been collected, not only from the Philippines themselves, but also from the surrounding coasts, this information has now been embodied. The author says that, "owing to the opening up of the Far East in recent years, an endeavour has been made to extend the usefulness of the work by giving a greater compass to the study of the phenomena which cause, accompany, and follow the atmospheric perturbances which are experienced in the various seas of the Far East." The title of the revised edition is changed from "Cyclones of the Philippines" to "The Cyclones of the Far East." The present edition appears in English, and is freed from the formidable list of errors found in the English version of an earlier edition. Among the many additions contained in this new edition may be mentioned some practical rules for navigating in case of encountering a typhoon, and a list and description of the ports of refuge during storms in the Far East, especially in the Philippine Archipelago.

Commendation should certainly be given of the careful arrangement and division of the whole work, which aid much the general study and grip of the valuable material, whilst numerous illustrations add much to the elucidation of the subject. Father Algué must be credited with what is only too commonly overlooked. At the conclusion of each chapter reference is given to the works which may be consulted in connection with the branch of the subject dealt with. The references appear to have been chosen with the greatest impartiality and with the sole desire to render the work as complete as possible. This example may commend itself to authors of other branches of scientific work.

The principal cause which influences the progressive movement of typhoons is said to be the general movement of the atmosphere in which they take place, not of that part only which overlies the land and sea over which they pass, but especially of that portion of the atmosphere which moves at higher altitudes, as we are to look there for the seat of the greater part of the energy and power which nourish and sustain the atmospheric whirls. This opinion is endorsed by all who discuss the nature and law of storms, but, unfortunately, too little light can be thrown on the movement of the upper air, although praiseworthy efforts are being made in this direction.

The storms which visit the Philippine Archipelago vary greatly in frequency according to season, the months with the greatest number being July, August, and September, whilst the months with the least frequency are January, February, and March. Much good work is done in the classification of cyclones, and diagrams are given showing the paths of eleven different types. Considerable attention is paid to the precursory signs of cyclones, and naturally much importance in this direction is attached to the form and movement of clouds.

The whole treatise is suggestive of further scientific inquiry, and Father Algué has done much by this work to advance our knowledge of the law of storms.

C. H.

The Animals of New Zealand: an Account of the Colony's Air-breathing Vertebrates. By F. W. Hutton and J. Drummond. Pp. xiv+381; illustrated. (Christchurch and London: Whitcombe and Tombs, Ltd., 1904.)

Some months ago, when noticing Captain Hutton's valuable "Index" of the New Zealand fauna, we had occasion to refer to the impending issue of the present volume; now that it is before us, we are happy to be able to state that it fully realises our expectations, and forms a most valuable history of the air-breathing vertebrates of the colony, written in a pleasant style which cannot fail to make it acceptable to a large circle of readers. At starting, the authors refer to their indebtedness to the late Mr. T. H. Potts, who did such good work in describing a fast vanishing fauna before it was too late. The melancholy story of the waning of this curious and interesting fauna forms, indeed, the key-note of the introduction of the volume. From the time that Captain Cook, in 1773, turned down pigs in Queen Charlotte's Sound, the native fauna has had to contend with competitors from Europe of a stronger and more aggressive type, the natural result being that many forms, like the tuatera lizard, have already disappeared from the mainland, although in some instances surviving in the adjacent islets, and many more are destined to go ere long. Among the latter (if, indeed, it be not already extinct) is the short-tailed bat, the sole representative of the genus Mystacops, its rarity, or extermination, being attributed to the destruction of insect life caused by the introduction of European birds.

From a purely commercial standpoint the authors do not, however, by any means condemn the introduction of many of the foreign species, having even a good word to say for the much abused sparrow. "Without the sparrow, or some other bird equally common," they write, "residents in the colony would be over-run with the insects again, and life would be insupportable." The phrase concerning insects, it may be explained, refers to the "plagues" of various species which occurred when European food-crops were first introduced into the colony. On the other hand, the introduction of certain species, such as the greenfinch and, above all, the rabbit, is most strongly condemned. The acclimatisation of several kinds of deer is considered to be of considerable advantage to the general prosperity of the islands, as it leads to the visits of European sportsmen.

Among the species which have suffered most severely from foreign competition may be mentioned the two bats, the kiwis, the weka rail, and the tuatera. The moas appear to have been completely and the Notornis all but exterminated by the Maories before the European advent.

Limitations of space alone prevent further commendation of a very excellent, interesting, and beautifully illustrated work.

Zellenmechanik und Zellenleben. By Prof. Dr. Rhumbler. Pp. 43. (Leipzig: J. A. Barth, 1904.) Price 1 mark.

This little work represents a sketch of the author's views on the causes and means of manifestation of cellular activity. The point of view adopted is a materialistic one. It is considered that the whole subject should be dealt with from the physical or the physico-chemical aspect, even when this fails to present a complete solution of all the difficulties that may arise. It is becoming more and more recognised that many of the acts which used to be regarded as specially the outcome of vital activity find their parallel in inorganic nature. An amœba when ingesting a filament of oscillatoria much longer than itself is able completely to enclose it because the algal thread becomes coiled up within the protoplasmic body of the protozoan. But an exactly similar state of things is produced if a drop of chloroform is placed in water and a filament of shellac be then presented to it. The filament is drawn into the chloroform, and coiled up much as the alga in the amœba; and if a short glass thread be coated with shellac, it is also "ingested," but as the lac becomes dissolved the glass thread is gradually extruded. The whole question here resolves itself into one of surface tension, and perhaps the processes of ingestion and excretion may ultimately prove to be essentially similar in nature.

Again, the remarkable uniformity in the details of nuclear divisions (karyokinesis), from whatever source the cells may originate, strongly suggests that a comprehensive physical explanation of the process will one day be forthcoming.

But although the physical aspects of cellular activity will certainly become more clear and definite, this is only the first step on to the threshold of the temple in which the secret of life is guarded. Behind the proximate physical phenomena lies a vast complex of changing chemical conditions, and it will be long before we are likely to be able exhaustively to analyse them. The more successfully we do so, however, the more nearly shall we be able to grapple with the physical problems of movement and the like. Rhumbler regards changes of surface tension, and the reactions that affect it, as constituting one of the most profitable of the many possible lines of cytological investigation.

Studies in Astronomy. By J. Ellard Gore, F.R.A.S., M.R.I.A. Pp. xi+336. (London: Chatto and Windus, 1904.) Price 6s.

In this book the reader is presented with a series of disconnected essays on a variety of astronomical subjects, many of which include interesting and suggestive results of calculations made by the author. The subjects range from "giant telescopes" to the "construction of the visible universe," but Jupiter is the only planet to which any detailed reference is made, and the sun is only dealt with from the point of view of its stellar magnitude and its motion in space. The chapter on "Messier's nebulæ," bringing together all the recent information with regard to these objects, will be of considerable value to those who possess telescopes, and the notes comprising "recent advances in stellar astronomy" give a useful summary of the state of our knowledge of the subjects dealt with at the beginning of the present year.

Most of the papers have already appeared as magazine articles, and, notwithstanding the revision which has been made for the present purpose, there is necessarily a considerable amount of repetition. Apart from this, however, the book provides a very acceptable course of not too difficult reading for those who have a general elementary acquaintance with the subject.

Salts and their Reactions. By Dr. L. Dobbie and H. Marshall. Pp. 198. (Edinburgh: James Thin, 1904.) Price 3s. 6d. net.

THIS book is intended to serve as an introduction to the study of practical chemistry, and has for its basis a series of notes intended for use in the Edinburgh classes. In an interesting preface Prof. Crum Brown states his belief in the possibility of devising a course that would be "something better than a mechanical training to enable students to pass a mechanical examination consisting in the detection of simple salts in solution." Notwithstanding this assurance, one finds that about half the book consists of descriptions of the ordinary tests and schemes of analysis common to most books treating of elementary practical chemistry.

The first part of the work consists of a short and very clear account of the general physical properties of salts and salt solutions. An outline is given of the ionisation hypothesis and of its applications, some of which are practically illustrated at a later stage. After a short account of the nature and use of indicators, a chapter is devoted to alkalimetry and acidimetry. The experimental part of the book, excluding the sections on qualitative analysis, is only represented by about twenty-five pages, and although the selection of experiments has evidently been carefully made, it seems a pity that the practical illustration of a really excellent theoretical introduction should be so meagre.

The remainder of the book is taken up with a description of the reactions of metallic and salt radicals, and with schemes for analysis. In several small particulars a departure from the conventional methods has been made with distinct advantage. Dry-way reactions, which so few chemists appear to appreciate, are relegated to an appendix, which also contains the inevitable and perfectly useless description of the reactions of the so-called rare elements. Teachers who have the management of large practical classes should find the volume of value.

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.*]

Radiation Pressure.

ON p. 515 of your issue of September 22 I stated that there is a retarding force on the earth as it moves along its orbit amounting in all to about 20 kgm. The calculation was made on the supposition that the earth is a full radiator of uniform temperature. I have found on revising the calculation that there was an error in the arithmetic, and that the force is considerably greater, though still too small to have an effect worth considering. The following is a simple method of obtaining its value. It assumes that the earth may be treated as a black sphere exposed to sunlight, radiating as much as it receives, and with all its surface at one temperature.

If the stream of solar energy falling normally on 1 sq. cm. is S per second, a black sphere, radius a, receives $\pi a^2 S$ per second. If it radiates R per second per sq. cm. its total radiation is $4\pi a^2 R$, and the assumption of equal receipt and expenditure gives $R = S/4$. The total repulsive force exerted by the sun's radiation is $S\pi a^2/U$, where U is the velocity of light. The total retarding force due to velocity u in the orbit is $4/3\ Ru/U^2 . \pi a^2$. This is the Doppler effect due to crowding of energy in front and opening out behind (*Phil. Trans.*, A, ccii. p. 546, corrected by final note). Hence we have

$$\frac{\text{Retarding force}}{\text{Solar repulsion}} = \frac{u}{3U}.$$

At the earth's distance u/U is about 10^{-4}, so that the retarding force is about 1/30,000 of the solar repulsion.

If we take S/U as 5.8×10^{-5} dyne/sq. cm. (*Phil. Trans., loc. cit.*, p. 539), and the radius of the earth as 6.37×10^8 cm., the total solar repulsion is about 75×10^6 kgm., say 75,000 tons, and the retarding force is about 2500 kgm.

But another effect comes in which will more than counterbalance this. The hemisphere of the earth which is advancing in the orbit is on the whole colder than that which is retreating, owing to the lag in the warming of the surface exposed to the sun. I find that if one hemisphere is at 301° A. and the other at 300° A., the greater radiation from the warmer side gives a net push directed from that side to the colder of about 165,000 kgm. Of course this hemispherical distribution of temperature is only a rough approximation to the real condition, and even if the force be as large as 165,000 kgm. only a component of it acts along the orbit tending to accelerate the motion. Still, that component must almost certainly be much greater than the retarding force due to the Doppler effect, and on the whole, therefore, there is probably a small acceleration in the orbit. A force of 2500 kgm. would destroy about $4/10^{16}$ of the earth's momentum in one year. Even if the accelerating force were twenty-five times as great as this it would only generate $1/10^{16}$ of the present momentum in one year. This illustrates the insignificance of radiation pressure on the larger bodies in the solar system.

I take this opportunity of correcting another error in the address in NATURE of September 22, which has been pointed out to me by Mr. C. T. Whitmell. It arose from some very faulty arithmetic on p. 541 of the paper in the *Philosophical Transactions* already referred to. Apparently in the formula giving the radius of each of two equal spheres the mutual radiation-repulsion of which balances their gravitative attraction, a square root of 10 was omitted, and the value of that radius should be $a = 0.69\theta^2/10^4\rho$. A wrong value was also assigned to the density of the sun. Mr. Whitmell has very kindly re-calculated the results depending on this formula, and I have worked them out independently. We now find that two equal spheres will have equal radiation-repulsion, and gravitative attraction with radii as given below:—

Temperature absolute		Density		Radius in centimetres
6200°	...	1·375	...	1930
300	...	1	...	6·1
300	...	11	...	0·5645
300	...	5·5	...	1·13

The last was given previously as 3·4 cm.

The effect of radiation pressure on terrestrial dust is worthy of consideration, for it may be quite appreciable when the particles are small and are among surroundings at different temperatures. For simplicity of calculation, let us suppose a very small dust particle, of density ρ, to be cylindrical with radius a and length a, and let its flat ends be black and let its curved surface be perfectly reflecting. Let it be situated between two indefinitely extended parallel vertical walls, one at a temperature θ_1° A., the other at a lower temperature θ_2° A., and let its ends be parallel to the walls. The two faces of the dust particle will, if it is small enough, be at very nearly the same temperature, so that we may leave out of account the pressures due to the emitted radiation and consider only those due to that received from the walls. If σ is the radiation constant 5.32×10^{-5}, and if U is the velocity of light, the difference of pressure on the two sides will be $2\sigma(\theta_1^4 - \theta_2^4)/3U$, and the acceleration due to this on area πa^2 and mass $\rho\pi a^3$ is $2\sigma(\theta_1^4 - \theta_2^4)/3U\rho a$. When $\rho = 1$, $a = 10^{-3}$, $\theta_1 = 400°$ A., $\theta_2 = 300°$ A., this acceleration is 0·02 cm./sec.^{2}.

If the law of radiation pressure can be taken as still holding when the radius is reduced to $a=10^{-5}$, the acceleration is 2 cm./sec.^{2}. This implies that such a particle of dust, in a vacuum, and between vertical walls respectively at 27° C. and 127° C. would not fall vertically, but would deviate about 2 mm. per metre towards the colder wall.

The effect found by Prof. Osborne Reynolds (*Phil. Trans.*, ii., 1879, p. 770) on a silk fibre exposed to radiation from a hot body, and assigned by him to "radiometer" action, is far larger than this. The radius of the fibre was 0·000625 cm., and its length was probably about 15 cm. When it was hung up in a test tube containing hydrogen at atmospheric pressure, and was exposed to radiation from a neighbouring jar filled with boiling water, the lower end of the fibre moved through 0·01 cm. This would imply an acceleration of about 0·7 cm./sec.^{2}, about sixty times the acceleration on a dust particle of the same radius under the conditions assumed above. The action detected by Reynolds increased, too, very rapidly as the pressure fell, being ten times as great when the pressure was reduced to 1 inch of mercury.

J. H. Poynting.

The University, Birmingham, December 15.

The Date of Easter in 1905.

Already queries have been addressed to me on the subject of the date of Easter in 1905, owing to the fact that, according to the almanacs, the moon is full at 4h. 56m. Greenwich mean time on the morning of March 21 next, and that therefore, according to the Prayer Book rule, it would appear that Easter Day should be the Sunday following March 21, viz. March 26. As the misunderstanding on the subject seems widely spread, perhaps you will allow me to explain that the "moon" referred to in the ecclesiastical calendar is not the actual moon in the sky, which is full at a definite instant of time, but a fictitious moon, the times of the phases of which are so arranged as not to differ much from those of the actual moon. These phases are held to occur, vaguely, on certain days, and therefore hold good for all longitudes, and so avoid a practical inconvenience that would arise from the use of the actual moon. Thus, in the instance before us, in which the actual moon is full at 4h. 56m. a.m. Greenwich mean time, the same moon is full at 11h. 48m. p.m. (*on the preceding day*) Washington mean time. The people adopting Greenwich time would, therefore, in the supposed circumstances, keep Easter Day on March 26, whilst those adopting Washington time would keep it on April 23.

Perhaps the simplest expression for the date of the Paschal full moon is March (44 − epact), which gives the date directly when the epact is less than 24. When the epact is equal to or greater than 24, this expression gives the date of the preceding full moon, and the Paschal full moon is found by adding 29 to this date.

Thus in 1905 the epact is 24, therefore the calendar moon is full on March 20, and again on April 18. The latter is, by the rule, the Paschal full moon, and Easter Day is the following Sunday, viz. April 23.

A. M. W. Downing.

H.M. Nautical Almanac Office.

Lepidocarpon and the Gymnosperms.

The concluding sentence in your note on Mr. H. E. H. Smedley's admirable models of the fructifications of Palæozoic plants (Nature, December 22, p. 183) may possibly be misleading to some of your readers. As the models of Lepidocarpon shown in your figure were prepared from my instructions, I may be supposed to share the responsibility for the hypothesis of an affinity between the lycopodiaceous cones and the Gymnosperms, stated to have been urged by "the author," especially as the points of agreement mentioned are quoted, with some slight abridgment, from my paper on the seed-like fructification of Lepidocarpon in the *Philosophical Transactions*.[1] Such an affinity has never appeared to me to be probable. The characters cited—the presence of an integument and micropyle, the single functional megaspore, and the detachment of the indehiscent, seed-like organ as a whole—are important points of analogy with true seeds, but in Lepidocarpon "these organs differ too much in detail from the seeds of Gymnosperms to afford any evidence of affinity."[1] I doubt whether my friend Mr. Smedley really intended to suggest anything more than an analogy.

As regards the Gymnosperms, evidence has been accumulating for some time past indicating their connection with the fern-phylum rather than with the Lycopods. Some account of this evidence will be found in my discourse at the Royal Institution on the origin of seed-bearing plants (1903),[2] while a more recent summary is given in Mr. Arber's article on Palæozoic seed-plants in Nature for November 17, p. 68.

The seed-like organs of some Palæozoic Lycopods, such as Lepidocarpon and Miadesmia,[3] seem to be cases of homoplastic modification, and not to be indicative of any affinity with those groups of seed-plants which have come down to our own day.

D. H. Scott.

Jodrell Laboratory, Kew.

[1] *Phil. Trans.* R.S., Series B, vol. cxciv., 1901, p. 320. See also Nature, vol. lxiii., 1900–1901, pp. 122 and 506.

[1] *Phil. Trans., loc. cit.* p. 324.

[2] Nature, vol. lxviii., p. 377.

[3] Miss M. Benson, "A New Lycopodiaceous Seed-like Organ," *New Phytologist*, vol. i., 1902, p. 58.

Fishing at Night.

The notice in your Journal of the "Sea Fishing Industry," written by Mr. Aflalo, suggests to me that he or some other of your readers may inform me why sea fishing takes place for the most part at night. I have heard the subject discussed all my life, and the answers have been of the most opposite and unsatisfactory character, such as to obtain a supply of fish for the morning markets, and because fish come nearer to the surface in the dark. Everyone must be familiar with the sight of our fishing boats preparing to take their departure as the evening approaches in the different harbours on our coasts. Some of the masters, unfortunately, like the Apostle Peter, have toiled all night and caught nothing.

S. W.

December 20.

A New British Bird!

A fine example, a male, of the Pacific eider-duck, *Somateria v-nigrum*, was killed at Scarborough on December 16. This is the first recorded instance of the occurrence of this bird on our shores. Closely resembling the common eider, *Somateria molissima*, it may yet be readily distinguished therefrom by the bright orange colour of the bill, and the sharply defined, black V-shaped mark on the throat—hence the specific name *v-nigrum*.

The Pacific eider occurs in abundance along the coasts of north-western America and north-eastern Asia.

W. P. Pycraft.

Natural History Museum, South Kensington.

Intelligence of Animals.

In reference to the question of intelligence in animals, it may be of interest to mention a case of distinct reasoning power in a cat which for nine or ten years associated himself with our family; he would have scorned the suggestion that he belonged to it. When he found himself on the wrong side of a closed door—a very constant occurrence—he stood up and, catching the handle in his fore paws, *rattled* it. I do not think he tried to *turn* the handle, but he certainly knew that it played an essential part in the opening of the door. He is now no more, and *de mortuis nil nisi bonum* bars any further reference to his career, for he was a dissipated old scoundrel; but it is a pleasure to me to pay, with your permission, the above little tribute to his memory.

Greenock, December 17. T. S. Patterson.

FAUNA OF THE HIGHLANDS.[1]

THIS handsome new addition to Mr. Harvie-Brown's "Vertebrate Fauna of Scotland" maintains the high standard of excellence which has marked the preceding volumes. It is punctiliously accurate and at the same time picturesque and full of interest. One of the authors, the Rev. H. A. MacPherson, sacrificed himself too whole-heartedly to an enthusiasm for ornithology, and died in 1901 at the age of forty-three, and Mr. Harvie-Brown has also to deplore the loss of another collaborator, Mr. T. E. Buckley, who died in 1902. Of both these naturalists there are appropriate *in memoriam* sketches.

This volume deals specially with the western parts of the counties of Sutherland and Cromarty—west of the great "watershed"—and with similar portions of Ross-shire and Inverness-shire down to the boundary of "Argyll." In the introductory matter we find terse physiographical accounts of Skye, the Ascrib Islands, Handa, Priest Island, and the coast of the mainland, designed to illustrate the most outstanding faunal feature of the area, namely, its isolation. Mr. Lionel W. Hinxman contributes a brief account of the geology of the north-west Highlands, and there is another interesting section dealing with climatic and other changes, including those due to the hand of man. Few of these can be said to do man's intelligence much credit.

Mr. Harvie-Brown confesses that the chief interest of the area in question is the comparative poverty of its fauna. "The true faunal value lies in its isolation by sea and mountain ranges." "It appears to me to be almost the poorest and least favoured of our Scottish Faunal Areas, both as regards species and in its paucity of individuals of many of them." But it includes some old frequented haunts of some of our now rarer birds, it illustrates faunistic changes traceable to climatic changes, and it gives evidence of a keen struggle for existence amid which some species are still advancing. What Mr. Harvie-Brown particularly seeks to show is that the hemmed-in nature of the area is a main reason for its faunal poverty; thus some of the more prominent land-features of the country, such as the long tongue of land of Ardnamurchan, act as deterrents to the advance of land birds from south to north. The nature of the soil, the vegetation, the distribution and character of wooded areas, and the climatic conditions have also to be borne in mind, but Mr. Harvie-Brown has not done justice to himself or to his theme in his treatment of this aspect of the problem. Of course it is not given to everyone to be a Humboldt, but without attaining to his compre-

FIG. 1.—Fulmar's first nesting-place on Handa (at small white ×). From "A Fauna of the North-West Highlands and Skye."

[1] "A Fauna of the North-West Highlands and Skye." By J. A. Harvie Brown and H. A. MacPherson. Pp. civ + 378; illustrated. (Edinburgh: David Douglas.) Price 30s

hensiveness of outlook it would not have been difficult to improve the chapter on the "Faunal Position" of the area in question; and even in regard to the particular factors which Mr. Harvie-Brown emphasises in his interpretation of the faunistic peculiarities of the areas, his "argument," as he calls it, appears to us too jerky and elliptical to win conviction. But he gives some references to papers dealing with the physiographical conditions in some detail.

Turning to the list of mammals—which is somewhat mournful—we find that there is only one bat, the pipistrelle; the hedgehog, the lesser shrew, and the water-shrew are rare; the true wild cat still lingers; foxes, once *very* numerous, are now scarce; the marten, once abundant, is trembling in the balance between rarity and extinction; the polecat has become decidedly rare; a colony of badgers still persists; the rabbit, introduced about 1850, is in many places taking a rapid—lamentably rapid—hold of newly afforested grounds; and so on. The chief value of such information lies in the precision with which it records increase or decrease, *e.g.* of squirrel and polecat, within a term of years, and thus illustrates evolutionary processes going on around us.

We need hardly refer to the records of adder, lizard, and slow worm, of frog and toad, and two newts; but we may be allowed to note, without being captious, that the title on the back of the book and on the beautiful frontispiece, "A Fauna of the North-West Highlands and Skye," is somewhat too big for the volume, which deals with mammals, birds, reptiles, and amphibians, and no more.

The most entertaining part of the book is that which deals with the birds, in regard to which the authors speak from rich experience and with infectious enthusiasm. There is naturally enough a dominant *note personnel,* but it is always pleasant, even when the information given does not seem very important. Among the rare visitors we may mention the lesser whitethroat, the barred warbler, the nuthatch, the golden oriole, the great grey shrike, the waxwing, the rose-coloured pastor, the roller, the hoopoe, the osprey, the bittern, Pallas's sand-grouse, the red-necked phalarope, the great crested grebe, and the fulmar. Among the most interesting residents are the chough, the raven, the hen-harrier, the sea-eagle, the rock dove, and the ptarmigan. This section is rich in historical material, *e.g.* in regard to the starling, the golden eagle, the sea-eagle, the osprey, the grey lag goose, and the fulmar. Apart from their historical interest, the notes on the birds are full of interesting observations, and some of the descriptions by the late Mr. MacPherson are fine pieces of picturesque writing. Mr. Harvie-Brown gives here and there an inkling of his strong views on bird protection; thus, "the Bird Acts require steady and relentless revision and change. The idea of saving trouble at Westminster and County Council and Sheriff Courts, by dividing Great Scotland into two divisions—north and south—for all species mentioned in these Acts, is absurd, and appears to me to be eminently calculated to defeat all useful purposes of the Acts."

The book is beautifully got up and illustrated, and though, unfortunately, somewhat of a luxury, is sure to be welcomed by those who are interested in the wild life of Scotland. Its mood is one that will foster interest in open-air natural history, and the thoroughness of its lists should help to lessen the ruthless killing of supposed rarities. J. A. T.

A NATURALIST IN SARAWAK.[1]

NEARLY forty years ago Dr. Beccari, the well known traveller-naturalist, made extensive journeys in Sarawak, but not until now has he published an account of his experiences; indeed, for this volume we have to thank the Ranee, H.H. Lady Brooke, who wisely urged Dr. Beccari to give the public the benefit of his knowledge, for, as she justly stated, the conditions have practically remained unchanged from times unknown.

Fig. 1.—Adult Male Mayas Tjaping. From "Wanderings in the Great Forests of Borneo."

Dr. Beccari collected in the land of the Land Dyaks, of the Sea Dyaks, and of the Kayans, not to mention less numerous peoples, and he gives a first-hand account of the people, their houses, dress, weapons, and ways. All this is very interesting reading, but there is little, if anything, that has not been recorded in Ling Roth's great compilation "The Natives of Sarawak and British North Borneo," or in the writings of more recent travellers. Indeed, it is the great fault of this book that the numerous contributions that have of late years been made to the natural history and

[1] "Wanderings in the Great Forests of Borneo: Travels and Researches of a Naturalist in Sarawak." By O. Beccari. Translated by Dr. E. H Giglioli, and revised and edited by F. H. H. Guillemard. Pp. xxiv+424 illustrated. (London: A. Constable and Co., 1904.) Price 16*s.* net

ethnology of Sarawak are one and all ignored. A few references are given to older publications or the *Sarawak Gazette*, and to some of the papers based on the collections sent home by Dr. Beccari. The reader must consequently bear in mind that there is a considerable amount of information about the animals and people of Sarawak which, to say the least of it, supplements Dr. Beccari's book. To the ethnologist the chief value of the book lies in the identification of animals, and especially of plants, employed by the natives, as the author not only gives their uses, but their native and scientific names.

The general naturalist will find the book packed with interesting information. Dr. Beccari is an enthusiastic and keen witted field naturalist. The intending traveller will pick up many valuable suggestions, and the stay-at-home naturalist will gain an extremely good idea of the conditions of life in the jungles of Borneo. The author not only describes what he saw, but he seeks to trace the interdependence of organisms upon one another and their relations to the environment. As Dr. Beccari is a professional botanist, the botany of a tropical forest is dealt with more fully and with greater knowledge than is usual in similar books, and those botanists who are interested in ecology will find much that will be of service to them.

The most important zoological observations are those on the orang-utan. The Dyaks recognise several varieties of orang, the two more important being the "Mayas kassa" and the "Mayas tjaping," with a laminar lateral expansion of naked skin in front of each ear. (In a foot-note we read that *tjaping*, in Malay, is the term applied to a small, nearly triangular piece of silver which is hung in front of baby girls as a fig-leaf.) Wallace and others have expressed the opinion that at least two species of orang-utan exist in Borneo. Dr. Beccari has come to the following conclusions:—There is no well authenticated case of a female with lateral face-expansions, though there is some evidence that such do occur; but there are young orangs with milk dentition which have them well developed, and adult male individuals are found with the expansions rudimentary. Not associated with the above character is the frequent absence of the terminal phalange of the hallux with the total or partial suppression of the nail. Evidently there is great variability in the orang, but Dr. Beccari holds that there is only one species of *Simia satyrus* with two main varieties, "tjaping" with lateral adipose cheek-expansions and highly developed cranial crests, and "kassa" with no lateral cheek-expansions and its skull devoid of strongly pronounced crests. Nevertheless, he suggests "that in a remote past the Mayas tjaping and the Mayas kassa were two quite distinct species, perhaps having their origin in separate regions, and only later coming into contact on the same area . . . at present it seems hardly likely that the two races should remain distinct." Dr. Beccari brought home a large number of skins, skeletons, and heads of these animals, and he confesses to have killed and wounded others which he could not take away. He adds practically nothing to our knowledge of their habits.

FIG. 2.—Rafflesia Tuan-Mudæ, Becc. (flower 22 inches in diameter). From "Wanderings in the Great Forests of Borneo."

Dr. Beccari does not hesitate to throw out a number of hypotheses, many of which will by no means be implicitly accepted by biologists; for example, he suggests (p. 32) that the prominent nose with narrow nostrils directed downwards of the Semitic people is associated with living in an open country, "whilst Negroes and Malays, for the most part dwellers in the forest, have snub noses with wide nostrils turned upwards, such as characterise most monkeys." Again, he says, "I have always thought that there must have been a formative epoch, in which every creature had the power of special adaptation to its own needs—nay even to its own wishes or caprice. In this epoch of 'plasmation' when the so-called force of heredity—which tends to reproduction according to the type of the progenitor—had but little power, the world being still young, the organism must have been far more susceptible of modification by external forces (p. 36). . . . The actual power of adaptation in organisms is at the present day well nigh non-existent as compared with what they must have possessed in the past (p. 211). . . . The varied forms assumed by those groups of individuals called by naturalists species, would be merely the result of a plasmative force exerted by surrounding conditions on primitive beings (p. 208). . . . May it not be that the Rafflesia, and a host of other aberrant species, both animals and plants, are examples of the autocreation of organisms (derived from exceptional circumstances of the environment) and suddenly appeared *à l'improviste,* as it were, in that primitive epoch during which organic matter was easily plasmated, so as to adapt itself with facility even to extraordinary conditions of existence? (p. 389). . . . Therefore, contrary to the present prevailing tendency to attribute a powerful action to variability during the existing period, and to consider every species as inconstant, I hold the opposite opinion, namely, that at the present time species do not vary in Nature, returning thus to the old idea of the nearly absolute fixity of existing species (p. 210)." It is interesting to compare these views with those arrived at by Alfred Wallace, who wandered in the same jungles; and, as Dr. Guillemard, the English editor, rightly observes, "Whether the scientific reader does or does not admit the validity of all Dr. Beccari's theories concerning species-formation, he cannot call in question his abundant experience of the country, or his knowledge of the subjects of which he treats." A. C. H.

OILS FOR MOTOR-CARS.

POSSIBLY this article may be of interest to readers of NATURE who are not chemists, and therefore no apology need be made for treating certain parts of the subject in an elementary manner. The commercial names for motor-oils are numerous and confusing, and the automobilist may well be puzzled to discriminate between them, even if his chemistry has by no means become a mere schoolboy reminiscence.

The various liquids in use at the present time as fuels for motors are derived from three sources, namely, crude petroleum, coal tar, and alcohols. By far the largest quantity is furnished by the petroleum. Coal-tar "spirit" is scarcely beyond the experimental stage. Alcohol is somewhat largely used abroad, but at present is almost out of the question in this country.

Products from Crude Petroleum.—These, so far as motor fuel is concerned, are two: a *light oil* and a heavier or *"burning" oil.* The light oil, in one grade or another, is variously known as gasoline, petroleum spirit, petrol, petrol spirit, motor spirit, mineral spirit, motol, moto-essence, naphtha, petroleum-benzine, and benzoline. Of these, gasoline has the lowest density, benzoline the highest. The oil is obtained in the distillation of American crude petroleum, and may be said generally to be the portion of the distillate passing through the still between the temperature-limits of 60° C. and 150° C., and having a specific gravity ranging from 0.68 to 0.74. The limits, however, vary somewhat with the different refineries. To obtain a good motor "spirit" this fraction of the distillate is purified with sulphuric acid and with soda, and rectified by re-distillation. Such a spirit is clear, has no strong odour, and leaves no residue when evaporated from the hand. Two or three years ago the best English petrol had a specific gravity of 0.680; but, for reasons to be mentioned later, the density has been gradually raised, and is now generally about 0.720 or more.

Chemically, light oil or petrol is a mixture of several members of the homologous series of paraffin hydrocarbons, C_nH_{2n+2}. It is generally assumed to be mainly heptane, C_7H_{16}, and octane, C_8H_{18}, but both lower and higher members are usually present, and some analyses indicate that the range may commonly be from hexane, C_6H_{14}, to undecane, $C_{11}H_{24}$. A point to notice is that whilst petrol as a whole is a light, volatile oil, it is by no means a homogeneous liquid. The different hydrocarbons composing it have not the same volatility as one another, and they require different quantities of air for their complete combustion.

The heavier oil obtained from crude petroleum corresponds to what is ordinarily known as kerosene, petroleum oil, or paraffin. It is obtained by refining the fraction which distils between 150° and 200°, and has a density of about 0.78 to 0.81. This product contains higher members of the paraffin series than those of petrol. It is consequently less volatile, and has a higher flash-point.

Kerosene is not only cheaper than petrol, but safer in the handling. Why, then, is petrol used so largely as a motor fuel instead of kerosene? And why are some kinds of petrol better than others? To answer these questions we have to remember that, to form the proper explosive mixture for the engine, it is necessary to have the vapour of the liquid mixed with a particular proportion of air. With too little air the mixture burns too gently; with too much there is a diluent effect, and liability to failure of ignition. The ready volatility of petrol allows of the requisite mixture being made more easily, more certainly, and with a simpler form of carburetter than when kerosene is used. Failure to ignite is less frequent, and the combustion is cleaner.

Nevertheless, since the supply of petrol is not limitless, attempts are being made, with some success, to utilise kerosene as a source of motor energy. The principle employed is that of heating up the vapour of the kerosene, or the liquid itself, in order to allow of a readier admixture with the air in the carburetter. This is effected either by the heat of the exhaust or by some other special contrivance. A "smokeless petroleum engine" has recently been described which is said to run without smoke or smell, and without "sooting" the cylinder. It will not, however, start with the cold kerosene. Petrol is used for the first revolutions in order to heat the vaporiser and raise the kerosene to the necessary temperature.

As regards differences of quality met with in motor spirits (petrol), the first thing to notice is that the higher the density of the liquid the nearer does it approach to the character of kerosene and to the possession of the disadvantages peculiar to the latter. To meet the growing demand, makers have been more and more inclined to eke out their supply of petrol by including a portion of the heavier fractions that were formerly rejected. Hence many of the present oils are to that extent of inferior quality. Next, the density alone is not an infallible criterion, because a spirit having a density of, let us say, 0.700, may be made up in different ways. Ideally, it might consist of a single hydrocarbon having the density in question. On the other hand, it might be compounded of two hydrocarbons having widely different densities, such as 0.660 and 0.740 respectively. In the first case it would distil completely at one uniform temperature, in the second there would be a difference of perhaps a hundred degrees between the initial and the final boiling points. With homologous hydrocarbons the lower-boiling member vaporises more readily than the higher; consequently, in practice, the vapour from the second spirit would in the early stages of a run contain an excessive proportion of the more volatile constituent, and in the later stages too much of that which is less volatile. For satisfactory combustion these two constituents require very different proportions of air; hence if the carburetter was initially arranged to give the proper quantity it would not do so in the later stages. The practical bearing is that, to avoid waste of fuel or loss of heat, more attention must be paid to the carburetter when the petrol has a wide range of boiling points than when it is more nearly homogeneous.

As already mentioned, the petrols in actual use consist of several hydrocarbons; there is none containing only one, or even only two. But the foregoing examples typify the better and the inferior qualities respectively.

Products from Coal-tar.—These are known commercially as benzol or benzole, benzine, and coal-tar spirit, all of which terms mean nearly the same thing, and toluol, which is a very similar liquid of lower density. (Benzol or benzine should be distinguished from benzoline, the petroleum product previously referred to.) In the first group the aromatic hydrocarbon benzene, C_6H_6, is the chief constituent, but toluene, C_7H_8, and xylenes, C_8H_{10}, also accompany it. Benzol is commercial benzene, *i.e.* benzene with some impurities and homologues; benzine is a cruder variety; these differ only in the proportions of the admixtures, and are often indistinguishable the one from the other. Coal-tar spirit is a general term for either. In America and in France, as well as sometimes in this country, the term "benzine" refers to the petroleum naphtha, not to the coal-tar product.

Benzol has a greater density than petrol (about 0.883 at 15°.5 C.), and a higher boiling point, viz. about 90° C. Nevertheless, it has the advantage of distilling, as a whole, within much narrower limits than most varieties of petrol do. Thus, while there may be a difference of more than 100° C. between the initial and final boiling points of petrol, a good sample of "90's benzol" will distil completely within a range of about 55° C. or less, *i.e.* between 90° and 145°. Benzol is consequently more like the ideal homogeneous fuel than petrol is, and this, together with the necessity of supplementing the supply of petrol by some other fuel, has led to its frequent employment abroad and to experimental trials in this country. Deutz benzol locomotives have been used for some time in Germany, and the tram-cars of the Saalgau-Herbertingen-Riedlingen line are worked by a 14 h.p. benzol motor, whilst a mixture of benzol and alcohol is used in some of the French racing cars. So far as the German experience has gone, the results are said to indicate that the benzol motor is about 10 per cent. cheaper in working than the alcohol engine. The British trials seem to show that benzol works more uniformly than petrol, and is generally satisfactory, except that with too great a compression in the cylinders there is a liability to pre-ignition.

One disadvantage of benzol is the presence in it of sulphur compounds, chiefly carbon disulphide and thiophene. These not only give an evil-smelling exhaust, but may conceivably corrode the metal of the cylinder through the formation of acid vapours in the combustion. Probably at a cost of about a penny per gallon the benzol could be sufficiently freed from sulphur, and it is thought that, with a good demand, the purified liquid might be supplied at a price of about 7*d*. a gallon, or less. Unfortunately, however, the supply of benzol is even more limited than that of petrol; the yield from coal-tar is only some 0.6 per cent., and much of what could be produced is already absorbed by the chemical and dye industries. It seems, therefore, very unlikely that benzol will ever largely supplant petrol, though it may usefully supplement this fuel.

Toluol (crude toluene), of lower density but higher boiling point than benzol, has also been recently tried, though not on a sufficiently extended scale to give much practical information. Benzol is essentially a mixture of pure benzene and toluol, and in one respect the mixture is better than pure benzene, because the latter freezes at 0° C., and this is prevented by the presence of toluol.

Alcohols as Fuels.—The industrial side of the question has encouraged the use of alcohol in France and Germany, since, other things being equal, it is better to support home agriculture than foreign oil-fields. Strong alcohol can be bought in Germany at a cost of 8½*d*. to 10*d*. per gallon, and at this price its use is said to be economical compared with petrol. Pure alcohol, of course, is heavily taxed—in this country the duty amounts to 17*s*. per gallon of 90 per cent. alcohol—and that used for motor purposes is "denatured" by the addition of foreign substances. In England the denatured product is methylated spirit, obtained by mixing "spirits of wine" with not less than one-ninth of its bulk of wood-naphtha, and when intended for retailing, with 0.38 per cent. of mineral naphtha or petroleum oil in addition. In France the denaturant is a mixture of heavy "benzine" and malachite green. Ordinary methylated spirit, in some experiments made a short time ago, was said to give an exhaust with an odour so vile as would preclude its general use; this is attributed to the denaturant, and to obviate it one suggestion is that alcohol intended for motor-fuel should be denatured with petrol. There are, however, some fiscal difficulties in the way.

Alcohol is a substance already partly oxidised; it contains rather less hydrogen than does petrol, and only about one-half as much carbon, the difference being made up of oxygen. Consequently its available heat-energy, viz. the heat developed by the complete oxidation of its carbon and hydrogen, is not much more than one-half that of good petrol. Nevertheless, it has some compensations. It is of nearly uniform composition, and distils within much narrower limits than petrol; in fact, strong alcohol, not denatured, is an almost homogeneous body, which boils away completely at a practically constant temperature. Moreover, it is claimed that the alcohol engine has a much greater efficiency than the petrol motor. To get the best results, however, it has been found necessary to use a higher compression than that given by the ordinary petrol engine. In some cases both petrol and alcohol are employed, with two carburetters; the petrol is used for starting, and is automatically cut off by a governor when the motor is sufficiently hot. The net result of the alcohol trials at present seems to be that, for equal volumes, petrol is appreciably more efficient than denatured alcohol; but the difference is not considerable, and fluctuations in price may yet make alcohol a serious competitor with petrol where the fiscal difficulties can be overcome.

The cheaper higher alcohols of fusel oil (chiefly amyl and butyl alcohols) have also been proposed for use as motor-fuels. But practical trials are lacking, and in any case the supply of fusel oil is only a limited one. For the principal motor-fuel of the future it is probably to kerosene that we must look.

C. Simmonds.

ADMIRAL SIR ERASMUS OMMANNEY, K.C.B., F.R.S.

A WELL-KNOWN figure has been lost to scientific circles by the death of Admiral Sir Erasmus Ommanney, K.C.B., F.R.S., which occurred on December 21, at ninety years of age.

Erasmus Ommanney was born in London so long ago as the year 1814, and entered the Navy in 1826. He became Lieutenant Ommanney in 1835, and at once volunteered to serve under Sir James Ross in the voyage for the relief of a number of missing whalers reported to be caught by the ice of Baffin's Bay, and on the coasts of Greenland and Labrador. The objects of the expedition were successfully carried out, notwithstanding the extreme danger of the navigation during the winter months.

In 1850 he was appointed second in command under Captain Horatio Austin on the Arctic expedition in search of Sir John Franklin; and in August of that year was the actual discoverer of the first winter quarters of Franklin's ships. He also directed an extensive system of sledge journeys, by which the coast of Prince of Wales Land was laid down. After his return from the Arctic he was elected a Fellow of the Royal Society for his services to science.

After his retirement in 1877, he threw himself with zeal into the work of numerous learned societies, of which he was an energetic member. He was a Fellow of the Royal Geographical Society, and had been a member of the council. He was also a Fellow of the Royal Astronomical Society. An active member of the British Association, he had served upon its council, and went with it to Canada in 1884 as treasurer, receiving on that occasion the honorary degree of LL.D. from the McGill University, Montreal.

The funeral took place at Mortlake Cemetery on Tuesday afternoon. Among the wreaths placed upon the coffin was one from the president and members of the Royal Geographical Society.

NOTES.

It is proposed to establish in the University of Liverpool a memorial to Mr. R. W. H. T. Hudson, late lecturer in mathematics, whose brilliant career was so tragically cut short at the end of last September. The memorial will probably take the form of an annual prize in mathematics, to be awarded for distinction in geometry, the subject in which Mr. Hudson's work chiefly lay. For this purpose a sum of 100*l.* would be required. Contributions to the fund should be sent to Mr. Alexander Mair, the University, Liverpool.

Dr. J. MacIntosh Bell, a nephew of Dr. Robert Bell, F.R.S., has just been appointed Government geologist of New Zealand. Dr. MacIntosh Bell has seen much active service on the Canadian Geological Survey, having worked during four seasons under his uncle, the director. In the spring of 1899 he went with Dr. Robert Bell to Great Slave Lake, where he spent the following winter, and in 1900 he was sent to Great Bear Lake, several hundred miles further north. On his return he was employed in 1901 and 1902 as geologist by the Lake Superior Commercial Co., and in 1903 by the Ontario Bureau of Mines.

Replying to a vote of thanks, after laying the foundation-stone of the Chelmsford Free Library, School of Art, and Museum on December 21, Lord Rayleigh said that the visit to Stockholm from which he had just returned was of great interest. His colleagues and he received almost a royal welcome, and at the banquet which formed part of the proceedings it was very much impressed upon them that what Nobel had in view in providing his prizes was to bring scientific men of the various countries together not merely for the advancement of science, but to promote good feeling and the cause of peace between the nations of the world. Lady Rayleigh afterwards distributed the prizes to the students of the local science and art classes.

Lord Kelvin has accepted the nomination of the council for the presidency of the Faraday Society, in succession to Sir Joseph Swan, F.R.S.

The death is announced of the Rev. J. M. Bacon at the age of fifty-eight. Mr. Bacon had made a number of balloon ascents for scientific purposes, and some of the results of his studies are described in his works "The Dominion of the Air" and "By Land and Sky."

According to the *Patria*, negotiations have been entered upon by the Italian Minister of Posts and Telegraphs and the British Postmaster-General with a view to establish wireless telegraphic communication between the stations of Poldhu and Bari.

We are informed that the constitutional amendment exempting the California Academy of Sciences from further taxation was carried at the election, November 8, by a majority of nearly 11,000.

The bog-slide reported in several newspapers as having occurred on December 7 between Frenchpark and Castlerea, in the north part of the county of Roscommon, appears now to have come to rest, after invading a village and covering a large area of agricultural land. Local information reaches us to the effect that clefts still remain visible in the bog, but that the hollow formed at the origin of the slide is gradually closing in. The flow is attributed to heavy rain, with which existing means of drainage were unable to cope. Lord de Freyne is erecting huts for the dislodged tenantry, and about twenty men were still engaged at Christmas in clearing the main road from its peaty covering.

On December 22 the airship *Lebaudy II.* made its thirtieth experiment in aërial direction at Moisson, near Mantes. In these voyages the *Lebaudy II.*, the volume of which has been brought up to 2063 metres, returned each time to the shed which shelters it, after having gone away to distances so great as ten miles. The length of the balloon is 64 metres, and its regular crew consists of three people. Several times, however, it has taken passengers, as many as six persons having ascended at one time. The speed attained by its own propulsion, measured with a registering anemometer, may be estimated at 40 kilometres per hour. The airship has been taken out in wind blowing at 5 or 6 kilometres, and in rain. It has risen to the altitude of 500 metres. The ascent of December 22 was the last of the autumn campaign, eighteen ascents having been made during the months of November and December. During this season experiments were made to decide whether an astronomer aboard an airship can know the precise geographical position of the balloon when he makes his observation. An ascent was made between 1 and 2 a.m. on a foggy morning. In the car had been taken an acetylene searchlight equalling 100,000 lamps of ten candles each, like those at the Exposition of the Grand Palais. The balloon was invisible to persons on the earth, and the earth itself could not be seen by the aëronauts. But the light could easily be distinguished, and its movements followed. Next year new voyages to considerable distances will be undertaken, like that from Moisson to Paris, or to the Crystal Palace from London. In its last trial the *Lebaudy II.* remained inflated for sixty-four days.

WITH Mr. C. G. Barrett, whose death was announced last week, has disappeared one of the last of the old school of British lepidopterists, contemporary with Doubleday and Newman. The first mention we can find of Mr. Barrett's name is in the list of entomologists in the "Entomologist's Annual" for 1857, but from that time onwards he became a frequent contributor to the *Entomologist's Weekly Intelligencer*, and afterwards to its successor, the *Entomologist's Monthly Magazine*, the first number of which appeared in June, 1864, so that the fortieth year of this periodical has been marked by the demise of two out of the seven editors whose names appear on the early numbers of 1904, Robert McLachlan, the last of the original staff who still continued to act, and C. G. Barrett, who joined the staff of that magazine in 1880, and became a member of the Entomological Society of London in 1884. Mr. Barrett was an enthusiastic and very successful collector of British Lepidoptera, and as he held a position in the Excise which involved his being moved from one station to another, he had great facilities for investigating the insects of widely separated localities. Perhaps the most important of his captures was the extremely interesting moth which he obtained on the Hill of Howth, near Dublin, and was named *Dianthoeia Barrettii* after him. Mr. Barrett's contributions to entomology, with one notable exception, were published almost exclusively in magazines, but in 1892 he commenced his great work, "The Lepidoptera of the British Isles," in serial parts, and he had completed the Macro-Lepidoptera at the time of his death. Mr. Barrett's last paper, a description of the larva of *Doryphora palustrella*, Douglas (one of the Tineina), appeared in the *Entomologist's Monthly Magazine* for the present month, so that he may be said to have died in harness.

THE *Standard's* correspondent states (December 26) that the Vienna Veterinary Institute has just opened a laboratory for the study of the diseases of fish, which will be in charge of Prof. Fiebinger.

THE Paris correspondent of the *British Medical Journal* details some of the conclusions of the committee appointed to investigate Dr. Doyen's claims respecting the cause and treatment of cancer (December 24, p. 1720). M. Metschnikoff, one of the committee, states (1) that in culture tubes inoculated by Dr. Doyen with cancerous material in his presence the *Micrococcus neoformans* developed; (2) that the characters of the microbe so obtained agreed with those described by Dr. Doyen as characteristic of the *M. neoformans*; (3) it is not yet possible to report on the specificity or pathogenic characters of the microbe; (4) it is not possible yet to state whether Dr. Doyen's serum has a curative action or no. It will be seen that this report is a very guarded one, and very different from the details published in the daily Press.

WE learn from the *Times* (December 21) that a considerable number of beautifully worked flints have recently been discovered at Culmore, which is said to be in the south of Scotland, but we have been unable to find the locality on maps. The spot where the flints were found has the appearance of having been surrounded by marshy ground, and it is possible that the flint-tools may have belonged to lake-dwellers. Arrow-heads, scrapers, anvil and hammer stones, are abundant among the worked flints. The collection has been acquired by Mr. Ludovic Mann, and will be exhibited for a few weeks in the People's Palace, Glasgow.

THE annual conversazione of the Royal College of Science and Royal School of Mines was held at the college as we went to press last week, and was attended by about five hundred guests. The company included Sir Norman Lockyer, Sir Arthur Rücker, Mr. Morant, Prof. Judd (the dean), Prof. Tilden, Prof. Perry, Prof. Callendar, Prof. Gowland, and Mr. G. W. C. Kaye (secretary). There were many interesting exhibits in the various departments in chemistry, physics, astrophysics, mechanics, metallurgy, mining, geology, and biology, under the direction of their respective professors. The Solar Physics Observatory was open by permission of Sir Norman Lockyer, and a kinematograph exhibition was given, while the college company of the Corps of Electrical Engineers showed a searchlight. Dr. W. Watson, F.R.S., delivered a lecture during the evening on radium and twentieth century alchemy.

Spolia Zeylanica for October contains the description by Mr. Boulenger of a new snake of the genus Aspidura, and an illustrated account by Mr. J. L. Hancock of the Cingalese representatives of the grasshoppers of the family Tettigidæ.

THE October number of the *American Naturalist* is entirely devoted to botanical subjects, even the usual pages of notes being omitted. In the first article Prof. Penhallow completes his account of the anatomy of conifers, in the second Dr. B. M. Davis contributes the fourth instalment of his studies of the plant-cell, while in the third Prof. D. H. Campbell discusses the affinities of the ferns of the groups Ophioglossaceæ and Marsilaceæ.

AT the meeting of the Zoological Society held on December 13 Mr. Rothschild exhibited a wonderful series of mounted skins and skulls of gorillas and chimpanzees, most of which had been set up by Rowland Ward, Ltd. A long paper was also read on this unique collection, in the course of which the author stated that he recognised four different forms of gorilla, two of which constituted species. Unfortunately, in our opinion, he advocated the transference of the name *Simia satyrus*, so long applied to the orang-utan, to the chimpanzee. Surely a title to a name ought to become valid after such a long period of unchallenged use.

TWO articles from the twentieth volume of the *Journal* of the Imperial University of Tokyo were received by last mail. In the first Mr. T. Fujita discusses the mode of formation of the germinal layers in gastropod molluscs. More general interest attaches, however, to the second, in which Mr. H. Yabe describes a number of cephalopod remains from the Cretaceous rocks of Japan, this being his second contribution to the subject. Most of the species belong to European genera, and the large size of some of the specimens of turrilites is very noticeable. We have also received article 8 from vol. xviii. of the same serial, in which Mr. B. Hayata gives a list of the plants of the order Compositæ found in Formosa.

IN the December number of *Bird Notes and News* the Royal Society for the Protection of Birds records its efforts in regard to the late osprey case in Surrey. It may, however, be asked whether it would not be well to admit that the preservation of such stragglers is a practical impossibility, and that ospreys and motors are incompatible. Similarly, in view of recent letters in the *Field*, the question as to whether birds are or are not harmful requires discussion on a business footing, altogether apart from sentiment. If they are proved harmful, we can decide whether we will put up with the damage for the sake of the attraction they add to the landscape; but let us abandon attempts to gloss over charges of damage and to defend birds at all costs. The society urges the advisability of establishing a "bird and tree day" throughout the country; possibly an excellent way of developing interest in nature—but this time will show.

WE have received four zoological papers from American serials. The first (from the *Proceedings* of the Boston Natural History Society) contains a list of molluscs from Frenchman's Bay, Maine, by Mr. D. Blaney, while in the second (from the same journal) Mr. W. R. Coe discusses the terrestrial nemertean worms of the genus Geonemertes from Bermuda. These worms, it may be remembered, were first discovered, dwelling in company with ordinary earthworms, during the *Challenger* cruise, but the specimens were lost, and no others were ever collected until 1898 and 1901. In the third paper (from the *Proceedings* of the U.S. National Museum) Mr. P. Schmidt re-determines a Japanese fish, while in the fourth (from the *Proceedings* of the American Academy) Messrs. Parker and Starratt record some interesting experiments with regard to the effect of heat on the colour-changes of the American chamæleon-iguana (*Anolis carolinensis*).

MESSRS. Jordan, Russell, and Zeit publish details of experiments on the longevity of the typhoid bacillus in water (*Journ. of Infectious Diseases*, i., No. 4, p. 641), from which it appears that under conditions probably closely simulating those in nature the vast majority of typhoid bacilli introduced into a water perish within three or four days. This is rather opposed to the views now generally prevailing, and needs confirmation before it can be absolutely accepted.

AT a meeting of the Institute of Mining and Metallurgy held on December 15 Messrs. Thomas and Macqueen read a paper on methods of dealing with dust in the air and gases from explosives in a Cornish mine (Dalcoath). Miners' phthisis is especially due to inhalation of stone dust, and it is found that the use of a water-jet with machine drills entirely prevents dust if used from the commencement of operations and properly directed, a coarse spray being more efficient than a fine one, but is difficult to apply when the drill-holes become deeper than about two feet. James's water blast was found particularly effective for laying the dust caused by shovelling and blasting.

AN interim report has been issued by a committee appointed by the British Association to inquire into ankylostomiasis in Britain. The Ankylostoma is an intestinal parasite producing serious and sometimes fatal effects. The report states that there are many channels by which the Ankylostoma might be introduced into British coal mines (it has been introduced into the Westphalian coal fields and into the Dalcoath tin mine in Cornwall, as already recorded in these columns). The conditions existing in our mines are such that it would probably flourish and become firmly established. Once introduced it is doubtful if it could ever be eradicated, and therefore it is recommended that proper sanitary regulations should without delay be formulated and enforced to prevent infection of the pits.

A REPORT by Drs. Haldane and Wade has been issued by the Local Government Board on the destruction of rats and disinfection on shipboard, with special reference to plague. For destroying rats the burning of sulphur, the use of liquid sulphurous acid, carbonic oxide, carbonic acid, and the Clayton process are discussed. Carbonic oxide, while very fatal to rats, has no effect on insect vermin and no disinfecting action, and having no odour may be dangerous to man, and may form an explosive mixture with air. Carbonic acid, while fatal to rats, is similarly without lethal effect on vermin, has no disinfecting action, and a large quantity is required, which makes it expensive, but it is less dangerous to man than carbonic oxide. Burning sulphur is tedious and only applicable in empty cabins and holds, but is cheap and fairly effective. Much the same may be said of liquid sulphurous acid, but it is quicker though more costly. The Clayton process consists in burning sulphur in a furnace, the fumes from which are pumped into the holds, &c., and is probably the best of the methods discussed. Properly carried out it is fatal to rats and all vermin, has considerable disinfecting and penetrative power, is not likely to cause accident as its odour is so marked, but it damages certain articles, especially if damp, and does not diffuse well in a closely packed hold.

THE area planted with cotton this season in the West Indies is estimated in the *Agricultural News*, November 19, at from eight to ten thousand acres, excluding Carriacou, where four thousand acres were planted mostly with Marie Galante cotton. Of this amount Barbados and St. Vincent each have sixteen hundred acres under cotton, and in St. Kitts the acreage exceeds two thousand acres. The crops generally are much healthier than in the previous year, and an output of about 5000 bales may be expected.

THE *Quarterly Record* of the Royal Botanic Society of London for the second quarter of this year contains an account of the horticultural exhibition held in June, and most of the papers read at the conferences have been published. The educational section attracted a number of speakers and visitors when nature-study and horticulture formed the subjects of addresses by Sir George Kekewich, Mr. F. Verney, and others. At the forestry conference Prof. W. R. Fisher delivered the address, in the course of which he discussed the selection of seeds of forest trees, and advocated the formation of experimental stations in order to study the suitability of different trees for particular districts and soils.

THE morphological nature of the ovary in the genus Cannabis has engaged the attention of many botanists, including Payer, C. B. Clarke, and Briosi and Tognini; finally, Dr. Prain, having been deputed by the Government of India to report upon the cultivation of *gánjá*, has upon the evidence of certain abnormal forms contributed a new explanation in No. 12 of the Indian *Scientific Memoirs*. Previously the views had been expressed that the pistil consists either of a single carpel, or of two carpels of which the anterior alone is developed, and bears an ovule; the bicarpellary nature of the ovary is, in Dr. Prain's opinion, fully borne out by specimens showing phyllody of the gynœcium, but it is the posterior carpel which is fertile. With respect to the character of the diclinism of the flower, this is shown to be primitive and not vestigial.

WE have received from the Rev. J. de Moidrey, S.J., of the Zi-ka-wei Observatory, an interesting and useful memoir on the climate of Shanghai, based upon observations made between 1873 and 1902. The coldest weather occurs about the beginning of February, and the warmest about August 1, nearly forty days after the solstices. The mean temperature for thirty years at Zi-ka-wei was 59°·2 F., and the mean range 43°·2. The extreme readings were:—maximum 102°·9, minimum 10°·2. A variation of the climate is not apparent. The average monthly relative humidity is 78 per cent.; the annual variation is insignificant, averaging only 4 per cent. The average yearly rainfall is 43·6 inches; June is preeminently the rainy month, both for frequency and amount, while December is the driest month. The paper contains useful remarks upon the cyclones experienced over the China seas.

WE have received a copy of "Meteorology in Mysore" for 1903, being the results of observations at Bangalore, Mysore, Hassan, and Chitaldrug; these observing stations lie at the corners of a quadrilateral comprised between 12° 18′ and 14° 14′ N. latitude and 76° 10′ and 77° 36′ E. longitude, Bangalore being 190 miles west of and 3000 feet higher than Madras. The results, including the means for eleven years, 1893–1903, have been very carefully worked out by the director, Mr. John Cook, and contain some interesting features. The highest reading for eleven years of air temperature in shade was 103° at Chitaldrug in April 1901 and 1903, and the lowest 42°·7 at Hassan in December, 1895. The mean relative humidity varied from 57 per cent. to 62 per cent., but extreme dryness was occasionally experienced, the humidity varying between 4 per cent. and 6 per cent. Rainfall is fairly uniform throughout the province, varying from $26\frac{1}{4}$ to $37\frac{3}{4}$ inches per annum. The value of the report would be enhanced by a key-map of Mysore and surrounding districts.

IN the *Sitzungsberichte* of the Vienna Academy, cxiii., 3 and 4, Dr. Fritz Hasenöhrl discusses the laws of reflection and refraction of light as applied to a body which is moving relative to the ether, in connection with the thermodynamical aspects of the principle of reciprocity, and also the variations in the dimensions of matter due to motion through the ether.

IN No. 86 of the *Communications* from the Leyden Physical Laboratory Dr. H. Kamerlingh Onnes and Dr. H. Happel discuss the application of Gibbs's volume-energy-entropy model to the representation of the continuity of the liquid and gaseous states on the one hand, and the various solid aggregations on the other. For this purpose models have been constructed for an ideal substance, showing the continuity of the solid and liquid as well as of the liquid and gaseous states.

A SERIES of experiments on the influence of abnormal position upon the motor impulse is described in the *Psychological Review* for November 1 by Mr. Charles Theodore Barnett. Without going into the theoretical aspect of these investigations, we notice that the author refers to the well known puzzle of drawing a rectangle and its diagonals in front of a looking-glass, and the difficulty of playing the piano with crossed hands, as Beethoven so often requires in his sonatas, is another illustration which suggests itself.

PART i. of vol. xlviii. of the *Transactions* of the Institution of Engineers and Shipbuilders of Scotland contains a paper by Mr. F. J. Rowan on the smoke problem, which is of especial interest on account of the recent inquiry by Sir John Ure Primrose at the sanitary congress in Glasgow into the connection of smoke with the production of rain and fogs in large cities. It is pointed out that although domestic fires are principally responsible for atmospheric pollution in a large town, only the smoke issuing from factory chimneys is subject to municipal control, and that many kinds of industrial furnaces, other than those used for raising steam, are employed in operations of such a nature that they cannot but necessarily produce large volumes of smoke. In dealing with the question of the prevention of smoke from furnaces used in connection with steam boilers, the employment of smoke-consumers, smoke-washers, and similar appliances is condemned, and a system of gas firing is advocated. Mr. Fyfe, the sanitary inspector of Glasgow, in the course of the discussion of the paper, stated that although the Public Health Act empowered prosecution in the case of "any chimney (not being the chimney of a private dwelling house) sending forth smoke in such quantity as to be a nuisance," it was customary in Scotland, under the Burgh Police Act, not to proceed against other kinds of furnaces than those used for heating boilers. His own experience had convinced him that gas firing was not absolutely necessary in such cases, but that by means of a suitable and inexpensive smoke-consumer, consisting of ignited jets of producer gas, all the smoke could be got rid of, and an additional supply of heat given to the boiler.

SAMPLES of an improved form of crucible lid have been sent to us by Messrs. J. J. Griffin and Sons. It is made slightly convex towards the crucible, and has been designed to obviate the loss of substance which so readily occurs in simple gravimetric experiments, such as the conversion of copper into copper oxide by means of nitric acid, when the ordinary form of crucible lid is employed.

ACCORDING to a paper by M. Bertrand in the *Comptes rendus* (No. 20, p. 802) mountain ash berries not only contain the alcohol sorbitol, but an isomeric alcohol, sorbierite, is also present. To obtain it the sorbitol is completely converted into sorbose by the action of the sorbose bacterium, and the sorbose is removed by crystallisation. Sorbierite has been obtained from the mother liquor in the form of deliquescent crystals. That the new alcohol is hexahydric has been established by the cryoscopic determination of its molecular weight, and by the preparation and analysis of the di- and tri-benzoic acetals.

A VERY interesting paper dealing with the primary formation of optically active substances in nature is contributed by Dr. A. Byk to the *Zeitschrift für physikalische Chemie* (vol. xlix. p. 641). It is shown in an indirect experimental manner that it is possible to effect the resolution of racemic substances by a purely physical agent—circularly polarised light. The reflection of the plane polarised rays of sunlight from the surface of water under the influence of the earth's magnetism is supposed to give rise to a predominating quantity of one form of circularly polarised light, and this is the cause which determines the production of optically active substances in the photochemical processes taking place in animal and plant life.

WE have received Williams and Norgate's "International Book Circular." An article on some contemporary foreign chemists, illustrated by twenty portraits, is contributed by Dr. M. O. Forster.

PROF. M. W. TRAVERS's work on the experimental study of gases has been translated into German by Dr. T. Estreicher, and the translation has been published by Messrs. F. Vieweg and Son, Brunswick.

AN authorised translation, into German, of Prof. J. J. Thomson's lectures on "Electricity and Matter," reviewed in NATURE of May 26 (vol. lxx. p. 73), has been made by Herr G. Siebert, and published by the house of F. Vieweg and Son, Brunswick. The work forms the third volume of a series of monographs issued under the general title "Die Wissenschaft."

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JANUARY, 1905.

Jan. 2–3.	Epoch of January meteors (Radiant $230° + 53°$).
6.	4h. 52m. to 7h. 5m. Transit of Jupiter's Sat. III. (Ganymede).
8.	2h. Saturn in conjunction with Moon (Saturn 3° 3′ S.).
9.	3h. Venus in conjunction with Moon (Venus 2° 13′ S.).
,,	11h. Juno in conjunction with Moon (Juno 0° 11′ S.).
10.	5h. 9m. to 6h. 23m. Moon occults ϕ Aquarii (Mag. 4·4).
11.	Perihelion Passage of Encke's Comet.
13.	8h. 52m. to 11h. 6m. Transit of Jupiter's Sat. III. (Ganymede).
,,	10h. 36m. Minimum of Algol (β Persei).
15.	Venus. Illuminated portion of disc = 0·650, of Mars = 0·903.
16.	7h. 25m. Minimum of Algol (β Persei).
24.	12h. 43m. to 13h. 40m. Moon occults β Virginis (Mag. 3·8).
27.	10h. Mars in conjunction with Moon (Mars 2° 45′ S.).
28.	15h. 7m. to 16h. 11m. Moon occults γ Libræ (Mag. 4·1).

ELEMENTS AND EPHEMERIS OF COMET 1904 *d*.—*Circular* No. 69 from the Kiel Centralstelle contains a set of elements, calculated by Herr M. Ebell from the observations made on December 17, 18, 19, and a short ephemeris, for comet 1904 *d*, recently discovered by M. Giacobini at Nice. They are as follows:—

Elements.

T = 1905 Jan. 3·2814 Berlin.

$$\left.\begin{aligned} \omega &= 75° \;\; 9'·8 \\ \Omega &= 225° \;\; 1'·2 \\ i &= 103° \;\; 27'·3 \end{aligned}\right\} 1904·0$$

$\log q = 0·27173$

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

1904–5		α h. m. s.		δ ° ′		log Δ		Brightness
Dec. 26	...	16 37 56	...	+31 45	...	0·3328	...	1·12
,, 30	...	16 49 48	...	+33 53	...	0·3234	...	1·17
Jan. 3	...	17 2 37	...	+36 8	...	0·3146	...	1·22

Brightness at time of discovery = 1·0.

From the above it will be seen that both the northern declination and the brightness of the comet are increasing, but at the same time its right ascension is approximating more closely to that of the sun, thereby rendering observations increasingly difficult, and only possible during the few minutes preceding dawn.

OBSERVATIONS OF BRIGHT METEORS.—During a sea voyage undertaken in 1903–4, Dr. J. Möller, of Elsfleth, observed a large number of meteors, and in No. 3984 of the *Astronomische Nachrichten* he records the essential data regarding the observations of the sixteen brightest objects seen during November–December, 1903, and March, 1904. Of these, two were as bright as Jupiter, and five were brighter than Saturn. The latitude and longitude of the place of observation are given in each case, so that in the event of duplicate observations having been made the real paths may be computed.

The same observer recorded in No. 3971 of the same journal an authenticated naked-eye observation of Jupiter's third satellite on November 1, 1903.

THE GREAT RED SPOT ON JUPITER.—In a note to No. 3983 of the *Astronomische Nachrichten* Mr. Denning gives the results of his own and the Rev. T. E. Phillips's observations of the Great Red Spot since the last conjunction of Jupiter. They show that for the seven months prior to last September the motion of the spot indicated a rotation period, for the zone wherein it is located, of 9h. 55m. 38·6s., a shorter period than any observed since 1883, when it was 9h. 55m. 38·2s.

In the same publication Mr. Stanley Williams gives the results of his observations of this phenomenon, and shows that from his eye-estimates of the times of transit, during the period August, 1903, to January, 1904, the average time of rotation was 9h. 55m. 41·52s.

He points out that this is a remarkable increase on the rotation period (viz. 9h. 55m. 39·66s.) of the preceding year.

REPORT OF THE UNITED STATES NAVAL OBSERVATORY.—Rear-Admiral Chester's report of the work done at the United States Naval Observatory during the fiscal year ending June 30, 1904, shows that the observatory and the staff are still maintaining their reputation as regards the number and excellence of the observations made. In all 15,287 observations were made, including photographs of the sun taken on 210 days which show an increase of 93 days on which spots and faculæ were recorded on the solar disc. A new photo-visual triple objective with an aperture of 7·5 inch and a focal length of 65 feet, giving a 7-inch image, is to be obtained for the photoheliograph, and will also be used on future eclipse expeditions for photographing the corona. In regard to next year's eclipse the superintendent asks for a special grant of 1200*l.* and recommends the employment of a man-of-war and its crew to assist in the observations, which he suggests should be made at two widely separated stations in Spain.

The report also contains individual reports from the assistant in charge of each department, and records the personnel, the routine work performed with each instrument, and the publications issued during the period with which it deals.

The branch observatory at Tutuila, Samoa, has now been established, and placed under the supervision of assistants from Washington.

MATHEMATICAL DRAWING.[1]

THE appearance of a useful little book by Prof. Gibson may be made the occasion of emphasising the importance of drawing in mathematics, whether pure or applied, especially as the University of London has recently made a paper on drawing compulsory for all mathematical candidates for the B.Sc. degree. It was not without due consideration of the attendant difficulties that this step was taken. For the last two years the paper on drawing was left optional for the candidates in order that teachers as well as students should have time to obtain some definite notion of what is required; but even now, in the absence of well established text-books, a considerable amount of uncertainty exists as to the nature and scope of the subject. Time will, no doubt, set this right, and we welcome Prof. Gibson's text-book as assisting towards the desired object.

There are three prominent conceptions of mathematical drawing which may be noticed. These are:—(1) plotting, which means the construction of curves by taking a set of successive values of an abscissa and from them calculating (by a book of tables or otherwise) the values of the corresponding ordinate, and finally marking the positions of the points on squared paper; (2) the construction of curves—usually conic sections—from certain geometrical data; (3) what is generally called "geometrical drawing," embodying the principles and processes of projective geometry, and including problems in three dimensions. This is, perhaps, a rough division, but it will suffice.

Plotting may be a very humble process—"mere" plotting, as it is sometimes contemptuously called—or it may be what has long been known as curve tracing, and is to be found in treatises on the differential calculus. But even in this latter and higher character it is not (at least as usually employed by students) a system of accurate drawing. The construction of circles, and conics generally, from assigned data is certainly not a pure exercise in drawing, because it involves a very large knowledge of theorems on the part of the student. An exercise in this subject is apt to be, in reality, a severe examination in Euclid or in the theory of conic sections, and it cannot be what was intended by the advocates of a paper on drawing. With regard to projective geometry the case is somewhat different; the principles involved are not very numerous, and it cannot be said that a

[1] "An Elementary Treatise on Graphs." By George A. Gibson, M.A., F.R.S.E., Professor of Mathematics in the Glasgow and West of Scotland Technical College. Pp. x + 183. (London: Macmillan and Co., Ltd.) Price 3*s.* 6*d.*

knowledge of a large assortment of theorems is necessary; but the practical value of the study to students who are neither engineers nor architects is another matter.

There is, however, another kind of mathematical drawing which does not fall under any of these heads, and which consists in the invention of graphic solutions of equations which can be solved with great difficulty, if at all, by the stock processes of accurate mathematics. This branch is at once the most useful and the most vague; it is impossible to lay down its principles in systematic order—it must be learnt by abundant exemplification.

The ordinary academic problems of statics and hydrostatics furnish many examples of this subject, but only a few of these can be noticed here.

If AB and BC are two ladders freely jointed together at B, of different weights and lengths, placed with the ends A and C resting on a rough horizontal plane, A being prevented from moving while C is drawn out along the plane, the inclinations, θ, ϕ, of AB and BC to the ground when the limiting position is reached are determined from two equations of the forms

$$a \sin \theta - b \sin \phi = 0; \; m \tan \theta + n \tan \phi = k,$$

where a, b, m, n, k are all given quantities. The graphic solution of these equations is effected with great ease thus:—draw a line OH equal to m, and produce OH to O′ so that HO′ $= n$; at H draw HC perpendicular to OO′ and equal to k; through O draw any line OQ meeting HC in Q; take a point R in CH such that CR = HQ, and draw O′R; then the point, P, of intersection of OQ and O′R is a point on the locus represented by the second of the above equations, the angles θ, ϕ being POO′ and PO′O. These points, P, are therefore constructed with great ease and rapidity. Also the locus represented by the first equation is a circle having for diameter the line joining the points which divide OO′ internally and externally in the ratio $a : b$, and the points of intersection of these two loci give the required values of θ and ϕ.

The following problem leads to precisely the same equations as the above:—rays of light emanate from a fixed point P in one medium separated by a plane surface from a second medium; find the ray proceeding from P which will be refracted to a given point, Q, in the second medium.

Again, the fact that when a uniform chain hangs with free extremities over two fixed supports of equal heights there are either two figures of equilibrium or none results from the solution of an equation of the form $xe^{a/x} = k$, which is effected by drawing the curve $y = e^x$ and the right line $y = kx/a$, and then it is at once seen that there are either two points of intersection or none.

When a heavy wire rope has its ends fixed at two points in the same horizontal line, and a load is suspended from the lowest point of the rope, the rope forms parts of two distinct catenaries, and the determination of these curves leads to an equation of the form

$$e^{k/x} = [(x^2 + a^2)^{\frac{1}{2}} + a]/[(x^2 + b^2)^{\frac{1}{2}} + b],$$

in which x alone is unknown. The tracing of the curve obtained by putting y equal to the right-hand side of this equation is quickly effected by means of two fixed circles and the drawing of right lines.

The figure of equilibrium of a revolving self-attracting liquid spheroid gives an equation which is a particular case of $x(a + bx^2)/(c + x^2) = \tan^{-1}x$, and this is best solved by the tracing of two curves. If we put y equal to the left-hand side we have a curve of the third degree the geometrical construction of which is exceedingly simple, and requires only a fixed circle and right lines.

Whenever a problem involves two unknown angles in two equations one of which is of the form $m \cos \theta + n \cos \phi = c$, where m, n, c are given, all angles satisfying this equation can be represented as the base angles of a triangle the base of which, AB, is fixed, and the vertex of which describes what may be called a quasi-magnetic curve, the geometrical construction of which is this: take any two fixed points, A, B; about A as centre, with radius m.AB/c describe a circle; about B describe a circle with radius n.AB/c; draw any line perpendicular to AB meeting these circles in Q and R respectively; then the lines AQ and BR intersect in a point on the required curve. When $m = n$ we have the common magnetic curve the construction of which is not nearly so well known as it should be.

The solutions of the above examples have all been of a purely geometrical kind, and have not involved the plotting of points by coordinates arithmetically calculated. There are other problems of a slightly different kind, still independent of plotting, but involving *trial*; the value of a certain unknown quantity which has to satisfy a certain geometrical condition is found by trial to do so very nearly if not completely. In all such cases Taylor's theorem furnishes a still closer value than the observed one, and completes the solution with all desirable accuracy.

For example, many problems lead to the equation $a \sin 2(\theta - \alpha) = b \sin \theta$ for an unknown angle θ, the other quantities being all given. This can be solved by two circles thus:—draw a line AB equal to b, and on it as diameter describe a circle the centre of which is C; draw AD making the angle BAD $= \alpha$ and cutting the circle in D; draw CD and produce it to E so that CE $= a$, and on CE as diameter describe a circle. Now find on the circumference of the first circle a point P such that if CP meets the second circle in Q we have BP = EQ. This is done with great accuracy by the eye, and Taylor's theorem will improve the solution.

An equation which can be solved also very easily by trial is $a \sin^2 \theta = b \cot \theta$, which may be taken in the form $a \sin^3 \theta = b \cos \theta$, and a graphic solution suitable to each form is easily found.

Finally, we may notice equations of the form

$$\tan x = ax/(c - x^2),$$

which we obtain from Bessel functions in certain problems relating to vibrations. Such an equation is easily solved by the intersections of the curve $y = \cot x$ with the hyperbola $y = (c - x^2)/ax$, and the construction of the hyperbola belongs to the most simple case of this curve, viz. given one point on the curve and the asymptotes. As compared with the graphic solution of equations given by physical problems, the graphic solution of algebraic equations is unimportant, though not devoid of interest, because Horner is always available for numerical cases.

Prof. Gibson gives many examples of the solutions of quadratics and of cubics by graphic methods; but as regards quadratics it must be confessed that there is no utility in the process, and too much space is usually devoted to it. For cubics in general he gives a graphic solution and an interesting discussion. In a second edition of his book he might treat the biquadratic similarly, because its graphic solution can be easily effected by means of a circle and a parabola, or by means of a right line and a curve easily derived from a parabola. Many curves occurring in physics are dealt with in the book—such as isothermals and adiabatics; there is also a useful discussion of Fourier's theorem, and a treatment of the curves belonging to vibrations, damped as well as undamped. The graphic method is also applied to the solution of some of the simpler mixed trigonometric and algebraic equations, and the book concludes with a chapter on the properties of conic sections.

GEORGE M. MINCHIN.

CENTRAL AMERICAN MAMMALS.[1]

THREE years ago the author of these volumes published, in the same serial, a valuable synopsis of the mammals of North America and the adjacent seas. In the present larger work he has taken in hand the mammals of the tract generally known in this country as Central America, but on the other side of the Atlantic termed, at any rate by zoologists, Middle America, together with those of the West Indian islands. The greater bulk of the present work is accounted for, not so much by the greater number of species (690 against 606) as by the increased elaboration of the mode of treatment, the addition of diagnostic "keys" to the various genera, and by a fuller account of the habits of many species, the latter feature rendering these volumes proportionately more valuable to the naturalist, and at the same time of more general interest. The illustrations, too, are more numerous, comprising, besides crania, figures of the external form of a considerable number of species.

[1] "The Land and Sea Mammals of Middle America and the West Indies." By D. G. Elliot. *Field Columbian Museum Publications*, Zoological Series, vol. iv., parts i. and ii., pp. xxi+850 illustrated.

the addition of the latter likewise tending to popularise the work.

In his preface Dr. Elliot reiterates and emphasises the remarks made in the companion volume as to "the excessive and probably unwarranted multiplications of species and races (made easy by the too liberal application of the trinomial system)" of American mammals in general. Many of the forms, he adds, which have received separate names are separated on the evidence of comparative instead of distinctive characters. That is to say, their differences from other types are so slight as to be incapable of definition except by comparison with the latter, often, indeed, involving the necessity of placing specimens of each side by side. Consequently, in many instances specimens cannot be referred to their respective species or races without access to museums.

Perhaps it is rather unfortunate that the author did not see his way to go one stage further, and mention what species and races are entitled, in his opinion, to recognition. A step would then have been made towards the elimination of the forms named on insufficient distinctive characters. Nowadays it is the fashion to assign a distinct name to every recognisable form, however slight may be its points of difference; but some limit in this direction will apparently have to be imposed before long, unless zoology is to become an impossible science. In our opinion, one way of mitigating the difficulty is by using specific terms in a comparatively wide sense, thus leaving the subspecies, or races, to be recognised or not according to the discretion of the individual student.

Nomenclature is another point on which the author has a good deal to say, and he mentions that some of the names employed in the companion volume have been changed in the present work. He hopes, however, that as the result of such changes "a nomenclature that at least will approach stability may, in the distant future, be expected to be reached." Possibly it may—at the cost of rendering all the older standard works on zoology, palæontology, distribution, and scientific travel worse than useless—but a proposal like that of emending such a name as Odocoileus (in universal use among his naturalist countrymen) to Odontocœlus scarcely seems calculated to pave the way to such a happy millennium!

Among changes in nomenclature that we specially regret to see is the substitution of Agouti for Cœlogenys as the name of the paca, largely on the ground that the former is the popular title of a totally different group of rodents, for which reason we think its use in the scientific sense should be barred. It is also distressing to see the familiar

FIG. 1.—Lord Derby's Opossum and young. From Elliot's "Mammals of Middle America."

name Hapale, for the marmosets, banished in favour of Callithrix, so long used for the titi monkeys, which now figure as Saimiri. On a par with the latter is the substitution of Tayassu for Dicotyles, of Coendu for Cercolabes, and of Potos for Cercoleptes, which is like an invasion of zoological Goths and Vandals into the sacred precincts of classic Rome. One point in regard to the plan of the work—whether intentional or accidental it is not easy to say—strikes us as unsatisfactory. In the case of certain species, such as *Odontocoelus americanus* and *Ovis cervina* (pp. 69 and 84), for example, of which the typical form does not occur within the limits of the area under consideration,

FIG. 2.—Long-tailed Skunk. From Elliot's "Mammals of Middle America."

the species-name itself does not appear in the list at all, but only the subspecies, such forms consequently lacking a distinctive number, and thus rendering the census of specific types occurring within the area inaccurate.

Otherwise we have nothing but commendation to bestow on the general mode of treatment of the subject, and it may be safely affirmed that the author has earned the gratitude of all naturalists on this side of the Atlantic by putting in a convenient and easily accessible form such a vast amount of information with regard to the mammalian fauna of an extremely interesting region. The illustrations (two of which are reproduced), it may be added, are, for the most part, beyond praise.

R. L.

THE FISHERIES OF SCOTLAND.

THE twenty-second annual report of the Fishery Board for Scotland, for the year 1903, is issued in three parts as usual, the first dealing with the sea fisheries, the second with the salmon fisheries, and the third being concerned with marine research.

With regard to sea fisheries, tables are given showing the results of the trawl fishing and the line fishing. The number of steam trawlers has been increasing steadily for the last seven years, and rose from 109 in 1896 to 280 in 1903. The average catch per vessel increased from 5030 cwt. to 5594 cwt., while the value of the catch per cwt. was practically the same in 1903 as it was in 1896.

In the line fishing the number of steam liners increased from 39 vessels in 1898 to 91 vessels in 1903, the number having varied somewhat in the intermediate years, 23 vessels having been added in 1903. The total number of boats was slightly less than in 1898, owing to a steady decrease in the number of sailing craft. The catch, since

1898, has steadily decreased from 1,050,000 cwt. to 602,600 cwt., and the value per cwt. has slightly decreased. The reason given for the reduction in value of line-caught fish is that the trawlers have been landing large quantities of cod. Thus, in spite of the large increase in the number of steam liners, which are, of course, independent of wind in getting to the fishing grounds, the catch per boat fell from about 182 cwt. to about 121 cwt.

It is interesting to note that for the herring fishing in the Buckie and Peterhead districts experiments have been made with sailing boats fitted with auxiliary steam power. The value of steam power is shown in another part of the report, where the catch of the Scotch boats (sailing craft) working from English ports during October and November is compared with that of the English boats, a large number of which are steamers. The Scotch boats caught more than 65½ per cent. of the total catch, but only got 46⅝ per cent. of the total value, the steamers always being able to make the market first.

The west coast mackerel fishing has shown great improvement, the catch in 1903 being 57 per cent. better than in 1902. The trade apparently only requires development, as "shoals of mackerel almost every year visit the coast."

In the report on salmon fisheries we learn that during the year Mr. Calderwood, Inspector of Salmon Fisheries for Scotland, made inquiries as to the views of the various fishery boards with regard to the limitation of netting in narrow waters, this move being an outcome of the report of the Royal Commission on Salmon Fisheries.

Some of the boards have already taken steps to reduce the netting in their rivers. In the Annan all nets have been removed, while in the Spey only about three miles of water is now netted. In the Aberdeenshire Dee an association has, for about thirty years, annually bought off the nets on some sixteen miles of water, and now both upper and lower proprietors are seeking to secure the permanent removal of these nets.

While eleven of the boards consulted passed resolutions in favour of reducing the netting, six were unable to express an opinion, and only one, the North Esk Board, passed a resolution against any such reduction. In Mr. Calderwood's words:—"The resolution was prepared and agreed to by the lower proprietors—who are in the majority—before the meeting took place, and was based upon the argument, supported by good evidence, that the present amount of netting in the district—which netting has been constant for a great number of years—has not produced a decline in the stock of fish. The question of improving the general interest of their *whole* district is complicated by other considerations which need not be referred to here."

One of the most important papers in this report is Mr. Calderwood's contribution to the life-history of the salmon as observed by means of marking adult fish, the first part of which appeared in the report for 1901. Since then 62 additional re-captures of marked fish have been made, which, with those previously caught, gives a total of 252 re-captured fish. From this material, and also from other results obtained in Scotland, Ireland, and Norway, Mr. Calderwood has been able to draw some important conclusions. We now have evidence bearing out the commonly accepted view that the great majority of salmon after visiting the sea return to the river they left.

The marking experiments seem to show that grilse spend less time in fresh water than salmon, running up and down from the redds more quickly than the latter.

Another very interesting fact brought out is that a grilse kelt after running down to the sea may return within a few months as a summer salmon of about 10 lb., or may remain in the sea until the following year, returning to the river as a spring salmon. This partly upsets the belief that spring salmon are old fish, for, although there is no doubt that old fish do run up in the spring, we now know that a fish of 18 or 20 lb. may only be five years old, according to Mr. Calderwood, and on its second return from the sea.

There is evidence showing that some fish spawn in two successive seasons, and one case, No. 7298, seems to suggest that the fish was spawning for the third year in succession.

There is a diagram, in which fish of various weights are considered as being of various ages, which shows the interesting facts observed as to the "dual migration" which exists, perhaps, in all stages of the salmon's life-history.

We know that all the fish of one hatching do not migrate to the sea at the same time. Some migrate at one year old, the great majority at two years, and some again at three years.

For the smolt to grilse stage Mr. Calderwood mentions three cases in which the smolts returned after a year and some months as grilse of 3½, 3½, and 6½ lb. respectively, and says "we have no data to show any other seasonal migrations which may occur at this stage." We do not know whether the authority for the cases is untrustworthy, but we recollect records of smolts marked and released being re-caught after a few months as grilse up to 8 lb. weight. Such cases are mentioned by Fraser ("On the Salmon, &c.," 1833, pp. 15, 16) and by Brown ("Stormontfield Experiments," p. 92), who says "the experiments here have shown . . . that all the smolts of one year do not return the same year as grilse, the one half returning next spring and summer as small salmon."

Mr. Calderwood shows that what he considers five-year-old fish do not increase in weight in the way that four-year-olds and six-year-olds do, and he suggests that this may represent the period in the life of the adult salmon when the reproductive function is at its best, and thus asserts itself at the expense of the body-growth.

Surely this classing of fish into ages by size can only be roughly correct at best. We do not yet know to what extent fish spawn annually or biennially, or whether a fish may rest several seasons after spawning. Yet if Mr. Calderwood's suggestion that the activity of the reproductive organs checks growth is sound, surely a fish spawning three years in succession—as No. 7298 suggests may happen—would be considerably smaller than a fish of the same age which spawned in alternate years or less often.

There are several other interesting papers in this part, but space precludes us from referring to them.

Part iii., scientific investigations, contains eight papers on various subjects connected with marine fisheries. Dr. T. Wemyss Fulton, the superintendent, gives an account of the trawling investigations, and in another paper continues the report of his investigations on the rate of growth of fishes. He also reports upon the operations of the Nigg Marine Hatchery, and has another paper entitled "Ichthyological Notes" on the various interesting species taken during the year.

An important paper is that by Dr. Williamson on the life-histories of the edible crab and other decapod Crustacea. Dr. Williamson has discovered that the ova of the crab are not attached by mucilage to the long hairs of the spinnerets as was supposed, but that the eggs are actually pierced by the hairs, and are thus spitted in rows, the eggs not being attached to one another.

Dr. Thomas Scott contributes a paper on some rare and interesting marine Crustacea, and another upon some fish parasites new to the Scottish marine fauna.

The report is published at His Majesty's Stationery Office, and can be obtained through any bookseller.

FRANK BALFOUR BROWNE.

PRIZE AWARDS OF THE PARIS ACADEMY OF SCIENCES.

AT the annual meeting of the Academy of Sciences the list of prizes awarded for the year 1904 was announced as follows:—

Geometry.—The Bordin prize to M. Servant, for his memoir on the determination of surfaces applicable to the paraboloid of revolution which pass through a given contour; the Vaillant prize, divided between M. Emile Borel (3000 francs), and M. Bricard (1000 francs); the Francœur prize to M. Émile Lemoine; and the Poncelet prize to M. Désiré André.

Mechanics.—A Montyon prize to M. Gustave Richard.

Navigation. The extraordinary prize, of 6000 francs, divided in equal parts between M. Jacob (for his theoretical researches on the transmission of submarine explosions), M. Gayde (for a study of the resistance of hulls to submarine explosion), and M. La Porte (for hydrographic work on the coast of Brittany); the Plumey prize to M. Lucien Mottez, for important services to submarine navigation.

Astronomy.—The Pierre Guzman prize is not awarded;

the Lalande prize to Mr. S. W. Burnham, for his work on double stars; the Valz prize to M. de Campos Rodrigues, for work done at the Lisbon Observatory, with especial reference to the determination of the solar parallax by means of the planet Eros; the Janssen medal to M. Hansky.

Geography.—The Binoux prize, divided between M. Baratier (for his work in connection with Colonel Marchand's expedition in Central Africa), M. Bénard (for his work on Arctic exploration), and M. Alphonse Berget (for his book on the physics and meteorology of the globe); the Gay prize to Mr. Bell Dawson, for his hydrographic work in eastern Canada; the Tchihatchef prize to Lieut.-Colonel Lubanski, for his explorations in Indo-China; the Delalande-Guérineau prize to M. Auguste Pavie, for work in French China.

Physics.—The Hébert prize to M. Georges Claude, for his book on electricity for general readers; the Hughes prize to Lieut.-Colonel E. Ariès, for his publications on the theory of heat and chemical statics; the Kastner-Boursault prize to Captain Ferrié, for his work on wireless telegraphy.

Chemistry.—The Jecker prize, divided between MM. Freundler, Minguin, and Lespieau; the Cahour prize, divided between MM. Chavanne, Kling, and Binet du Jassoneix; a Montyon prize (unhealthy trades), divided between MM. Dupont and Détourbe.

Botany.—The Desmazières prize to M. Guilliermond, for his work on cryptogams, especially fungi; the Montagne prize to M. Camille Sauvageau, for his work on algæ; the de la Fons-Melicocq prize is not awarded.

Anatomy and Zoology.—The Savigny prize to M. Krempf; the Thore prize to M. d'Orbigny.

Medicine and Surgery.—A Montyon prize to M. Paul Reclus, for his memoir on the proper use of cocaine in surgery; to M. Kermogant, for his work on exotic pathology and hygiene; and to M. Cazalbou, for his researches on the trypanosomiases of the French Soudan. Mentions are also accorded to MM. P. Launois and Roy, for their biological studies on giants; MM. F. Bezançon and M. Labbé, for their treatise on hæmatology; and to M. Odier, for his work on the action of electricity and certain poisons on nerve cells. MM. F. Marceau, P. Briquel, J. Gagnière, and R. Voisin are accorded citations. The Barbier prize to MM. Prenant, Bouin and L. Maillard, for their book on histology, and a mention to M. Pierre Lesage; the Bréant prize (accumulated interest) to M. Frédéric Borel, for his memoir on cholera and plague in relation to Mahometan pilgrimages; the Godard prize to MM. J. Albarran and L. Imbert, for their memoir on tumours of the kidney; the Baron Larrey prize to M. Conor, for work on typhoid fever, M. E. Lafforgue receiving a mention; the Bellion prize to M. Jules Delobel, for his book on hygiene in schools, M. Gabriel Gauthier receiving a mention; the Mège prize to M. G. Delamare, for his experimental researches on morbid heredity.

Physiology.—A Montyon prize to M. J. Jolly, for his memoir entitled "Experimental Researches on the Indirect Division of the Red Blood Corpuscles," a very honourable mention being accorded to M. C. Fleig, for his work on the mode of action of chemical stimulants on the digestive glands; the Philipeaux prize to M. Cristiani, for his work on thyroid grafting, an honourable mention being accorded to M. Joseph Noé; the Lallemand prize, divided between M. Maurice de Fleury (for his works on the nervous system) and MM. J. Camus and P. Pagniez (for their memoir on psychotherapy); the Pourat prize to M. J. Tissot, for a study of the physical and chemical phenomena at high altitudes; the Martin-Damourette prize, divided between M. A. Frouin (1000 francs) and M. Manquat (400 francs).

Among the general prizes, the Lavoisier medal was awarded to Sir J. Dewar, for his work on the liquefaction of gases; the Berthelot medal to MM. Freundler, Minguin, Lespieau, Kling, Binet du Jassoneix, Dupont, and Paul Villard; the Jerome Ponti prize to M. Maurain; the Trémont prize to M. A. Guillemin; the Gegner prize to M. J. H. Fabre; the Lannelongue prize to Mme. Vve. Nepveu; the Leconte prize to M. René Blondlot, for his work taken as a whole; the Wilde prize to M. Paul Villard, for his work in physics; the Houllevigue prize to MM. Henri de la Vaulx and Henri Hervé, for their work in aëronautics; the Saintour prize to M. Charles Frémont, for his experimental researches on the elasticity of metals; a Montyon prize (statistics), divided between M. V. Lowenthal, for twelve memoirs relating to the depopulation of France, and M. Paul Razous, for his memoir on the mortality and liability to disease in dangerous professions, MM. Henry Guégo, E. Maury, and Ott receiving mentions; the Jean-Jacques Berger prize is divided between MM. J. Resal (6500 francs), A. Alby (3500 francs), Laurent (2000 francs), Grimaud (1500 francs), and Retraint (1500 francs).

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Liverpool.—The arrangements for excavations to be made during the winter under the auspices of the university institute of archæology, in Upper Egypt, have been completed, and the work will be begun at Hierakonpolis before the New Year. The excavations have been placed as in previous years at Beni-Hasan, Negadeh, and elsewhere under the care of the university reader in Egyptian archæology.

Dr. Norman Moore has been appointed a member of the consultative committee *vice* Prof. Bertram C. A. Windle, F.R.S., who has resigned his membership upon appointment as president of Queen's College, Cork. Dr. Moore is chairman of the board of advanced medical studies of the University of London, and represents the Royal College of Physicians upon the General Medical Council.

The annual meeting of the Geographical Association will be held at the Royal Colonial Institute, Northumberland Avenue, London, W.C., on Friday, January 6, at 4 p.m. The president, Mr. Douglas W. Freshfield, will be in the chair. A report on the eighth international geographical congress will be read by Mr. H. Yule Oldham, and there will be a discussion on practical geography in schools.

On December 20 Lady Warwick distributed the prizes gained by the students of the evening classes and of the day secondary school of the Carpenters' Company at Stratford. In the course of some remarks upon the school, she said that England needed a better system of secondary education, and it was now acknowledged that the State should take the matter in hand. But in the meantime the city companies were doing a good work in bringing secondary education to the doors of the people.

The annual conference of the Public Schools Science Masters' Association will be held at Westminster School on Saturday, January 14, 1905. The following are among the subjects to be discussed:—(1) the importance of including both Latin and natural science in a scheme of general education; (2) recent proposals for school leaving certificates; (3) the use and misuse of terms in science teaching; (4) the possibility of teaching "scientific method" to boys whose education is almost entirely literary and who have no time for a regular course in chemistry and physics. Sir Michael Foster, K.C.B., is the president of the association for the year.

New buildings of the Willesden Polytechnic, erected at a cost of about 10,000*l.*, were formally declared open by Sir W. Anson on December 21. After distributing prizes to the successful students, Sir W. Anson remarked that polytechnics marked what he hoped was becoming the modern view of education, that it did not consist of independent sets of studies, but was a composite whole, no part of which did not rest upon or form a foundation for another part. It should be borne in mind that a polytechnic did not merely train a student in a handicraft. The object of such an institution was to combine theory and practice, to teach the student not only how to do a thing, but why it was done in a particular way, so that he became not only skilful in the craft upon which he was engaged, but got to understand the scientific principles underlying his work.

Mr. L. L. Price read a paper at the meeting of the Royal Statistical Society on December 20 entitled "Accounts of the Colleges of Oxford, 1893–1903, with Special Reference to their Agricultural Revenues." The paper is based on the accounts, published annually, of the colleges (and the university) of Oxford, and is a continuation of one read in 1895. The gross external receipts of the colleges (and the university) in 1903 exhibited an increase on 1893 of 29,797*l.*, and on 1883 of 16,343*l.* The net external receipts of the colleges alone showed an increase of 16,566*l.* on 1893, and a decrease of 10,311*l.* from 1883. Later in his paper Mr. Price states that it hardly seems extravagant to affirm that during a quarter of a century the colleges (and the university) have lost between a third and a fourth of their agricultural revenues. Had it not been for an increase in revenues derived from other sources, they would have been crippled yet more seriously. The most noticeable feature is the large increase in the receipts from houses and sites of houses. Between 1883 and 1903 these receipts were doubled, and between 1893 and 1903 they increased from 56,877*l.* to 91,388*l.* On the whole this gross increase has more than balanced the gross diminution in the receipts from lands and tithe. The internal receipts of the colleges increased by 5814*l.* between 1883 and 1893, and by 11,428*l.* between 1893 and 1903.

THE annual conference of headmasters of public schools was held this year at Christ's Hospital, West Horsham, on Thursday and Friday last, December 22 and 23. Among the subjects discussed on Thursday were the recommendations of the consultative committee of the Board of Education for the establishment of school certificates, and the policy of the Board of Education in encouraging the sending of intending elementary school teachers to secondary schools in lieu of pupil teacher centres. The following resolutions were adopted:—"That the question of school certificates be referred to the committee of the conference with a view to immediate action, and that it be an instruction of the committee to obtain in writing the opinion of every member of the conference on the various points involved in the scheme of the consultative committee." "That this conference pledges itself to support the education authority in its policy of providing that candidates for pupil teacherships in public elementary schools shall receive a substantial portion of their education in a public secondary school, and considers it desirable that as many recruits as possible for teacherships in public elementary schools should be obtained from the ranks of ordinary pupils of secondary schools." On Friday a discussion took place on the subject of Greek, with special reference to the proposals of the Cambridge Syndicate, and the following resolution was carried by twenty-one votes to eight:—"That, without committing itself to details, the conference generally disapproves of the Cambridge Syndicate with regard to Greek in the Previous Examination." The conference also expressed itself against some of the reforms of the new Army entrance examinations, and carried the following resolution unanimously:—"That this conference hopes that the scheme for qualifying certificates in the examination for Woolwich and Sandhurst will be so amended as to encourage the study of Latin." A strong representation is to be made to the War Office on this subject. It was also agreed that the committee of the conference should consider the syllabus issued by the Board of Education on the teaching of English literature, and should include their recommendations in the annual report.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Meteorological Society, December 21.—Capt. D. Wilson-Barker, president, in the chair.—Decrease of fog in London during recent years: F. J. **Brodie** (*Discussion*).—The study of the minor fluctuations of atmospheric pressure: Dr. W. N. **Shaw**, F.R.S., and W. H. **Dines**. The authors described an apparatus called the "microbarograph," which they have designed to magnify the minor fluctuations, and at the same time to disentangle them from the general barometric surges. They also showed some records from three of these instruments. The authors wish to obtain information as to the nature of the disturbances and the causes to which they may be assigned. Among the causes which suggest themselves as likely to produce temporary fluctuations of the barometric curves are stated by the authors to be (1) atmospheric billows passing along surfaces where there is discontinuity of density in a manner somewhat similar to ocean waves; (2) the passage of minute whirls or cyclonic depressions of small scale; (3) variations of pressure due to the attraction or repulsion produced by electric stress as masses of air at different potential pass over; (4) the mechanical effects of wind; and (5) the mechanical effects of rapid condensation of aqueous vapour.

DIARY OF SOCIETIES.

MONDAY, JANUARY 2.

VICTORIA INSTITUTE, at 4.30.—Confucianism: Rev. A. Elwin.

WEDNESDAY, JANUARY 4.

GEOLOGICAL SOCIETY, at 8.—The Marine Beds in the Coal Measures of North Staffordshire: J. T. Stobbs.—The Palæontology of the Marine Bands in the North Staffordshire Coalfield: Dr. Wheelton Hind.—The Geology of Cyprus: C. V. Bellamy, with Contributions by A. J. Jukes-Browne.

THURSDAY, JANUARY 5.

RONTGEN SOCIETY, at 8.15.—Description of an Automatic Vacuum Pump: C. E. S. Phillips. (The apparatus will be shown at work.)—Exhibition of a Method by which Strongly Adherent Films of Aluminium may be applied to Glass.—A Note on the Coloration of Glass by Radium Radiation.

FRIDAY, JANUARY 6.

GEOLOGISTS' ASSOCIATION, at 8.—The Third Issue of the British Association Geological Photographs: Dr. C. G. Cullis.

CONTENTS.

THURSDAY, JANUARY 5, 1905.

MODERN OPTICAL METHODS.

Die Bilderzeugung in optischen Instrumenten, vom Standpunkte der geometrischen Optik. By the Scientific Staff of Carl Zeiss's Works. Edited by M. von Röhr. Pp. 588; with 133 woodcuts. (Berlin: Julius Springer, 1904.)

Grundzüge der Theorie der optischen Instrumente nach Abbe. By Dr. Siegfried Czapski. Second edition. Edited by Dr. O. Eppenstein, with the assistance of M. von Röhr. Pp. 490; with 176 woodcuts. (Leipzig: Johann Ambrosius Barth, 1904.)

THE old geometrical optics which we used to read at Cambridge was a delightful subject. It would have been a still more delightful subject had examiners set better questions on it. Probably no other branch of mathematics would lend itself so well to the kind of treatment which is now fortunately coming into fashion, viz. the use of graphical and experimental methods. If the German system of Lehrfreiheit prevailed in this country I would rather teach geometrical optics to an elementary class than geometry adapted to modern requirements.

This elementary optics, however, bears about the same relation to the optics treated in the first of these books that Newton's deductions from Kepler's laws bear to the planetary theory. The analogy is the more complete in that both the optician and the astronomer have found it impossible to obtain an exact solution by direct methods, and they have therefore been led to employ the method of trial and error in order to obtain successive approximations giving the desired results to closer and closer degrees of accuracy. As Messrs. Czapsky and Siedentopf point out (p. 25), the exact determination of the forms of the refracting surfaces required to produce exact images subject to given conditions has never been effected, except in a few cases, such as the Cartesian oval, in which rays from one focus converge to a point in the other. We therefore take spherical surfaces, and by calculating the various kinds of aberration, show how they may be corrected. It is, however, interesting to learn that the theory of non-spherical surfaces has quite recently been put into practice in the Zeiss works for the first time in the construction of lenses other than large reflectors and refractors for telescopes. It has, in fact, been found possible to correct certain residual aberrations by applying finishing touches to the lenses giving them a slight deviation from sphericity.

The analogy between the problems of the optician and the astronomer is made still closer by observing how different specialists have confined their attention to particular kinds of aberration in the one case and of perturbation in the other, and have devised special methods for simplifying the calculation of the corresponding terms.

In his preface Dr. Czapski tells us that the present work owed its origin to the demand for a revised edition of his "Theorie der optischen Instrumente nach Abbe," published in 1893. Being unable to undertake the work himself, the idea suggested itself that a better purpose would be served by obtaining the collaboration of a number of joint authors, and that no better body of men could be found for the purpose than the scientific staff of the Zeiss firm.

The work has been divided among the seven joint authors as follows:—The first chapter, dealing with the fundamental principles of optics, including the laws of refraction, the principle of minimum path, and the characteristic function, is contributed by Drs. Czapski and Siedentopf; Drs. König and von Röhr contribute the second chapter, on formulæ of calculation, and the fifth, on spherical aberration, in which latter is contained a complete exposition of Abbe's method of invariants and its application to the determination of the ten corrections determined by the problem of Seidel. The chapters on chromatic aberration and on determination of optic systems according to the theory of aberrations (chapters vi., vii.) are contributed by Dr. König alone. "The Geometrical Theory of Images after E. Abbe" is the title of the third chapter, by Dr. Mandersleb. In the fourth chapter, by Dr. P. Culmann, on the realisation of optical images, we actually do find our old friend the formula

$$\frac{\mu}{v}-\frac{1}{u}=\frac{\mu-1}{r},$$

in a position, however, of subsidiary importance. Dr. Löwe contributes a chapter on prisms, while Dr. von Röhr is responsible for the last two chapters, dealing with the breadths of pencils, penetration, brightness of images, and similar matters.

The second of these books is of a more elementary and practical character. It contains a general discussion of images formed by small pencils, and illustrated descriptions of the principal optical instruments. The corrections are discussed, but the discussions are less mathematical. The theory of conjugate foci receives fairly full treatment, and among the interesting features which we notice at a first glance, attention may be directed to the series of sections of a pencil of light on p. 24, and the figures of an object and its image on p. 40, where the object is an arrow in a plane through the axis of a lens, and is bisected by the focal plane of the lens.

This is the second edition of a book of which the first edition was written for Winkelmann's "Handbuch der Physik." Of matter new in this edition, Dr. Eppenstein contributes chapters on screens, on projection apparatus, and on the illumination of objects; chapters on vision, on photographic objectives, and on spectacles are contributed by Dr. M. von Röhr.

The perfection to which the manufacture of optical instruments has been brought by the Zeiss firm is well known, and it is also pretty generally realised that the results attained could not have been accomplished by an establishment run on purely business lines by "practical men" falsely so-called. The usual stock form in which the last named class of individual recommends his wares to the public is the stereotyped statement that "The materials used in the preparation of these goods are of the best quality obtainable."

The present books furnish abundant proof that this statement is particularly applicable to the Zeiss instruments in regard to the quality of those materials most essential for the production of good optical apparatus, viz. brains and knowledge of advanced mathematics.

G. H. Bryan.

AMERICAN CYTOLOGY.

Fecundation in Plants. By David M. Mottier, Ph.D. Pp. viii + 187. (Washington: Published by the Carnegie Institution, 1904.)

Contributions to the Knowledge of the Life-History of Pinus, with Special Reference to Sporogenesis, the Development of the Gametophytes and Fertilisation. By Margaret C. Ferguson, Ph.D. Pp. 153. (Washington: Published by the Washington Academy of Sciences, 1904.)

MR. MOTTIER'S "Fecundation in Plants" gives to those who are interested in cytology an account of the phenomena of fertilisation throughout the vegetable kingdom, written by one who has carried on investigations in several branches of the subject with success. His practical acquaintance with his subject confers even on his descriptions of the investigations of others a freshness which makes his work a pleasure to read. The first chapter is perhaps the most generally interesting. In it he gives an account of some of the vexed problems of karyology which are at present calling out so much controversy among cytologists. Among these problems may be mentioned the existence of centrosomes, the homology of centrosomes and blepharoplasts, the nature of synapsis, the significance of the sexual process, and the numerical reduction of chromosomes. The author's method of discussion is candid. He avoids being dogmatic in expressing his own views, although he criticises somewhat severely the observations of others. He holds that centrosomes and centrospheres do not occur in plants higher than the liverworts, and are, indeed, only well established in a few of the Thallophyta. It is remarkable that he does not allude to the possibility that the radiations at the poles of mitoses may be in part artefacts produced by the fixing agents. He considers Belajeff hasty in coming to the conclusion that the centrosome is the homologue of the blepharoplast; but he admits later on that certain "facts lend encouragement to the belief that centrosome and blepharoplast may be homologous structures." Mottier regards synapsis as due in a large measure to the action of reagents. He accepts Strasburger's theory of the numerical reduction of chromosomes as a good working hypothesis, and he holds now that there is no evidence for Weismann's "reduction" to be found in the mitoses of plants. His candid expression of doubt as to the persistent individuality of the chromosomes preserved through the successive mitoses—so often assumed, though almost involving a miraculous resurrection—is typical of his attitude of independence.

The succeeding chapters give an account of fertilisation in types taken from the various subdivisions of the vegetable kingdom. These descriptions are most useful in bringing together what is scattered sporadically through botanical literature into the compass of a short, well written book. The work is illustrated by blocks in the text, which show in a satisfactory manner the points to be brought out.

Miss Ferguson's memoir has a more limited scope, but this allows her to devote more space to her own researches, which have been very extensive in the cytology of the spore-production of conifers. It is quite remarkable to see how two cytologists, writing almost simultaneously, can hold so divergent views on fundamental subjects. While Mottier sees in the fusion of sexual nuclei the blending of two lines of descent, Miss Ferguson's researches lead her to believe that no fusion-nucleus, combining the paternal and maternal hereditary substances, is formed. Rather the processes of mitosis allow these to be kept apart during the life of the offspring, and the "reduction" or qualitative division occurring some time during the life-cycle secures that the gametes shall be "pure." It is evident that the later writer is concerned with the relation of mitosis to Mendel's views rather than to Weismann's hypothesis. With regard to synapsis, Miss Ferguson believes it to be a normal stage in heterotypic mitosis. Another point of difference is the mode of origin of the double chromosomes of heterotypic mitosis. Miss Ferguson finds confirmation in her preparations for the view (first published by the writer of this review in 1896, *Proc.* Roy. Irish Acad.) that the two arms of the chromosomes are approximated pieces of the nuclear thread, and do not arise by longitudinal cleavage as Mottier believes. This interpretation seems to be gaining ground, and the Louvain school, once so much opposed to it, has recently accepted it, putting the folding back, however, to the synaptic stage. The reviewer's investigations seem to suggest the possibility that two distinct foldings take place, one during synapsis and another between that stage and the differentiation of the chromosomes. Whatever views are held on these disputed matters, all cytologists are indebted to the author for her beautiful drawings, which are reproduced in a series of twenty-four plates.

There is no doubt that the publication of these two memoirs, the one by the Carnegie Institution and the other by the Washington Academy, will be of much service to those engaged in cytological research.

H. H. D.

PHYSICAL RESEARCH AT LEYDEN.

Het Natuurkundig Laboratorium der Ryks-Universiteit te Leiden in de Jaren 1882–1904. Gedenkboek aangeboden aan den Hoogleeraar H. Kamerlingh Onnes, Directeur van het Laboratorium, by gelegenheid van zyn 25-jarig Doctoraat op 10 Juli 1904. Pp. viii + 288. (Leyden: Eduard Ydo, 1904.)

THIS volume was prepared by colleagues and pupils of Prof. Kamerlingh Onnes, of Leyden University, and presented to him on the twenty-fifth anniversary of his receiving the degree of Ph.D. It differs in character from the usual collections of scientific papers which it has become the fashion on the Continent to present to eminent men of science on similar occasions. Since 1882 Prof. Onnes has been director of the physical laboratory at the University of Leyden, and the book gives a description of the growth of the institution since his accession to the directorship, of its present condition, and of the work carried out by himself and by his pupils under his supervision. In a sense it is a matter for regret that by the nature of the case he himself had to be excluded from the list of contributors; on several of the subjects dealt with it would be interesting to have the director's personal views.

After an eloquent dedication from the hand of Prof. Bosscha, we find in the first chapter, compiled by Prof. Haga and others, a detailed description of the laboratory and of the more important machinery and fittings, particularly those belonging to the "cryogenic" department, to which Prof. Onnes has devoted most of his personal labours; the low temperature baths prepared here are extensively used throughout the laboratory for various researches.

In an appendix to this chapter Dr. Siertsema gives an interesting account of the training school for apprentice mechanics instituted by Prof. Onnes in connection with the laboratory. This institution is probably unique; it was started in 1886 with one pupil, and the number has risen steadily until this session no less than thirty-three boys are receiving systematic instruction in the various mechanical arts, with the object of qualifying themselves as instrument makers, glass-blowers, electricians, and for similar professions. The boys are supposed to assist to a certain extent in the routine work of the laboratory and earn corresponding small wages, while in the evening they have to attend classes in the municipal technical institute. A better training for the purpose could hardly be imagined, and one is not astonished to learn that after the completion of the three years' course the boys appear to be much in request in laboratories and various engineering and technical works.

In chapter ii. thermodynamical investigations are reviewed; Prof. van der Waals gives an account of Prof. Onnes's researches on thermodynamical surfaces, Prof. Kuenen writes on the phenomena of condensation of binary mixtures, and there are further articles on accurate isothermals of gases, on the construction of models of surfaces, and on capillarity and viscosity of liquids up to the critical region.

The third chapter, edited by Prof. Lorentz and others, is devoted to optical and magneto-optical work; here we find a discussion of experiments on the reflection of light by mirrors, on the magnetic rotation of the plane of polarisation in gases, liquefied gases and other liquids, on the influence of pressure on the rotation of sugar solutions, on the reflection of light by magnetised mirrors (Kerr's phenomenon), and an account of Zeeman's discovery of the modification in spectra by magnetic forces. The phenomenon discovered by Egoroff and Georgiewsky, that a sodium flame placed in a magnetic field emits partially polarised light, was investigated by Prof. Lorentz himself, and appears to be closely connected with Zeeman's phenomenon.

In the last chapter Prof. Zeeman gives a description of researches on Hall's phenomenon in bismuth at various temperatures down to the boiling point of oxygen, measurements of the dielectric constant of liquid oxygen and liquid nitrous oxide, and of the absorption of Hertz vibrations by salt solutions.

A detailed account of all the research work is published regularly in the *Communications* from the physical laboratory at Leyden, the issue of which was commenced in 1892, but the present papers give a useful general summary of the work carried out, presented in a manner which should make it intelligible to the uninitiated.

The volume bears ample testimony to the success which has attended Prof. Onnes's manifold labours for his laboratory, which owes to him its position as one of the best known institutions of its kind. It is well illustrated, and contains as a frontispiece a striking likeness of Prof. Onnes, apparently after a drawing.

PRACTICAL SILICATE ANALYSIS.

Manual of the Chemical Analysis of Rocks. By H. S. Washington, Ph.D. Pp. ix+183. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 8s. 6d. net.

Of late years greatly increased attention has been directed to the chemical investigation of rocks, and the science of petrology has been enriched by many excellent analyses. Among these the work of the United States Geological Survey deservedly holds the highest place, both on account of its abundance and its thoroughness. The present treatise arises from an endeavour to make the methods used by Clarke, Hillebrand, and other chemists in the United States laboratory available to all workers. It is excellently clear and detailed, and though the experienced analyst will not find in it much that is not already published in more succinct form in the official *Bulletins* of the Survey, he will glean a few details of manipulation and discussions of the bearings of chemical petrology that will at any rate repay perusal.

The author intends his book to be used mainly by the rather numerous class of geologists and petrologists who combine a fair knowledge of chemistry with a desire to make their own rock analyses. Undoubtedly this is a far more satisfactory proceeding than, as is usually done, to have the analyses executed by some analyst who has no special knowledge of the intricacies of this part of practical chemistry, and follows methods which are discredited or discarded. In any case such a worker will do well to place himself, for a time at least, under some teacher who is thoroughly at home in the subject; we hope that this book will not stimulate the production of analyses of rocks by students in course of training. Much of the worst analytical work with which chemical petrology is burdened has been executed in that way. If it helps to spread the knowledge of the methods used by Clarke and Hillebrand this book will do much good, as it is desirable that these should henceforward be recognised as standards, from which any important departure should be notified when the results are published.

In a few respects Dr. Washington has simplified the standard American procedure. We think this is wise, and, while we endorse his opinion that only the best work should be aimed at, we do not think that this means that the very elaborate American analyses should be emulated by the ordinary worker. From twenty to twenty-five elements are usually sought for by the American chemists, and nearly one-half of these may be present in less than 1 per cent. of the total rock. Such analyses look exceedingly well on paper, but require the greatest experience and manipulative dexterity if they are to be trustworthy. Moreover, their value is as yet not beyond question. Certainly an analysis in which ten or twelve elements are determined as exactly as possible is more welcome than an analysis which is more elaborate but less accurate. We notice that the author discourages the routine execution of duplicates. No doubt this is right; they take up much time, and may be useless or misleading; it is better for the experienced chemist to occupy himself in the most thorough testing of his reagents, the purity of which is never above suspicion. Still, there can be no doubt that duplicate analyses do show how far it is possible for the results to vary when two samples of the same powder are analysed. They help to check any exaggerated confidence in analytical refinements. In this respect it would be interesting to know what are the probable limits of error in analyses executed by the methods given in this book. The author gives his opinion (apparently not founded on any special investigations), and it strikes us that he is more sanguine in this respect than the majority of experienced silicate analysts in Britain or on the Continent.

OUR BOOK SHELF.

Application of some General Reactions to Investigations in Organic Chemistry. By Dr. Lassar-Cohn. Translated by J. B. Tingle, B.A. Pp. 101. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 4s. 6d. net.

It would be difficult to say with what object and for what class of readers this little volume (it is scarcely more than a pamphlet, and may be read in an hour) was written. Yet anyone engaged in the practical pursuit of organic chemistry cannot fail to be interested in it. One may say roughly that the book treats of the unsystematic part of organic chemistry, *i.e.* of the ordinary reactions which do not succeed, and how they may be made to do so.

Without always offering a very satisfactory explanation of the causes of success or failure, for the terms "protective influence" and "contact action" are after all merely names, the author points out how an apparently unimportant modification may affect the whole course of a reaction and convert an unprofitable method into a successful or commercially lucrative one. Incidentally, he urges the systematic study of these anomalous reactions.

As an example may be mentioned the well known fact that the accidental introduction of a few drops of mercury into the experimental vessel, in which the preparation of phthalic acid from naphthalene was in progress, rendered the operation and consequently the production of artificial indigo a success.

As a rule the difficulties encountered by the anomalous behaviour of organic compounds are met not by more drastic treatment, but by milder reagents. The whole trend of modern organic synthesis seems to lie in this direction. Thus the caustic alkalis have been replaced in many cases by alcoholic solutions of sodium ethoxide, by diethylamine, pyridine, or chalk, the strong mineral acids by phosphoric, boric, or one of the organic acids. High temperatures have given place to lower ones. The days of so-called "pyrogenic synthesis" are past. No one nowadays makes organic compounds by the aid of a red-hot tube.

In this connection it is suggestive that the fundamental reactions of living matter which embrace oxidation and reduction of a far-reaching kind, as well as synthetic processes more complex than anything achieved in the laboratory, are all effected at ordinary temperatures and with the mildest reagents.

It follows, therefore, that the more closely organic chemists succeed in imitating these conditions the more surely will those mysterious contact or fermentation problems usually associated with living protoplasm, but not unknown in the laboratory, approach solution. J. B. C.

A Further Course of Practical Science. By J. H. Leonard and W. H. Salmon. Pp. ix+224. (London: John Murray, 1904.) Price 2s.

In this book the principles of natural science are taught and enforced in a scientific manner by means of a course of experimental work, simple in character, but involving quantitative measurements, and carried out personally by the student. To begin with, lengths are measured with an ordinary rule, and tests are made in order to find out the limits of accuracy within which the measurements may be relied on. These measurements serve as an introduction to "physical arithmetic," or simple arithmetical computations specially suitable for dealing with numbers which are avowedly only approximately correct. Then follows a chapter on elementary mensuration involving the estimation of angles, lengths, areas, and volumes, the balance very wisely sharing in this work.

Experiments are devised to illustrate some of the fundamental properties of matter, such as those of indestructibility, inertia, porosity, ductility, &c. The next six chapters deal with mechanics, the subjects including uniform linear acceleration, Newton's laws, relative motion, statical equilibrium of uniplanar forces, and simple machines. This difficult section is not treated in a very satisfactory manner. The method is too deductive, the experiments are somewhat scanty and not very well chosen. Thus there is no direct verification of the fundamental principle of the conservation of momentum. Vectors, though introduced, are not made sufficiently prominent, and in the so-called "simple machines" it seems rather antiquated to find the three kinds of levers, the three systems of pulleys, the wedge, &c., introduced.

In the concluding chapters relating to the properties of liquids and gases, and the nature of heat, the authors are happier in their treatment, notwithstanding an occasional looseness in the statement of a principle. The book deserves to be very favourably received, and teachers will find that arrangements have been made to facilitate the purchase of the apparatus necessary for conducting the experiments.

Die drahtlose Telegraphie. By Dr. Gustav Eichhorn. Pp. x+256; numerous figures. (Leipzig: Veit and Co.) Price 5 marks.

This is an elementary exposition of the principles and practice of wireless telegraphy with especial reference to the systems developed by Dr. Braun. It is evidently intended to enable a practical man to become acquainted with this method without, at the same time, any attempt being made to give such a complete account as would warrant its use as a class text-book. By means of the first five chapters a reader who knows a little about the elements of electricity and magnetism will be able to appreciate the nature of electric waves and of Hertz's achievement in producing them. Then, after briefly alluding to the early system of Marconi, the writer passes on to the particular devices of Dr. Braun. The book is well and clearly written, but is in no sense a complete compendium on the subject, and the reader who derives all his knowledge from it will be inclined to think that there is only one system in the world, and that Eichhorn is its prophet. More recent methods of detecting waves by means of effects arising from hysteresis in iron are dismissed in a couple of pages, where there is no reference to Rutherford's early detector working on the same principle, while Lodge's steel-mercury-contact detector does not appear even to be mentioned, although the "Literature" appendix at the end includes the year 1903. In appendix ii. the Thomson-Kirchhoff theory of the oscillatory discharge of a condenser is given; the credit, of course, belongs to Thomson (Lord Kelvin).

Notes on the Natural History of the Bell Rock. By J. M. Campbell. Pp. xv+112; title-piece. (Edinburgh: David Douglas, 1904.) Price 3*s.* 6*d.* net.

As a record of the various types of aërial and marine life commonly seen by the guardians of the lonely lighthouses of the east coast of Scotland in particular, and of the British coasts in general, these random notes are worthy of all commendation, more especially as they are written by a man who does not appear to have had a scientific training. Mr. Campbell was assistant light-keeper on the Bell Rock for the long period of nine years, and he is therefore well qualified to know all that is to be known with regard to the general habits of the commoner and more conspicuous species frequenting the environment of his station; while a period of such a length is sufficient to include the visits of many of the rarer stragglers. Most or all of the notes, it appears, have been previously published in the local Press of the neighbouring mainland, and they are certainly worthy of rescue from such oblivion. The only point for regret is, perhaps, that the author does not say more about bird migration. Mr. James Murdoch, late secretary to the Board of Northern Lighthouses, has contributed an interesting introduction on lighthouses and lighthouse-men in general.

R. L.

The British Journal Photographic Almanac, 1905. Edited by Thomas Bedding. Pp. 1612. (London: Henry Greenwood and Co., 1904.) Price 1*s.* 6*d.* net.

THIS bulky volume, with its mine of miscellaneous photographic information, is compiled on the same lines as the earlier issues, and will be found to be a necessary adjunct to the studio and library. Among the host of articles in these pages may be mentioned a condensed summary of the story of the *British Journal of Photography* and the almanac which appeared in the jubilee number of the above mentioned journal, and also a selected number of the jubilee articles. Recent novelties in apparatus, &c., by the editor, forms also a conspicuous feature, and represents the progress in this branch of photography. No less important are the practical notes on numerous subjects, the formulæ, tables, list of photographic societies of the United Kingdom, &c., all of which add to the utility of the volume. The full indices to advertisers and contents make a quick reference to any portion of the book quite an easy matter, an important consideration in a book containing 1612 pages. The processed illustrations and woodcuts are as numerous as ever.

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.]*

Mean Temperatures of High Southern Latitudes.

ON p. 131 of NATURE of December 8, 1904, you give an approximate calculation of the mean temperatures of high southern latitudes, by Mr. Krebs, based upon the observations of the most recent Antarctic expeditions.

For the new edition of my "Lehrbuch der Meteorologie" I have made a similar calculation, and have made use of the observations in order to calculate afresh the mean temperature of the southern hemisphere. My preliminary results are as follows:—

S. latitude	50°	60°	70°	80°
Yearly temperature	5·5	−2·0	−11·5	−19·8 C.
January	8·3	3·2	−0·8	−6·5 ,,
July	2·9	−7·6	−22·2	−31·5 ,,

Mean temperature of both hemispheres:—

	January	July	Year	Annual variation
S. hemisphere	17°·3	10°·3	13°·6	7°·0 C.
N. ,,	8·0	22·5	15·2	14·5 ,,
Whole earth	12·6	16·4	14·4	3·8 ,,

Ferrel and myself formerly determined the mean temperature of the southern hemisphere to be 15° C. (from temperatures up to 55° S. lat.). The new observations in high southern latitudes have now shown that the southern hemisphere is considerably colder than the northern, viz. by about 1°·5 C. The publication of the temperature observations of the *Discovery's* second year will be very important for this question; in my calculations I could only make use of the observations relating to the first year.

Vienna, December 30, 1904. JULIUS HANN.

Reversal of Charge from Electrical Induction Machines.

LAST week, while working with a small Voss machine, I accidentally observed, on stopping the machine, giving about two turns in the wrong direction and then re-starting the machine in the original direction, that the poles had reversed. I repeated the experiment a dozen times, and invariably the reversal occurred. The reversal was observed by examining the spark between the knobs.

I mentioned the fact to Prof. Gray, and we then tried the effect with a vacuum discharge tube connected to the knobs. While the tube was fresh the reversal occurred, but after a little time the reversal occurred but seldom. It was found, however, that if the discharge was made to pass by connecting one terminal of the tube to earth, the other terminal to one pole of the machine, while the second pole of the machine was kept insulated, then the reversal invariably occurred when the procedure mentioned was followed.

We next tried the large Wimshurst machine in the laboratory with the same results. It was noticed, however, when the induction rods were so arranged that the machine excited both ways, that the reversal did not occur.

As I do not remember to have seen the experiment mentioned before, I think it worth directing attention to, as it provides a simple way of getting the discharge to pass in whatever direction it is required.

GEORGE W. WALKER.

Physical Laboratory, The University, Glasgow.

Fishing at Night.

THERE are, as I have explained in the book referred to by "S. W." in NATURE of December 29, 1904 (p. 201), many reasons for night-fishing by our pilchard and other fishing fleets. He quotes one, however, which is quite unsatisfactory, namely, the convenience of catching the morning market. To a few ports this might apply, but as a general rule the fish-train for Billingsgate leaves the coast towns about six or seven in the evening, the fish reaching the central market by van first thing in the morning. The actual reasons for this preference for night-fishing are many. In the case of pilchards taken in drift-nets, the habits of the fish themselves furnish the explanation. In the case of trawlers, the reasons are diverse. In some cases the water is so shallow that the nets would be seen and avoided by the fish in daylight, and this, in fact, is still more the case with the drift-nets. Elsewhere, they trawl at night because they want soles, just as many Plymouth boats trawl by day because their best market is for the rougher kinds of fish. There is no night-trawling in Cornwall by reason of the local regulations, which clear the sea by night of other fishing craft in order that the drifters may work without interruption or risk. F. G. AFLALO.

14 Westover Villas, Bournemouth, Hants.

The Cost of Chemical Synthesis.

IN your review of Prof. Meldola's "Synthesis of Vital Products," your reviewer argues that though certain products, viz. alizarin and indigo, "can be synthesised so cheaply that natural products cannot compete with them in the market"; yet this is of little interest from the biochemical point of view.

May I point out that this argument is even stronger than it seems, for the *cheapness* is quite accidental, and due to the fact that the world requires coal gas, and iron.

If the syntheses above were dependent on anthracene and naphthalene obtained from coal treated strictly *ad hoc* this cheapness would disappear. R. J. FRISWELL.

43-45 Great Tower Street, London, E.C., January 2.

"Bastard" Logwood.

THE Jamaica *Bulletin* of the Department of Agriculture for November, 1904, prints a very interesting article on this subject by B. C. Gruenberg and William Gies, contributed originally to the *Bulletin* of the Torrey Botanical Club.

During the past few years the growers of logwood in Jamaica have been greatly disturbed by an apparent increase on their properties of an unmerchantable variety of the plant known as "bastard" logwood; the exportation of this wood along with real logwood has served to condemn all the logwood from the districts which have shipped it.

"Bastard" logwood differs from the genuine varieties, from the dyer's standpoint, in yielding little or no hæmatoxylin, but instead a yellowish-green pigment which is of no value, and which, when mixed with the commercial extract, reduces the characteristic tinctorial properties. Chips of the "bastard" logwood present a yellow, pale pink, white, or even chocolate coloured surface, instead of the dark red or deep purple bronze-tinted colour of the best logwood. There appears great uncertainty, even when the trees are cut down, as to whether a tree is really a "bastard" tree or not. What is known as a "bastard" tree is frequently dark enough when first cut to lead one to believe that it is a good red-wood tree, but instead of darkening with age it remains the same colour, or becomes lighter rather than darker. "Bastard" wood is not the result of disease or of any lack of vigour; the trees producing it are perfectly healthy and normal.

It is not the result of soil or climatic conditions, since bastard and normal trees are found growing side by side under absolutely identical conditions.

It is not the result of immaturity; aged trees may produce bastard wood.

These facts point to heredity as the probable cause of the trouble, that is, certain trees produce "bastard" wood because they grow from seed of a "bastard" tree; in other words, "bastard" logwood is a variety of *Haematoxylin Campechianum* that normally produces little or no hæmatoxylin. The chemical differences existing among all these logwoods are quantitatively very slight, and there are no striking structural differences among all the varieties of logwood.

There can be no doubt that "bastard" logwood is a distinct variety or subspecies of *Haematoxylin Campechianum*, notwithstanding the slight morphological difference that distinguishes it from the "red" logwood and blue logwood.

The Jamaica *Bulletin* has done good service to the colony in bringing the fact prominently before the planters that the admixture of useless wood which has been the source of unnecessary loss to them may be avoided.

S. N. C.

Intelligence of Animals.

THE instance of intelligence in a cat recorded by Mr. T. S. Patterson on p. 201 is not unusual. I have known several cats, all of them males, that were accustomed to rattle the handle or some part of the lock in order to get a door opened. F. J. ALLEN.

Cambridge.

A NEW CONTRIBUTION TO ASSYRIAN HISTORY.[1]

IN a handy little volume, to which we have much pleasure in directing the attention of our readers, Mr. L. W. King, of the British Museum, has published the cuneiform text and a translation of a very important historical Assyrian document, which has been recently exhibited in the Assyrian and Babylonian room in the British Museum. This document is a slab of limestone, about 15½ inches long and 11½ inches wide, which is inscribed with sixty-seven lines of cuneiform text, thirty-seven lines being on the obverse and thirty on the reverse. The writing is in bold, well formed characters, but it seems to have been cut somewhat hurriedly, for the mason was obliged to make nine erasures, and in two passages he has left out a sign, apparently without having detected the omission. We need not discuss the palæographical importance of the text, which is of considerable interest, and it is only necessary to state that it exhibits the style of Assyrian characters employed in monumental inscriptions in the early part of the thirteenth century before Christ.

The contents of the text, which is actually the official summary of the principal events in the reign of Tukulti-Ninib I., King of Assyria about B.C. 1275, fall readily into four divisions, which respectively record the king's name and titles, his military expeditions, the foundation of the city Kar Tukulti-Ninib, and an appeal to future rulers. The stone tablet or slab which supplies this information was either placed in a niche in the wall or laid in a box of stone or clay, and then built up in the foundation of the city Kar Tukulti-Ninib. In passing, Mr. King discusses briefly but clearly the question of foundation deposits, both in Egypt and Assyria, and shows how the ideas concerning them in the two countries agree in some respects and differ in others.

Turning now to the campaigns of Tukulti-Ninib I., we find that in the first he conquered the Kuti and the inhabitants of four other districts; in the second he became master of the land of Shubari, and ten other provinces; in the third he vanquished forty kings of the land of Na'iri; and in the fourth he defeated Bibeashu, King of Babylon, and completely subjugated the regions of Sumer and Accad. The last campaign was undoubtedly the most important of all, for with

[1] "Records of the Reign of Tukulti-Ninib I., King of Assyria, about B.C. 1275." By L. W. King, M.A., F.S.A. Pp. xvi+185, and 11 illustrations. (London: Luzac and Co., 1904.) Price 6s. net.

the fall of Babylon Tukulti-Ninib became master of all Mesopotamia. The resistance offered by the Babylonians was stubborn in the extreme, and the Assyrian king slew large numbers of them and destroyed their city wall. Tukulti-Ninib looted the city and plundered the treasuries of E-sagil, the great temple of Marduk, and he carried off to Assyria not only Bibeashu himself, but the statue of his god Marduk. No victory could have been more complete, and even at this distance of time it is impossible not to feel some sympathy with the vanquished Babylonian king when we read that he, a prisoner and bound in chains, was led, with his god Marduk, into the presence of Ashur, the great god of Assyria, as witnesses of the comprehensive manner in which Tukulti-Ninib had performed Ashur's commands.

The account of the conquest of Bibeashu and of the capture of Babylon by Tukulti-Ninib is especially important from a chronological point of view, for it establishes beyond a doubt the fact that these two kings were contemporaneous. For some time past it has been known from the "Babylonian Chronicle" that Tukulti-Ninib conquered Babylonia, but the name of the Babylonian king, although it occurs on this document, was not recognised. Both Mr. Pinches, who published a translation of this "Chronicle," and Dr. Winckler, who published a copy of the text, misread the passage in which the name occurs. The identification of Bibeashu and the correct reading of his name we owe to Mr. King, who has succeeded in establishing a new and very important synchronism in Assyrian and Babylonian history. Thus the system of chronology which made Bibeashu to live sixty or seventy years after Tukulti-Ninib I. is proved to be incorrect.

In connection with the conquest of Babylon by Tukulti-Ninib I., mention must here be made of the copy of an inscription which is found on a small clay tablet (K. 2673), now in the British Museum. This copy was made from a lapis-lazuli seal, on which the original inscription was engraved by a scribe of Sennacherib, who caused some lines to be added to commemorate his conquest of Babylon and the recovery of the seal by himself. The lapis-lazuli seal, as Mr. King tells us, was not made for Tukulti-Ninib I., as was once generally thought, but for Shagarakti-Shuriash, a Kassite king. When Tukulti-Ninib captured Babylon he found the seal there, and carried it off to Nineveh, and he had his own inscription engraved upon it without erasing that of Shagarakti-Shuriash. The seal was subsequently, in circumstances unknown to us, carried back to Babylon, where Sennacherib found it about 600 years later, and he, of course, restored it to Nineveh, and, having added his own inscription to it, had a copy of the inscription of the Kassite king, that of the King of Assyria, and of his own made on a tablet. The first to translate the copy of Tukulti-Ninib's inscription on the tablet was Mr. George Smith, but that of Shagarakti-Shuriash baffled him, and he failed to read the characters of which it was composed. Profs. Hommel, Bezold, and Schrader were likewise unable to translate it, and Mr. King has been the first to prove that, in addition to the words added to the seal by the order of Sennacherib, the copy contains two distinct inscriptions, namely, one of Shagarakti-Shuriash and one of Tukulti-Ninib I. The copy of Sennacherib's inscription is very important, for it enables us to assign the date of Tukulti-Ninib's reign provisionally to about B.C. 1275; its length cannot at present be stated with exactness.

In addition to the interesting text of Tukulti-Ninib, of which a general summary has been given above, Mr. King adds the inscriptions of Shalmaneser I. from the fragments of inscribed bowls now in the British Museum, a passage from the synchronous history, the inscriptions from the lapis-lazuli seal of Shagarakti-Shuriash, and Sennacherib's accounts of his capture of Babylon both in 702 B.C. and 689 B.C.; in fact, every bit of evidence which relates to the period of which his book treats, and is found in the cuneiform inscriptions, is appended for the assistance of the reader, with full transliterations and translations. That Mr. King has published not only a new, but important historical inscription is clear, and all who are in any way familiar with the subject will find his sober and concise observations on its contents helpful and stimulating. Messrs. Harrison's large cuneiform type has been used for printing the text, and paper and binding leave nothing to be desired. We note that the volume is the first of a series of "Studies in Eastern History" which Luzac and Co. are about to publish, and we feel that if the succeeding volumes are as valuable as the "Records of the Reign of Tukulti-Ninib I." the success of the undertaking is assured.

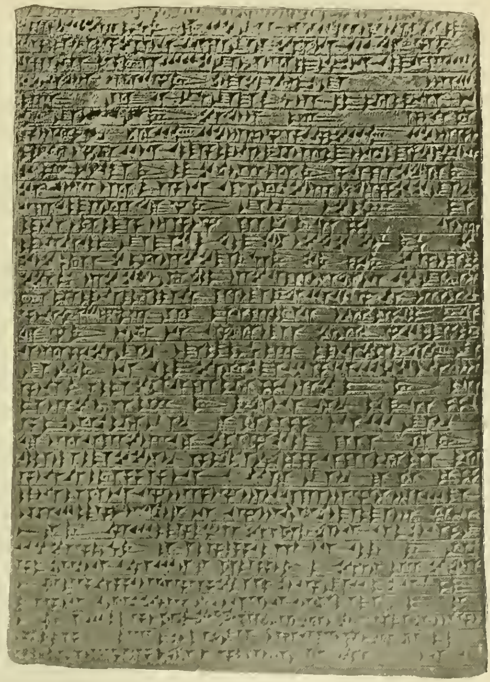

FIG. 1.—Limestone Tablet inscribed with the annals of Tukulti-Ninib I., King o Assyria. From "Records of the Reign of Tukulti-Ninib I."

SEISMOLOGY IN JAPAN.

UNDER the title of "Recent Seismological Investigations in Japan," Baron Dairoku Kikuchi, former Minister of Education, has issued for private circulation only an "address" prepared for the late exposition in St. Louis. When we look at this address, which is a quarto volume of 136 pages filled with illustrations, we feel that its author should have doffed his modesty and called it seismology as developed in Japan. To describe the work more closely, we shall not be far from the mark if we say it is an epitomised translation of a number of publications which to Europeans have hitherto been cryptogramic. It gives us not only a *résumé* of sixteen numbers of the publications of the Tokyo Earthquake Investigation Committee—called for short the E. I. C.—which have been published in a European language, and with which we are more or less familiar, but there is added an abstract of forty-seven numbers or volumes published in Chinese idiographs. Many seismologists have looked at them and wondered what they meant. The contents of these sixty-three publications have been epitomised, mixed, and systematised.

FIG. 1.—Model of a Farmer's Cottage. Showing the essential points of construction recommended by the Earthquake Investigation Committee. The chief points to be observed are diagonal bracing, the use of iron straps, and the avoidance of mortices and other cuts at joints.

After an introduction to the "recent" investigations, which tell us that the first earthquake recorded in Japan was in A.D. 416, and reference to various investigations made by Europeans in Japan, we are introduced to the system under which investigations and their results have been classified and discussed.

Under the heading "Statistical" we find data relating to the distribution of earthquakes in space and time, their relation to meteorological conditions, and various phenomena. Earthquakes which have a submarine origin are most frequent in summer, when the level of the Pacific Ocean bordering Japan is higher than in winter. Those originating on the land are most frequent in winter, at which season barometric pressure is at a maximum. Out of forty-seven destructive earthquakes which originated beneath the Pacific, twenty-three were accompanied by *tsunami* or sea waves, which probably means that on these occasions marked and sudden changes had taken place in the configuration of the sea bed.

Among the instruments which are described we notice a horizontal pendulum the bob of which is controlled by a small inverted pendulum. Although the vertical and horizontal dimensions of this apparatus are each only 1 metre, Prof. Omori tells us that a period of one minute can be obtained without difficulty. Macroseismic motion is described, and after this reference is made to microseisms or pulsations. These two classes of movement Prof. Omori finds alternate in their frequency, so that when the small movements are at a minimum the larger ones may be expected. This observation, we learn, has enabled him on several occasions to predict within ten or twelve hours the occurrence of an earthquake.

The geological investigations which have been made chiefly refer to the survey of volcanoes, which is a work outside that done by the Geological Survey.

The investigations of relationships that may exist between earthquakes and various physical phenomena which affect or are affected by strain in the earth's crust are particularly interesting. At present continuous magnetic observations are being made in Japan at five stations, from which, amongst other things, it has been observed that on several occasions magnetic

FIG. 2.—Nagoya Spinning Mill. Showing the effects of the Mino-Owari Earthquake of 1901 on a brick building and on a chimney constructed according to European practice.

needles have been disturbed before or at the time of large earthquakes. Speaking generally about these investigations, Baron Kikuchi considers that they promise to throw light upon the state of underground stress, and as one of the chief objects of the E. I. C. is to devise means to predict earthquakes which may be taken as announcements that stress has been relieved, it will be recognised that the inquiries relating to local magnetic disturbance are of a promising nature.

Other phenomena which receive attention are variations in latitude, the determination of gravity, underground temperatures, *seiches*, changes in the level of water in wells, and the elastic constants of rocks.

The last section of this interesting volume is an account of investigations which have been made with the object of reducing the disastrous effects of earthquakes to a minimum. To the practical person this is no doubt the most important branch of all seismological research. Already it has accomplished much, and after a severe shaking we have learned that in Japan new types of structures are to be seen standing amongst the ruins of older types.

We welcome Baron Kikuchi's volume, and trust that although its circulation is private it may also be wide.

THE FOUNDER OF AUSTRALIAN ANTHROPOLOGY.[1]

DR. A. W. HOWITT is our highest authority on the native tribes of Australia. Ever since the publication of "Kamilaroi and Kurnai," in 1880, he has been adding to our knowledge of the most instructive and interesting aboriginal population in the world. The present work, therefore, which summarises the data collected by him during forty years of personal intercourse with the "blackfellows," is of the greatest importance. Most of the material here incorporated was written up before 1889; a few modifications of theory and many new facts have been introduced, and some corrections made, but the broad deductions remain unaltered.

The main body of the work is preceded by a useful summary and criticism of the principal views that have been put forward as to the origin and ethnological affinities of the Tasmanian-Australian stock; Dr. Howitt rejects both the Dravidian and the Malayan hypotheses. The tribes here dealt with came into contact with the white man at a date too early, perhaps, to allow them much chance of survival; many of them are now practically extinct, and most of them are at least deorganised. The area they occupied is about one-quarter of the continent, extending on the north to near the tropic of Capricorn, and on the south bordered by the Southern and Pacific Oceans, connected by Bass Strait. This area has a wide range of climate and temperature, and the tribes themselves present almost every variety of social organisation, from that of the Dieri and central districts through the ordinary Australian types to the unique system of the Kurnai in Gippsland. Excellent maps, very numerous and complete, illustrate both the tribal areas and the range of the various social systems.

In this matter of organisation Dr. Howitt traces the gradations in a way conclusive enough to point to the probable course of evolution. In particular he reduces the problem of exogamy to the bisection of the community into two exogamous intermarrying moieties—the typical Australian system—which bisection is based, as he implies, on the prohibition of marriage between brothers and sisters. It is to be regretted that he does not fully discuss this ground of exogamy. He quotes Dr. Frazer and the present writer as having independently reached the same conclusion, and it seems that we are at last approaching unanimity as to this primal law of human social relations. He

Fig. 1.—One of the Krauatungalung Clan of the Kurnai Tribe. From Howitt's "The Native Tribes of South-East Australia."

agrees with Spencer and Gillen that the primary functions of totemism were in existence before exogamy became established, and that the relation between totemism and exogamy is secondary only. On the other hand he sees no reason to modify his original view that the bisection was a reformatory measure, instituted after a long reign of the "Undivided Commune." It is doubtless impossible to deny some purposiveness to the innovation, if innovation it was; Mr. Lang is here inclined to agree. But to engineer such bisection in a large undivided commune seems beyond the powers even of primitive man. A shorter way may be easily suggested:—the moieties practically correspond to two groups of intermarrying relatives; we may suppose, then, to begin with, two small families or fire circles, A and B, making inter-

[1] "The Native Tribes of South-East Australia" By A. W. Howitt, D Sc. Pp. xix+819; illustrations and maps. (London: Macmillan and Co., Ltd., 1904.) Price 21s. net.

marriage, and continuing to do so in successive generations. Now here we have in A and B not only the two moieties of the future tribe, but the tribe itself, in the making. The bisection *grew* out of a quasi-purposive exogamous instinct against marriage within the fire-circle.

There seems to be nothing against Aristotle's view that the tribe grew out of the family, except the curious but fashionable prejudice in favour of an organisation for primitive man of the baboon type. Mr. Atkinson in a remarkable paper has dealt the latest and one of the shrewdest blows at this prejudice, and doubtless anthropologists may in time revert to Darwin's suggestion that the earliest form of the human family resembled rather that of the unsocial anthropoids, such as the gorilla. It is noteworthy that Dr. Howitt modifies considerably the earlier conception of the Undivided Commune, and regards it as having been originally something like "what occurs when the modified Communes of the Lake Eyre tribes reunite." The battleground of the two schools is, of

FIG. 2.—The *Bret* or Dead Hand. From Howitt's "The Native Tribes of South-East Australia."

course, the so-called group-marriage of the tribes last named. In this connection the author does good service by putting together a full and revised account of the Dieri marriage-system, with its *Tippa-malku* or individual marriage, and its *Pirrauru* or group-union. We are thus enabled with some certainty of data to compare the notorious Urabunna and Arunta systems. But when Dr. Howitt says, "the germ of individual marriage may be seen in the Dieri practice; for as I shall show later on, a woman becomes a *Tippa-malku* wife before she becomes a *Pirrauru* or group-wife" (p. 179), the logic strikes one as curious. The inference should surely be that the group-marriage has been evolved from the individual system, and not the other way about.

The author still regards the practice, as amongst the Wiimbaio, of exchanging wives on the approach of a pestilence, as a survival of group-marriage, and the right of access as a survival of the *jus primae noctis* and an "expiation" for individual marriage. One had thought that these two last categories had been relegated to the limbo of outworn fictions anthropological. Noticeable details are that the action of jealousy is very strong in the Dieri tribe; that, as the Rev. O. Siebert puts it, "the practice of *Pirrauru* is worthy of praise for its strength and earnestness in regard to morality, and in the ceremonial with which it is regulated, since no practice could be less in accord with the hetairism which Lord Avebury has imagined for the Australian aborigines" (p. 186).

It is disappointing to find that no mention is made of Cunow's theory of the four and eight subclasses; it would have been instructive to see what light an unrivalled personal knowledge of the system and an acquaintance, doubtless extensive, with the dialects might have thrown on the view that these classes are age-divisions, and have primarily nothing to do with marriage-restrictions. The Kurnai with their totems which do not affect marriage, and their local, not class-divisions, present a fascinating problem, and no one knows more about the Kurnai than does Dr. Howitt. Their marriage by elopement, and the systematic use therein of priestly assistance, are remarkable customs. "It was the business of the *Bunjil-yenjin* to aid the elopement of young couples. For instance, when a young man wanted a wife, and had fixed his mind on some girl, whom he could not obtain from her parents, he must either go without her, persuade her to run off with him, or call in the aid of the *Bunjil-yenjin*. In the latter case his services were retained by presents of weapons, skin-rugs, or other articles." The *Bunjil-yenjin* then sang a magic song until he thought his magic strong enough to secure the "covering up" of the parents in a state of coma.

The author in a very interesting essay applies the facts of "maternal descent" to the Teutonic Salic Laws. Among the more important features of the book is the masterly and final settlement of the vexed questions of the native headmen, and the belief in supreme beings, like *Daramulun*. The connection between the two questions is that the headman in the sky is the analogue of the headman of the tribe on the earth. Among the Kurnai—to note another difference between many of the south-eastern tribes and those studied by Spencer and Gillen—the knowledge of *Mungan-ngaua* is confined to the initiated men, who impart it in all sincerity to their novices; the Arunta, as Spencer and Gillen inform us, take this opportunity of explaining their deity away as a being only believed in by women and children. Among further details of interest are the Kurnai custom of the Dead Hand, the performance of the Indian Rope Trick by Kurnai medicine-men, the magical influence which exists between opposite sexes, and the belief that the initiated elders infuse their own magical power into boys at confirmation.

The book is a fitting crown to Dr. Howitt's labours, and is, in effect, the most considerable and important of all studies of the Australian race.

A. ERNEST CRAWLEY.

CHANGES UPON THE MOON'S SURFACE.

UNTIL within the last few years there has been a very general opinion that the moon was a cold, dead world, or, as it has been sometimes expressed, a burned out cinder, upon which nothing ever happened. This view was apparently due to the fact that the men who wrote the text-books on astronomy were not the men who studied the moon. Among the selenographers themselves, those astronomers who made a special study of the moon, there is not one, so far as the writer is aware, who has not expressed his belief that changes of some sort, volcanic or otherwise, occasionally occur upon our satellite. Reference is made to such men as Mädler, Schmidt, Webb, Elger, and Nieson.

As the result of his lunar observations in Peru, Jamaica, and California, the writer has come to the conclusion that physical changes do occur upon the moon, and that they may be classified under three heads, those due to volcanic action, those due to the formation and melting of hoar frost, and those due to vegetation.

In the first class the classical example is that of Linné, which, according to the measurements of Lohrmann, Mädler, and Schmidt, prior to 1843, had a diameter of between four and seven miles. Its diameter at present is three-quarters of a mile. A few years ago a new crater was announced by Klein in the vicinity of Hyginus. The writer is not sufficiently familiar with this region to speak from personal experience, having but a few sketches of it, but he believes that a change there of some sort is generally admitted by selenographers.

Perhaps no area of its size upon the moon has been so thoroughly examined as the floor of Plato. It has been studied at intervals of about eleven years, first in 1870 by a committee of the British Association, next by A. S. Williams and others in 1881, and again a few years later, then by the writer at Arequipa in 1892, and again this past summer in California. In each survey about forty craterlets have been mapped, and each time some new ones have been discovered, while at the same time a few of those previously observed had ceased to be visible. The original trigonometrical survey of 1870 was based upon four craterlets located near the centre of the floor, and selected as primary stations. The easternmost of these was last seen as a crater in 1888. A trace of it was suspected in 1892, but a search for it this past summer with a 16-inch telescope working under most favourable climatic conditions failed to reveal any trace of it whatever. Even the large white area upon the floor which formerly marked its position has partially disappeared.

A map of the floor of Plato, based on a survey made in 1892, is given in the Harvard *Annals* (xxxii., plate x.). On this map the craterlet numbered 3 corresponds to craterlet number 22 of the older surveys. This craterlet was tenth in order of conspicuousness in 1870. In 1881 it had risen to the seventh place. In 1892, although carefully looked for, it could not be found, and it was entered on the map as a missing crater. A study of this region during the past summer revealed the presence of what appeared to be a large crescent-shaped bank of sand, six miles in length by from one to two miles in breadth. Its height was computed at not far from 1000 feet. It is the only object of the sort upon the floor, and the writer has so far found no previous record of its existence. When the sun is setting upon Plato it is by far the most conspicuous object within the crater walls, and was readily revealed by a 6-inch objective in Cambridge, Mass., working under very unfavourable atmospheric conditions. At sunrise it was also in part seen without difficulty under fair conditions. It seems incredible that so conspicuous an object as this should have been overlooked by all the earlier observers, had it then been visible.

I accordingly wrote to Mr. Williams, and he kindly sent me a list of forty-two observations made during the years 1879 to 1890, dealing with the particular portion of the crater floor where this formation was situated. Five of these observations were made during that portion of the lunar day when the object is now conspicuous, and when it is much more so than any of the craterlets upon the floor. Three of Mr. Williams's observations record that nothing was visible upon this portion of the floor. One observation records two small white spots, one of which he thinks may have been the original crater, and the other is possibly a neighbouring hill. Both of them as shown by this sketch were evidently very small objects as compared to the present formation. The fifth observation records a bright streak passing through the spot in question and extending for about thirty miles across the floor. Evidently if the present sandbank had been in existence at that time Mr. Williams could not have failed to have seen it and recorded it upon his sketches. Between this sand heap and the crater wall a large craterlet now exists. It is, in fact, the largest upon the floor, measuring about two miles in diameter, but owing to its peculiar position, and also to the fact that it is never bright like most of the others, it can only be seen at lunar sunset, and even then is not conspicuous.

Turning now to the second class of physical changes visible upon the moon, those due to the formation and disappearance of hoar frost, we find numberless examples scattered over the surface, but in most cases favourable atmospheric conditions and a large glass are necessary to render them clearly visible. Before dealing with any specific cases, however, it may be well to endeavour to answer some of the objections raised on theoretical grounds to the possibility of the existence of water vapour upon the moon.

The writer believes that he himself was one of the first to point out that if water vapour existed upon the lunar surface, it must sooner or later be dissipated into outer space (*Astronomy and Astrophysics*, 1892, xi., p. 781). That such a dissipation must have been going on in times past seems to be inevitable, but before reaching a conclusion as to the present existence of water vapour upon the moon, there are one or two important considerations that must be taken into account.

Vulcanologists are now generally agreed that the vast quantity of water, amounting to thousands, and sometimes to millions of tons, given off during volcanic eruptions is not rain water, nor yet water that has reached the interior from the ocean, but is water that either is being expelled for the first time from the earth's interior or is being expelled by heat from the rocky materials of the earth's crust with which it was previously united by the forces of crystallisation. If the earth is still discharging such large quantities of water from its interior there is no reason why the moon should not be doing the same thing. It is true the moon is smaller, but then also it began life later than the earth. The reason why the earth has oceans is that it is large enough and massive enough to retain the expelled water in that form. The moon, on the other hand, is too small to do so, and the water therefore appears scattered widely over its surface in the form of hoar frost before being dissipated into outer space.

Another objection to the theory of the existence of water vapour that has been raised is the statement that there is no evidence of erosion upon the moon. This statement is clearly a mistake, but the eroded valleys are small, and it requires good atmospheric conditions to detect them. Fairly conspicuous examples, however, exist upon the central peaks of Theophilus and Eratosthenes. Although the valleys are small, it is hard to understand how the comparatively minute amount of hoar frost at present found in these regions could have produced so great an effect, and we must conclude that formerly there must have been a great deal more of it. The only strong evidence that water in the liquid state ever existed upon the surface of the moon lies in the dry river-beds. The best example of these lies on the eastern slopes of Mt. Hadley, at the base of the Apennines. Another river-bed, partially fragmentary, discovered this past summer lies sixty miles due south of Conon. Although difficult objects, the former has been seen in Cambridge, Mass. A sketch of it is given in the Harvard *Annals*, xxxii., plate vii.

Turning now from theory to fact, one of the clearest evidences of hoar frost upon the moon is found in connection with the pair of small craters known as Messier and Messier *A*. Sometimes one of these craters is the larger and sometimes the other. Sometimes they are triangular and sometimes elliptical in shape. When elliptical their major axes are sometimes parallel and sometimes nearly perpendicular to one another. When the sun first rises on them they are of about the same brilliancy as the *mare* upon which they are situated, but three days later they both suddenly turn white, and remain so until the end of the lunation. When first seen the white areas are comparatively large, especially that surrounding Messier itself, but it gradually diminishes in size under the sun's rays. By the eighth day little is left outside the crater itself, while at the end of the lunation only the bottoms and interior western walls remain brilliant. The general character of these changes can be followed even with a 4-inch telescope working under only moderate atmospheric conditions. Photographs of these craters showing their varying shapes and sizes will be found in the Harvard *Annals* (li., p. 28). Those to whom the *Annals* are not accessible will find these photographs and most of the other illustrations referred to in this article in my book "The Moon."

FIG. 1.—1901, July 26, 2·6 days, 43°.

FIG. 2.—1901, March 31, 3·5 days, 54°.

The white area surrounding Linné also shows evidence of change in size during the lunation. Soon after sunrise it measures 4″ in diameter, at noon 2″, and at sunset 3″·5. The change is evidently analogous to that shown by the polar caps of the earth and Mars, lunar noon in this case corresponding to midsummer for the planets, and sunrise and sunset to spring and autumn.

In the crater Eratosthenes there is a brilliant white area on the summit of the central mountain range. When the sun first rises on it it measures five miles in length by two in breadth. It soon, however, begins to dwindle, and two and a half days later all is gone save two little spots, each about a mile in diameter. They reach their minimum size five days after sunrise, when the smaller is about half a mile in diameter. They then begin to increase, the northern one attaining a length of five miles shortly before sunset. If these markings are due to white quartz, or some similar rock, it is difficult to account for their change in size.

The third class of physical changes with which we shall deal the writer believes to be due to the presence of vegetation. Changes of this class are more conspicuous than those of either of the other two, and if the explanation of vegetation is admitted, both the other explanations almost necessarily follow. It is therefore important to study these changes with the greatest care.

Before describing the facts, it may be well first to deal with the principal objection that has been made to the suggested explanation, namely, the lack of water on the moon in the liquid form. The reason that we believe liquid water to be lacking is that it is known that as we reduce the atmospheric pressure the boiling point of water is gradually lowered, until when we reach a pressure of 4·6 millimetres the boiling and freezing points coincide. Below this pressure ice changes at once into the gaseous form without passing through the liquid state. While, therefore, there can be no free water upon the surface of the moon, there is yet nothing to prevent it from occurring beneath the surface of the ground, retained by the capillary action of the soil. This action is so strong that, as has recently been shown by Cameron (*Science*, 1903, xviii., p. 758), it is capable of extracting water from a membrane against a calculated osmotic pressure of 36 atmospheres.

Since on the earth plants can live on moisture which they have in turn extracted from such a soil, there seems to be no difficulty in understanding how they could live on the moon, in a soil which could thus retain considerable moisture in spite of the low atmospheric pressure. Although in a state of nature, even in desert regions, all plants are occasionally exposed to water in the form of rain or dew, yet under artificial conditions we know that even such highly organised structures as house plants can flourish on water that in the liquid form reaches them only by capillary absorption from the soil.

Turning now to our observations, as early as 1837 it was pointed out by Mädler that there were two small spots in the crater Alphonsus which always became very dark at about the time of full moon, while earlier and later they were much lighter. A similar observation had been made by him regarding a region just to the south of the Mare Crisium. Little else was known regarding the matter until 1892. Since that date spots presenting these characteristics have been found all over the moon's surface, except in the vicinity of the poles. The most northern spot known is in latitude +55°, the most southern in latitude −60°. It is possible that some of the *maria,* notably Tranquillitatis, and part of the borders of Serenitatis and Vaporum, are covered with these spots, but in any case they do not cover more than 5 per cent. of the moon's visible surface, and possibly it is very much less.

It should be mentioned here that the western spot shown by Mädler in Alphonsus is now comparatively inconspicuous, but that north and south of it lie two others, which with Mädler's eastern spot form a very striking isosceles triangle at full moon.

We will now direct our attention to the crater Eratosthenes, which has been more carefully studied than any other region presenting these phenomena, and which exhibits the changes on a sufficiently large scale to enable us to make use of photography. The four photographs here shown were taken in the Island of Jamaica in 1901, and are enlargements from some of the negatives used in printing the Harvard "Atlas of the Moon." Beneath each figure is given the date on which it was taken, the number of terrestrial days that had elapsed since the sun rose upon it, and the colongitude of the sun, taken from Crommelin's ephemeris. The photographs are all on the same scale of 1/2,000,000, or about thirty-two miles to the inch. Upon this scale the moon would be 68.5 inches in diameter.

When the sun rises upon this formation the whole of the floor is at first of a light grey tint, whatever detail there is being but faintly marked. This tint is maintained by the south-western quadrant of the floor throughout the lunation. About three days after sunrise a dark spot appears on the north-western slopes of the central mountain range. The regions at its immediate base darken at about the same time, and an irregularly mottled dark sector appears as the result. On the fourth day the centre of the sector lightens, leaving two canal-like forms radiating from the central peaks. Although in a small telescope these canals appear straight, yet when well seen with a large glass they are found to present considerable irregularity of structure. On the eleventh day the southern one fades out, and just before sunset the northern one also disappears.

A faint X-shaped marking distinguishes the north-eastern quadrant of the floor at sunrise. The centre rapidly darkens as the sun rises upon it, and soon becomes intensely black. Three branches of the X successively fade away, leaving only the south-eastern one, which on the seventh day becomes very pronounced. A new branch or canal forms by gradual darkening on the east, while the canal on the north-east, which had disappeared, forms anew by a progressive growth downwards from the crater rim. This growth progresses for five days at a nearly uniform rate of 250 feet per hour, or about 4 feet a minute.

FIG. 3.—1901, April 2, 5·6 days, 79°.

FIG. 4.—1901, March 5, 7·0 days, 97°.

The south-eastern quadrant, while very light at first, soon surpasses all the others in darkness. The dark area on the outer wall, which in the first figure is undoubtedly in part due to shadow, must very soon be partly due also to something else, for it still shows upon the third figure, which was taken but 0.8 day before full moon, when shadows are geometrically impossible. The last figure was taken 0.8 day after full moon, and the darker portion of the spot is seen to have rapidly increased in size and to have grown downwards with considerable velocity towards the central peaks.

Since this dark area cannot be shadow, our only alternative seems to be that we have here a real change in the character and brightness of the lunar surface. Since we do not know of any mineral which gradually darkens as the sun shines upon it, and later fades out again, our only alternative seems to be to call in the aid of vegetation. At all events nobody has ever cared to propose any other explanation of the facts, so far as the writer is aware.

As the lunation progresses the western portion of this dark area slowly fades out, while the eastern is absorbed in the gathering shadows of the lunar night.

In various parts of the crater, but especially in the south-eastern and northern portions, numerous small canals and lakes present themselves. These markings are practically identical in appearance with those seen upon the planet Mars. They are too small to be well shown in the photographs, and seem to be of much more regular structure than the larger markings, which are here also called canals. It is possible that this difference is due merely to the fact that the larger markings are better seen. A more detailed account of the phenomena here described will be found in the Harvard *Annals* (liii.).

WILLIAM H. PICKERING.

SIR LOWTHIAN BELL, BART., F.R.S.

SIR Lowthian Bell, whose death at the age of eighty-eight has already been announced, studied physical science at the University of Edinburgh and the Sorbonne at Paris, and at the age of twenty-four entered the Walker ironworks, near Newcastle. There, we learn from the obituary notice in the *Times*, he remained until 1850, when he became connected with the chemical works at Washington, in North Durham. He greatly enlarged the works and laid down extensive plant for the manufacture of an oxychloride of lead introduced as a substitute for white lead by his father-in-law, Mr. H. L. Pattinson, F.R.S., with whom he was associated in the business at Washington. There, too, was introduced in 1860 almost the first plant in England for the manufacture of aluminium by the Deville sodium process.

Soon after the discovery of the main bed of Cleveland ironstone near Middlesbrough, Sir Lowthian Bell, in conjunction with his brothers, Thomas and John, started ironworks in 1852 at Port Clarence, on the north bank of the Tees. The Clarence works was one of the earliest and is now one of the largest iron-smelting works on the Tees. About half a century ago the Tees then flooded ground where iron furnaces now stand. Sir Lowthian Bell and his brothers acquired their own ironstone mines, collieries, and limestone quarries, while they were always prompt to adopt any improvement in process or apparatus that seemed likely to be advantageous.

In the development of the Cleveland iron industry the Bell firm played a very important part, and what has been the extent of that development may be judged from the fact that whereas the district in 1850 produced less than 25,000 tons of pig iron, at the present time Middlesbrough produces about one-quarter of the total output of this country. The firm was active in prosecuting those technical studies by which processes have been devised enabling Cleveland ores to compete as raw material for the production of iron and steel with others possessing greater natural advantages. In regard to steel, the great trouble with those ores is the high percentage of phosphorus (1.8 to 2.0 per cent.) contained in the cast iron which they yield; yet Middlesbrough, largely as a result of experiments carried on under Sir Lowthian Bell's direction, at a cost, it is said, of between 40,000*l.* and 50,000*l.*, produces steel rails in which this percentage is reduced to 0.07 or less.

When the British Association met at Newcastle in 1863, Sir Lowthian Bell contributed a paper on the manufacture of iron in connection with the Northumberland and Durham coalfields. In 1870 he wrote a paper on the sanitary condition of Newcastle, and more recently he compiled an elaborate account of the iron trade of the United Kingdom, compared with that of the other chief iron-making countries. On the chemistry of iron he was a high authority. The establishment of a chemical laboratory in connection with the Clarence works shows how fully he realised the importance of the scientific study of industrial processes, and his own researches on the chemistry of iron and steel have become classic. Many of these appeared first in the form of papers read before the Iron and Steel Institute, and a number of them were subsequently collected and published in a volume entitled "The Chemical Phenomena of Iron Smelting." Sir Lowthian was also the author of a book on the "Principles of the Manufacture of Iron and Steel," as well as of many papers contributed to other scientific societies.

He was one of the original founders, in 1869, of the Iron and Steel Institute, and filled the office of president from 1873 to 1875, and in 1874 became the first recipient of the gold medal instituted by Sir Henry Bessemer the year before. He was a member of the Institution of Civil Engineers and of the Chemical Society, and a past president of the Institution of Mechanical Engineers. In 1874 he was elected a fellow of the Royal Society. In recognition of his services as juror of the international exhibitions at Philadelphia in 1876, and at Paris in 1878, he was elected an honorary member of the American Philosophical Institution, and an Officer of the Legion of Honour. He was elected on the council of the Society of Arts in 1876, and in 1895 was awarded the Albert medal of the society "in recognition of the services he has rendered to arts, manufactures, and commerce by his metallurgical researches, and the resulting development of the iron and steel industries." The honour of a baronetcy was conferred on him in 1885, and in 1893 he received the degree of LL.D. from Edinburgh University.

NOTES.

A SELECTION from the specimens recently presented to the British (Natural History) Museum by His Majesty the King of Portugal has recently been placed on public exhibition in the north hall.

THE annual meetings of the American Association for the Advancement of Science and of the American Physical Society were held in Philadelphia, Pa., in "Convocation Week," from December 26, 1904, to January 2.

THE International Botanical Congress will meet at Vienna in June next, when a discussion will take place on the important question of uniformity of nomenclature, regarded both from a scientific point of view and in connection with international reports.

UNDER the title "Lichtenstein Prize," the Montpellier Academy of Sciences offers a prize for the best essay dealing with any question of zoology not referring to man. The last day is November 1, 1905. Printed memoirs more than three years old, or papers which have gained previous prizes, are excluded.

THE third International Congress of Philosophy will be held at Heidelberg in 1908. Among the English speaking members of the organising commission the name has been added of Prof. Strong, of Columbia University. A detailed account of the congress held this year at Geneva is given in a special number of the *Revue de Métaphysique et de Morale* for November, 1904.

The Postmaster-General has made provisional arrangements with the Marconi International Marine Communication Company for the acceptance and prepayment at telegraph offices in the United Kingdom of telegrams for transmission from wireless stations on the coast to ships at sea. The arrangement came into operation on January 1.

Prof. R. S. Woodward, dean of the faculty of pure science, Columbia University, has been elected president of the Carnegie Institution. Prof. C. A. Young, who has held the chair of astronomy at Princeton University since 1877, will retire at the close of the present academic year.

Captain R. F. Scott, leader of the National Antarctic Expedition, has been awarded a gold medal by the Royal Danish Geographical Society.

We learn through *Science* that Mr. Andrew Carnegie has given 108,000*l.* for the establishment in Boston of an institute similar to Cooper Institute, which is to be added to a fund of 54,000*l.*, which has grown from 1000*l.* left one hundred years ago by Benjamin Franklin.

The twenty-second annual dinner of the old students of the Royal School of Mines will be held on Thursday, February 9. The chair will be taken by Mr. T. A. Rickard. Applications for tickets should be made to Mr. D. A. Louis, 77 Shirland Gardens, London, W.

A correspondent of the *Times* states that Frédéric Mistral, the Provençal poet recently awarded 2000*l.* as half share of the Nobel prize for literature, intends to devote this sum to the development and adequate installation of the ethnographical museum—Le Musée Arletan—founded by him some years ago at Arles. For this purpose the municipal authorities agree to make over an old palace, now used as a college, the restoration and adaptation of which will cost 10,000*l.* An American resident at Avignon, Mr. Edward Leon, has offered 2000*l.* as a subscription, and will arrange for five lectures in the United States to help on the fund thus inaugurated.

The prizes for the year 1904 have been awarded, we learn from *La Nature*, by the Paris Society for the Encouragement of National Industry. The grand prix of the Marquis d'Argenteuil has been awarded to MM. Auguste and Louis Lumière for their discoveries in photography. The "chemical arts" gold medal has been awarded to M. Héroult for his works on electrometallurgy, and the "constructions and fine arts" medal to M. Arnodin. Gold medals have also been awarded to M. Boulanger for his micrographic work, to M. Grey for a rolling-mill, to M. Guillet for his work in metallurgy, and to M. Schwœrer for his system of superheated steam.

An optical convention will be held, under the presidency of Dr. R. T. Glazebrook, F.R.S., at a date toward the end of May next, at the Northampton Institute, Clerkenwell, London, E.C. The object of the convention is to bring into cooperation men interested in optical matters. A subcommittee has been appointed to consider the subjects of papers on optical questions which should be brought before the convention, and suggestions as to subjects for discussion will be welcomed. It has been decided to organise an exhibition, of a scientific character, of instruments manufactured in this country, with a view to show the progress recently made and to stimulate further efforts. In order that interest in the convention may be not confined to London workers in optics, a subcommittee is being formed to secure the assistance of local representatives. The honorary secretary of the convention is Mr. F. J. Selby, Elm Lodge, Teddington.

Writing on the subject of "Greek at Oxford," a correspondent of the *Times* again expressed the common belief that "Darwin regretted not having learnt Greek." A letter from Mr. Francis Darwin in the *Times* of December 29, 1904, shows that the statement is altogether opposed to Darwin's views. Darwin says of his education at Shrewsbury School:—"Nothing could have been worse for the development of my mind than Dr. Butler's school, as it was strictly classical, nothing else being taught, except a little ancient geography and history" ("Life and Letters," i., 31). He was, in fact, a victim of that "premature specialisation" which is generally referred to in a somewhat one-sided spirit, and from which the public schoolboy is not yet freed. Mr. Darwin adds:—"If the name of Charles Darwin is to be brought into this controversy it must not be used for compulsory Greek, but against it. In 1867 he wrote to Farrar, 'I am one of the root and branch men, and would leave classics to be learnt by those alone who have sufficient zeal and the high taste requisite for their appreciation' ('More Letters of Charles Darwin,' ii., 441)."

The Aëro Club of Paris has asked permission from the municipal authorities to make experiments in aviation in the Galerie des Machines next February. Under the head of aviation, among other experiments will be some in mechanical aërial direction. The building is so large that the results will be almost the same as would be obtained in the open air, with the difference that the disturbing effect of wind need not be feared.

St. Catherine's Lighthouse, situated on the south coast of the Isle of Wight, has just been provided with a new light of 15,000,000 candle-power, as against 3,000,000 obtained with the old apparatus. Seen from the land there are three distinct beams of light revolving in view, one just on the point of disappearing behind the "blank" or shield, while the others pass rapidly over the waters of the English Channel. The new lens is by Messrs. Chance Brothers, Birmingham; and the whole of the revolving part floats in a trough of mercury, instead of being on rollers, which has hitherto been usual, about 816 lb. of mercury being required to float it. Hitherto chain has been used in lighthouses for suspending the weights, but in this case a fine steel cable, about $\frac{1}{4}$ inch in diameter, has been adopted.

The annual report of the Russian Geographical Society gives the full list of medals awarded by the society at its annual sitting. The following medals were awarded:—the Constantine medal to the veteran geologist Friedrich Schmidt, the Count Lüthe medal to Sir John Murray, and the Semenoff gold medal to Prof. N. I. Kuznetsoff. Five small silver medals were awarded, to V. A. Vlasoff, Th. N. Panaeff, and W. M. Nedzwiedski for meteorological work, to M. M. Siazoff for the part he took in the expedition of Grum-Grzimailo, and to E. L. Byakoff for the support he gave to the same expedition.

According to information communicated by the Meteorological Observatory of Irkutsk, the earthquake which took place in Transbaikalia on September 28 last covered an area of about 4500 square miles, representing an imperfect oval elongated from N.W. to S.E., its furthest points being Troitzkosavsk in the south-east and Balagansk in the north-west. The centre of this earthquake, which was undoubtedly of tectonic origin, was located in the neighbourhood of the station Pereyemnaya, on the south-east shore of Lake Baikal. No less than three earthquakes have had their origin at this centre during the past three years.

In the *Zoologist* for December Mr. A. H. Patterson records a number of more or less remarkable specimens of fishes captured off Great Yarmouth during the year. Several examples of flat-fish with the two sides of the same colour are recorded, a plaice of this type being further remarkable from the fact that the dorsal and anal fins united beneath the tail. In a second article Mr. G. Dalgleish directs attention to the recent migration into India of birds native of eastern Central Asia—notably the mandarin-duck.

The October issue of the *Proceedings* of the Philadelphia Academy contains two papers devoted to the histology and early development of invertebrates. In the first Dr. J. A. Nelson discusses that puzzling creature Dinophilus, referred by some authorities to the turbellarians, and by others to the annelids. If the "trochophore" be regarded as a larval form common at least to all annelids, the development of Dinophilus cannot be considered as primitive. Rather it may be looked upon as an annelid the larval stage of which has become one towards which development tends, and which has consequently become specially modified. In the second of the two papers Mr. T. H. Montgomery gives the results of his investigations into the development and structure of the larva of the parasitic thread-worm Paragordius.

The December issue (vol. vii., No. 2) of the *Journal* of the Marine Biological Association of the United Kingdom contains a full list of the marine invertebrate fauna of Plymouth, compiled from the records of the association. An excellent map of the Plymouth district accompanies the list, together with notes on the various dredging-grounds and their characteristic zoological products. Some of these grounds, which formerly yielded rich harvests, have been more or less completely spoiled by being made the receptacle for rubbish and refuse from the neighbouring towns. Attention is directed to the large number of species of marine organisms attacking the limestone of which the Plymouth breakwater is constructed. To such an extent, indeed, is the stone eaten into by these creatures that considerable damage is done to the structure, and constant repairs are rendered necessary.

We have received copies of three papers by Dr. J. E. Duerden dealing with the morphology, development, and relations of corals and sea-anemones. Their titles are respectively "The Antiquity of the Zoanthid Actinians" (*Rep. Michigan Acc.*, No. 6, pp. 195–8), "Recent Results on the Morphology and Development of Coral-Polyps" (*Smithson. Miscell. Contrib.*, vol. xlvii. pp. 93–101), and "The Morphology of the Madreporaria," No. 5 (*Biol. Bull.*, vol. vii., No. 2). The main thesis of the first two papers is that, since ordinary hexamerous coral-polyps differ from sea-anemones to a great extent only by the absence of a skeleton, and the presence of such skeleton is a secondary development, the second group must be older than the first. From this basis it is argued that the tropical polyps known as zoanthids, which differ in regard to the number of their septa from the hexamerous group, bear a similar relationship to the Palæozoic tetramerous "rugose" corals, and are consequently of still more ancient origin. In the author's own words, "The Rugosa and Zoantheæ undoubtedly constitute a common group of skeleton-forming and skeletonless polyps, just as do the modern Madreporaria and ordinary hexamerous Actiniaria."

Three papers by Dr. R. Broom on the fossil reptiles of South Africa and their relationship to mammals appear in vol. xxv., part iii., of the *Transactions* of the South African Philosophical Society. In the most important of these the author discusses the origin of the mammalian carpus and tarsus. After a brief review of the nature of these two portions of the skeleton in other groups, Dr. Broom points out that in dicynodonts and theriodonts the mammalian approximation is most marked. To quote his own words, "In these latter we find more or less approximation to the mammalian type, but if we take into consideration the extreme mammalian specialisation—the presence of a large tibiale and fibulare, with a centrale which is not in the centre but comes between the tibiale and the first tarsale, then we are driven to the conclusion that the mammalian ancestor must have been a dicynodont, a theriodont, or a form belonging to a closely allied order. From the examination of the skull we have good reason to believe that the ancestor was a theriodont, and the evidence of the tarsus fully confirms that drawn from the skull and other parts of the skeleton; and the carpus, while it does not add any very strong evidence, certainly does not afford any evidence that is not in harmony with this conclusion."

A remarkable instance of what the author thinks may be true mimicry among plants is described by Dr. R. Marloth in the *Transactions* of the South African Philosophical Society, vol. xv. p. 97. Years ago, it appears that the traveller Burchell picked up on stony ground an object he mistook for a pebble, but which on exaimnation proved to be a plant of the genus Mesembrianthemum. Both in colour and in form this plant, previously named *M. truncatum*, presented a remarkable resemblance to the stones among which it grew. A second species, *M. bolusi*, growing on the hills around the Karru, generally produces two leaves about the size of a duck's egg, which have a surface like weathered stone, and a brownish grey colour tinged with green. In this state it closely resembles the surrounding stone, although for a short time its bright yellow flowers render it conspicuous enough. *M. nobile* is very similar. A fourth species of the same genus, together with *Anacampseros papyracea* (in which the leaves are covered with white papery stipules), resembles the quartz pebbles among which it grows. In the author's opinion, *M. bolusi*, *M. nobile*, and perhaps *M. truncatum* (which, unlike some of the other plants mentioned, do not change their characters under cultivation), may afford instances of true mimicry, or "homoplasy."

We have received a report on forestry in the Transvaal by Mr. D. E. Hutchins, conservator of forests, Cape Town. The report deals with the immediate necessity for the afforestation of those large tracts of land in the colony which are unsuitable for agriculture. The importance of forestry in the Transvaal cannot be over-estimated, as a perusal of this report will show. After a tour of inspection, Mr. Hutchins has been able to indicate in his report the organisation and equipment necessary for the scheme. A list of trees suitable for cultivation in the Transvaal is given, together with short notes on their sylvicultural characteristics and uses. It may be interesting to mention that the common ash, *Fraxinus excelsior*, does not thrive in the Transvaal.

Messrs. F. Darton and Co., St. John Street, E.C., have submitted to us a very handy and portable little instrument, the "Piesmic" barometer, invented by Mr. A. S. Davis. It consists of a glass tube about seven inches long, bent in the form of a syphon, the longer arm being of strong capillary tubing of one-tenth inch bore, the shorter arm being of thin quill tubing. The end of the longer tube opens into a small cast iron cistern, containing mercury;

when the instrument is out of action the tube lies horizontally, and the mercury lies on one side of the cistern, leaving the open end of the tube exposed to the air. When the tube is brought into a vertical position the mercury flows over and closes the mouth of the tube, and then flows down the tube to a greater or less depth, dependent upon the atmospheric pressure at the time. We have made a number of comparisons with a mercurial standard barometer, and find that its indications are correct to within about 0·12 inch. The readings, to the nearest tenth of an inch, or, by interpolation, to the hundredth of an inch, can be rapidly obtained. As a weather-glass it appears to be very useful, and even less likely to get out of order than an aneroid, but it would not be suitable for accurate scientific observations like an ordinary mercurial barometer. It has the advantage of being less costly, small in size, and easier of transport than an ordinary barometer.

WE have received from Messrs. C. F. Adolph and Co., of 14 Farringdon Road, E.C., their new price list of selenium cells and apparatus. This firm has introduced a new type of selenium cell which possesses the advantage over the old form of cell that it is exposed to the light on two surfaces with a consequent increase in the sensibility of fully 75 per cent. Complete sets of apparatus for demonstrating the sensitiveness of selenium to light and the transmission of sound by means of light are also described and illustrated in the list.

IN No. 21 of the *Physikalische Zeitschrift* Mr. Josef Rosenthal describes a number of improvements which he has introduced in the construction of mercury air-pumps of the Sprengel type. These pumps usually suffer from the disadvantage that the glass tube in which the mercury falls is liable to sudden fracture after the pump has been in action during a few weeks. The fracture appears to be due to the friction of the mercury on the glass producing an electrical charge which, by influencing the moist air without, converts the glass wall of the tube into the insulator of a condenser. The possibility of a discharge through the glass is eliminated by surrounding the dropping tube with a larger glass tube filled with oil, which acts as an efficient insulator. It is stated that a tube protected in this way lasted five months, although in daily use.

THE *American Journal of Science* for November, 1904, contains an investigation by Mr. Bertram B. Boltwood of the radio-activity of natural waters which is of particular interest because of an attempt that is made to explain its origin. It is shown that neither hot nor cold water dissolves any appreciable quantity of radium, as such, from a mass of finely powdered uranium minerals consisting principally of uranophane, although a brief contact with these minerals is sufficient to impart to water enough of the radium emanation to produce a very marked radio-activity. Water can also acquire a measurable quantity of the radium emanation by simple contact with gaseous mixtures which contain it. It is considered that an extremely minute trace of uranium minerals in the rocks and soils through which a water percolates would be sufficient to impart to it a measurable radio-activity. But waters such as those of Bath and Baden Baden, which contain true dissolved radium, must owe the presence of the latter to a special decomposition taking place under the influence of high temperature and great pressure.

MESSRS. LONGMANS AND CO. have in the press a translation, by Mr. J. Garcin, of M. Blondlot's papers on *n*-rays communicated to the Paris Academy of Sciences. The volume will contain additional notes and instructions for the construction of phosphorescent screens.

MESSRS. MACMILLAN AND CO., LTD., have published an edition of "An Elementary Course of Mathematics," by Messrs. H. S. Hall and F. H. Stevens, in which parts i. and ii. of the authors' "School Geometry" have been substituted for the parts of Euclid's elements contained in previous editions.

MESSRS. F. VIEWEG AND SON, Brunswick, have issued the fifth edition of Wiedemann and Ebert's comprehensive work on practical physics—"Physikalisches Praktikum." The book contains a good systematic course of practical work in physics, the experiments being well arranged and clearly illustrated.

THE issue of the *Antiquary* for January commences the first volume of a new and enlarged series. The magazine, which is devoted to the study of the past, has been enlarged by the addition of eight pages. A new section, called "At the Sign of the Owl," has been introduced, and consists of about two pages of notes concerning books of archæological interest. A good selection of articles is promised for the present year.

THERE has now been published at the Patent Office a subject list of works on the fine and graphic arts (including photography), and art industries, in the library of the Patent Office. The list consists of two parts—a general alphabet of subject headings, with entries in chronological order of the works arranged under these headings, and a key, or summary, to these headings shown in class order. The catalogue includes some 2916 works, representing 5373 volumes.

OUR ASTRONOMICAL COLUMN.

ANOTHER NEW COMET (1904 *e*).—A telegram from the Kiel Centralstelle announces the discovery of a new comet by M. Borrelly at Marseilles on December 29, 1904. The position of the object at 9h. 7m. (Marseilles M.T.) was

R.A. = 1h. 13m. 40s., dec. = $-10°\ 0'$,

and its apparent daily movement was found to be +1·6m. in R.A. and $-54'$ in declination. A nucleus was seen.

A further telegram states that the comet was observed by Dr. Cohn at Königsberg on December 31 at 6h. 22·2m. (Königsberg M.T.), when its position was as follows:—

R.A. = 1h. 15m. 56·53s., dec. = $-8°\ 29'\ 59''$.

The position of the comet is near to that of θ Ceti.

COMET 1904 *d* (GIACOBINI).—Further observations of comet 1904 *d* are published in No. 3986 of the *Astronomische Nachrichten*, together with Herr Ebell's elements and ephemeris. A photograph taken at the Konigstuhl Observatory, Heidelberg, on December 19d. 17h. 37·3m. (Konigstuhl M.T.) showed a short tail and a complex nucleus, whilst the position of the object for 1904·0 was

R.A. (app.) = 16h. 19m. 38·8s., dec. (app.) = $+28°\ 23'\ 9''$.

OBSERVATIONS OF LEONIDS AT HARVARD, 1904.—Several observers at Harvard kept the eastern part of the sky under observation for meteors from 12h. to 17h. on the night of November 14–15. As a rule, four observers kept watch, whilst a fifth wrote down their results, and between them they saw 275 meteors, of which 183 were Leonids.

The following table shows the horary rate, for a single observer, at intervals of twenty minutes:—

Nov. 14–15 h. m.	Rate	Nov. 14–15 h. m.	Rate	Nov. 14–15 h. m.	Rate
14 40	40	15 40	28	16 40	24
15 0	36	16 0	26	17 0	28
15 20	29	16 20	25		

Of the total number 35 were of the first magnitude or brighter, but none exceeded magnitude $-2·0$. At the moment of explosion the heads were generally blue or white, but in two cases, at least, the colour was clearly red or orange, probably indicating, according to Prof. W. H. Pickering, a different chemical constitution.

The radiant appeared to cover a considerable area, about 8° in diameter, and seemed to be double, the two principal centres being situated at R.A. = 9h. 56m., dec. = +24°, and at R.A. = 9h. 40m., dec. = +26°.

Although elaborate preparations were made for securing photographs, only two trails appeared on the resulting negatives. One, due to a Leonid, commenced at R.A. = 9h. 17·2m., dec. = +28° 57′, and ended at R.A. = 9h. 8·8m., dec. = +29° 52′, a more careful measure showing that the meteor passed through a point having the position R.A. = 9h. 57·0m., dec. = +24° 14′ (1855). The other trail extended from R.A. = 4h. 52·5m., dec. = +0° 52′, to R.A. = 5h. 10·7m., dec. = −4° 39′ (1855), and was, therefore, not due to a Leonid (Harvard College Observatory *Circular*, No. 89).

LIGHT-CURVE OF δ CEPHEI.—Employing the method used by Dr. W. J. S. Lockyer in his discussion of the observations of η Aquilæ (Göttingen, 1897), Dr. B. Meyerman has reduced the observations of δ Cephei.

As a result he obtained the following as the formula for determining the epochs of maxima:—

1840 September 26·3588 + 5·366404 E. (Bonn).

A comparison of the phases determined from this formula with observed values gives small differences which compare favourably with those previously obtained by other observers. The new observations are consistent with an invariable period (*Astronomische Nachrichten*, No. 3985).

STRUCTURE OF THE THIRD CYANOGEN BAND.—Some interesting results concerning the structure of the third cyanogen band have been obtained by Herr Franz Jungbluth at Bonn. By employing the third order of a Rowland grating having 630 lines to the millimetre (*i.e.* about 16,000 to the inch) and a focal length of 6·6 metres (about 21·6 feet), he obtained a greater dispersion than has hitherto been used for this purpose.

His results, stated briefly, are as follow:—(1) the third cyanogen band consists of double lines; (2) the maximum intervals between successive lines in the four strongest series form an arithmetical progression; (3) the view of King, that the inverted "heads" are to be regarded as "tails" of the bands connected with the known "heads," possesses a high degree of probability; (4) the connection of groups of "heads" and "tails" is such that the *first* "head" and the *last* "tail" belong to the same series, the second "head" to the penultimate "tail," and so on; (5) the hypothesis of Thiele, that the intervals between successive lines in a band increase only to a certain point and then *decrease* until the series ends in a tail, *appears to be correct*; (6) the lengths of the successive series form an arithmetical progression (*Astrophysical Journal*, vol. xx., No. 4).

NEW REFRACTION TABLES.—A set of new refraction tables whereby one may find the refraction correction to 0·01 of a second of arc are given in No. 3983 of the *Astronomische Nachrichten* by Dr. L. de Ball, of Vienna. The tables are adaptable to a range of atmospheric temperatures and pressures and of zenith distances. Knowing the temperature and pressure at the place of observation, one finds the logarithm of the actual density of the atmosphere from table i., and with this and the known zenith distance finds the refraction correction to the second decimal of a second of arc from table ii.

THE "ANNUAIRE" DU BUREAU DES LONGITUDES.—Continuing the scheme inaugurated in last year's "Annuaire" for the alternation of various subjects in the successive issues, the volume for this year contains, in addition to the astronomical data, tables regarding statistics, geography, &c., to the exclusion of data for chemistry and physics.

The astronomical section contains, among many other things, the following useful information: A table for calculating the altitude from readings of the barometer, a complete table of the elements of variable stars of known periods, tables of stellar parallaxes, double stars and proper motions, and an article of stellar spectroscopy by M. Gramont, whilst the sun-dial, solar physics, the table of minor planets, &c., are reserved for the issue of 1906.

ECLIPSE RESULTS AND PROBLEMS.—In the December (1904) number of the *Bulletin de la Société astronomique de France* M. le Comte de la Baume Pluvinel reviews the results obtained during the total solar eclipses of the last thirty years, and in connection with the study of each eclipse phenomenon he outlines the problems which yet require further elucidation. To those interested in eclipse work the article will be found to be a useful *résumé*.

BIBLIOGRAPHY OF CONTEMPORARY ASTRONOMICAL WORKS.—We have received from Prof. Ernest Lebon, of the Lycée Charlemagne, Paris, an extract from a plan of an analytical bibliography of contemporaneous writings on historical work in astronomy, as submitted by him to the International Congress of Historical Science held at Rome in April, 1903. Judging from the list of authors named in the plan and the specimen extracts given therein, the bibliography will be found extremely useful by those workers in astronomy who have occasion to refer to previous results obtained since 1846.

PRIZES PROPOSED BY THE PARIS ACADEMY OF SCIENCES FOR 1905.

GEOMETRY.—The Francœur prize (1000 francs), for discoveries or work useful for the progress of pure or applied mathematics; the Poncelet prize (2000 francs), for work in applied mathematics.

Mechanics.—A Montyon prize (700 francs), for the invention or improvement of instruments useful in the progress of agriculture, the mechanical arts or sciences; the Poncelet prize (2000 francs), for a work on applied mathematics; the Fourneyron prize (1000 francs), for a memoir on the theoretical or experimental study of steam turbines.

Navigation.—The extraordinary prize of 6000 francs as a recompense for any work tending to increase the efficiency of the French naval forces; the Plumey prize (2500 francs), for an improvement in steam engines or any other invention contributing to the progress of steam navigation.

Astronomy.—The Pierre Guzman prize (100,000 francs), for the discovery of a means of communicating with any celestial body other than the planet Mars; failing the award of the capital sum, the interest will be awarded every five years for a work important to the progress of astronomy. The Lalande prize (540 francs), for the observation, memoir, or work most useful to the progress of astronomy; the Valz prize (460 francs), and the G. de Pontécoulant prize (700 francs), under similar conditions. The Damoiseau prize (2000 francs); the question proposed for this prize is as follows:—there are a dozen comets the orbit of which, during the period of visibility, is shown to be of a hyperbolic nature. The problem set is to find out whether this was the case before the arrival of the comet in the solar system, going back to the past history of the comet, and allowing for the perturbations of the planets.

Geography.—The Gay prize (1500 francs), for an explorer in Africa who has determined with great precision the geographical coordinates of the principal points on his journey; the Tchihatchef prize (3000 francs), as a recompense or encouragement for naturalists of any nationality who have most distinguished themselves in the exploration of the Asiatic continent, more especially in the lesser known regions; the Binoux prize (2000 francs).

Physics.—The Hébert prize (1000 francs), for a discovery or treatise on the popular applications of electricity; the Hughes prize (2500 francs), for a work contributing to the progress of physics; the Gaston Planté prize (3000 francs), for a discovery, invention, or important work in the field of electricity; the L. la Caze prize (10,000 francs), awarded in one sum for works important in physics.

Chemistry.—The Jecker prize (10,000 francs), for work in organic chemistry; the Cahours prize (3000 francs), for the encouragement of young chemists; the Montyon prize, unhealthy trades (2500 francs and a mention of 1500 francs), for a means of rendering a trade less unhealthy or dangerous; the L. la Caze prize (10,000 francs), for the best work on chemistry during the last two years; the Bordin prize (3000 francs), for a memoir on the silicides and the part played by them in metallic alloys.

Mineralogy and Geology.—The Delesse prize (1400 francs), for a work concerning geology, or, failing that, mineralogy; the Fontannes prize (2000 francs), for the best publication on palæontology; the Alhumbert prize (1000 francs), for a memoir on the period of the last volcanic eruptions in France.

Botany.—The grand prize of the physical sciences (3000 francs); the question proposed is the demonstration of the various modes of formation and development of the egg in the Ascomycetes and the Basidiomycetes. The Desmazières prize (1000 francs), for the best work published during the preceding year on Cryptogams; the Montagne prize (1500 francs), for work having for its object the anatomy, physiology, development, or the description of the lower Cryptogams; the Thore prize (200 francs), for work on the cellular Cryptogams of Europe.

Anatomy and Zoology.—The Savigny prize (1300 francs), for the assistance of young travelling zoologists, not receiving Government assistance, who have especially occupied themselves with the invertebrates of Egypt and Syria.

Medicine and Surgery.—A Montyon prize (2500 francs and a mention of 1500 francs), for works and discoveries useful in the art of healing; the Barbier prize (2000 francs), for a valuable discovery in surgical, medical, or pharmaceutical science, or in botany having relation with medicine; the Bréant prize (100,000 francs), for the discovery of an absolute specific against Asiatic cholera, or to point out in an irrefutable manner the causes of Asiatic cholera, so that the suppression of the disease will follow. Failing the award of the capital sum, the annual interest will be given for a rigorous demonstration of the existence in the atmosphere of matter capable of playing a part in the production or propagation of epidemic diseases. The Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the genito-urinary organs; the Baron Larrey prize (750 francs), for the best work dealing with the subject of military medicine, surgery, or hygiene; the Bellion prize (1400 francs); the Mège prize (10,000 francs); the Serres prize (7500 francs), for a memoir on general embryology applied as far as possible to physiology and medicine; the Dusgate prize (2500 francs), for the best work on the diagnosis of death and the prevention of premature burial.

Physiology.—A Montyon prize (750 francs), and the Philipeaux prize (900 francs), for work in experimental physiology; the Lallemand prize (1800 francs), for work on the nervous system; the Pourat prize (1000 francs), for an essay on the origin of muscular glycogen.

Statistics.—A Montyon prize (500 francs), for a memoir on French statistics.

Among the general prizes offered in 1905 are the following:—the Binoux prize (2000 francs), for a work on the history of science; the Trémont prize (1100 francs), the Gegner prize (3800 francs), the Lannelongue prize (1200 francs), the Wilde prize (4000 francs), the Saintour prize (3000 francs), the Petit d'Ormoy prizes (two of 10,000 francs), all for work useful in the promotion of scientific knowledge. Of these prizes those bearing the names of Pierre Guzman, Lalande, Tchihatchef, La Caze, Delesse, and Desmazières are especially mentioned as being awarded without distinction of nationality.

GEOLOGICAL NOTES.

VERY little geological information appears to have been published on the State of Durango, in western Mexico. The observations therefore recorded during a brief journey by Dr. O. C. Farrington are of considerable interest (Field Columbian Museum, No. 89, geological series, vol. ii., No. 5). His route extended from the city of Durango, which is situated upon an alluvial plain hemmed in by low and rugged hills, to the silver-mining town of Villa Corona or Ventanas, distant about seventy miles in a direct line. The ground, which forms part of the interior plateau of Mexico, rises from about 6000 feet at Durango to 9000 feet. While large tracts of the area are semi-arid and sparsely covered with soil and vegetation, in some places corn is successfully grown, and elsewhere there occur extensive pine forests with oaks. Views of the scenery are given. Eruptive rocks prevail, and near the Ciudad ranch, on one of the highest parts of the plateau, there is a tract of weathered masses known as La Ciudad de Rocas ("The City of Rocks"). The outlines of the rocks are domed and rounded, and they appear to be due to the weathering of fairly homogeneous rhyolitic materials.

Particular attention is directed by the author to the famous Cerro Mercado or Iron Mountain, a hill largely made up of solid iron-ore, and situated less than a mile north-east of Durango City. It rises abruptly from the alluvial plain to an average height of about 300 feet, with single peaks 50 feet to 100 feet higher. The length of the hill is about $1\frac{1}{3}$ miles, and its average width about one-third of a mile. The ore appears to be chiefly hæmatite, although some magnetite also occurs; in physical characters it varies, being hard and soft, black, red, specular, and earthy. Hard, solid black ore, however, forms the chief mass of the "mountain," the black colour being in striking contrast to the yellow and green of the surrounding plain. The ridge is almost bare of vegetation, except for straggling cacti, and its outline is bold and rugged. Steep cliffs 10 feet to 20 feet high are not infrequent, and in places they exhibit a distinct columnar structure like that of basalt (see Fig. 1). The existence of this hill appears to have been made known in 1552 A.D., but the first serious attempt to work the iron-

FIG. 1.—Cliff showing columnar structure of iron-ore at western end of the Cerro Mercado or Iron Mountain of Durango, Mexico.

ore was made in 1828. Successful operations were not conducted until 1888, and only within the last five years has a steady production been maintained. The amount of ore exposed above the level of the plain is estimated at 360 million tons. The author briefly discusses the origin of the iron-ore, regarding it as probably igneous. The associated rocks of the district are rhyolites, probably of later Tertiary age, but the relation, either in time or manner of origin, between the associated eruptive rock and the iron-oxide, and the origin of the iron-oxide itself, seem as yet difficult to determine.

A geological description of the Baraboo iron-bearing district of Wisconsin, by Dr. Samuel Weidman, has been issued by the Wisconsin Geological and Natural History Survey (*Bulletin* No. 13, economic series No. 8). The area is formed mainly by pre-Cambrian quartzites, which stand out in bold north and south ranges, so connected both on the east and west as to constitute a cordon of bluffs enclosing a depressed drift-covered interior. Isolated areas of still older rocks, rhyolite, granite, and diorite, occur along the outer borders of the ranges. Potsdam sandstone is found beneath the drift, and on the slopes of the Baraboo quartzites, while later Palæozoic strata are met with at higher levels. Special interest has recently been aroused by the discovery of large deposits of iron-ore beneath the drift-covered valley, a discovery made while digging or drilling the farm wells in this otherwise well settled agricultural district. The iron-bearing rocks, termed the Freedom formation, from the town of North Freedom, comprise slate, chert, dolomite, and iron-ore, and all gradational phases between these kinds of rock, including banded ferruginous chert like that in the iron-bearing series of Lake Superior. The author points out that the Baraboo pre-Cambrian series may be compared with the upper portion of the Lower Marquette series, the Freedom formation corresponding with the Negaunee iron-bearing formation. Detailed accounts are given of the various rocks and drift deposits, and of the circulation of underground water.

The recent numbers of the *Boletin del Cuerpo de Ingenieros de Minas del Peru*, issued during 1904, continue to testify to the energy and activity of the Government officers charged with the development of Peru. No. 8, by Señor Venturo, describes important deposits of hæmatite in the extreme north of the country, the ore appearing on the surface, and being probably derived from the dehydration of an old lake-iron deposit. Fragments of rocks from the margins of the former lake are found surrounded by the iron oxide, and the iron itself seems to have been dissolved out from the acid igneous masses in the neighbourhood.

In view of the demand for nickel for plating, for alloying steel, and for coinage, Señor Eduardo de Habich was sent to report on the nickeliferous veins of the province of La Mar, which present practically a virgin field. His memoir (No. 11) seems encouraging, the chief ores being ullmannite and nickeline (kupfernickel), occurring mostly in veins of quartz, which may also contain both gold and silver. No. 12 has probably the widest interest for geologists in general, giving as it does the results of a visit to central Peru by Dr. Gustav Steinmann, of Freiburg-im-Breisgau, early in 1904. Señor Elmore is the author of *Boletin* No. 13, on the water-supply of the Rimac valley. It is shown that the permeable subsoil in the valley-floor, from Chosica downwards, becomes charged with a good potable water by infiltration from the River Rimac, and this is capable of furnishing a healthy supply wherever it may be desirable to tap it. The marked rise of this underground water in Callao is interestingly attributed to the obstacle furnished by the neighbouring island of San Lorenzo. The economic aspect of Señor Elmore's report is sure to be widely welcomed in a populous and practically rainless district.

The fourteenth volume of the *Berichte der naturforschenden Gesellschaft zu Freiburg-im-Breisgau* (1904) contains several papers of geological interest. A. Freiherr von Bistram's studies on the dolomitic region of the Alps of Lugano were commented on when they first appeared in separate form (NATURE, vol. lxix. p. 112). Walther Schiller and W. Paulcke are both concerned with the structure of the Engadine, the former giving a detailed account of the region south-east of Schuls, of which the Piz Lischanna forms the centre, while the latter examines the structure of a wider area, from Landeck to the basin of the Po.

Palæontological papers seldom contain so much personal revelation as is to be found in Herr Georg Boehm's first section of his *Beiträge zur Geologie von Niederländisch-Indien* (*Palaeontographica*, supplement iv., Stuttgart, 1904). The splendid series of ammonites therein described, probably from a Tithonian horizon, were obtained for the most part from the collection of a postmaster of Sula Besi, and from one of "die Alfuren," the latter name being applied to any uncivilised natives. Some specimens were even extracted from concealment in the scanty clothing of the boatmen. The postmaster and his allies appear, consciously or unconsciously, to have lost touch with the true locality of their finds, and to have opened up a delusive route through the forest in Taliabu, whereby Herr Boehm was led to a spot where he found abundant belemnites and Nuculæ, but none of the highly prized ammonites. The "Alfuren-Sammlung" proves to be of unusual interest, and may perhaps grow in the course of time, if judicious sums are expended on the "uncivilised" population. The inclusion of fossils smuggled in from other places is now, however, a possibility against which it will be difficult to guard.

Part ii. of the seventh volume of the *Transactions* of the Geological Society of South Africa (Johannesburg, 1904) bears witness to the prevalence of research in Africa in all branches of geology. Dr. Hatch contributes two papers, one in conjunction with Prof. Corstorphine, who has been drawn off from the service of Cape Colony into a more adventurous field. Mr. J. P. Johnson shows that two types of stone implements are found in the Taaibosch Spruit, the older and rougher lying beneath 15 feet of alluvium, and the newer type upon the surface. Mr. F. W. Voit furnishes a paper of general interest on the geology of German South-West Africa, in which a large series of ancient metamorphic rocks is dealt with; these are accompanied by intrusions of granite. The author urges that some of what might be regarded as ordinary contact-phenomena are here carried out on a regional scale, and must be referred to the action of pressure rather than to the invasion of the granite. The metamorphic rocks are impregnated with important deposits of copper-ore, sometimes localised in quartz veins, and sometimes spread in cloud-like masses through the schists.

In the first part of the *Jahrbuch der k.k. geologischen Reichsanstalt* for 1904 (September 15), Franz Toula describes the results of his journey to the Dobrudscha in 1892, and discusses in particular the forms of Exogyra met with. Dr. Petrascheck, in examining the granitic mass near Brixen, in the Adige valley, reviews the nature of Sederholm's "Myrmekite," an intergrowth of triclinic felspar and quartz, and concludes that it is a primary product of the consolidation of the igneous magma. Dr. Ampferer's important examination of the terraces along the valley of the Inn (pp. 91-160) should be considered by all who seek to explain the topography of glaciated areas. The author finds that the terraces of gravel rest on an earlier series of terraces cut in the rock, which are at very different levels on opposite walls of the valley. He summarises his results in a series of fifty-six propositions, among them being the conclusion that the Inn valley, on the retreat of the ice, exhibited a succession of shallow basin-like excavations, which were filled in later by a continuous deposit of alluvium. These hollows, like the smaller details of the ice-erosion, were formed independently of the hardness of the rocks concerned, and Dr. Ampferer believes that the variation in the activity of a glacier as an abrading agent depends in reality on variations in the local pressure and velocity. With reduced pressure and greater velocity the same amount of erosion can be performed as with greater pressure and less velocity. The author opposes the view that rock-obstacles on the walls of a valley are inevitably worn away by the passage of glacier-ice; he urges, on the other hand, that such irregularities may be left standing out, while others are actually produced by the lack of uniformity in the forces of erosion, to which he specially directs attention.

The *Verhandlungen der k.k. geologischen Reichsanstalt*, Nos. 9-12, for 1904, continue to be rich in papers on Bohemia and Moravia, and students of petrology in the broad sense, as well as of Palæozoic and Mesozoic faunas, must endeavour to keep pace with the monthly observations furnished by Dr. Katzer, Jaroslav J. Jahn, Friedrich Trauth, and others. The Dalmatian islands also receive attention in Dr. Waagen's reports of his recent journeys.

AGRICULTURAL EDUCATION AND RESEARCH.

THE writings of Henry, Babcock, King, and others have made the University of Wisconsin familiar to English agricultural students, so that considerable interest attaches to the twentieth annual report of the experiment station, which contains a short history of the College of Agriculture, and summarises the results of twenty years' research. The college is one of the best known in the United States, and its record is typical of many similar institutions. A professor of agriculture was appointed in 1866, there was the usual attempt to teach before the materials for a course of university grade existed, and there was the usual failure. Then, when the indignation and forcible action of "some thirty representative farmers" led the regents of the university to realise the need of "better directed measures," there was a change of policy. The farmer's educational requirements were studied, suitable courses were devised, and research in his interests was begun. The success of this changed policy is testified to by every chapter of the report, and is strikingly shown by the material progress of the institution. When the present director took charge in 1880 the buildings consisted of a dwelling house and two barns, worth about 1000*l.*; the present buildings are worth more than 60,000*l.* In 1881 the income of the agricultural department was represented by the salary of the professor and a grant of about 1000*l.* for experiments. In 1903 the College of Agriculture had an income of 10,000*l.* for administrative and teaching purposes, and of 6000*l.* for research; and in addition free instruction in languages, mathematics, and pure science was provided for agricultural students in other departments of the university.

But the "better directed measures" of the regents of Wisconsin University have had an influence outside the College of Agriculture. At the jubilee of the university last summer, Prof. Chamberlin, of Chicago, delivered an address on "The State University and Research." In this address it was argued that "the fundamental promotion of education lies in an increase in the intellectual possessions of a people, and in the mental activities and attitudes that grow out of the getting, the testing, and the using of these possessions" (*Experiment Station Record*, xvi., 3). As an illustration of the effects of properly directed research on a community, the work of the Wisconsin Experiment Station was referred to in the following words:—"It was my privilege to compare the Agricultural conventions of this State at two periods separated by a decade, within which the experiment station became a potent influence. The dominant intellectual and moral attitude of the earlier period was distinctly disputatious and dogmatic. . . . In the second period the dominant attitude was that of a scientific conference. . . . The whole was characterised by a notable approach to the methods of approved scientific procedure. The intellectual and moral contrast of the two periods was one of the most pronounced expressions of advance in the higher education in a great mass of people in the midst of a practical life which it has ever been my privilege to witness."

The educational value of research may be traced here and there in our English shires, where agricultural experts have won the confidence of farmers by conducting well devised experiments in their midst. But our education authorities still view research with suspicion, and one finds agricultural experiments, for example, labelled "demonstrations" for no other reason than to satisfy the county auditor! One wishes that our education committees, entrusted as they are with funds for the encouragement of agriculture, would study the "better directed measures" which have been so successful in Wisconsin, and not in Wisconsin only, but throughout the States. They would probably find in the American institutions confirmation of a view expressed by Prof. Chamberlin in the above quoted paper.

He remarks that while it is a good thing to provide technical instruction in agriculture, it is "a much higher and truer function to develop the science of agriculture, to increase the intellectual activity of every farmer, to improve the agricultural art on every farm, and by such improved art to furnish better and safer food to every citizen."

T. H. MIDDLETON.

SCIENTIFIC REPORTS OF THE LOCAL GOVERNMENT BOARD.[1]

As is customary, the report under notice is divided into three portions, (1) an excellent digest by the principal medical officer, Mr. Power, of the contents of the volume; (2) statistics of vaccination and details on outbreaks of disease investigated by the board's inspectors; and (3) the reports of scientific investigations carried out for the board, and of the board's vaccination department.

It is reassuring to learn that abstention from vaccination seems to be steadily diminishing, the percentage of births remaining unvaccinated being 20·8 in 1899, 19·9 in 1900, and 17·3 in 1901. The epidemic of small-pox which raged in London in 1901–2 again directs attention to the danger of small-pox hospitals in disseminating this disease in their vicinity. Practically all the London cases were removed to the hospital ships moored in the Thames at Long Reach, opposite to which is the village of Purfleet, containing a number of unvaccinated persons, and an excessive incidence of small-pox prevailed there attributable to aërial conveyance of infection from the ships. The populations of Purfleet garrison and of the training ship *Cornwall* close by were, however, thoroughly vaccinated and re-vaccinated, and not a single case of small-pox occurred in these communities, another instance of the protective power of vaccination. The report by Dr. Bulstrode on outbreaks of typhoid fever at Winchester and Southampton attributable to infected oysters has already been noticed in these columns (see NATURE, vol. lxviii. p. 303).

An outbreak of throat illness at Lincoln attributable to milk was the subject of investigation by Dr. Mair. Although bearing considerable resemblance to scarlatina the outbreak was conclusively proved not to be one of this disease. From a few of the cases a yeast was isolated from the throat by Drs. Klein and Gordon which proved pathogenic to mice, and reproduced on inoculation some of the features of the human disease.

Dr. Bulstrode's report on the excessive incidence of typhoid fever at Bridgend (Glamorgan) supplies an instructive instance of the superiority of properly conducted bacterioscopic examination over chemical analysis for detecting a *slight* degree of pollution of water supplies. Turning to the scientific investigations carried out for the board, it is difficult in a short space to give adequate notice of their contents and importance.

Dr. Klein records some observations on the bacteriological diagnosis of plague, and the manifestations of this disease in the rat. He regards the natural disease in this animal as one of slight virulence and feeble infectivity, and considers that it is spread from rat to rat mainly through their fighting propensities. Dr. Klein, in continuation of his study of agglutinins, also details experiments made to test the ability of two or more agglutinins to coexist in the blood of the same animal. Cultures of *B. typhosus* and *B. enteritidis* (Gärtner) injected simultaneously in an animal were found to produce agglutinins corresponding to each of these microbes. But if the cultures were injected not simultaneously, but in sequence, the agglutinin of the first microbe was to a large extent replaced by that of the second microbe injected.

Dr. Sidney Martin has continued his investigations of the toxic substances elaborated by diarrhœa-producing bacteria, dealing in the present instance with those of the *Proteus vulgaris*. He finds the toxin to be proteid in nature, but not albumose, and readily extractable from the bacterial cells by distilled water. An injection of the toxin produced diarrhœa with depression of temperature.

The report by Dr. Mervyn Gordon on a bacterial test for the estimation of pollution of air is one of great interest and importance. First examining the natural bacterial flora of the saliva, he found that a streptococcus having the power of producing acid in glucose and in lactose media, acid and clot in milk, and of changing the colour of an anilin dye neutral red, was extremely abundant, no less than 10,000,000, and in some cases 100,000,000, being contained in 1 c.c. of saliva, and by using a neutral red broth and incubating anaërobically minute traces of saliva may be detected. By placing, therefore, dishes of neutral red broth at varying distances from a speaker, and subsequently incubating and examining, the distance to which particles of saliva may be carried can be ascertained. It was found that particles of saliva were present in the air no less than 40 feet in front of and 12 feet behind the speaker during loud speaking. Dr. Houston has carried out an exhaustive study of the bacterial flora of human dejecta, with special reference to the colon bacillus. He finds that not less than 90 per cent. of the total number of this organism present have the characters of the typical *B. coli*.

The same observer details the results of the chemical and bacteriological examination of Tunbridge Wells deep well waters, and, in conjunction with Dr. Klein, reports on the use of nutrose agar for the identification of the typhoid bacillus.

[1] Supplement containing the Report of the Medical Officer for 1902–03. (Thirty-second Annual Report of the Local Government Board, 1902–03.)

The remainder of the volume is occupied with reports of scientific investigations carried out in the board's vaccine laboratories by Dr. Blaxall, Mr. Fremlin, and Dr. Green, and a number of excellent plates illustrating the various researches. R. T. HEWLETT.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—During the first fortnight of last month some four hundred candidates were being examined at Cambridge for entrance scholarships. The majority of the larger colleges are now combined into two groups, the larger of which includes Pembroke, Gonville and Caius, Jesus, St. John's, Christ's, King's, and Emmanuel, whilst the smaller comprises Peterhouse, Clare, Trinity Hall, Trinity, and Sidney Sussex. Queens' examined alone, and a week later than the two large groups. As a result of the examination of these thirteen colleges a sum amounting to a little more than 6000*l.* was awarded in scholarships to 108 successful candidates. This total does not include the sum, which amounted to some hundreds of pounds, given in exhibitions, sizarships, and subsizarships, and in certain extra scholarships offered by some of the colleges after the result of the first selection had been published. It is interesting to note the number of scholars and the value of the scholarships given in the different subjects. Out of a little more than 6000*l.* awarded to 108 candidates, classics gained 2850*l.*, divided amongst 49 scholars, mathematics, with 34 scholars, earned 1945*l.*, and the natural sciences divided 990*l.* amongst 20 successful competitors, whilst candidates in history and oriental and modern languages were successful in only five instances, and these 5 divided amongst them 220*l.*

AMONG the papers down for reading at a conference of the National Federation of Head Teachers' Associations, arranged to be held at Cambridge yesterday and to-day, is one by Sir Lauder Brunton, F.R.S., on "The Proposed National League for Physical Education and Improvement."

Science announces that Mr. E. D. Adams has given 10,000*l.* to Columbia University for the foundation of a research fellowship in physical science. The gift is accompanied by a valuable collection of scientific apparatus to be allotted to the electrical, physical, and psychological laboratories of the university.

THE prospectus for 1904–5 of the Colorado School of Mines shows that much importance is attached in the metallurgical courses to visits arranged for the students to works where typical processes in metallurgy can be seen in operation under commercial conditions. Immediately after taking up the study of metallurgy, trips extending throughout the junior and senior years are begun. These excursions, intended to illustrate the lectures, are taken while the particular topics are under discussion, and tend to aid greatly in an appreciation of approved machinery and practice. By means of outlines with which the student is provided, which he is required to fill out, care is taken that all the important points in connection with each plant visited are studied and reported upon.

THE following recent educational appointments are announced:—Dr. Foster P. Boswell assistant in psychology and Mr. Edwin Lee Norton instructor in philosophy at Wisconsin. Miss Florence Fitch associate professor of philosophy in Oberlin College. Prof. F. S. Luther, who occupies the chair of Trinity College, Hertford, Conn., has been elected president of the college. Dr. J. Stebbins has been appointed assistant professor of astronomy, and Mr. A. H. Wilson instructor in mathematics, at Illinois; Dr. H. B. Evans assistant professor of mathematics at Pennsylvania; Mr. C. P. Weston assistant professor of mechanics, Mr. H. R. Willard instructor in mathematics, and Mr. R. K. Morley tutor in mathematics, at Maine; Mr. W. D. Cairns associate professor of mathematics, and Mr. J. R. Luckey assistant in mathematics and physics, at Oberlin; Mr. E. D. Grant associate professor of mathematics at the Michigan College of Mines; Dr. K. Schmidt professor of mathematics and astronomy at Lake City, Florida.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 17, 1904.—"Theory of Amphoteric Electrolytes." Part ii. By Prof. James **Walker**, F.R.S.

In a previous paper (see NATURE, April 7, 1904, vol. lxix. p. 545) it was shown that it is possible to express the concentrations of the ions present in the aqueous solution of an amphoteric electrolyte in terms of the concentration of the un-ionised substance, the dissociation constants of the substance acting as acid and as base respectively, and the ionisation constant of water. In the present paper the values for the aminobenzoic acids have been re-calculated, and a closer concordance obtained between theory and experiment than was apparent in the former calculations. As a knowledge of the concentration of the un-ionised proportion of an amphoteric electrolyte in solution is of fundamental importance in the application of the theory, a table is given of the values of this magnitude with varying constants and total concentration. From this table it appears that when the acidic and basic constants approximate in value, dilution has little effect on the total ionisation of an amphoteric electrolyte, although the proportions of the two positive ions, and consequently the molecular conductivity, may vary greatly.

For a series of amphoteric electrolytes with a constant product $k_a k_b$, where k_a is the acidic and k_b the basic constant, it may be shown that the simultaneous alteration of $1/k_a$, k_b, and v in the same ratio has no effect on the total ionisation. From this and the preceding result it may be deduced that in such a series, beginning with an infinitely small value of k_b the total ionisation falls off as k_a diminishes and k_b increases, the fall being at first rapid, thereafter becoming slower until, through a comparatively long range, it is practically constant at the minimum value, which is actually reached when $k_a = k_b$. At this point the substance is absolutely neutral. As k_a still further diminishes, and k_b correspondingly increases, the ionisation begins to increase, very slowly at first, and the substances considered become more and more basic in character. Finally, the ionisation increases rapidly, and we deal at last with a practically simple base for which k_a is infinitely small.

The theory has been applied to cacodylic acid and to asparagine with satisfactory accordance with the experimental results.

December 1, 1904.—"On Chemical Combination and Toxic Action as exemplified in Hæmolytic Sera." By Prof. Robert **Muir** and Carl H. **Browning**.

This paper deals with the mode of action of complements—those comparatively labile bodies which are present in the serum of normal animals, and which are the active substances in hæmolysis and bacteriolysis. Towards red corpuscles treated with the suitable immune-body (the anti-substance developed by the injection of such corpuscles into an animal of other species) a complement may be regarded as a toxin, and already many points of similarity in the constitution of toxins and complements have been brought forward. The hæmolytic dose of a particular complement varies greatly in the case of different corpuscles, when each variety is treated with the corresponding immune-body, and the question dealt with in this communication is whether such variations in dosage are due to variations in the combining affinities of complements or to variations in their toxic action. For example, the hæmolytic dose of guinea-pig's complement is ten times greater in the case of its own corpuscles than it is in the case of the ox's corpuscles, and the writers show by quantitative methods that in the former case the whole of this large dose of complement enters into combination with the guinea-pig's corpuscles (through the medium of the immune-body); there is no want of combining affinity of complement, but its toxic action is slight. A similar result was obtained with each of three sera investigated—a relative non-sensitiveness of the corpuscles of an animal to its own complement; in one case there was also a deficiency in the combining power of the complement. All the results go to emphasise the importance of distinguishing these two factors in the action of a complement, which correspond with the two chief atom groups designated by Ehrlich "haptophore," or combining, and "zymotoxic." As bearing on the general biology of the subject, the following may be quoted:—"No one has yet succeeded in producing an anti-substance or immune-body by injecting an animal with its own corpuscles or cells—such a body as with the aid of complement would produce destruction of these cells. This is manifestly a provision against self-poisoning, and Ehrlich has applied to it the term *autotoxicus horror*. The results which we have brought forward, if they were found to hold generally, would go to show that even if some substance should appear which acted as an immune-body, there is a provision whereby the complement of an animal should produce comparatively little harmful effect."

Chemical Society, December 14, 1904.—Prof. W. A. Tilden, F.R.S., president, in the chair.—The following papers were read:—Hydrolysis of ammonium salts: V. H. **Veley**. It is shown that when aqueous solutions of ammonium salts are heated the evolution of ammonia and the concomitant acidity of the solutions are due not to dissociation, but to hydrolysis.—The viscosity of liquid mixtures, part ii.: A. E. **Dunstan**. The author's conclusions, given in a previous paper (Chem. Soc. *Trans.*, 1904, lxxxv., 817), are confirmed by the present series of viscosity-concentration measurements for a number of binary mixtures containing hydroxy-compounds.—The diazo-reaction in the diphenyl series, part ii., ethoxybenzidine: J. C. **Cain**. The author has examined the action of heat on the solution of the diazonium salt prepared from ethoxybenzidine, and has shown that the diazonium group, adjacent to the ethoxy-group, is normally substituted by hydroxyl, whilst the other remains intact.—The sulphate and the phosphate of the dimercurammonium series: P. C. **Rây**. When dimercurammonium nitrite, NHg_2NO_2, is treated with an oxyacid, the dimercurammonium complex remains intact. In this way, the author has succeeded in preparing the sulphate and the phosphate of the series.—A method for the direct production of certain aminoazo-compounds: R. **Meldola** and L. **Eynon**. The authors have found that most diazotised amines when treated in aqueous solutions with a strong solution of sodium dichromate give crystalline precipitates of diazonium chromates. These chromates are more or less explosive when dry, and it is suggested that some of them might find technical application as high explosives.—The combination of mercaptans with olefinic ketonic compounds: S. **Ruhemann**. Studies in optical superposition, part i.: T. S. **Patterson** and F. **Taylor**. Menthyl acetate, *l*-menthyl *d*-tartrate, and *l*-menthyl diacetyl-*d*-tartrate have been prepared and their rotations examined between 0° and 100°. It is shown to be possible by analogy to trace the separate effects of the different active groups composing menthyl tartrate and its diacetyl derivative.

Linnean Society, December 15, 1904.—Prof. W. A. Herdman, F.R.S., president, in the chair.—The ecology of woodland plants in the neighbourhood of Huddersfield: Dr. T. W. **Woodhead**. The plant-associations of this portion of west Yorkshire having been dealt with on broad lines by Smith and Moss, the author has endeavoured to carry the study a stage further by paying special attention to a very limited area. A small wood (Birks Wood, near Huddersfield) was examined in great detail, and the main factors determining the distribution of the more important plants of the undergrowth studied, such as soil, shade produced by the dominant tree, moisture, exposure, and wind. The results thus obtained were then tested by an examination of the woodlands in an area of 66 square miles to the south and west of Huddersfield; special attention was also paid to the distribution of these species beyond the limits of the woodlands.—Experimental studies in heredity in rabbits: C. C. **Hurst**. The studies were based on breeding between a Belgian "hare" and an albino Angora; the second generation showed but little outward variation from the Belgian parent, but the third generation displayed great diversity of colour—albino, grey, black, and variegated. These experiments tallied in a very close degree with the numbers expected according to the Mendelian laws.

Faraday Society, December 19, 1904.—Mr. J. Swinburne, vice-president, in the chair.—The electric furnace: its origin, transformations, and applications, part ii.: M. Adolphe **Minet**.—Electrolytic analysis of cobalt and nickel: Dr. F. Mollwo **Perkin** and W. C. **Prebble**. *Cobalt.*—The aim of the experiments was to obtain bright deposits of the metal that should be quantitatively accurate. The most satisfactory results were obtained with a solution containing an alkali phosphate and a little phosphoric acid, the latter to prevent the precipitation of the double sodium cobalt phosphate. *Nickel.*—Similar solutions were tried for nickel deposition. In this case good results were obtained with a borate solution, while a phosphate solution, which gave good figures in the case of cobalt, was not at all satisfactory.—(1) The electrolytic preparation of tin paste; (2) note on the electrolytic recovery of tin: F. **Gelstharp**. The electrolytic process is less costly than other processes in spite of the low current efficiency (50 per cent.), and it can be worked continuously. The process consists in dissolving anodes of tin, roughly cast from commercial ingots, in dilute hydrochloric acid, and depositing the metal in the form of sponge on kathodes of block tin or tinned iron. In the second note an experiment is described that has some bearing on the conditions necessary for electrolytically stripping tin plate.

PARIS.

Academy of Sciences, December 26, 1904.—M. Mascart in the chair.—On the theorem of areas and conservative systems: Paul **Painlevé**.—Groups of negative bands in the air spectrum with a strong dispersion: H. **Deslandres**. A detailed examination under high dispersion of the ultra-violet band λ 3914. This band is intense round the negative pole in vacuum tubes filled with air or nitrogen, and it constitutes nearly exclusively the kathode light of gases; it is found in the aurora borealis and in the radium light.—On the constitution of the sodium salts of certain methenic and methinic acids: A. **Haller** and P. Th. **Muller**. A differential optical method has been employed in this work, comparing the molecular refraction of the sodium salt with its corresponding acid, so far as possible in the same solvent and at equal concentrations. The substances studied included cyanacetic ester, propionyl-cyanacetic ester, malonic and cyanomalonic esters, malonitrile, and cyanocamphor. The results indicate that all the sodium salts examined have a different constitution from that of the generating acid, and hence that the latter should be classed as pseudo-acids.—On some new geological discoveries in the Soudan: A. **de Lapparent**. The fossils found present a fresh proof of the existence of an arm of the sea penetrating into the Soudan.—On the new Giacobini comet: M. **Giacobini**. Observations, the elements and ephemeris of the new comet, discovered on December 17, 1904, at the Observatory of Nice.—The provisional elements of the Giacobini comet (December 17, 1904): G. **Fayet** and E. **Maubant**.—Observations of the Tempel comet (1873, 2) made at the Observatory of Algiers with the bent equatorial of 31·8 cm. aperture: MM. **Rambaud** and **Sy**.—On the stability of aërostats fitted with steering apparatus: G. A. **Crocco**.—On the fragility of certain steels: A. **Perot** and Henri Michel **Levy**. A study of the effect of shock on notched test-pieces, a photographic method of recording the results being adopted.—On the kathode rays and the laws of electromagnetism: P. **Villard**. Diagrams are given showing the comparison of the theoretical curves with those actually obtained, and it was found that none of the experimental results present anomalies requiring the assumption of a magnetic friction.—On the thermoelectricity of the aluminium alloys: Hector **Pécheux**. Alloys of aluminium with tin, lead, bismuth, magnesium, antimony, and zinc were studied at 100°, 180°, and 380° C.—On the theory of magnetism: P. **Langevin**. An application of the hypothesis of electrons to the explanation of the phenomena of para- and dia-magnetism.—On a phenomenon of retinal adaptation relating to visual perception of faintly illuminated colours: A. **Polack**.—On the reduction by amorphous boron of the oxides of manganese, and on the preparation of a new boride of manganese: Binet **du Jassonneix**. The composition of the new boride studied is represented by the formula MnB. It fits into the series of well defined and crystallised borides FeB, NiB, and CoB prepared by M. Moissan by means of the electric furnace.—On quadrivalent oxygen: E. E. **Blaise.** Ethyl ether and magnesium iodide form a well defined, crystalline compound from which the ether is only driven off when heated to temperatures approaching 190° C. Its probable constitution is given as

$$\begin{array}{ccccc} C_2H_5 & & I\ \ I & & C_2H_5 \\ & \rangle O & & \langle O & \\ C_2H_5 & & Mg & & C_2H_5 \end{array},$$

in which the oxygen must be tetravalent. If this substance is treated with an ether containing an alkyl group of higher molecular weight, as amyl ether, the latter replaces the ethyl ether, and a vigorous reaction ensues.—On the reduction of the anhydrides of the dibasic acids: G. **Blanc.** The anhydrides of pyrotartaric, αα-dimethylsuccinic, αα-dimethylglutaric, ββ-dimethylglutaric, and camphoric acids, when reduced with sodium and absolute alcohol, give good yields of the corresponding lactones.—A general method for the synthesis of aldehydes with the aid of substituted glycidic acids: Georges **Darzens.** A mixture of monochloracetic ester with any ketone is treated with sodium ethylate in powder. The acid formed by this condensation is unstable, and splits up easily into carbon dioxide and an aldehyde of the type RR′CH—CHO, where the original ketone was RR′ : CO. The reaction has been applied to a considerable number of ketones and found to be quite general.—On the diastatic coagulation of starch: A. **Fernbach** and J. **Wolff.** It is shown that the diastatic coagulation of starch is only possible if it is in a state of liquefaction, this being produced either by a liquefying diastase or artificially.—On the combustion of sulphur in the calorimetric bomb: H. **Giran.** The heat of combustion of sulphur has been determined in the Berthelot bomb at pressures varying between 2·5 and 45 atmospheres, with the unexpected result that the heat of formation of sulphur dioxide increases with the pressure. This result is regarded as being possibly due to the formation of the persulphuric anhydride of Berthelot.—On the electrical conductivity of colloidal solutions: G. **Malfitano.** In order to eliminate the effect possibly produced by the presence of minute traces of electrolytes in solution, the conductivity of the colloidal solutions was taken both before and after filtration through a thin film of collodion, it having been shown by preliminary experiments that solutions of pure electrolytes undergo no appreciable change after such filtration. It was found that the conductivity due to the fine particles in suspension was practically nil.—On the comparative production of alcohol and carbonic acid during fermentation: M. **Lindet** and P. **Marsais.** The ratio of alcohol to carbonic acid has been followed throughout the whole course of a fermentation, the effect of varying temperature being also studied.—Study of calcium carbide used as an explosive in mining work: Marcel P. S. **Guédras.** The cartridge used consisted of a charge of calcium carbide separated by an insulating membrane from water. The membrane is broken by a cap controlled electrically, and after five minutes the explosive mixture is fired also by electrical means. The explosion takes place in a manner well adapted for mining work.—On the histology of the myocardium in the primitive molluscs: P. **Vigier** and Fr. **Vlès.**—Intranuclear fat in the suprarenal capsules of mammals: P. **Mulon.**—On the migration of glucosides in plants: W. **Russell.**—On the destruction of the winter egg of Phylloxera by lysol: G. **Cantin.** An account of experiments demonstrating the practical efficacy of a 1 per cent. solution of lysol against the disease.—On the mineral species of arable earth: A. **Delage** and H. **Lagatu.**—The geology of Sahel, Algeria: General **de Lamothe.**—The culture of the parasite of dysentery of warm countries: A. **Lesage.**—On infectious anæmia of the horse: MM. **Carré** and **Vallée.**

DIARY OF SOCIETIES

THURSDAY, JANUARY 5.

RONTGEN SOCIETY, at 8.15.—Description of an Automatic Vacuum Pump: C. E. S. Phillips. (The apparatus will be shown at work.)—Exhibition of a Method by which Strongly Adherent Films of Aluminium may be applied to Glass.—A Note on the Coloration of Glass by Radium Radiation.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Thames Barrage: James Casey.

FRIDAY, JANUARY 6.

INCORPORATED SOCIETY OF MEDICAL OFFICERS OF HEALTH, at 7.30.—The Report of the Inter-Departmental Committee on Physical Degeneration: Sir Lauder Brunton, F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The Third Issue of the British Association Geological Photographs: Dr. C. G. Cullis.

ROYAL GEOGRAPHICAL SOCIETY, at 3.30.—National Antarctic Expedition: Capt. R. F. Scott. (Lecture to Young People.)

MONDAY, JANUARY 9.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Some Chemical Aspects of the St. Louis Exhibition: Walter F. Reid.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Mr. Reginald Enock's Journeys in Peru: the President.

TUESDAY, JANUARY 10.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Recent Visit to the United States and Canada: Sir William Henry White, K.C.B. (The Address will be repeated on the following day at 3.30 p.m.)

WEDNESDAY, JANUARY 11.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Brandy: Otto Hehner.

THURSDAY, JANUARY 12.

MATHEMATICAL SOCIETY, at 5.30.—Generational Relations for the Abstract Group simply Isomorphic with the Abstract Group LF $[2, p^n]$; Dr. W. Bussey.—On a Class of Expansions in Oscillating Functions: Prof. A. C. Dixon.—Isogonal Transformation and the Diameter Transformation: H. L. Trachtenberg.—A Generalisation of the Legendre Polynomial: H. Bateman.—Current Flow in Rectangular Conductors: H. Fletcher Moulton.—Basic Generalisations of some well known Analytic Functions: Rev. F. H. Jackson.

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THURSDAY, JANUARY 12, 1905.

SCIENTIFIC THOUGHT IN EUROPE.

A History of European Thought in the Nineteenth Century. By John Theodore Merz. Vol. i., pp. xiv + 458; vol. ii., pp. xiv + 807. (Edinburgh and London: William Blackwood and Sons, 1903–4.)

A NEWSPAPER review of this book has come into our possession, which gives the impression that its most prominent feature is the treatment of biological questions such as the Darwinian theory. Doubtless the reviewer was a biologist. His remark that "the book is not a very easy one to read" is, however, very true.

Now to the present writer the feature which appears most noteworthy is the author's intimate knowledge of *mathematics*, as revealed in his masterly expositions of the development of all branches of mathematical thought during the last century. Probably an exhaustive account of this work could only be given by a number of different reviews written by specialists in different subjects, and such reviews would be so different that it would be difficult to realise that they all referred to the same book. The course we propose to follow is to give a general outline of the scope and subject-matter of the book, to scrutinise a little more closely the portions devoted to mathematics and mathematical physics, and to subject such branches as thermodynamics and kinetic theory to a still closer scrutiny.

At the outset (pp. 24–27), Dr. Merz is confronted with the difficulty that he can find no precise equivalent in French or German for our English word *thought*; for instance, he says:—

"No other language has a word so comprehensive, denoting at once the process and the result, the parts and the ideal whole of what is felt and meant. . . ."

"And yet I think I am right in saying that the conception of thought in the sense in which I am using it is truly an outcome of international, not of specifically English progress, and belongs mainly to the period of which I am treating. . . ."

What thought precisely is the author considers impossible to define, but it is only thought which renders the phenomena of nature intelligible, as he says (p. 2):—

"That which has made facts and events capable of being chronicled and reviewed, that which underlies and connects them, that which must be reproduced by the historian who unfolds them to us is the hidden element of thought."

It is the object of these volumes, as the author remarks on page 13,

". . . . . to rescue from oblivion that which appears to me to be our secret property; in the last and dying hour of a remarkable age to throw the light upon the fading outlines of its mental life; to try to trace them, and with the aid of all possible information gained from the written testimonies or the records of others to work them into a coherent picture, which may give those who follow some idea of the peculiar manner in which our age looked upon the world and life, how it intellectualised and spiritualised them."

On p. 34 he says:—

"A history of this thought will be a definition of thought itself."

In order to limit the scope of the inquiry, Dr. Merz confines his attention to European thought, and of this, again, he only selects the central portion, the thought embodied in French, German, and English literature. Accordingly the first three chapters deal with the scientific spirit in France, Germany, and England respectively. This order of arrangement is a fitting one, and well brings out all that has been said by various writers about "England's neglect ot science." Thus (p. 75):—

"Compared with Germany in philosophy and with France in science, England during the early part of the century appears remarkably unproductive. English science and English philosophy had flourished in the seventeenth and eighteenth centuries and leavened the whole of European thought, but in the beginning of our period we find neither represented by any great schools. The great discoveries in science belonged to individual names who frequently stood isolated; the organisation and protection which science could boast of in France was then unknown in England; into popular thought it had hardly entered as an element at all."

It is to France that we must turn in order to find what might be described as a *national* scientific spirit, and this spirit was very largely the outcome of the foundation of the Paris Academy of Sciences.

"Whilst the Royal Society of London only received a charter, and existed by the entrance payments and contributions of its own members, augmented by private donations; the Paris Academy had as far back as 1671 received the funds with which to commence its labours in connection with the survey of the kingdom and its extensive dependencies." . . . "It was almost exclusively by these observations that the data were found with which to substantiate Newton's mathematical reasoning; in his own country that fruitful cooperation which can only be secured by an academic organisation and the endowment of research was wanting" (p. 99). "In two important departments—the popularisation and the teaching of science—France for a long period led the way. A general interest was thus created in the proceedings and debates of the Academy. . . . ."

In the present connection are cited Laplace's "Mécanique Celeste," and the development of the analytical methods rendered possible by Leibnitz's invention of the calculus, about which we are told (p. 101),

"No learned body did more than the Paris Academicians to perfect (with purely scientific interest) this new calculus, which in the course of the eighteenth century had in the hands of Lagrange been adapted to all the purposes and problems contained or suggested in Newton's Principia."

As another illustration we take the popular interest which centred round Laplace's discovery of the calculus of probabilities (pp. 120 *et seq*).

Passing on to Germany we find national interest converging towards another equally important centre, namely, the university system, which is unique of its kind. This system was perfected in the eighteenth, and fully developed at the beginning of the present century. It is essentially a training school of research

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and its ideal is expressed in the word *Wissenschaft*. This word, Dr. Merz considers, "cannot be defined by any single word of the English language."

"In fact, the German word for science has a much wider meaning than *science* has in French or English, it applies alike to all the studies which are cultivated under the roof of an 'alma mater'; it is an idea specially evolved out of the German university system, where theology, jurisprudence, medicine and the special philosophical studies are all held to be treated 'scientifically' and to form together the universal, all-embracing edifice of human knowledge" (p. 170).

It was not, however, until the second quarter of the century that the scientific spirit had entered the universities.

"During these twenty-five years Gauss lived and soared in solitary height—a name only to the German student as Euler had been before him." "The man to whom Germany owes its first great school of mathematics was Jacobi" (pp. 184–5).

"German science was essentially cosmopolitan, and the absence of a central body like the Paris Academy, led to an important result, the publication of a large number of periodicals devoted to special branches of science."

Turning to Great Britain the author says (p. 225):—

"Considering that the great scientific institutions of the Continent—the Paris Institute, the scientific and medical schools in Paris and the German universities—have done so much for the furtherance of science and the diffusion of the scientific spirit, it is natural that we should ask, What have similar institutions done in this country?"

A perusal of this chapter leads to the general conclusion that a "national" scientific spirit has never existed in our country. The records of the great discoveries made in Britain during the half-century ending 1825 (given in a footnote on p. 229) show that in that period hardly a year passed without some great scientific discovery being made by an Englishman, and fully justify the statement that

"England had during the early part of the century in all but the purely mathematical sciences a greater array of scientific names of the first order than Germany, and nearly as great an army as France."

And yet we find the works of these writers quite unknown in their own country, and in many cases only rescued from oblivion by falling into the hands of the Continental schools of science. We have only to instance Dr. Merz's references to the difficulties encountered by Young, Green, Babbage, Boole, Dalton, Faraday, and a host of others, and then to refer to foreign opinions on English science, as expressed by Cuvier and Prof. Moll, and quoted (pp. 235–7), as evidence of the high estimation in which British scientific work was held on the Continent. The lack of stimulus to scientific research, the absence of higher mathematical studies, were peculiarly noticeable in the two older universities, where traces of the same spirit survive to this day in spite of the internationalising influences which have played such an important part in recent scientific work. If Britain played a prominent part in the origination of the metric system, and if Continental nations base their zone system of time on the meridian of Greenwich, no better evidence of the general *national* apathy to science could be adduced than the fact that Britain is one of the few European States which have not yet universally adopted either of these systems.

The last two chapters of vol. i. are devoted to "The Astronomical View of Nature" and "The Atomic View of Nature," while chapters vi. to xii. in vol. ii. deal with the "kinetic or mechanical," the "physical," the "morphological," the "genetic," the "vitalistic," the "psycho-physical," and the "statistical" views of nature. These chapters refer more especially to the second half of the present century, and it is in them that we feel ourselves compelled to single out a few selected points rather than attempt to cover the whole range of subject-matter.

It is well known that many of our leading scientific ideas can be traced back to very ancient sources; as instances, Dr. Merz refers to the law of gravitation and the atomic theory as known to the Greeks and Romans, the kinetic theory as suggested by Heraclitus, the vortex atom theory as forestalled by Descartes and Malebranche (pp. 312–4). In passing judgment on these prior claims, Dr. Merz very rightly remarks:—

"It is the scientific method, the exact statement, which was wanting, and which raises the vague guesses of the philosophical or the dreams of the poetic mind to the rank of definite canons of thought, capable of precise expression, of mathematical analysis and of exact verification." "In every case the awakening touch has been the mathematical spirit, the attempt to count, to measure, or to calculate."

Those who flood our breakfast tables with "new" theories of the ether or designs of flying machines only constructed on paper will do well to bear these remarks in mind.

Let us now examine how Dr. Merz treats the second law and the ideas of temperature and entropy. In commenting on the work of Lord Kelvin and Clausius, he says (p. 128):—

"The result was the doctrine of the 'conservation of energy'—not of heat as Carnot had it—and the embodiment of the two correct ideas contained independently in Carnot's and Joule's work in the two well-known laws of thermodynamics—viz. the conservation, equivalence and convertibility of energy as expressed in the first law and the doctrine of the availability of energy as expressed in the second law."

In speaking of entropy (p. 169) he is no less definite in associating that conception with unavailable energy, and he only falls into a pitfall on p. 594, where he speaks of "entropy (or energy which is hidden away)" as if the two were identical and did not differ by a temperature-factor. But the footnote on p. 189 of Maxwell's "Heat," seventh edition, shows that in this he has erred in good company. In the footnote on p. 315, in discussing the absolute scale of temperature, he is more unfortunate. The scale "in which every one degree had the same dynamical value" was not the *present* absolute scale (which approximates fairly closely to the gas scale), but Lord Kelvin's *first* absolute scale, published in 1848, in which the absolute zero is not $-273°$, but minus infinity.

Of the application of statistical methods to the kinetic theory we can speak equally well in regard to the completeness with which the author has traversed the literature of the subject. We do not find any reference to the underlying *assumption* which has up to the present been unearthed in every attempt to treat the problem mathematically. But this is hardly a point on which anyone but a specialist could be expected to light, and the majority of specialists make the assumption without knowing it (*pace* Burbury's criticisms).

The last chapter but one deals with the development of mathematical thought. We have selected for special examination the portions dealing with Cantor's researches on the transfinite and the continuum, and we find the subject treated in such a way as to present a clear and definite picture to one who has not specialised in this difficult branch of mathematical thought. The last chapter contains a retrospect and prospect.

We must not omit to mention what is, perhaps, as important a feature as any, namely, the footnotes, which occupy a considerable proportion of the whole book, and constitute a kind of historic encyclopædia.

We do not believe in filling reviews with lists of misprints, but the "Racket" (index, p. 800) may perhaps better describe Stephenson's locomotive than its correctly spelt name. A more serious defect is that these two large and bulky volumes have been issued with the pages uncut, and readers have to waste much time in doing what is the proper work of the guillotine before they can begin the book. This want of thought on the part of the publisher (on his own head be it—*i.e.*, the guillotine) constitutes a serious obstacle to the attempts made by scientific workers of the present day in endeavouring to cope with the ever-increasing mass of literature that accumulates before them.

G. H. BRYAN.

THE PROBLEMS OF VARIATION.

Variation in Animals and Plants. By H. M. Vernon, M.D. The International Scientific Series. Pp. ix + 415. (London: Kegan Paul and Co., Ltd., 1903.) Price 5*s*.

THIS little book meets a real want. The frequent discussions of recent years upon the problems of evolution have been followed with much interest by an increasing number of readers and listeners, with the desire but often the inability to understand. A very large amount of interest and stimulus has been excited by such questions as acquired characters and their transmission or non-transmission by heredity, the continuity of the germ-plasm, physiological selection, continuous or discontinuous evolution, De Vries's experiments and views on mutation, the Mendelian hypothesis as opposed to that of Galton and the bearing of the great array of facts, the fruits of observation and experiment conducted by those who take opposite sides in the controversy. The present writer has often been surprised at the keenness of the interest which can coexist with an almost complete lack of knowledge of the essential details, and he feels that the present work provides precisely the information that is required—a clear, accurate, and dispassionate statement, not too long or too detailed, of researches and reasoning upon problems connected with variation.

The notable success of Section D during the late meeting of the British Association at Cambridge provides an excellent illustration of the wide and deep interest excited, at the present moment, by the last of the subjects mentioned above, and was in itself in some measure an answer to the complaint in the presidential address that insufficient attention was paid to the re-discovered discoveries of Mendel. The subject was new to probably a large proportion of the audience: those among them who had taken the opportunity of reading the fourth and fifth chapters (on blastogenic variation) of this work must have felt that they were thoroughly prepared to follow the discussion in all its detail.

The book is divided into three parts, of which the first, dealing with the *facts of variation*, contains three chapters, on the measurement of variation, dimorphism and discontinuous variation, and correlated variation respectively; the second, the *causes of variation*, includes two chapters on blastogenic variations, one on certain laws of variation, and four respectively treating of the effects of temperature and light, moisture and salinity, food and products of metabolism, and conditions of life in general; the third, *variation in its relation to evolution*, is considered in chapters on the action of natural selection on variation, and on adaptive variations.

The author wisely uses the word "hybridisation" very prominently in his account of Mendel's researches and conclusions. In the comparison between the Galtonian and Mendelian views of heredity an important difference is sometimes lost sight of—the present writer does not remember hearing it expressly mentioned, although it was certainly implied, at Cambridge. The former view is, at any rate chiefly, built upon the results of interbreeding between individuals separated by ordinary differences, the latter upon interbreeding between individuals separated by differences comparatively large. "Ordinary" differences are the points of distinction—generally small, mainly differences of degree—by which we discriminate between the individuals of a species forming a single compact mass, or if the species be broken up into two or more masses—then between the individuals within each of them. The larger differences alluded to are the points of distinction—generally large, frequently differences of kind—between the individuals of one mass ("species," "race," or "breed") and those of another, or between the ordinary individuals of a mass and those sudden large departures from its type which are apt to appear spontaneously in its midst. Even when breeds or races are distinguished by a test apparently so superficial and unimportant as colour, we are probably often confronted by the mere outward sign of inward and important distinction.

If the Mendelian view should hereafter be established beyond the possibility of doubt, there will still remain the interesting question of the part it has played in evolution. This is very largely the attempt to decide whether Darwin's earlier or later views were correct, whether evolution proceeds from the selection of large variations, "as when man selects," or from the selection of ordinary individual differences as defined above. The question cannot be discussed on the present occasion, but it is well to bear in mind that however completely the *causes* of evolution in the past may evade our attempts at demonstrative proof, the *history* of evolution is a subject which can be brought to the test. For many years it has seemed to the writer that palæontology can settle decisively whether evolution has been continuous or discontinuous. Those who desire to bring conclusive evidence to bear upon this important controversy would do well to follow the example of Prof. W. B. Scott, of Princeton, who told us at Cambridge that he was "just crazy" over the fossil mammals of Patagonia.

In the last chapter, on adaptive variations, the author would have done well to place in the forefront the warning that a superficially apparent example "of direct adaptation to surroundings in the ordinary acceptation of the term . . . may be the calling up, in response to one of two stimuli, of one of two groups of characters long since acquired by the plant protoplasm." The principle contained in these words should be prominently before the mind of the naturalist who attempts to investigate the response of an organism to its environment. He should remember that the species which he investigates are "heirs of all the ages," thoroughly inured to experimental research, past masters in the art of meeting by adaptive response the infinite variety of stimulus provided by the environment. If he remember this he will always be on his guard against a too hasty interpretation based upon the fundamental properties of protoplasm.

The discussion of the question, are acquired characters inherited? (pp. 351 *et seq.*) is a particularly interesting and suggestive introduction to the subject. A few well chosen examples of the evidence chiefly appealed to in support of such transmission are followed by a brief but well balanced discussion. The author supports the conclusion that the soma, and through the soma the environment, exert a chemical influence upon the germ-cells, and he makes effective use of the "internal secretions" which have marked an epoch in physiological research.

Several examples, generally believed to supply evidence of the "cumulative action of conditions of life" (pp. 352 *et seq.*), would be more satisfactory and convincing if they were re-investigated as a piece of special research. Too often they bear the impress of an off-hand opinion without any secure foundation upon specially directed inquiry. Thus, in the transport of adult sheep or dogs to a different climate, it may be expected that less change will be manifest in the hairy covering of the parent than in that of the offspring which has been born and passed the whole of its life in the new conditions. Thus the appearance, but by no means necessarily the reality, of an accumulated effect may be produced. In order to test the hypothesis of accumulation, it would be necessary to neglect the generation which has been subjected to two very different environments and to determine quantitatively with all possible accuracy the characters of those which follow. The often repeated statements about the telegonic effect of mating "Lord Moreton's mare" with a male quagga, when compared with the results of Prof. Cossar Ewart's researches, prepare us for the belief that many a general impression which has been produced as evidence will collapse when it has become the subject of searching and critical investigation.

In the preface the author speaks with some diffidence of the prominence given to his own researches. Investigations such as those into the effect upon offspring of the relative freshness or staleness of the parental germ-cells would, in any circumstances, be an unfortunate omission from a book on variation. They are, moreover, described in the publications of scientific societies not always freely accessible to the general reader. For another reason also the book would have suffered if these researches had been treated less fully. When the author of a general work is not altogether wanting in the sense of fitness and proportion, the account of his own contributions to science will probably be the salt of his book. These subjects stirred his own enthusiasm for research, and in writing of them he is likely to stir the enthusiasm of others.

E. B. P.

MATHEMATICAL THEORY OF ECLIPSES.

The Mathematical Theory of Eclipses, according to Chauvenet's Transformation of Bessel's Method. Explained and illustrated by Roberdeau Buchanan, S.B. Pp. x+247. (Philadelphia and London: J. B. Lippincott Co., 1904.) Price 31*s.* net.

WHEN a practical man devotes himself to the task of explaining to others the difficulties of any specialised subject on which he has been engaged for many years, the result is likely to be satisfactory. There is always the chance that the prolonged study of one particular subject has had the effect of unduly exalting its importance, with the consequent loss of a proper perspective, and when one sees a comparatively narrow branch of astronomical inquiry, like eclipses, occupying a rather ponderous volume, he may be led to think that the subject has been indiscreetly expanded. We therefore hasten to say that there is no evidence of disproportionate treatment in Mr. Buchanan's book. He himself has been employed for twenty-three years in the office of the "American Ephemeris and Nautical Almanac," and during that time has been responsible for the accurate preparation of the necessary information connected with eclipse prediction. His practical acquaintance with the subject eminently fits him for the task he has undertaken, and his book is a success. The moon's nodes have made more than one complete revolution since he began his work, and an entire series of eclipses has revealed to him their peculiarities and oddities.

The theory of eclipses has been well explained by various astronomers, and practical rules given by some. Hallaschka, in his "Elementa Eclipsium," following the method of orthographic projection, has worked out an example in full. Woolhouse, in the appendix to the "Nautical Almanac" for 1836, not only discussed the subject with great fulness, but gave practical rules for the determination of the phenomena, which for many years were followed in the preparation of the English ephemeris, and perhaps are so still. Bessel gave a more thoroughly consecutive discussion, which Chauvenet followed in his treatise, and this last forms the basis of Mr. Buchanan's work. The practical part of the arrangement does not seem to be easily systematised. A computer finds some difficulty in translating the formulæ into numbers. There are to the uninitiated continual ambiguities about the quadrants; and the manner in which angles are to be reckoned is frequently a stumbling block to the unwary. Perhaps these little difficulties are more noticeable in Woolhouse's method than in Bessel's, but it is with the view of limiting these troubles and of giving a convenient arrangement to the whole of the work that Mr. Buchanan has written his book. In his time he must have met with all the difficulties with which a young computer has to contend, and must have removed these out of the path of many. Knowing these pitfalls, he has done his best to get rid of them by suitable explanations, and probably with success. But those who have conducted pupils through carefully worked examples know only too well that a fresh set of difficulties is apt to reappear with a new case.

The author has divided his book into two parts. In the first he treats of solar eclipses and the method of deriving the various curves which are necessary for the exhibition of the whole circumstances of the phenomenon on a map. Here we get the north and south limits of total and partial eclipses, the position where the eclipse begins and ends with the sun in the horizon, and one can follow the method by which are drawn those weird curves on the eclipse maps that accompany every nautical ephemeris. By way of adding a little lightness to a rather dreary subject, we may notice some curiosities the explanation of which is not very readily seen without the assistance of a competent guide, such as the occurrence of a north limiting curve of totality falling south of the south limiting curve. Ingenuity might construct some further troublesome problems of this nature when the clue is furnished, and one can imagine an examiner exulting over the discovery of such oddities, affording as they do opportunity for worrying unhappy candidates who fall into his hands.

In the second part of the book we have detailed the method of computing the circumstances of lunar eclipses, occultations of stars by the moon, and of the transits of Venus and Mercury. These are practically particular cases of the same problem as that treated in the first part, simplified by certain conditions. In the case of the lunar eclipse, the absolute position of the moon and shadow are independent of the position of the observer on the earth, and therefore the effects of parallax can be treated much more simply. We notice that the semi-diameter of the shadow is increased by the fiftieth part of its amount, in preference to the older estimate of 1/60, but the whole question of semi-diameters is a troublesome one, which will soon have to be treated with great rigour. The occultation semi-diameter is not altogether satisfactory, and some international convention is needed to secure uniformity. From a letter from Dr. Downing, quoted by the author, we gather that the occultation diameter of the moon, as used in the preparation of the English "Nautical Almanac," differs $2''.36$ from that employed in eclipse calculations. But we find a little difficulty in following the author in his reference to authorities. In the matter of lunar parallax, Adams is not quoted, and Lardner's "Handbook of Astronomy," or Proctor on "The Moon," can scarcely be considered original and trustworthy sources.

W. E. P.

ENGLISH FIELD-BOTANY.

Flora of Hampshire, including the Isle of Wight. By Frederick Townsend, M.A., F.L.S. Second edition. Pp. xxxviii+658. (London: Lovell Reeve and Co., Ltd., 1904.) Price 21s. net.

ENGLISH field botanists frequently complain that the British flora has not yet received the careful critical attention which has been lavished on Continental floras. To a certain extent this is doubtless true. We have no manual that for thoroughness of treatment and wealth of reference to original descriptions and type-specimens can compare with Rouy and Foucault's "Flore de France"; at the same time there is an abundance of valuable information scattered through our numerous natural history journals only waiting for some energetic and widely experienced systematist to collate and bring together in a really satisfactory British flora. There are several botanists eminently fitted for such an undertaking, and it is urgently to be desired that one or more of them should take the matter in hand. Meanwhile, our numerous and rapidly accumulating county floras are paving the way to a complete botanical survey of the British Isles.

In Mr. Townsend's "Flora of Hampshire and the Isle of Wight" we have one of the best books of its class, and the work and careful attention expended upon its production must have been very considerable. The volume opens with a chapter on topography and climate. This is followed by an account of the geological structure of the district, including a summary of Mr. Clement Reid's researches on the fossil seeds of the Stone and Silchester beds of the newer Tertiary formation. In his list it is particularly interesting to notice the names of several plants usually regarded as weeds of cultivation, or as colonists, such as *Brassica alba*, Boiss., *Thlaspi arvense*, L., *Linum usitatissimum*, Linn., and also damson and plum.

The now generally approved method of dividing a district into botanical areas according to its river-systems is here in the main followed, and a useful map of the county is appended. Turning to the systematic section—by far the larger portion of the book—so many points call for attention that it is quite impossible within the limits of a short notice to mention more than a few of them. In the section devoted to Ranunculus, what appears to be a satisfactory account of the forms of *R. acris* is given; this will be appreciated by many collectors. The name *Nymphaea alba*, Linn., is retained instead of *Castalia speciosa*, Salisb., which found favour in the eyes of the editors of the "London Catalogue" (ninth edition). *Viola calcaria*, Bab., appears as var. β of *V. hirta*, Linn., though the author admits an inclination to regard it as a starved or stunted form rather than a variety. No mention is made of *V. calcaria*, Gregory, which has been cultivated, and appears to be a good species.

V. canina, Linn., is given as synonymous with *V. flavicornis*, Sm., non Forster, while *V. ericetorum*, Schrader, appears as a hybrid *canina* × *lactea*. All botanists will not find themselves in agreement with Mr. Townsend upon this point, for *V. ericetorum* is sometimes abundant where *V. lactea* is extremely scarce. Perhaps it may be hoped that cultivation will settle the question, especially if it be found that hybrid violas obey Mendel's law of segregation.

The list of Rubi brings the number up to eighty-five, making the county, with one exception, the richest in brambles of any in the British Isles. Some useful notes on the genus Erythræa are given, and the variety *sphaerocephala*, Towns., of *E. capitata*, Willd., is beautifully figured; the author now considers that the plant does not merit a varietal name.

Among the Monocotyledons, the Rev. E. F. Linton's *Orchis ericetorum* is fully described. It appears to be a well marked plant, and the fact that it grows only on heaths while the chalk plant is typical *O. maculata* cannot be said to militate against its claim to specific rank in view of the parallel case of distribution of the two plants included under the name *Valeriana officinalis*, Linn. But here again there may be great virtue in cultivation. It is satisfactory to find the truth told about *Ruscus aculeatus*. The plant with staminate flowers has narrower cladodes than the pistillate plant, and there is no evidence for a narrow-leaved and a broad-leaved variety.

In an appendix appear notes on several plants, amongst which are *Stellaria umbrosa*, Opiz, and *S. media*, Linn. (both of which are fully diagnosed), *Prunus spinosa*, Linn., *P. fruticans*, Weihe, *P. insititia*, Linn., and *P. domestica*, Linn. An account of Murbeck's arrangement of the gentians is given, and all the forms of Euphrasia and Salicornia noted in the county are described. So much matter of general interest is brought together that no field botanist, be he a native of the district or a worker in any other part of the country, can afford to neglect this volume.

SANITARY ENGINEERING.

Small Destructors for Institutional and Trade Waste. By W. Francis Goodrich. Pp. 127. (London: Archibald Constable and Co., Ltd., 1904.) Price 4s. net.

MR. GOODRICH'S book on "Refuse Disposal and Power Production," which dealt with the problems arising in the disposal of civic waste, was recently reviewed in these columns (May 12, 1904, vol. lxx. p. 25); in the present volume the same author treats of the equally important subject of the disposal of institutional and trade refuse, that is, with the design and working of small destructors. The aim has been to make clear the fact that high temperature working is as vital in the small as in the large destructor.

In an introductory chapter Mr. Goodrich lays down the principles which must be observed in the design of small destructors, and he points out that it is possible to operate at a low working cost such destructors when built on modern lines. The weak points in the design of the earlier forms were precisely those which were found in the early forms of large municipal destructors, namely, low temperature system of working, slow combustion, and inadequate and unsatisfactory methods of feeding the refuse into the cells; these difficulties, however, have all been overcome, and at the present day small destructors for use in institutions such as isolation hospitals, hotels, &c., can be obtained as satisfactory in every respect as the large ones now so commonly employed. On account of the unpleasant substances which have to be dealt with in many of these institutional destructors, they are often neglected, and proper supervision over them is not maintained; this leads to the refuse being improperly fed into the destructor; in a good modern type there is no risk of this misuse, as it is impossible to feed the destructor in any other way than that originally provided by the designer.

A number of typical destructors suitable for such institutions are described and illustrated, the drawings being fairly complete. In thinly populated districts it is often advisable to have a portable destructor, and two very successful ones of this type, namely, a Horsfall and a Meldrum, are described. Such portable destructors would be invaluable during campaigns and in our home training-camps. How dangerous the waste from a large camp may become to health was vividly shown during the inquiry by the Royal Commission into the war in South Africa. Many of the medical witnesses expressed the opinion that hundreds of lives might have been saved had the necessary steps been taken to destroy camp refuse properly and to supervise thoroughly the sanitary condition of camps. In America, which, strangely enough, has lagged behind in the adoption of municipal destructors, there has been a considerable development in the utilisation of the smaller forms, both for hospitals and for hotels. The latter portion of the book treats of the disposal of trade refuse, and the author points out how valuable from the point of view of generation of power this trade refuse often is. Such trade refuse can only be burnt in boilers specially designed for fuel of low calorific power, and where the boilers are properly designed there is no difficulty in utilising it. A number of different types of furnaces and boilers suitable for use with trade waste are described and illustrated in these chapters.

The last few pages of the book are devoted to a discussion as to the advantages of disposing of carcases of diseased and condemned beasts by means of suitably designed destructors. The book will be found, like Mr. Goodrich's other books upon this important branch of sanitary engineering, extremely valuable by all who are engaged in dealing with the disposal of solid refuse. T. H. B.

OUR BOOK SHELF.

La Statique chimique basée sur les deux Principes fondamentaux de la Thermodynamique. By E. Ariès. Pp. viii+251. (Paris: A. Hermann, 1904.) Price 10 francs.

Die heterogenen Gleichgewichte vom Standpunkte der Phasenlehre. Zweites Heft, erster Teil. By H. W. Bakhuis Roozeboom. Pp. xii+467. (Brunswick: F. Vieweg and Son, 1904.) Price 12.50 marks.

THE two volumes under review are concerned with the application of thermodynamics to the problems of general chemistry, but are yet so different in material and in treatment that few points of resemblance may be found between them.

In the book by Lieut.-Colonel Ariès the mathematical derivation of the laws of equilibrium from the fundamental principles of thermodynamics are stated in the most abstract and general form with just sufficient exemplification to indicate the bearing of the deductions on the practical work of physical chemistry. The author uses as characteristic function the thermodynamic potential at constant pressure, and it may be said in a word that his deductions are as simple and concise as the case will allow, the introduction of useless conceptions and formulæ being scrupulously avoided. One noteworthy feature which might with advantage be imitated in other works on thermodynamics applied to chemistry is the postponement of the discussion of the perfect gas to a point in the last third of the volume. The student is only too apt in dealing with the involved formulæ of certain cases of chemical equilibrium to introduce unconsciously into his equations some result which has its origin in a consideration of perfect gases, thereby obtaining a simple result apparently general, but in reality not so. The temptation to do this is greatly lessened by the simplification of the perfect gas being delayed until the general formulæ are well developed. The book is well and clearly written, and those interested in mathematical chemistry will be thankful for this lucid exposition of the subject.

The first part of Prof. Roozeboom's book has already been noticed in NATURE. It dealt with the equilibria of systems of one component. The present volume deals with the equilibria of binary systems, though such is the wealth of material that it has been found necessary to reserve the discussion of many systems presenting special features for a subsequent volume. In contradistinction to the work of Colonel Ariès, there is scarcely a mathematical formula to be found in Prof. Roozeboom's treatise; the graphic method is used to the practical exclusion of others. In the present part there are 150 diagrams, chiefly of curves the co-ordinates of which are pressure, volume, temperature, and composition in some combination. As in the first part, the various equilibria are carefully classified according to the nature of the phases involved, and each class is discussed in detail with the most pains-taking completeness, and with full reference to the original sources of the experimental work used in illustration. In general terms the volume may be said to deal with simple solutions, and no one whose interest lies in this direction can afford to dispense with the aid of such a valuable guide to the work already accomplished, and to the theory of the practical work still to be performed. J. W.

The Timbers of Commerce and their Identification. By H. Stone. Pp. xxviii+311. (London: William Rider and Son, Ltd., 1904.) Price 7s. 6d. net.

THIS work is sure to meet with a cordial reception and to be welcomed by all branches of the timber trade. The information contained in its pages is such that only an enthusiast and expert could bring together with the cooperation of others interested in the growth and utilisation of timber in every part of the globe. In all 247 different species are described, even to the minutest detail. In each case the specific name and authority are stated, and, wherever necessary, to avoid confusion, the synonyms have also been added. Then comes a list of the alternative names, or what we might call the common names. It is a well known fact that frequently one and the same kind of timber receives two different names, whereas two totally different species may be known by the same common name. The vernacular names in foreign languages, so far as they are not to be found in dictionaries, have also been quoted. Following this comes a paragraph dealing with physical characters, &c., such as recorded dry weight, hardness, taste, combustion, character of ash constituents, &c. The grain and bark are next described. The following paragraph deals with the uses to which the timber may be put. The colour is also given as a means of identification, and the anatomical characters, as seen in transverse and longitudinal sections, are fully described.

The author seems to have spared no pains in collecting and authenticating the vast amount of information and details necessary for the above purpose. A very valuable feature of the book are the illustrations, numbering 183 photomicrographs, which represent all the genera mentioned in the text, except where a single illustration serves for more than one genus. In most cases the photographs are taken from transverse sections, though in many cases longitudinal sections are also given. It is stated that the scale of magnification is three times the actual size, and is designed to show the appearance of a transverse section as seen by means of an ordinary hand lens. For those desiring further general information about wood a very useful bibliography is given at the end of the book. Also two appendices are added, which respectively describe the method and apparatus for measuring the amount of resistance in timber to impact and the absorption of water by a given area on any surface of a piece of wood.

At the beginning of the book a very interesting chapter, entitled "Practical Hints," is included, which we are sure will be read with much interest and profit by all those who work with wood. The index is a very complete one, and will render the book invaluable as a ready work of reference.

Verhandlungen der deutschen zoologischen Gesellschaft, for 1904. Pp. 252; illustrated. (Leipzig: Engelmann.) Price 11s. net.

THIS valuable publication contains the papers read at the twenty-fourth annual meeting of the society, held at Tübingen on May 24–26, 1904. The congress was opened by an address from Prof. Spengel, in which the society was congratulated on the good work it continued to produce, and especially on recent investigations on the structure of the Protozoa and on the relations of the nucleus to the general mass of protoplasm. To Prof. Blochmann was assigned the pleasant task of welcoming the society to Tübingen. The published papers are sixteen in number, in addition to which were numerous exhibits and demonstrations. Most of the former are of an extremely technical character, and to a large extent interesting chiefly to specialists. Among them we may refer to Prof. A. Brauer's account of recent investigations into the structure of the light-organs of the bony fishes, more especially of the deep-sea forms, in which the question of the relation of these structures to the lateral line system is discussed at considerable length. Dr. von Buttel-Reepen's article on the mode in which the larvæ of the honey-bee are made to assume a particular sex is also one of considerable importance. In the course of a discussion on the zoological system as commonly taught, Prof. H. E. Ziegler emphasises the view that the rhizopod and flagellate animalcules, together with the Sporozoa, form an allied assemblage, while the ciliated animalcules, both as regards the nature of the nucleus and the mode of reproduction, are altogether different. In a fourth important communication Dr. Bresslau amplifies and illustrates his discovery that the marsupium of the marsupials, in place of being a simple organ, is really formed by the amalgamation of a number of small pouches. These pouchlets, which at first form solid ring-like growths of the epidermis, soon begin to degenerate, and are merged in the wall of the marsupium. R. L.

The Optical Dictionary. Edited by Charles Hyatt-Woolf, F.R.P.S. Pp. x+77. (London: The Gutenberg Press.) Price 4s. net.

THIS is an optical and ophthalmological glossary of English terms, symbols, and abbreviations, together with the English equivalents of some French and German terms arranged alphabetically. The meanings are, as a rule, very clearly given, and the book should prove of use to students (especially medical students) who suddenly come upon an unfamiliar term in the course of their general reading. Of course, it must be understood that it is practically impossible to explain properly any scientific term in a line or two, and this is all that is attempted; the meanings given must therefore in most cases be somewhat unsatisfactory. But the book will doubtless succeed in its aim, especially in the translation of foreign terms. As regards accuracy—the *sine quâ non* of a dictionary—we only notice a very few actual errors, *e.g. dioptrically* does not mean *by reflection,* and in the definition of *numerical aperture* the words *refractive index of the medium in which the object is immersed* scarcely indicate that the medium must extend into contact with the objective. *Underlant* is apparently a misprint for *undulant,* and one-third of p. 70 has got into its wrong place.

But these are not very important blemishes, and we cordially recommend the book to those whom it may concern.

Practical Professional Photography. Vols. i. and ii. By C. H. Hewitt. Pp. 126 and 114. (London: Iliffe and Sons, Ltd., 1904.) Price 1s. net each.

THESE two volumes form a very useful addition to the *Photography* bookshelf series, of which they form Nos. 17 and 18. Although the author does not profess to go into any great detail, he gives an excellent account of the necessary requirements of the professional photographer, from the choice of business premises, the handling of customers, book-keeping, &c., down to the packing up of the finished pictures and their dispatch. The chapters on portraiture, composition, and lighting are especially satisfactory, and many a valuable hint is contained therein.

A great number of illustrations accompany the text. and serve the useful purpose of illustrating the author's remarks on many lines of work.

Solutions of the Exercises in Godfrey and Siddons's Elementary Geometry. By E. A. Price. Pp. 172. (Cambridge: The University Press, 1904.) Price 5s. net.

THIS book will be found very useful to all, both pupils and teachers, who use the well known work of Messrs. Godfrey and Siddons. The solutions, 1836 in number, contain not only the deductive, but the drawing exercises, the figures being all such as the pupil is required to construct. We cannot refrain from pleading for a better figure of a hyperbola than that given on p. 143, which a trained eye rejects at once, although it is not essential to the pupil's work.

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.*]

Average Number of Kinsfolk in Each Degree.

MAY I ask you to insert yet another brief communication on the above subject, because private correspondence shows that paradoxical opinions are not yet wholly dispelled? The clearest way of expressing statistical problems is the familiar method of black and white balls, which I will now adopt.

Plunge both hands into a dark bag partly filled with black and white balls, equal in number, and well mixed. Grasp a handful in the right hand, to represent a family of boys and girls. Out of this unseen handful extract one ball, still unseen, with the left hand. There will be *on the average* of many similar experiments, as many white as black balls, *both* in the original and in the residual handful, because the extracted ball will be as often white as black. Using my previous notation, let the number of balls in the original handful be $2d$. Consequently the number in the residual handful will be $2d-1$, and the average number in it either of white or of black balls will be half as many, or $d-\frac{1}{2}$. It makes no difference to the average result whether the hitherto unseen ball in the left hand proves to be white or black. In other words, it makes no difference in the estimate of the average number of sisters or of brothers whether the individual from whom they are reckoned be a boy or a girl; it is in both cases $d-\frac{1}{2}$. The reckoning may proceed from one member of each family taken at random, or from all its members taken in turn; the resultant average comes out the same.

This, briefly, is my problem. FRANCIS GALTON.

On the State in which Helium Exists in Minerals.

IN 1898 I published in the *Proceedings* of the Royal Society the results of some experiments on the evolution of gases from minerals on heating them. I succeeded in proving that the hydrogen and carbon monoxide in the gases could be accounted for quantitatively by the reduction of water vapour and carbon dioxide by ferrous oxide, or by similar substances, and that, except in cases in which cavities could be proved to exist, the evolution of a gas from a mineral implied chemical change at the moment of heating. In the cases in which helium was evolved on heating a mineral, I pointed out that by the action of heat it is possible to obtain only half the helium, though the evolution of this gas never really ceases, but only becomes very slow. This I took to be evidence of the existence of a chemical compound of helium with some constituent of the mineral.

Recently (*Trans.* Roy. Dublin Soc., 1904) Mr. Moss has shown that by grinding pitchblende *in vacuo* helium is evolved, and considers this result as certain evidence of the existence of the gas in the free state in cavities. Since, however, helium is evolved, though slowly, from the crushed mineral at a temperature not above 300° C., the liberation of the gas in Mr. Moss's experiment may be attributed to local heating set up in the process of grinding.

In view of recent discoveries it appears to me that both of us have been on the wrong track in looking for an explanation of the phenomenon. As Sir William Ramsay and Mr. Soddy have shown, the presence of helium in the minerals may have resulted from the decomposition of radioactive matter, formerly present in them. Recently Dr. Jaquerod, of Geneva (*Comptes rendus*, 1904, No. 20, p. 789), has found that when helium is heated in a quartz bulb to a temperature above 500° C. the gas passes out through the quartz with a velocity which increases with the temperature. At 1100°, in a comparatively short time the pressure in the bulb fell considerably below that of the atmosphere. Hydrogen appeared to behave similarly.

This experiment shows that quartz, and probably substances of the nature of the minerals we are considering, though impermeable to helium at low temperatures, become permeable at moderately high temperatures, and furnishes us with a solution of the second part of our problem.

I think that we are now justified in assuming that the helium, a product of radio-active change, is present in the minerals in a state of supersaturated solid solution; that the mineral substance being impermeable to the gas at ordinary temperatures, the velocity with which equilibrium is established between the helium in solution and the helium in the gaseous phase is infinitely small, but increases very rapidly with rise of temperature; that as the solubility of helium in the mineral substance is probably very small, the mineral cannot be made to re-absorb the gas. Grinding even to an impalpable powder, if unaccompanied by local heating, should result in the evolution of minute quantities of helium only.

I may point out in conclusion that the "deflagration" which takes place when "fergusonite" is heated, and was taken by Sir Wm. Ramsay and myself to indicate the presence of a chemical compound of helium, also takes place in the case of some minerals which contain no helium.

University College, Bristol. Morris W. Travers.

The Pollination of Exotic Flowers.

In connection with Prof. Groom's article on the pollination of exotic flowers (November 10, 1904, p. 26) the following notes may be of interest. The inflorescence of *Marcgravia Umbellata* is described in Schimper's "Plant Geography," where Belt's description is quoted from the "Naturalist in Nicaragua." The plant is common here, climbing to the summit of the forest trees, and is frequently visited by humming birds. The bird settles on the top of the flowers and inserts its long curved beak into the pitchers below to suck the sweet juice which they contain. I have not seen insects visiting the flowers, neither have I found them in the pitchers, and conclude that the birds are attracted by the sweet juice itself rather than by insects in search of it as Belt suggests.

Flowers with strong scent and brush-like stamens are very common, and one of them, the Pois Doux (*Inga laurina*), is surrounded when in blossom by a motley crowd of bees, large beetles, and insects of every description, as well as by humming birds of several species. The latter certainly visit very different plants, but are most familiar hovering round the banana flowers, sucking the drops of sweet liquid continually oozing from them.

Flowers like the Pois Doux are easily destroyed by heavy rain, and blossom only for a short period. A large number of others are provided with horned stamens, with barren anthers or anther lobes. May not this be a protection against loss of pollen by rain and wind, it being kept in a sheltered situation, and only set free when an alighting insect moves the stamens? It would be interesting to observe how far the abundance of flowers with horned stamens is correlated with heavy rainfall and constant wind.

Dominica, December 13, 1904. Ella M. Bryant.

Reversal of Charge in Induction Machines.

I have tried Mr. G. W. Walker's experiment with a small Wimshurst, with 8″ plates, and find that the reversal he mentions generally takes place, but not always. In my case, however, the machine is made so as to excite either way, and the reversal will not take place unless excitation has occurred while the motion is reversed.

R. Langton Cole.

Sutton, Surrey, January 6.

EVIL SPIRITS AS A CAUSE OF SICKNESS IN BABYLONIA.[1]

In a former number of Nature (vol. lxix., p. 26) the attention of our readers was directed to the appearance of the first volume of a work which Mr. Campbell Thompson, of the British Museum, was devoting to the consideration of the important function which devils and evil spirits were believed to play in the production of disease by the early inhabitants of Babylonia. It was impossible at that time to state the final conclusions at which Mr. Thompson had arrived, for the publication of his work was not completed; but now that we have the second volume in our hands our readers are in a position to judge for themselves of the character and importance of the results, which have now been clothed in the dress of a modern language for the first time. The sources of such results, we need hardly say, are the terra-cotta tablets of the royal library at Nineveh, now preserved in the British Museum, and after a careful examination of Mr. Thompson's volumes we are able to say that the translator has done his best to reproduce the meaning of the documents which he places before us without unnecessary comments or theories.

It must be said at the outset that we do not regard Mr. Thompson's work as final in all particulars, for in respect of many Assyrian texts this work is the *editio princeps*; but none can fail to be pleased with the manifest honesty of the translations, which quite justifies us in overlooking the baldness and crudity of expression which sometimes characterise them. In studies of this kind we want the texts and the best rendering of them possible, but the most important point of all is that the editor should not read meanings into the words of his texts or twist them to suit preconceived notions. It goes without saying that Mr. Thompson's translations will not be accepted by other labourers in his field without reservation. Indeed, we may note in passing that M. Fossey has already animadverted upon them in the *Recueil de Travaux*, in the *Revue Critique*, and in the part of the *Journal Asiatique* just issued. It is no part of our duty here to attempt to vindicate Mr. Thompson's renderings or to belittle M. Fossey's knowledge of the science of ancient magic, but it must in common fairness be stated that the latter *savant* is not skilled in dealing with cuneiform documents except through the medium of the copies of other scholars who have been trained in making transcripts direct from the original tablets, and the mere fact that he condemns Mr. Thompson's derivations from the Syriac proves that he does not comprehend the importance of one northern Semitic dialect in helping to explain another. On the other hand, Mr. Thompson has spent some years in the task of copying the various classes of tablets which he is now editing and translating, and though some may admire M. Fossey's tempting renderings, and prefer them to those of Mr. Thompson, it should be remembered that the translations set forth in the volume before us are those of the skilled workman who is working at his trade, whilst those of M. Fossey are the product of a student of magic and religion in general.

The groups of tablets published by Mr. Thompson are five in number. The first are inscribed with exorcisms and spells which are directed against the disease of ague or fever; the second contain charms and incantations which were intended to do away with headache; the third deal with a series of diseases of an internal character, but it cannot at present be said exactly what those diseases were; the fourth are inscribed with texts written with the view of destroying the "taboo" to which, it seems, man was thought to be peculiarly liable; and the fifth supply descriptions of supernatural beings, among whom may be mentioned a creature who was half woman and half snake. Mr. Thompson identifies her with the goddess Nin-tu, who was the Babylonian equivalent of the Egyptian goddesses Hathor, Isis, Mer-sekert, &c., and the Virgin Mary among Oriental Christian peoples. Like each of those goddesses she was a form of the World-mother, or chief Mother-goddess who plays such an important part in many mythologies. By way of supplement, Mr. Thompson has added the

[1] "The Devils and Evil Spirits of Babylonia." By R. Campbell Thompson. Vol. ii. Pp. liv+179. (London: Luzac and Co., 1904.) Price 12s. 6d. net.

translation of an ancient prescription for curing the tooth-ache. The sufferer was ordered to mix some beer with oil and with another unknown ingredient, and, having rubbed it on his tooth, he recited the following words three times:—"When Anu had created the heavens, the heavens created the earth, the earth created the rivers, the rivers created the canals, the canals created the marshes, the marshes created the Worm, which came and wept before Shamash and cried out before Ea, saying:—'What wilt thou give me for my food? What wilt thou give me to eat?' To this the Sun-God replied:—'I will give thee dry bones and scented . . . wood.' To this the Worm made answer:—'Of what use are dry bones and scented . . . wood to me? Let me drink between the teeth and let me be at the gums, that I may drink the blood of the teeth and sap the strength of the gums, then shall I be master of the bolt of the door.'" When the patient had said the above, he was ordered to address the Worm and say, "May Ea smite thee with

FIG. 1.—Bronze animal-headed figure of one of the Babylonian Powers of Evil. From "The Devils and Evil Spirits of Babylonia."

the strength of his fist, O Worm!" We can only hope that these potent words relieved the sufferer.

The bulk of Mr. Thompson's present volume is, of course, occupied with the transliterations and literal translations of the documents of which he treats; but, as these are manifestly intended for the expert in cuneiform only, we may briefly note the summaries of their contents, which appear in the preface. The texts which refer to words of power show that they possessed much in common with a similar class of document found in Egypt and elsewhere. The Sumerian magician having found out the name of the devil which caused the sickness he was called upon to cure, proceeded to deal with it by means of sympathetic magic. He employed ceremonies of various kinds, in which magical figures, loaves of bread, pieces of hair, water, a virgin kid, &c., played prominent parts. Sicknesses could be transferred to the dead bodies of kids and pigs, and devils could be made to disappear into masses of water collected in pots, whereupon the vessels themselves would break. In Sumer and Accad knotted cords were much used for purposes of witchcraft, and knotted locks of hair were held to be all-powerful. The section which treats of the ban and taboo is especially suggestive, and we hope that Mr. Thompson will say more on these subjects when he has collected a larger number of examples. Finally, he directs attention to the existence of the word "*Kuppuru*," which is the equivalent in meaning to the Mosaic idea of "atonement," and the texts printed in the volume before us show conclusively that the acts which formed the atonement removed the taboo which man had incurred. The Sumerian ceremonies of atonement were certainly developed out of sympathetic magic, and the examples of atonement given in the Bible show that the ceremonies mentioned were, in more than one case, closely connected with primitive Hebrew magic. Those who are interested in the study of magic in all its forms will find Mr. Thompson's book of considerable interest and importance.

SPEECH CURVES.

AN interesting lecture[1] was recently delivered in the psychological institute of the University of Berlin by Prof. Scripture, of the University of Yale, whose investigations in phonetics are well known. Prof. Scripture's method is that first employed by Fleeming Jenkin and Ewing, and afterwards developed by Hermann, the writer and others, namely, to record on a moving surface, either by photography or by a direct system of levers, the curves imprinted by speech on the cylinder of a phonograph or on the disc of a gramophone. Dr. Scripture has recently improved the mechanism of his apparatus so as to obtain an amplification of the curves, about three times in the horizontal and three hundred times in the vertical direction, while the speed of the movement of his gramophone plate was reduced 126,300 times that at which it rotates during the acoustical reproduction of the sound. His curves have been submitted to analysis, and it shows the energy with which the research is being prosecuted when he is able to state that in America he has twenty persons engaged in this special bit of work.

In the discussion of his results, Prof. Scripture, in the first instance, refers to some remarks by Prof. Sievers, of Leipzig, on what may be called the "melody" of vowels and words. Prof. Sievers says that each line and verse of a poem has its own melody, and that this will be determined by the psychological condition of the individual at the time of its vocal expression. An author, too, while writing a poem, say one of a dramatic character, may give a certain "melody" to the expressions of one individual. Goethe, for example, causes Faust to drop his voice at the close of a sentence, while the voice of Mephistopheles rises and falls in a variable manner. Sievers also points out, as a curious fact, that when Goethe completed the poem, many years after he wrote the earlier portions, he had forgotten these melodic effects, and the later portions have not the same melodic characteristics. Prof. Scripture supports Prof. Sievers's view. This melodic character will thus affect the quality of a vowel sound.

Prof. Scripture holds that the movement of the vocal cords does not produce a sinuous curve, and herein he agrees with Marage, of Paris. By the movements of the cords a number of sudden and more or less violent shocks are given to the air, and each shock is communicated to the air in the resonators. In this way

1 "Über das Studium der Sprach Kurven." By E. W. Scripture. *Annalen der Naturphilosophie*. (Leipzig: Veit and Co.).

we can interpret the groups of marks made on the wax cylinder of the phonograph. Each group corresponds to a "shock" from the cords, and the smaller curves making up the group are due to the movements of the air in the resonators. Prof. Scripture is not satisfied with the theory of Helmholtz that the resonators develop overtones in a harmonic series, nor with that of Hermann, who asserts that the resonance tones need not necessarily be harmonic. He states that he cannot interpret his tracings by the rigid application of either of these theories, and he lays stress on the fact that the walls of the resonating cavities above the cords are not rigid like the resonators of musical instruments, but are soft, as if the wall were fluid. Such a resonator, he says, will give its own tone in response to all tones. We confess that here we are not able fully to comprehend the author's meaning.

Prof. Scripture endeavours also to establish a close relationship between the form of the vibration of the cords and the action of the resonators. According to him, the form of the vibration of the cord may be altered by changes in the action of the muscular fibres that tighten the cord, so as to produce a tone of a given

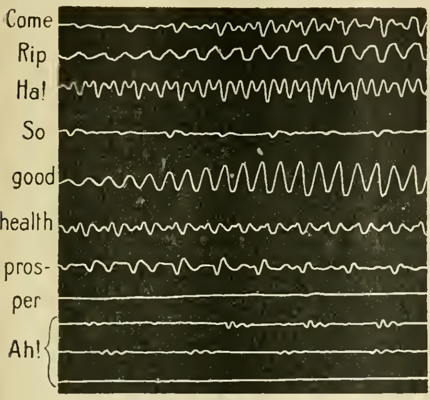

FIG. 1.—Curves of Rip van Winkle's Toast, spoken by the American actor, Joseph Jefferson.

pitch. Assuming that each muscle fibre has a separate nerve fibre (which is highly improbable), one can see that the tension of the cords, even when adapted to the production of a tone of a given pitch, might be so modified as to give out a tone-wave of a special form, and that thus an almost infinite variety of qualities of tone (tone-colours) might be produced. The special quality of tone would thus in the first instance depend on the psychical condition of the individual at the moment. In the next place, according to Prof. Scripture, the "water-wall" resonators, as he calls them, will develop their own tones, independently of the cord-tones, and thus, again, by a summation of these tones, the quality of the vowel-tone may be almost infinitely varied. In this way there is a *physiological* association between the movements of the cords and the action of the resonators.

Prof. Scripture also notes that each vowel has its own harmony, depending on the resonators, and that if it is sounded for even a short time its "melody" may change. This is why it is that when we examine the waves corresponding to a vowel as transcribed from the gramophone they are often seen to change in character as we approach the end of the series of waves. The writer can corroborate this view from his observations by his own method of recording directly the vibrations of a phonograph recorder on a rapidly moving glass plate.

Prof. Scripture also points out a fact that was soon apparent to all observers in experimental phonetics, namely, that in the records of the phonograph or gramophone there are neither syllables nor intermediate glides, but a succession of waves, infinitely diverse in form, corresponding to the tones of the voice or the sounds of any musical instrument. The sound of a single vowel may be in a groove a metre long on the wax cylinder of the phonograph, and in the bottom of this groove there may be thousands of little groups of waves. The writer possesses records of songs that if drawn out would be 100 metres in length. Finally, Prof. Scripture lays emphasis on the effect of varying intensity as influencing quality. Apart from the theory of vowel-tones advanced by the author, this interesting lecture owes its value to the way in which Prof. Scripture approaches the problem from the physiological and psychological side. The mode of production of vowel-tones is in this sense not entirely a physical problem. We are dealing with living cords moved by living muscles, and with curiously shaped resonators having living walls.

JOHN G. MCKENDRICK.

GEOLOGY OF SPITI.[1]

THERE are spots, insignificant in themselves, which have a world-wide celebrity among those interested in certain pursuits or investigations. Such is Gheel to the alienist, Shide to the seismologist, or Bayreuth to the musician, and such, too, is Spiti, a barren and sparsely inhabited valley in the centre of the Himalayas, which has long been known to geologists for its extensive series of richly fossiliferous rocks. A district like this could not long escape the notice of the Geological Survey of India, and one of the earliest volumes of its memoirs is that by Dr. F. Stoliczka and F. R. Mallet. Published in 1864, this remained the standard, and practically the only, description of the geology of Spiti until the publication, in 1891, of Mr. C. L. Griesbach's memoir, in which, while adopting his predecessors' mapping in the main, he introduced great modifications in the sequence. Neither of these descriptions, however, is entitled to rank as more than a reconnaissance, but now we have the results of what may fairly be described as a survey of this region, and, in an interesting and clearly expressed memoir, Mr. Hayden has gone far towards clearing up the points which were in dispute. In all cases where he has found himself at variance with his predecessors' conclusions he has produced good evidence, and it is in one way satisfactory that he is generally in agreement with the one who can no longer defend his views.

The Spiti valley contains representatives of every series from Cretaceous to Silurian, and a Cambrian age is inferred for a series of sedimentary, but unfossiliferous, beds underlying the latter. In all these Mr. Hayden not only collected from known, but also discovered several previously unknown, fossil-horizons, among the most interesting of which we may mention that of the land plants of Culm age. In the Silurian he has restored Stoliczka's correlation and fully supported it by fossil evidence; on the other hand he has confirmed Mr. Griesbach's discovery of Lower Triassic beds, and his conclusion that there is, in Spiti, a continuous conformable sequence from Permian to Upper Trias, and in this connection has rendered ample

1 "The Geology of Spiti, with Parts of Bashahr and Rupshu." By H. H. Hayden. (*Memoirs* of the Geological Survey of India, vol. xxxvi, part i.). Pp. vi+129; illustrated (Calcutta: Government Printing Office, 1904.)

acknowledgment of the work of the late Dr. A. v. Krafft, by whom it had been intended that the description of the Triassic rocks should be undertaken.

A chapter is devoted to the correlation of the unfossiliferous sequence of the outer Himalayas with that in Spiti, and an impartial account is given of the guesses—they are nothing more—which have been made. Mr. Hayden does not attempt to deliver judgment on this vexed question, but seems inclined towards Dr. Stoliczka's view; in this we think that he has not taken sufficient account of what may be called extra-Himalayan considerations. The differences between Spiti and the outer Himalayas, the long sequence of fossiliferous rocks in the one, the complete absence of fossils in the other, seem to admit of only two explanations—either the rocks of one area are unrepresented in the other, or the conditions of deposition were so dissimilar that lithological similarity in the two areas is not to be looked for, and either supposition precludes all hope of direct correlation.

Fig. 1.—Muth Quartzite at Head of Teti River, Bashahr. 6, Daonella Shales; 5, Muschelkalk; 4, Lower Trias; 3, Productus shales; 2, Muth Quartzite; 1, Silurian limestone. From "The Geology of Spiti."

The memoir is indexed and illustrated by plates, several of which are reproductions of photographs by the author; it bears the stamp of careful work, and is worthy of the reputation of the Geological Survey of India. We regret that we cannot say as much for the method of stitching adopted by the Calcutta Government Press; the book may be re-bound, but the torn and mangled leaves can never make a seemly volume.

SIR LAUDER BRUNTON ON THE NEED OF PHYSICAL EDUCATION.

The report of the inter-departmental committee on physical deterioration, while in the absence of scientifically ascertained data it hesitated to pronounce the evil it investigated to be widespread, has pointed us all to a better way, and Sir Lauder Brunton in these two addresses[1] drives home the lesson.

In speaking at Cambridge to the Head Teachers' Association on the National League, which owes its inception to his statesmanlike grasp of the psychological moment at which to enlist the sympathy and interest of the nation, half alarmed, half repentant of its easy optimism and *laissez-faire*, Sir Lauder Brunton went direct to the point—

How can we alter most surely and speedily those conditions which tend to physical deterioration?

The answer lies in a nutshell. By training the young to open-air work and play, to care of teeth and exercise of muscles, the girls in preparation of appetising food, the boys in such drill as will make them real defenders of their country.

We may not go so far as Sir Lauder in his belief in the educative value of the wall picture of the ravages of the tubercle bacillus—we remember the fearful joy with which we contemplated a ghastly picture of volcanic colouring which an old lady assured us was an accurate delineation of a drunkard's stomach—nor do we think his picture of the country cottage altogether accurate; but he has seized the fact that the master of the situation is the teacher, and to the teacher he turns, confident in his zeal, his devotion, his stimulating propaganda, his patient training, confident, too, in the plastic material our schools bring to his hand.

To another large class of workers in the public service, the medical officers of health, Sir Lauder Brunton also appeals. He pointed out to the Incorporated Society that physical efficiency is more than doubtful in the mass of people even if physical deterioration is unproved.

For accurate data as to height and weight, growth and physical development of the youth of the nation, we must look to the teachers in daily touch with them. Such data have hitherto been conspicuous by their absence, but once in existence they will enable the statesman and statistician alike to realise the problem they have to solve.

This involves periodical measurement, and to render their task effective the teachers will need instruction, and the most likely person to be called in to give that instruction is the M.O.H. Without trenching on the medical profession the teacher may learn from them to detect signs of fatigue or mental strain, to note defective vision and physical weakness, all of which too often escape notice until irremediable mischief is done.

Sir Lauder Brunton dwelt on the question of the milk supply, the feeding of underfed school children, and the housing question, and warmly endorsed the committee's recommendation that the medical officer of health should have security of tenure in view of the local jealousies he may arouse, the local prejudices he may cross. Discussing the report, Sir Lauder Brunton approved the desire for a Board of Health to undertake some of the duties of the over-worked Local Government Board; failing such a board, he cordially welcomed the idea of an advisory council for matters concerning the national physique, such council to consist of representatives of the Departments of State reinforced by men of science and by experts in questions of health and of physical development.

He is assured of the readiness of the medical profession to do their part in the educative work; he believes in equal readiness of the teachers to learn and teach what it is of vital importance the coming generation should acquire, not only theoretically, but practically—a knowledge of the laws of health.

The National League for Physical Education and Improvement has so far been mainly confined to the medical profession, but now that its aims are focused and defined Sir Lauder looks to a wider public. He

[1] January 5.—National Federation of Head Teachers' Associations, "The Proposed National League for Physical Education and Improvement." January 6.—Incorporated Society of Medical Officers of Health, "The Report of the Inter-Departmental Committee on Physical Degeneration."

hopes that before long not only every medical officer of health and every school teacher, but every man and woman who knows what is needed, will join its ranks. Thus will be formed that body of enlightened public opinion which is the moving power in every reform worked, in every advance made by nation, district, or parish, and thus the gospel of physical culture and healthy environment may win its way to every British home. No more patriotic work can be imagined, even though "the foes be they of our own household."

NOTES.

THE council of the Geological Society of London has decided to award the medals and funds this year as follows:—Wollaston medal to Dr. J. J. Harris Teall, F.R.S.; Murchison medal to Mr. Edward John Dunn, of Melbourne; Lyell medal to Dr. Hans Reusch, director of the Geological Survey of Norway; Bigsby medal to Prof. J. W. Gregory, F.R.S.; Wollaston fund to Mr. H. H. Arnold-Bemrose; Murchison fund to Mr. H. L. Bowman; and Lyell fund to Mr. E. A. Newell-Arber and Mr. Walcot Gibson.

ST. MARGARET'S BAY, Dover, where great falls of cliff frequently occur, was the scene of another landslip on Tuesday, January 10, when an enormous slice of the cliff, estimated by the coastguard at about a quarter of a million tons, fell into the sea. The fall occurred a little to the eastward of the bay, where the cliff is about 250 feet high. When the fall took place, about 9.30 a.m., it is said that a very sharp earth tremor was felt throughout the village, and was at first believed to be an earthquake. A further fall occurred at noon. As the result of these landslips a gap about 200 feet wide and 50 feet deep appears in the cliff. The débris at the foot of the cliff covers a large area with some very large fragments of rock. The mass is 20 feet or 30 feet high, and extends seawards about a quarter of a mile.

WE learn from the *Times* that an International Archæological Congress will be opened at Athens by the Crown Prince of Greece on April 7. The opening meeting will be held in the Parthenon, and M. Carapanos, the Minister of Public Instruction, will address the members of the congress. The director of Greek antiquities and the directors of the foreign schools will give an account of the progress of archæological research in Greece. The congress will be divided into seven sections:—(1) classical archæology; (2) prehistoric and oriental archæology; (3) excavations, museums, and preservation of monuments; (4) epigraphy and numismatics; (5) Byzantine archæology; (6) instruction in archæology; (7) geography and topography.

A SLIGHT earthquake shock which lasted a few seconds was felt at Gibraltar on January 7, at 5 a.m. No damage was done. The disturbance was also felt in the Spanish towns of Algeciras, Campamento, and San Roque. At La Linea there were two severe shocks, each lasting about five seconds, the first occurring at 4.40 a.m., and the second at 4.52 a.m.

ON Tuesday next, January 17, Prof. L. C. Miall will begin a course of six lectures at the Royal Institution on the "Structure and Life of Animals." The discourse on Friday, January 20, will be delivered by Sir James Dewar on "New Low Temperature Phenomena," and on January 27 by Dr. E. A. Wilson on "The Life of the Emperor Penguin."

WE regret to see the announcement of the death of Mr. G. W. Hemming, K.C., in his eighty-fourth year. In addition to contributions extending over many years to various magazines and periodicals, he was the author of a "Differential and Integral Calculus," which appeared in 1848, and also of a work entitled "Billiards Mathematically Treated" (1893), of which a second edition was recently published.

THE death is announced of Mr. Robert Harris Valpy at the advanced age of eighty-five. Although a keen geologist, he published very little, but he made a very fine collection of fossils from the Devonian rocks of North Devon, and his assistance was acknowledged in the late Mr. Etheridge's work on the "Physical Structure of West Somerset and North Devon" (1867). Mr. Valpy was the author of "Notes on the Geology of Ilfracombe and the Neighbourhood," published anonymously by Twiss and Sons, of Ilfracombe.

THE first award of the Henry Saxon Snell prize will be made this year by the Royal Sanitary Institute. The prize was founded to encourage improvements in the construction or adaptation of sanitary appliances, and is to be awarded by the council of the institute at intervals of three years. The first prize, which will consist of 50*l*. and a medal of the institute, is offered in the year 1905 for an essay on "domestic sanitary appliances, with suggestions for their improvement." Essays must be delivered on or before March 30, addressed to the secretary of the Royal Sanitary Institute, 72 Margaret Street, W.

THE Association for Maintaining the American Women's Table at the Zoological Station at Naples and for Promoting Scientific Research by Women announces the offer of a third prize of 200*l*. for the best thesis written by a woman, on a scientific subject, embodying new observations and new conclusions based on an independent laboratory research in biological, chemical, or physical science. The theses offered in competition are to be presented to the executive committee of the association, and must be in the hands of the chairman of the committee on the prize, Mrs. Ellen H. Richards, Massachusetts Institute of Technology, Boston, Mass., before December 31, 1906. The prize will be awarded at the annual meeting in April, 1907.

THE death is announced of Mr. Beauchamp Tower, who was associated for some years with Mr. W. Froude, F.R.S., in the experiments made for the Admiralty on the models of ships and on full-sized vessels and engines of the Navy, from which experiments much of the present knowledge of the scientific design of ships has been derived. While working as a consulting engineer, says the *Times*, Mr. Tower developed several ingenious inventions, notably a machine to carry out Mr. Spencer Deverell's idea of obtaining work from wave motion, the well known "spherical" steam-engine, largely employed for some years where high rotary speeds were needed, a centrifugal pump revolution indicator for ships, and a gyroscopic steady platform for guns at sea, all of which afford good examples of originality and scientific acumen. He also undertook for the Institution of Mechanical Engineers, and carried to a successful issue, an extremely complete series of experiments on friction, by which much new knowledge on the subject was gained.

LONDONERS probably began to realise that the electrification of the "underground" railways was nearing completion when, last week, a partial electrical service was started on the section of the lines running from Baker Street to Harrow and Uxbridge. This marks the first step in the change which will be carried out by degrees over the whole system, the electrical trains being at first run in place of some only of the regular trains, their numbers being increased until eventually the complete service is electrical. When this has been effected, and the steam trains entirely displaced, the cleaning of the stations and tunnels will be taken in hand; it is not until this is complete that the public will derive the full benefit of the alteration, so it is to be hoped that no difficulties will be experienced to cause delay. It has been no small undertaking to prepare everything for the conversion of these lines, and the actual change itself must necessarily be carried out with care, especially as it has to be effected without interruption of the traffic.

M. H. BOURGET, of the University of Toulouse, writes to ask what is the form of the surface of a fowl's egg, and if precise measures have been made of eggs in order to determine whether the shape is constant and approaches that of any known geometrical figure. In reply to this inquiry, Prof. G. H. Bryan, to whom the matter was referred, remarks:—"I believe it is generally recognised that the shape of the meridian section of an egg is most approximately a Cartesian oval, that is, a curve given by the equation $ar_1+br_2=c$, where r_1 and r_2 are distances from two fixed points. For $a=b$ this becomes an ellipse, but with a and b unequal we get a figure with one end more rounded and one more pointed, very like an egg. But anyone who tried to find mathematical equations for the curves occurring in the forms of organic life would have a difficult task, especially if he were to tackle the Diatomaceæ. It should also be remembered that the number of curves which have an equation is infinitely small compared with the number of curves that cannot be so represented."

THE annual report of the Russian Geographical Society for 1903 has only just reached us. Among the scientific explorations accomplished during the year we notice the explorations of Lake Balkhash by M. L. S. Berg, of Lake Kosogol by M. V. S. Elpatievsky, of Lake Ladoga by M. J. M. Shokalsky, and of various lakes in European Russia, as also of Lake Gokcha, by several students under Prof. D. N. Anuchin. M. V. I. Lipskiy has continued to study the flora of Central Asia, in connection with his forthcoming work on this subject, and has made for this purpose interesting journeys in the Tian-Shan, while the range of Peter I. has been further explored by M. V. Th. Novitzkiy. The botanist, M. J. N. Voronoff, explored north-western Mongolia, M. N. B. Grinevetskiy the flora of Transcaucasia, V. A. Faussek the Transcaspian fauna, and V. E. Petersen the Lepidoptera of the Urals. A journey in the Pechora region, by P. P. Mataftin, is also worthy of notice. Several expeditions—Dr. Zarudnyi in Persia, Syeroshevskiy, explorer of the Ainos, in Yezo, Karskiy in White Russia—were at work during the same year, as also the committee for the scientific collection of folk-songs, with their music.

AT the meeting of the Institution of Civil Engineers held on January 10 Sir William White, K.C.B., delivered an address on the recent visit of the institution to the United States and Canada. He described the visits made to the principal engineering works in New York City and district, to those in Canada, and to similar enterprises in Chicago. In Canada, many opportunities were afforded to see examples of the utilisation of water power, and no one could fail to realise the enormous possibilities of development in the pulp and paper industry, with cheap power and a good supply of labour. The visitors were informed that within a few miles of Ottawa there is 200,000 h.p. of water power, and within a radius of forty-five miles nearly a million horse-power. At Niagara on the Canadian side three new undertakings are being rapidly advanced, together giving more than 400,000 h.p., while a fourth will yield 40,000 h.p. When these are completed the grand total of power derived from Niagara on both sides of the river will be about 700,000 h.p. These particulars were followed in the address by an account of the International Engineering Congress at St. Louis organised by the American Society of Civil Engineers. Concluding, Sir William remarked that there can be no doubt but this visit enabled American and Canadian engineers to give practical proof of their fellowship with British engineers. The visit must tend to strengthen the friendly feeling already existing between the United States and the British Empire. It must result also in a better understanding between the mother-country and Canada.

A VALUABLE report by Dr. Musgrave and Mr. Clegg on pathogenic amœbæ, the cultivation of amœbæ, and amœbic dysentery, has been issued by the Bureau of Government Laboratories, Manila (No. 18, 1904). It is considered that all amœbæ are, or may become, pathogenic. Pure cultures of amœbæ were obtained by a modified plate culture method, but it was not found possible to cultivate the organisms unless bacteria were present in the cultivations, and the amœbæ were often found to exhibit a preference for certain species of bacteria.

THE United States Department of Agriculture has added to its valuable memoirs on food and diet a report by Messrs. Woods and Mansfield on the food of the Maine lumbermen (*Bulletin* No. 149, 1904). These men perform hard manual labour, and are much exposed to cold, wet, and hardship, and the staple daily fare consists of pork or beef, sour dough biscuits made of dough which undergoes fermentation with a "wild" yeast, tea and molasses, and beans which are first parboiled in the forenoon, and are then packed with alternate layers of salt pork in a pot which is covered with hot ashes and earth, and allowed to cook over night. It is considered that the dietary, as regards protein and energy, is the highest yet recorded for any American labouring men, is well digested, and costs about 23·5 cents per person per diem.

WE have received a copy of the third and final part of a "Catalogue of Canadian Birds," by Mr. J. Macoun, issued by the Geological Society of Canada, which deals with such families of the Passeres as were not included in the preceding part. Owing to the fuller knowledge of the habits of most of the birds recorded in this part, as compared with those in its predecessors, a larger amount of space is devoted to the majority of the species, thereby enhancing the value of the work. Otherwise the method of treatment is the same as that adopted in parts i. and ii., which have been previously noticed in our columns.

IN the eighteenth annual report of the Liverpool Marine Biology Committee, dealing with the new biological station at Port Erin, Isle of Man, the director deplores that while there have been more students than in any previous year (who have worked harder than their predecessors) and more investigators engaged on original work, to say nothing of the success of the public meetings and the excellent result of the fish-hatching, yet the number of subscribers does not increase; and, in truth, the list of subscriptions to such an admirable institution is but a pitiful one—a total of 89*l.* 3*s.* 6*d.* The marvel, indeed, is how so much good work is accomplished and the establishment kept in going order on an income of 176*l.* 14*s.* 1*d.* Apparently, however, there must be some other fund for the up-keep of the building, as there are no items in the account for caretaker's wages or for repairs. The committee has been unfortunate in losing several influential friends and supporters, among them Dr. Isaac Roberts, during the past year, and regret is expressed that it becomes increasingly difficult to find men of the same stamp among the younger generation to fill their places. The report is illustrated with figures of the early stages of the development of the lobster and of the plaice. Although plaice-hatching was fairly successful, results were by no means so good as regards the rearing of lobsters. After one failure 5000 larvæ were successfully hatched; but of these, despite every care, very few attained the "lobsterling" stage. It is incidentally recorded that the female spiny lobster (*Palinurus vulgaris*) destroys her eggs in captivity. The general interest of the report is much enhanced by an illustrated account of Manx (or "Manks") antiquities, inclusive of fossil mammals, by Messrs. Kermode and Herdman.

In the *Sitzungsberichte*, No. 22, of the Imperial Academy of Sciences in Vienna, Mr. J. Dörfler gives an itinerary of a six months' tour in the island of Crete, undertaken for the purpose of collecting botanical specimens. From this point of view the journey was very successful, as 1200 plants were obtained, including *Triadenia Sieberi*, *Senecio gnaphalodes*, and the tiny *Bellium minutum*.

Two rare seaweeds, Rhipidosiphon and Callipsygma, both referred to the Codiaceæ, form the subject of a short article contributed by Mr. and Mrs. A. Gepp to the *Journal of Botany* (December, 1904), and Mr. Salmon presents a second instalment of his notes on Limonium. The second supplement (1898–1902) to the biographical index of British and Irish botanists, compiled by Mr. J. Britten and Mr. C. S. Boulger, is concluded in the same number.

In addition to the maintenance of the more ornamental gardens, the director of the Public Gardens, Jamaica, in his report for the year 1903–4, describes a number of experiments which have been carried on at the Hope Experiment Station. With the view of combining the good qualities of different varieties of pineapples, a number of hybrid seedlings have been raised by crossing the Cayenne, Ripley, and Queen varieties. The method of growing Sumatra wrapper-tobacco under tent-cloth, as practised in the Connecticut valley in America, was tried with good results, but the climate at Hope was found to be too dry for curing the leaf satisfactorily. Considerable success has attended the budding of mango, nutmeg, cocoa, and other trees, and the process is strongly recommended, both as a means of rapid propagation and also with the object of improving the fruit.

We have received a further instalment of the States gazetteers, already noticed, in the "Gazetteer of West Virginia," by Mr. Henry Gannett, published by the United States Geological Survey.

The August and September (1904) numbers of the *Bollettino* of the Italian Geographical Society contain an extremely interesting and suggestive memoir by Prof. Gustavo Coen on the supposed decadence of Great Britain and the awakening of eastern Asia. The conclusions of the paper, which cannot be briefly summarised, are obviously the result of wide study and research, and should be of great value to geographical and political students in this country.

In a paper published recently in the Hungarian *Mathematischen und naturwissentschaftlichen Berichte* Dr. von Kalecsinszky gives an account of further observations and experiments on the warming of different layers of liquid by the sun's rays. Observations in lakes in which salt water is covered over with a stratum of fresh water show that the salt water may be warmed to a much higher temperature than the overlying fresh water. Experiments with solutions of magnesium sulphate, sodium sulphate, ammonium chloride, and sodium carbonate, and with fresh water covered with petroleum and with olive oil, gave similar results. It is concluded that the phenomenon is of general occurrence, and that it is a factor of geological importance in the formation of certain deposits.

The United States Weather Bureau has reprinted Mr. W. L. Moore's article on climate, written for the "Encyclopedia Americana," as No. 34 of its *Bulletins*. It embraces only thirteen pages of large octavo size, and is written in clear, simple language that can be understood by all. It contains in this small space a large amount of useful information relating to the effects of solar energy, distribution of land and water, and mountain ranges. With regard to secular variations, the author is of opinion that there has been no appreciable change in the climate of any large area within the period covered by authentic history.

We have received from the observatory of the University of Odessa a copy of its *Annals* for the years 1901–3. The observatory having then completed the tenth year of its existence, the volume in question includes, in addition to observations taken thrice daily, and the monthly and yearly results for 1901–3, a valuable series of means for the ten years 1894–1903. The observatory is situated in latitude 46° 26′ N.; the mean temperature is given as 28°·8 in January and 72°·1 in July. The absolute maximum was 94°·3, and the minimum −10°·3 F.; the temperature of the ground is observed at various depths. The annual rainfall is only 13 inches; the wettest month is June (2·3 inches).

We have received a copy of the report of the International Meteorological Committee's meeting at Southport in September, 1903. The meeting was well attended, and various subjects of interest were discussed, including the valuable reports by subcommittees and by individuals; these reports are printed *in extenso* in the appendix. Five of them refer to the arrangements existing or proposed for the exploration of the upper air by means of balloons and kites, and to the results hitherto obtained. Much credit is due to M. Teisserenc de Bort, who, in addition to the stations he has established at Trappes and Itteville, near Paris, has been chiefly instrumental in establishing similar stations at Moscow and Viborg (Denmark). This latter enterprise is acknowledged to be a most important contribution to meteorological science. Appendix vii. is a very valuable report by Sir Norman Lockyer on simultaneous solar and terrestrial changes, which may have an important influence on the meteorology of the future. After summarising the investigations made from earliest times, he points out the considerable advances made during the last quarter of a century. Among the other appendices we may specially mention two by Prof. Pernter (chief of the Austrian Meteorological Service) and by M. Rykatcheff (director of the Russian Service) on the use of the hair hygrometer instead of the wet-bulb thermometer. This instrument is found to be of much service in times of severe frost. M. J. Violle contributes a valuable report on radiation. The author points out that the question is exceedingly complex, and demands a complete study of each of the simple radiations which go to make up the total solar radiation. The International Meteorological Committee voted for the convening of a conference of all directors of meteorological offices, to be held at Innsbruck in September, 1905.

MESSRS. J. J. GRIFFIN AND SONS have sent us specimens of "Vitro-Ink," which is a non-corrosive ink for writing on glass, celluloid, wood, or other material. The ink may be used with an ordinary pen, and flows quite readily. A useful property is that it may be completely removed by means of a damp cloth at any time before it has set hard, so that mistakes can be rectified without difficulty. The ink will be found of especial service in labelling such things as laboratory or photographic dark room bottles, where labels of ordinary type quickly become discoloured or worn away. When written on with vitro-ink the inscriptions entirely resist strong acids, and it is only prolonged action of strong alkalis or boiling water which may efface the material. Microscopic slides, lantern slides, and glass or celluloid photographic negatives may be labelled and numbered direct, and as the ink is quite unaffected by alcohol it can also be employed for biological or other specimens which it may be necessary to preserve in spirit. Another useful field for this ink will be in the rapid production of diagrammatic lantern slides for class or lecture illustration, as the design may be drawn direct on the glass during actual projection, thereby placing considerable facilities in the hands of lecturers or others desiring to employ the screen in place of a blackboard or prepared wall diagrams. The ink can be especially recommended to photographers as an efficient labelling agent, showing good contrast in the dark room light, and capable of being washed clean instantly whenever the names become stained from the unavoidable oxidation of the various solutions employed.

MR. A. HENRY SAVAGE LANDOR'S new book, "Tibet and Nepal," will be published within the next few days by Messrs. A. and C. Black.

MESSRS. GEORGE BELL AND SONS have published a teacher's edition of part i. of "Elementary Algebra," by Messrs. W. M. Baker and A. A. Bourne. The arrangement by which the answers are printed on the page opposite to the examples which are to be given to pupils to work out should prove convenient for the teacher during class work.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A SIXTH SATELLITE TO JUPITER.—A telegram received from the Kiel Centralstelle announces the discovery of a sixth satellite to Jupiter by Prof. Perrine. The existence of the object was suspected in December, 1904, and was confirmed by an observation made on January 4. The position angle on that date was 269°, and its distance from the planet 45′, the latter quantity decreasing 45″ daily, whilst the apparent motion was retrograde.

A later communication from Kiel states that the discovery was made with the Crossley reflector, observations of the satellite having been made on December 3, 8, 9, and 10, 1904, and January 2, 3, and 4.

COMET 1904 *d* (GIACOBINI).—Another set of elements and an ephemeris for comet 1904 *d* have been calculated by Herr M. Ebell from positions determined on December 17, 21, and 26, 1904, and are given below.

Elements.

T = 1904 November 4·22 (Berlin).

$$\left.\begin{aligned} \omega &= 41^\circ\ 15'{\cdot}6 \\ \Omega &= 218\ \ 32{\cdot}0 \\ i &= 99\ \ 39{\cdot}1 \end{aligned}\right\} 1904{\cdot}0$$

$\log q = 0{\cdot}27536$

Ephemeris (12h. Berlin).

1905	α (h. m. s.)	δ (° ′)	log Δ	Brightness
Jan. 12	17 29 10	+40 37	0·3451	1·01
,, 14	17 36 1	+41 42		
,, 16	17 43 2	+42 47	0·3438	1·00

(Kiel *Circular*, No. 71).

ELEMENTS AND EPHEMERIS FOR COMET 1904 *e*.—The following elements and ephemeris for Borrelly's comet (1904 *e*) have been calculated by Dr. Elis Strömgren from the positions determined on December 31, 1904, January 1 and 2:—

Elements.

T = 1905 January 1·2710 (Berlin).

$$\left.\begin{aligned} \omega &= 341^\circ\ 23'{\cdot}22 \\ \Omega &= 69\ \ 54{\cdot}82 \\ i &= 35\ \ 30{\cdot}70 \end{aligned}\right\} 1905{\cdot}0$$

$\log q = 0{\cdot}19344$

Ephemeris 12h. (Berlin).

1905	α (h. m. s.)	δ (° ′)	log Δ	Brightness
Jan. 12	1 33 39	+1 17·4	0·0870	0·83
,, 16	1 40 8	+4 18·7	0·0985	0·78
,, 20	1 46 56	+7 13·6	0·1107	0·73

Brightness at time of discovery = 1·0.

According to the above the comet will pass through the south-eastern corner of the constellation Pisces into Aries, and will be about twenty-five minutes west of α Piscium on January 12 (Kiel *Circular*, No. 72).

COLOURS OF STARS IN THE SOUTHERN HEMISPHERE.—During the period October, 1903–March, 1904, Dr. J. Möller, whilst cruising in the tropical regions of the Atlantic and Pacific Oceans, made a number of observations of the colours of 169 stars situated between declination −20° and the South Pole, all of which were about magnitude 3·5.

The results of these observations are published in No. 3980 of the *Astronomische Nachrichten*, where the observer also shows the reduction of his colour values to Osthoff's scale and the differences between his own results and those obtained by the latter observer.

"THE HEAVENS AT A GLANCE."—The handy card calendar, "The Heavens at a Glance," published by Mr. Arthur Mee, Llanishen, price sevenpence, post free, is full of useful information for amateur astronomers. Among other things it contains a "celestial diary" which gives all the more important astronomical events during each month, a table showing the elements of the sun and planets, and a mass of information relative to the brighter stars, variable and double stars, and star clusters and nebulæ.

Intended to hang on the observatory wall, the calendar forms a most useful adjunct to the more voluminous almanacs which it epitomises.

ASTRONOMICAL "ANNUARIO" OF THE TURIN OBSERVATORY.—The first annual publication of the Turin Observatory appeared in the year 1787, but for various reasons their appearance has not been continuous. A new series commences with the "Annuario" for the present year, and in the preface Signor Boccardi, the director, explains its *raison d'être* by the statement that it does not contain the ephemerides, star-places, &c., published in the larger national almanacs, but deals more especially with the calculations and researches made at the Turin Observatory, and fills up the gaps left by those almanacs.

As examples of this we may mention the tables which contain the mean positions and the apparent positions at upper culmination (Greenwich meridian) of 202 stars not included in the "Nautical Almanac," the "American Ephemeris," or the "Connaissance des Temps." The heliocentric coordinates of Jupiter and Saturn (for 1905 and 1906), the elements and ephemerides of various minor planets, a mass of meteorological data, and a review of the meteorology of 1903 are also given.

ORIGIN OF LUNAR FORMATIONS.—In a paper on "A Possible Explanation of the Formation of the Moon," read before the Royal Society of Edinburgh on November 21, 1904 (see NATURE, December 8, 1904, p. 143), Mr. G. Romanes showed that there had never been sufficient heat developed in the interior of the moon by gravitational compression to account for volcanic action on its surface; and he explained how lunar markings could be accounted for on his hypothesis by the impact of meteoritic masses. Dr. Johnston-Lavis writes to say he has long held this view, and reminds us that Dr. G. K. Gilbert developed the impact theory of the formation of lunar craters several years ago (see *Bull.* Phil. Soc. of Washington, vol. xii., pp. 241–292, and NATURE, vol. xlviii., p. 82, May 23, 1893).

PLANT ASSOCIATIONS IN MOORLAND DISTRICTS.

DURING the last four years systematic observations have been made on the distribution of the various associations of vegetation covering the moorland region lying to the east of the Vale of Eden.[1] The boundaries of each plant association have been traced out in the field and laid down on the six-inch Ordnance map, and reduced to the one-inch map for publication. The factors governing the distribution of plant associations over such a limited area are mainly edaphic, although the differences in altitude, which amount to about 2500 feet in the area in question, produce changes in the vegetation which are chiefly due to climatic conditions. Much of the vegetation at present covering cultivated areas in Britain owes its distribution to artificial agencies, edaphic and climatic factors being to a great extent masked. The more remote moorland districts of the north of England and Scotland, however, give opportunities for studying plant associations the distribution of which is chiefly determined by edaphic and climatic factors, the artificial factors due to the influence of man being secondary.

FIG. 1.—Succession of moorland vegetation. Eriophorum Bog on the summit plateau. Nardus Grass Heath developed on the slopes below, changing to Grass Heath with Eriophorum as the wet, gently sloping foreground is reached. From the *Geographical Journal.*

The most important artificial agencies tending to modify the natural distribution of vegetation covering our moorlands at the present day appear to be drainage operations and grazing of cattle. On many of the alpine moorlands these factors are almost negligible, and any change in the vegetation has been caused, not by artificial agencies, but by secular changes in climate. The evidence of a change in vegetation, both on the alpine moorlands of England and Scotland, is unmistakable, and it is possible to a certain extent to reconstruct the waves of vegetation which have occupied the areas mentioned since the passing away of the last ice sheet.

[1] "Geographical Distributions of the Vegetation of the Basins of the Rivers Eden, Tees, Wear and Tyne." (*Geographical Journal*, March and September, 1904.)

The district in which mapping has been carried on by the author consists of a great extent of bleak, gently sloping moorland, of which about 10 per cent. lies above 2000 feet. The author has found that considerable and marked changes take place in the plant associations at about 2000 feet; tree vegetation ceases, and many alpine plants make their appearance which are absent from the lower moorlands.

The geological formation in the south and west of the district is chiefly Carboniferous limestone yielding only a small amount of detritus, whilst in the north and east the limestone thins out and is replaced to a great extent by sandstones, grits, and shales which yield a much larger amount of detritus. This feature has an important effect upon the vegetation, the wetter types of associations being developed upon those rocks yielding a large amount of detritus.

The moorlands first resolve themselves into two chief types, grass moorland and heather moorland, and these are frequently linked together by several intermediate plant associations. Dry heather moors or heaths do not cover any great extent of ground, and are chiefly found in the limestone districts of the south. The wetter types of heather moors are well developed, and the whole district can be briefly described as a wet heather and dry grass moorland country. These features are well shown in many of the "hopes" and gills leading out of Weardale and South Tynedale. The steep lower slopes of the hills are covered with an association having *Nardus stricta* as the dominant plant. Above 1500 feet to 1800 feet the slope of the ground becomes more gradual, and shales and grits make their appearance. At the same time the *Nardus stricta* association yields to heather associations in which Eriophorum is always a prominent plant. The

FIG. 2.—Calluna and Vaccinium association on a dry wind-swept summit at 2320 feet. The lower vegetation developed on wet peat shows a great increase in Eriophorum. From the *Geographical Journal.*

succession of different types of moorland is often well shown along some of the "edges" in the north-east of the district. At Redbourne Edge the almost flat, poorly drained summit is entirely covered by Eriophorium bog, developed on deep wet peat. As the edge of the bog is approached the peat becomes drier, and Eriophorum is replaced by a narrow band of Calluna moor. Peat is absent on the slope below, and the ground is tenanted by Nardus grass heath, yielding to a wetter type of grass heath dominated by Molinia and Eriophorum. Such a succession of terraces of Eriophorum bog, Calluna moor, Nardus grass heath, and Molinia-Eriophorum moor can be distinguished from a distance of many miles in the later months of the year, when the bleached Nardus stands out in vivid contrast to the sombre hued Calluna and Eriophorum associations.

The lower slopes of the alpine moorlands are generally covered by heather associations, which yield to pasture and grass heath as the summits are approached. The drier hills are covered by an association consisting of Calluna, *Rubus Chamaemorus*, *Vaccinium Myrtillus*, and *V. Vitis-Idaea*; the wetter hills are characterised by a much greater development of *Eriophorum vaginatum* and *E. angustifolium*.

The summits of the hills are generally tenanted by a few stunted members of the lower associations; in some cases, however, the vegetation only forms patches separated by bare stony soil or peat. Part of the summit plateau of Cross Fell at 2900 feet is entirely tenanted by *Racomitrium lanuginosum*, which forms low mounds of peat frequently broken by patches of stones and bare soil, a formation bearing a close resemblance to a moss-tundra of northern latitudes.

A considerable portion of the higher ground is covered with a deposit of peat varying in thickness from a few inches to nearly 20 feet. The peat appears to be undergoing rapid denudation at the present day—in many places large areas are quite unoccupied by vegetation, and exhibit the channelled and wasted appearance characteristic of peat-hags. These features can be seen on all the peat covered hills of the Pennines, the Cheviots, and the Scottish southern uplands, being particularly well marked on the Moorfoot Hills and in the Tweedsmuir district, and again appear in most of the peat districts of the Highlands. Many of the lowland mosses, particularly those bordering on the Solway Firth and along the west coast, exhibit no such denudation. How far the denudation of the mosses in the hill districts is due to drainage operations it is difficult to say, but the fact that the peat is generally wasted away quite as much on the more remote moorlands where artificial drainage has scarcely been carried on at all as on the drained areas lends strong support to the view that denudation is due to climatic changes. This is further supported by a detailed examination of the deeper peat beds, which frequently show many alternating beds of wet and dry condition plants. The peat beds on the Cross Fell chain are evidently of very ancient origin, as the author [1] has found the remains of an Arctic flora at the base consisting of Arctic willows, and the peat above contains the remains of extensive woodlands up to an altitude of 2700 feet. The area in which woodland remains in the peat have been observed is about 140 square miles, whilst only 11 square miles are forest clad at the present time.

Gunnar Andersson [2] has shown that the destruction of some of the woodlands buried in the peat of Sweden has been caused by artificial retention of drainage water and a gradual exhaustion of food supply in the upper layers of the peat, thus bringing about a gradual swing from woodland conditions to moss conditions, and again to heath conditions. These causes may have produced alternations of woodland, moss, and heath in some of our low-lying mosses, but an examination by the author of the peat lying between the woodland beds suggests that the destruction of much of the buried forest growth has been due, not to local alterations in drainage and failure of food supply, but to climatic changes acting over very long periods of time.

FRANCIS J. LEWIS.

THE ABNORMAL TIDES OF JANUARY 7.

AN abnormally high tide was experienced down the east coast of Britain on Saturday last, January 7, extensive areas being flooded and considerable destruction wrought. At 6 p.m. on Friday, January 6, as shown in the Meteorological Office reports, a very deep cyclonic system appeared over the upper part of the North Sea, the barometer at Sumburgh Head having fallen quickly to 28·7 inches. There was a steep gradient for north-westerly winds, and in the course of the night a more or less severe gale from that quarter was experienced over the North Sea, and as the south-going tide from the Pentland Firth was then on the flood, both its velocity and its volume were greatly increased, so that it reached the Thames estuary some hours ahead of its time, and was several feet above the calculated height. While the low barometer of Friday night may have caused the tide level in the far north to have been raised about a foot, the very rapid increase of pressure to 29·83 inches at 8 a.m. on Saturday at Sumburgh Head, a rise of 1·13 inches in fourteen hours, may have done something towards swelling the volume of the tide further south. Except for the hard gale, the conditions were very similar to those which prevailed with the great tide experienced on the southern and south-western coasts at the beginning of February, 1904 (NATURE, vol. lxix. p. 348).

Much damage was done all along the coast from Scarborough to the Thames. At the former place the pier was entirely washed away, and at Hull, Goole, Boston, Yarmouth and Lowestoft, and other places the low-lying parts of the towns were flooded. The damage was not due to unusual violence of the wind alone, but to the combined effects of wind and tidal waves. From the returns of the Meteorological Office it appears that the force of the gale from Wick to Yarmouth varied from 7 to 10 on the Beaufort scale. The tide was the third after the new moon, and laid down in the tide tables as less than a full spring tide. At Boston 28 feet 5 inches was recorded on the gauge at the dock, or 116·47 feet above Ordnance Datum, being 4 feet 8 inches above the height expected. The following tide in the evening was 21 feet 11 inches, or 1 foot 10 inches below the tide table height, the difference in the two tides being 6 feet 6 inches. The highest tide recorded there previously was in 1883, when the tide rose to 29 feet, the great record tide of 1810 rising to 29 feet 4 inches. Notwithstanding the great height to which the tide rose, it ceased flowing nearly half an hour before its proper time.

The tidal wave had fortunately somewhat expended its energy before reaching the Thames, but the water was in a very disturbed condition. By mid-day the water at Putney Bridge had risen as high as it should have been at full tide, which was not due until 3.45. At 1.30 it was a foot higher than any spring tide in recent years. Shortly after this the water began to recede, and continued to do so for half an hour. Then the water again rose, and at 3.15 the ebb again set in. The water in the Thames and Medway estuaries was kept from receding by the gale, and on the morning of Saturday it was 8 feet above its normal height. At 9 a.m., when the tide had still $4\frac{3}{4}$ hours to flow, it was running up the Medway 6 feet above the anticipated height at this stage. By 11 o'clock the level of high water was reached, but during the remaining $2\frac{3}{4}$ hours the flow was very slight compared with the earlier stages, and although the water rose from 2 to 3 feet above the normal height, there was no overflow or breaches in the banks.

THE ELECTRO-THERMIC MANUFACTURE OF IRON AND STEEL.[1]

THIS report is of great interest and importance to iron and steel metallurgists, and the appointment of the commission which has drawn it up suggests that Canada has an enterprise in fostering metallurgical knowledge which the Government of the mother country might well imitate for the advantage of British metallurgical industries. The English metallurgist attached to the commission was Mr. F. W. Harbord.

Three processes were experimentally examined :—(1) the Kjellin process at Gysinge, Sweden (this is an induction process not involving the use of electrodes); (2) the Héroult process at La Praz, France (this is a resistance method involving the use of electrodes); (3) the Keller process (also a resistance method in which electrodes are employed).

On p. 15 of the report Dr. Eugene Haanel, the chief

[1] British Association Reports, 1904, Section K.

[2] "Svenska Vaxtvarldens Historia." (Stockholm.)

[1] "Report of the Commission appointed by Mr. Clifford Sifton, Minister of the Interior, Ottawa, Canada, to Investigate the Different Electro-thermic Processes for the Smelting of Iron Ores and the Making of Steel in Europe." (Ottawa: Department of Interior.)

commissioner, remarks that he considers "By far the most important experiments witnessed by the Commission were those made by Keller, Leleux and Company at their works at Livet."

It is a little difficult to realise upon what grounds the above conclusion was arrived at. Putting aside the speculative calculations of M. Keller and descending to experimental facts, it appears that the commission saw smelted several tons of pig-iron, as a rule remarkably high in manganese (1·5 per cent. to 4 per cent.), and hence of limited commercial interest, and as it is evidently not thought by the commission that the electric furnace is to become a serious competitor with the blast furnace, the specified exceptional value of these results from an industrial point of view is not quite clear.

As regards steel, only one not very satisfactory and untested heat was made (see pp. 77–78), yet upon such evidence the report states that this process is capable of producing steel equal to the best products of Sheffield's crucibles. Such premature conclusions based on such scanty data are not calculated to carry conviction to the experienced metallurgical mind.

The commission also describes a series of experiments made by M. Héroult at La Praz works. The analyses of the steels obtained appear quite satisfactory, but this process is hardly capable of competing with the ordinary open-hearth furnace even from the rosy point of view taken by the commissioners based on costs calculated (in all good faith) by the patentee.

From a British point of view Kjellin's induction process deserves the most serious attention in view of (under certain conditions) its probable competition with the crucible steel process.

Analytically, mechanically, and micrographically this steel leaves nothing to be desired, but unfortunately chemical and tensile tests, and the indications of the microscope, have a limited value in determining the working capabilities of tool-steel.

In his "conclusions" on p. 115 of the report, Mr. Harbord states that "Steel, equal in all respects to the best Sheffield crucible steel, can be produced, either by the Kjellin or Héroult or Keller processes, at a cost considerably less than the cost of producing a high-class crucible steel."

The above statement, so sweeping and involving issues of profound industrial import, should have been made only as the result of a series of exhaustive working tests. For such, in the report, the reviewer has sought in vain.

It is true that a series of tests of turning tools made from Kjellin and Héroult steels has been carried out at Woolwich by Mr. H. F. Donaldson, but the results are quite inconclusive, because of the steels employed hardly one was fit for turning tools.

Cold sett steel, carbon 0·8, cold chisel steel, carbon 0·9, tap-steel, carbon 1·1, and drill steel, carbon 1·2, have all been set to do the work of a comparative turning tool steel of carbon 1·38 per cent.

The natural consequence is that in the Woolwich results, where "E" means equal to the ordinary Woolwich turning tool steel of carbon 1·38, and "NE" means not equal to that steel, we find in the report, pp. 87 and 88, five "equals" and no less than fourteen "not equals."

As to whether Kjellin electric steel is or is not equal to crucible steel time alone can show. The conclusion of the commission may be accurate, but it is certainly not based on any scientific evidence worthy of the name.

Such evidence on a commercial scale can be conclusively obtained only by at least two comparative years of shop practice, employing all kinds of tools, and recording the average wear and waste of the steels as evidenced by the ratio between the work turned out and the annual cost of the tool steels purchased.

In the micrographic section of the report the reviewer notes with regret a recrudescence of the use (in this connection) of the meaningless and unscientific term "grain" in describing the allotrimorphic crystals of ferrite.

These crystals, although usually lacking idiomorphic external faces, nevertheless present that internal molecular symmetry associated with individual crystals, and hence should be classed as such.

Prolonged tests on Kjellin steel of all carbons, compared with similar crucible steels, have been inaugurated at the University College of Sheffield, and the erection of a Kjellin furnace capable of making one ton of steel per day is under consideration.

Without in any way compromising one's industrial attitude as to the exact capabilities of the respective methods devised by Messrs. Héroult, Keller and Kjellin, one can cordially congratulate these gentlemen on the scientific ability displayed in the development of their several methods, all of which, within their legitimate spheres, are undoubtedly of great metallurgical value. It is the more necessary to say this because such value is liable to be discounted by the hasty and ill-digested conclusions drawn by the Canadian commission.

J. O. ARNOLD.

LONDON FOG INQUIRY, 1901–3.[1]

THE Meteorological Council have issued their final report on the above inquiry, which had to be terminated at the end of the winter 1902–3 as the London County Council were unable to make any further contribution to its cost beyond the 250*l.* originally assigned. A short account of the chief results obtained by Captain Carpenter from the observations of the winter 1901–2 has already appeared in these columns (vol. lxvii. p. 548). During the succeeding winter records of the duration and intensity of fog were continued at forty-six stations in and around London, and in addition to this the scope of the inquiry was extended to include a detailed study of the distribution of air temperature over the London area. With this object thermometer screens and dry bulb thermometers were issued to thirty fire brigade stations, and daily observations of the air temperature were made at fixed hours.

The material so accumulated has been utilised to determine so far as possible the physical causes most active in producing fog in each case. The guiding principles adopted in the classification are those suggested in an article by the secretary to the Meteorological Council which appeared in NATURE (vol. lxiv. p. 649) at the time when the inquiry was started. The majority of our fogs were found to be due to radiation from the earth's surface during calm nights. Others, among them the most persistent fog of the winter, were caused by the passage of warm air over a previously cooled surface, while a third group were identified as "cloud" fogs. A certain number of fogs could not be included in any of the above categories. They appeared to be mere accumulations of the products of combustion in an almost calm atmosphere, and as such were termed "smoke" fogs. Full particulars of the thirty-nine most serious fogs of the winter are given in an appendix.

Among the chief results of the inquiry must be reckoned the establishment of a workable scale for the estimation of fog intensity by different observers, based on the extent to which traffic is impeded by land, river, and sea.

Comparison of the fog statistics from the various stations confirms Captain Carpenter's results. With a few possible exceptions which need further investigation, there is no evidence to show that, in London, geological formation has any influence on liability to fog. Again, as was to be expected, the fog frequency on the river and in the parks is very high, but the evidence does not support the view that the fog there found drifts far into the neighbouring districts.

With regard to the main purpose of the inquiry, greater precision in fog forecasts, Mr. Lempfert points out that a first step would be the establishment of a night service at the Meteorological Office. As the majority of fogs are caused by nocturnal radiation, and the intensity of this radiation depends largely on the accident whether the sky is free from cloud or not, it is manifest that forecasts issued at the suggested hour of 5 a.m. would have a much greater chance of proving correct than the present ones, which are based on observations taken at 6 p.m. on the previous evening. As most fogs become thick soon after sunrise, several hours' warning could still be given, though the hour would

[1] Report of the Meteorological Council upon an Inquiry into the Occurrence and Distribution of Fogs in the London Area, during the Winters of 1901–2 and 1902–3, with Reference to Forecasts of the Incidence and Duration of Fogs in Special Localities, to which is appended the Report by R. G. K. Lempfert, M.A. on the Observations of the Winter 1902–3.

be too late for the dissemination of the forecasts by the morning papers. Under the existing arrangements it was found that sixteen out of twenty-four "radiation" fogs and four out of eight "smoke" fogs were anticipated. The three "cold surface" fogs and four "cloud" fogs were not forecasted. The present forecasts rarely, if ever, contain any indications of the intensity of the fog expected.

The problem of the issue of fog warnings for individual districts has been approached from two points of view. As was pointed out in the previous report, the observations of drift smoke, during the incidence of fog usually show an indraught of air to some central district of London, but this is rarely symmetrical; a preponderating direction, usually identical with that due to the barometric gradient, can in most cases be identified, and plays a most important part in determining the region of thickest fog. Out of forty-four days of fog twenty-seven showed the thickest fog to leeward, five showed it to windward, while in the remaining twelve cases no particular preference for any one locality could be identified. Captain Carpenter had suggested that a more detailed study of the distribution of temperature might prove useful in this connection, and Mr. Lempfert reproduces diagrams which show conspicuous differences of temperature within the London area, in which the thickest fog is also to be found in the coldest region. Four out of the five apparently exceptional cases in which fog was thickest to windward show the lowest temperatures also on the windward side. It is the more to be regretted that the inquiry has had to be discontinued as the winter proved to be singularly free from fog. Investigation of the thick fogs of the present season from this point of view would probably have yielded interesting results.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

EDINBURGH.—The annual report for 1904 shows that the total annual value of the university fellowships, scholarships, bursaries, and prizes now amounts to about 18,270*l*. In addition, a sum of upwards of 600*l*., being the income of the Earl of Moray endowment fund, is annually available for the encouragement of original research. As already announced, in response to the appeal for subscriptions to provide for the further development of the university, Sir Donald Currie has made the munificent gift of 25,000*l*. He has expressed a wish that the revenue from his money should be applied to the remuneration of a staff of lecturers such as the authorities of the university may find it advisable from time to time to appoint. The university court, being desirous of permanently associating his name with the fund, has resolved to designate it "The Sir Donald Currie Lectureship Endowment Fund." Other contributions to the extension scheme have also been intimated to the extent of 15,000*l*., including a sum of 5000*l*. given by Sir John Jackson to the Tait memorial fund, for the encouragement of physical research.

LIVERPOOL.—The committee of the institute of archæology has been enabled by the munificence of Sir John Brunner to take in hand the publication of a "History of Egypt," to include all the results of modern research, and to be, so far as possible, a complete history of the Egyptian civilisation from the earliest times down to the conquest by Alexander the Great. It is estimated that the work will take two years to complete, and it will be published with full photographic illustrations.

A CONFERENCE on school hygiene has been arranged by the Royal Sanitary Institute, to be held in the University of London, under the presidentship of Sir Arthur W. Rücker, F.R.S., on February 7–10.

A COURSE of ten lectures on "Enzymes" will be given by Dr. W. M. Bayliss, F.R.S., at University College, London, commencing on January 18. The lectures are open to all internal students of the university, and also to medical men on presentation of their cards.

THE sixteenth issue of the "Public School Year Book" that for 1905—with its select list of preparatory schools, as useful as ever. The information given respecting each public school connected with the Headmasters' Conference is of just the kind to help parents to a decision as to where to send their boys to be educated.

PROF. FRITZ HEISE, of the Berlin School of Mines, has been appointed director of the Bochum School of Mines, and Mr. Georg Baum, the author of several works on coal-mining, has been appointed to succeed him in the Berlin chair. Mr. August Schweman, mine manager of Neurode, has been appointed professor of mining at the Aachen Technical High School to fill the vacancy caused by the death of Mr. Lengemann.

IN view of the educational and scientific progress which Japan has made in recent years, the two lectures on "The Japanese Spirit," which will be delivered by Mr. Y. Okakura, of the Imperial University, Tokyo, at the London School of Economics, Clare Market, W.C., on January 17 and January 20, should be of special interest. Tickets of admission may be obtained free from the secretary of the school.

Science reports that Mr. W. A. Riebling, of Newark, N.J., has sent an additional 2000*l*. to the Rensselaer Polytechnic Institute, Troy, N.Y., to be used in replacing the building destroyed by fire. Mr. Riebling gave 2000*l*. last June. A gift of 1000*l*. from Mr. George B. Cluett is also announced. Wellesley College has received 3600*l*., we also learn, from the Robert Charles Billings fund, the income of which is to be applied to the department of botany.

THE West Riding Education Committee has resolved, says the *British Medical Journal*, subject to certain conditions, to make grants, which will doubtless be renewed annually, to the Universities of Leeds and Sheffield of 4500*l*. and 1500*l*. respectively. In thanking the county council for the grant to Leeds, the Pro-Chancellor, Mr. A. G. Lupton, stated that of the 100,000*l*. for which the university was now asking a sum of 64,000*l*. had already been subscribed.

THE 1905 edition of the "Schoolmaster's Yearbook and Directory" follows on the same excellent lines as the issue of last year. It contains an immense amount of well arranged information, and has become indispensable to all engaged in educational work. If the publication continues to increase in size, as it seems to do annually, the section on the books of the year might be dispensed with, as information of the same kind can be obtained from many educational periodicals. The editor is to be congratulated on the fact that this useful work of reference has become established so securely.

A RESEARCH scholarship or scholarships, founded by Mr. Andrew Carnegie, will be awarded shortly on the recommendation of the council of the Iron and Steel Institute. Candidates, who must be under thirty-five years of age, must apply on a special form before the end of February to the secretary of the institute. The object of this scheme of scholarships is not to facilitate ordinary collegiate studies, but to enable students, who have passed through a college curriculum or have been trained in industrial establishments, to conduct researches in the metallurgy of iron and steel and allied subjects, with the view of aiding its advance or its application to industry. There is no restriction as to the place of research which may be selected, whether university, technical school, or works, provided it be properly equipped for the prosecution of metallurgical investigations.

A CONFERENCE of teachers from elementary and secondary schools and technical institutes was held under the auspices of the London County Council at the Medical Examination Hall, Victoria Embankment, on January 5, 6, and 7. On the first of these days, under the presidency of Sir William Collins, the teaching of arithmetic was discussed. Mr. C. T. Millis, principal of the Borough Polytechnic, said that what is needed in the teaching of arithmetic is that some of the time now spent in teaching special rules in money sums should be devoted to giving a sound knowledge of general principles. Mr. S. O. Andrew, during the course of a paper on the same subject, remarked that whatever part of arithmetic may be given up or postponed, there is a general agreement that it must still include a knowledge of the standards of measurement necessary for the investigation of physical phenomena. The need for a co-ordination of the elementary instruction in arithmetic and geometry was emphasised by subsequent speakers.

THE third annual meeting of the North of England Education Conference was held in Liverpool on January 6 and 7. More than 2000 members of education committees, teachers, and others attended. The question of leaving certificates was discussed at the first meeting, and during the course of the discussion Sir Oliver Lodge said the use and not the abuse of examinations is admitted by all as an adjunct to teaching, but the point is to determine the relation between teachers and examiners, also between teachers and inspectors. People are no longer going to be satisfied with purely external examinations imposed from above upon the schools. It is not a dignified position for the schools, and they have rebelled. Prof. Sherrington, F.R.S., read a paper later on child study, in which he urged that this study could not devote itself more profitably at the present time than to what may be termed the natural history of the child. In healthy school life lay the first line of defence against race deterioration. It would help society if teachers and physiologists could combine to examine into the mischief to growth resulting from hours of breathing vitiated air, from want of warm clothing that economised food, from semi-starvation, from improper food, from chronic fatigue, and from insufficient rest and sleep in bed. Among other subjects dealt with were the teaching of geography, the teaching of domestic science, and the place of handwork in the school curriculum.

A DEPUTATION from the executive committee of the Association of Education Committees (England and Wales) recently waited upon the Board of Education to urge the adoption of a more liberal scale of grants for secondary schools, to ask for a larger share from the Government of the cost of training pupil teachers, and to urge the necessity for the compulsory attendance up to the age of fourteen at evening continuation schools of all children who do not continue as whole-day scholars up to that age. Sir William Anson, in reply to the deputation, agreed that more money should be allowed to secondary schools, but though such a demand would have his support, Sir William Anson said he was by no means sure of obtaining the necessary funds. He expressed the opinion that the question of cost made it almost impossible to enforce a system of compulsory attendance at evening continuation schools up to fourteen years of age for children leaving the day school before that time. Until we have better security that the education given in the elementary school lasted, and a better secondary education system with larger grants for secondary schools, Sir William added, he would not be a party to asking for another penny for elementary education, as such. It is satisfactory to find it recognised officially that this country must spend more money on secondary and technical education if we are to have an educational system which will assist national progress.

THE annual meeting of the Geographical Association was held on January 6. Mr. Douglas Freshfield presided, and an interesting discussion took place on the teaching of practical geography in schools. Prof. Dryer, of the State Normal College, Terre Haute, Indiana, opened the debate, and said that practical geography meant in America laboratory work. This work is not necessarily done in a special room, and, indeed, the best part of it is done out of doors. The study of maps plays a large part in this laboratory work. Contoured topographical maps are also much used, together with raised models illustrating different forms of the earth's surface. Pictures, photographs, and lantern slides also have a conspicuous place in the school's equipment. The instrumental study of the earth's atmosphere is taken next by the students, who keep records of their own observations for a period of three months. The official weather charts can be obtained daily at every school, and, owing to the area covered by them, it is possible to follow cyclonic and anti-cyclonic disturbances for several days together, and sometimes to predict in the school itself the arrival at a particular time of an atmospheric disturbance. Field excursions are regarded as the most important part of geographical study. Mr. B. B. Dickinson described an experiment in the teaching of practical geography carried out by him at Rugby School. The report of the association shows that 123 new members have been added to the roll, making the total membership 448. The members now include teachers of every grade, school inspectors, directors of education, technical education committees, and others interested in geographical education, both at home and abroad.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 1, 1904.—"The Ascent of Water in Trees." By Dr. Alfred J. **Ewart**, Lecturer on Botany in the University of Birmingham.

Since the time when Strasburger's researches seemed to show that the ascent of water in trees was a purely physical phenomenon, attempts have been made by Dixon and Joly, as well as by Askenasy, to prove that the ascent of water is due to a tensile stress set up by transpiration in the leaves, and transmitted downwards by continuous water-columns which are practically suspended from them. A knowledge of the resistance to the transpiration current in the stems of trees, and of the influence of various factors upon it, forms, however, an essential preliminary to any such explanation.

The author finds that when the vessels are completely filled with water and are open at both ends, the flow through them takes place in accordance with Poisseuille's formula, the rate of flow being directly proportional to the pressure and inversely proportional to the viscosity of the liquid and the square of the radius of the vessel. Hence in climbing plants where a rapid rate of flow is required the vessels are large, approaching 1 mm. in diameter, and in such cases the total viscosity resistance during average transpiration is equal to a head of water considerably less than the height of the stem. Under normal conditions, however, air bubbles always appear in the conducting vessels of angiospermous trees, and each bubble exerts a resistance to flow which is directly proportional to the surface tension of water against air and inversely proportional to the radius of the tube. In a tall tree the theoretical resistance due to this cause alone might amount to as much as 300 atmospheres, whereas calculations from direct experiments gave total resistances for the tallest trees of 100 atmospheres during active transpiration.

No leaf could produce or maintain an osmotic suction of this intensity, nor could the water columns in the vessels transmit it without rupture. In addition, actual observation showed that although differences do occur in the osmotic concentration of the cell-sap in the leaves at different levels, these are not sufficient to overcome the resistance to average flow in the intervening portions of the trunk. It appears, therefore, that a staircase pumping action must be exercised in the wood of a tall tree, which enables the leaves to obtain the water they require without their being forced to exercise tensions of more than $\frac{1}{2}$ to $\frac{2}{3}$ of an atmosphere. No satisfactory physical explanation of such action has yet been given, but the author points out that by appropriate surface-tension action along the length of a Jamin's chain the water could be led upwards from water-column to water-column, and maintained in a labile condition ready to flow in any direction where moderate suction was exercised. Various indirect estimations have been made which lend support to this view, but direct observations have not hitherto yielded satisfactory proof, so that further investigations are still needed in this direction, and these are, in fact, in progress.

December 15, 1904.—"An Analysis of the Results from the Falmouth Magnetographs on 'Quiet' Days during the Twelve Years 1891 to 1902." By Dr. Charles **Chree**, F.R.S.

The paper contains an analysis and discussion of the results obtained from the declination and horizontal force magnetographs at Falmouth on quiet days from 1891, when the records commenced, until 1902.

The total secular changes of declination from 1891 to 1900 at Kew and Falmouth were identical, and the changes from year to year were closely alike. In horizontal force the annual changes recorded at the two stations did not agree so closely, and on the average the change at Falmouth was somewhat the greater.

Whilst the mean daily range of temperature at Falmouth—a seaside station—is notably less than at Kew, the daily ranges of declination at the two places are as nearly as possible equal, and the daily range of horizontal force is somewhat larger at Falmouth.

The annual variation of diurnal temperature range is again notably less at Falmouth than at Kew, the winter range at the former station being relatively high, and the summer range low. There is in this case a somewhat analogous state of matters in magnetics, the difference between the diurnal ranges at midsummer and midwinter being relatively less at Falmouth than at Kew.

Analysing the diurnal inequality of temperature into harmonic terms, General Strachey (*Phil. Trans.* for 1893) found that the local time of occurrence of the maxima was distinctly earlier at Kew than at Falmouth, the difference being greatest for the 24-hour term, for which it amounted to nearly an hour. When the declination and horizontal force diurnal inequalities are similarly analysed, the local times of occurrence of the maxima are so nearly alike at the two stations that it is impossible to say with certainty which is the earlier. This result applies to the average year of a sun-spot cycle.

When the annual variations in the amplitudes of the daily ranges in declination and horizontal force at Kew, and of the 24, 12 and 8-hour terms in the diurnal inequality, were expressed as Fourier series, with an annual and a semi-annual term, there proved to be a remarkably close agreement between the dates of occurrence of maximum in the annual terms, and also in those of the semi-annual terms for the several elements. The same phenomenon appears at Falmouth, and there proves, moreover, to be a remarkably close agreement between corresponding Kew and Falmouth dates. This result again applies to the average year of a sun-spot cycle.

Applying Wolf's formula $R = a + bS$, associating the range R of a magnetic element with sun-spot frequency S, results are obtained for the variation of b and b/a throughout the year at Falmouth very similar in character to those previously obtained for Kew.

Taking the above formula, but making S represent in turn the areas of whole sun-spots, umbræ and faculæ as given by the Astronomer Royal, values are calculated for a and b in the case when R represents the range of declination or horizontal force in the mean diurnal inequality for the year. A comparison is then instituted between the ranges for individual years of the 12-year period as calculated from the values of a and b thus found, and the Astronomer Royal's mean yearly data on the one hand, and as actually observed on the other. When S represents areas of whole sun-spots or of umbræ, the agreement between observed and calculated ranges is nearly though not quite so good, especially in horizontal force, as when S represents Wolfer's sun-spot frequencies; but when S represents areas of faculæ the agreement is much inferior, especially in years of sun-spot maximum.

"The Effect of Temperature on the Thermal Conductivities of some Electrical Insulators." By Dr. Charles H. **Lees.**

The substance the thermal conductivity of which is to be determined has the form of a cylinder about 8 cm. long, 2 cm. diameter, surrounded by a thin cylinder of brass and placed in a Dewar tube. The heat is supplied by the passage of an electrical current through a platinoid wire embedded in the substance parallel to the axis of the cylinder, and about 0·4 cm. distant from it. The temperature is measured by the electrical resistance of two short spirals of No. 40 pure platinum wire, down the centre of one of which the heating wire passes.

The difference of temperature of the two spirals is determined by making them two arms of a resistance bridge, the other two arms of which are equal. By means of mercury cups resistances may be placed in series with either of the spirals until a balance is obtained.

A few values of the conductivities in C.G.S. units for a portion of the range of temperature on the hydrogen scale are given in the following table:—

	At 120° abs.	At 180° abs.	At 240° abs.
Ice	0·0062	0·0058	0·0052
Naphthaline	0·0013	0·0011	0·00091
Aniline	0·0011	0·00086	0·00070
Nitrophenol (para)	0·0010	0·00085	0·00070
Glycerine	0·00078	0·00082	0·00076
Paraffin wax	0·00060	0·00065	0·00061
β-Naphthol	0·00067	0·00065	0·00063
Diphenylamine	0·00058	0·00054	0·00052

Geological Society, December 21, 1904.—Dr. J. E. Marr, F.R.S., president, in the chair.—On certain genera and species of Lytoceratidæ: S. S. **Buckman.** This paper deals with certain specimens sent by Mr. Beeby Thompson from the Northampton Sands, one of which is remarkable for its homœomorphy with Phylloceras.—The Leicester earthquakes of August 4, 1893, and June 21, 1904: Dr. C. **Davison.** The earthquake of 1893 was a twin, with its principal epicentre between Markfield and Woodhouse Eaves, and the other near Tugby, about seventeen miles to E. 34° S. Its disturbed area contains about 2200 square miles. On June 21, 1904, two shocks were felt: the first, a very slight one, at about 3.30 a.m., the second at 5.28 a.m. The epicentre of the earlier shock was in the neighbourhood of Markfield and Groby, or near the south-eastern margin of the north-western focus of 1893. The distance between the epicentres of the earthquakes of 1904 was about twelve miles. Thus the foci of 1904 appear to have occupied the nearer margins of the foci of 1893.—The Derby earthquakes of July 3, 1904: Dr. C. **Davison.** Although weaker than the earthquake of March 24, 1903, this shock, owing to its occurrence at 3.21 on a Sunday afternoon, was felt over a much wider area (about 25,000 square miles). As in 1903, the earthquake was a twin, the epicentres being almost exactly coincident with those of that year, one being situated near Ashbourne, and the other, about six or seven miles from it, near Wirksworth and Matlock Bath.—Twin-earthquakes: Dr. C. **Davison.** In a twin-earthquake, the shock consists of two maxima of intensity, or of two distinct parts separated by a brief interval of rest and quiet. In Great Britain, one in every twenty earthquakes is a twin, and our strongest shocks (the Colchester earthquake of 1884, the Hereford earthquake of 1896, &c.) belong to the same class. The phenomena show that twin-earthquakes cannot be caused by reflection or refraction of the earth-waves, or by the separation of the waves of direct and transverse vibrations, or by the repetition of the impulse within the same or an overlapping focus. They must therefore be due to impulses in two detached, or practically detached, foci; and it is shown that all the known phenomena of twin-earthquakes can be thus accounted for. In British twin-earthquakes, the distance between the epicentres varies from four to twenty-three miles, the average for seven recent earthquakes being between ten and eleven miles. As a rule, the foci are elongated approximately in the direction of the line joining them, showing that they are portions of the same fault. The foci appear to be situated at different depths, and, in two cases, the fault probably changes hade in the region between them.

Royal Microscopical Society, December 21, 1904.—Mr. G. C. Karop in the chair.—Mr. **Conrady** read a short paper explaining an experiment he exhibited to prove the phase-reversal in the second spectrum from a grating of broad slits, the mathematical proof of which he gave in his paper on theories of microscopical vision read before the society at its last meeting. The object consisted of two gratings one above the other, similar in every respect except that one had broad slits and the other had narrow slits. In accordance with what was theoretically predicted by the author, the difference was brought out when the direct light plus the first and second spectra of *one side* were admitted, but when the direct light was cut off by the movement of a shutter the image of the *broad slits* underwent a startling change. The lines jumped across to positions mid-way between the correct ones, showing there was an antagonism of phase between the light of the first and that of the second spectrum. Some photographs showing the effects produced by cutting out the various spectra of one side were exhibited by Mr. Rheinberg, who suggested to Mr. Conrady that the experiment should be made to test the correctness of the theory.—Mr. J. W. **Gordon** then gave a summary of his paper on the theory of highly magnified images.

EDINBURGH.

Royal Society, December 5, 1904.—Dr. R. H. Traquair in the chair.—The igneous geology of the Bathgate and Linlithgow Hills: J. D. **Falconer.** Five successive zones of igneous rocks were described in detail, and important conclusions drawn as to their geological age and to the relations between the intrusive rocks and dykes so characteristic of the region. The region has been very recently re-surveyed by the Geological Survey, and Dr. Horne, Dr. Peach, and others of the staff were able to corroborate many of Mr. Falconer's results, the value of which could not be over-estimated. A further paper was promised dealing with the petrology of the district.—Experiments on the simultaneous removal of spleen and thymus: Drs. Noel **Paton** and **Goodall.** Already the authors had found that the removal of either had no apparent deleterious effect upon the life of the animal, and now they proved that the removal of both in no way affected the vitality. The experiments were made on guinea-pigs.—Crystallographical notes: Dr. Hugh **Marshall,** F.R.S. The author suggested (1) that the "axis of compound symmetry of second order" should not be used in crystallographical work, as it is not a definite direction in the crystal, and that the "centre of symmetry" should be used instead; (2) that in order to simplify the classification of crystals for teaching purposes, the rhombohedral and scalenohedral classes should be treated as members of the hexagonal and not of the trigonal system.

December 19, 1904.—Sir John Murray in the chair.—A supplementary note on the Lower Devonian fishes of Gemunden: Dr. **Traquair.** The author brought forward further evidence in support of his original description, which had been criticised by Prof. Bashford Dean.—A specimen of salmon caught in the Galway River which appears to be intermediate between the smolt and grilse stages: W. L. **Calderwood.**—Networks of the plane in absolute geometry: D. M. Y. **Sommerville.** Networks built up of the various regular figures in the Euclidean plane were discussed at considerable length, and the investigation was then extended to non-Euclidean planes.

PARIS.

Academy of Sciences, January 2.—M. Troost in the chair.—The cooling power of a current of fluid on an ellipsoid with unequal axes immersed in the current: J. **Boussinesq.**—Interference fringes produced by a system of two perpendicular mirrors: G. **Lippmann.** The system of fringes formed, possessing a white central fringe, is parallel to the intersection of the plane of the mirrors. The experimental arrangement for the production of these fringes, which is described in detail, is simpler than that required for the Fresnel fringes.—On the alkaline microgranites of the Zinder territory: A. **Lacroix.** The rocks are ægyrine and amphibole microgranites, and are characterised chemically by their extreme poorness in lime and magnesia, and by the quantity of alkali, the potash being slightly in excess of the soda.—On limiting functions and functional operations: Maurice **Fréchet.**—On substitutions with three variables and invariant curves by a contact transformation: S. **Lattès.**—On invariant subgroups of index p^2: G. **Miller.**—On the deviation of freely falling bodies: M. **de Sparre.** It is shown that the formulæ usually given for this deviation are based on incomplete data, and a new expression is deduced. It is, however, impossible to check the calculations by experiment, on account of the smallness of the deviations, which would amount at most to 0·1 mm. for a fall of 1000 metres.—On a fundamental formula in the kinetic theory of gases: P. **Langevin.** The formulæ given by Maxwell and Boltzmann for the diffusion of gases is re-investigated, and the results applied to the diffusion of ionised gases. The author arrives at the conclusion that the conductivity of flames is, for the most part, due to the presence of free kathodic particles arising from spontaneous corpuscular dissociation in the flame, under the action of the high temperature.—The measurement of the conductivity of dielectrics by means of ionised gases: Charles **Nordmann.** One of the faces of the dielectric, the other of which is connected with earth, is supplied with known quantities of electricity per unit of time, and the variation of the potential of this face is observed with an electrometer. The constant charge is produced by means of a radio-active substance placed between the plates of an air condenser, and the stationary potential is measured. Details of the measurements will be communicated in a later paper.—The influence of steam on the reduction of the oxides of iron by carbon monoxide and dioxide: O. **Boudouard.** With the view of throwing some light on the results of employing dried air in the blast furnace, the author has made experiments on the influence of moisture on the reducing action of carbon monoxide, either pure or mixed with the dioxide, upon ferric oxide. It has been found that the dry gases exert a more energetic reducing action than the moist gases, but that this difference, which is considerable at low temperatures, becomes negligible at high temperatures.—On the existence of a normal green chromic sulphate: Albert **Colson.**—The separation of the three dimethylanthracenes obtained by the action of methylene chloride upon toluene in the presence of aluminium chloride: James **Lavaux.** Modifications of the Friedel and Crafts method are described, by means of which larger and more constant yields are obtained. These modifications appear to be not only advantageous in this particular case, but are applicable to any reaction carried out in the presence of aluminium chloride.—Observations of the Giacobini comet (*d* 1904) made at the Observatory of Algiers with the 31·8 cm. equatorial: MM. **Rambaud** and **Sy.**—On the crystalline rocks collected by the Sahara expedition: F. **Foureau** and L. **Gentil.**—The resistance of water to the motion of vessels. Hulls of least resistance: Vice-Admiral **Fournier.**—Hydrogen peroxide in the nascent state and its bactericidal activity on organisms in water: Ed. **Bonjean.** It is shown that whilst 0·291 gram of hydrogen peroxide per litre was required to sterilise a litre of Seine water in six hours when commercial hydrogen peroxide was employed, under the same conditions, 0·060 gram was sufficient to produce sterilisation in four hours when the hydrogen peroxide was in the nascent state from calcium peroxide.—Hyphoids and bacteroids: Paul **Vuillemin.** Hyphoids and bacteroids are not purely parasitic formations, but are symbiotic products.—Research on plant radio-activity: Paul **Becquerel.** No trace of radio-activity of plant products could be observed if precautions were taken to prevent the moisture transpired by the plant from reaching the electrometer. The author therefore regards the positive results announced by M. Tommasina as being due to a neglect of this precaution.—On the accentuation of the alpine characters of leaves in juniper galls: C. **Houard.**—On the increase of weight of organic and mineral substances in oats as a function of the age: Mlle. M. **Stefanowska.**—Respiratory measurements on marine fishes: J. P. **Bounhiol.** By means of a specially devised tank the author has been enabled to determine the carbon dioxide per gram-hour, the oxygen per gram-hour, and the ratio CO_2/O_2 for several fishes. The effect of captivity in diminishing the respiratory exchanges was well marked.

NEW SOUTH WALES.

Linnean Society, November 30, 1904.—Dr. T. Storie Dixson, president, in the chair.—Contributions to the study of Australian Foraminifera, part i.: H. I. **Jensen.** This paper, for the most part, is a compilation of the species which have been identified in samples of sand or other materials obtained from various sources.—Revision of Australian Lepidoptera, part ii.: Dr. A. Jefferis **Turner.** Some supplementary remarks on the family Notodontidæ (revised in a previous paper) are offered, and the family Syntomidæ, comprising four genera with forty-four species (of which eight are described as new), is reviewed.—A yellow race of *Bacillus pseudarabinus* from the quince: Dr. R. Greig **Smith.** The organism is identical in its morphological and cultural characters with the white race previously isolated from the sugar-cane. The gum obtained from the slime was also identical in giving the reactions of arabin and in yielding only galactose upon hydrolysis. While the cultivations of the sugar-cane race were always white, those of the quince race were yellow.—The bacterial origin of Macrozamia gum: Dr. R. Greig **Smith.** An organism, *Bacillus macrozamiae*, n.sp., isolated from the tissues of *Macrozamia spiralis* which was exuding a gum, produced, upon lævulose media, a slime from which a gum was obtained.—On a new species of Rhizophyllum from the Upper Silurian rocks of Yass, New South Wales: A. J. **Shearsby.** A third species of Calceola-like, operculate, rugose corals is described.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 12.

MATHEMATICAL SOCIETY, at 5.30.—Generational Relations for the Abstract Group simply Isomorphic with the Abstract Group LF [2, p^n]; Dr. W. Bussey.—On a Class of Expansions in Oscillating Functions: Prof. A. C. Dixon.—Isogonal Transformation and the Diameter Transformation: H. L. Trachtenberg.—A Generalisation of the Legendre Polynomial: H. Bateman.—Current Flow in Rectangular Conductors: H. Fletcher Moulton.—Basic Generalisations of some well known Analytic Functions: Rev. F. H. Jackson.—On the Kinematics and Dynamics of a Granular Medium in Normal Piling: J. H. Jeans.—On Alternants and Continuous Groups: Dr. H. F. Baker.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Combination of Dust Destructors and Electricity Works Economically Considered: W. P. Adams. (Conclusion of Discussion.)—Fuel Economy in Steam Power Plants: Wm. H. Booth and J. B. C. Kershaw.

FRIDAY, JANUARY 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.—On the Temperature of Sun-spots and on the Spectrum of an Artificial One: W. E. Wilson.—On Terms of Long Period in the Complete Expression for the Moon's Longitude: E. Nevill.—The Longitude of the Moon's Perigee: P. H. Cowell.—On the Relative Brightness of Stars: J. E. Gore.—On the Variable Star Y Aurigæ: A. S. Williams.—The Spiral Nebula H I. 153 Ceti: W. S. Franks.—Sun-spots and Magnetic Storms: A. Schuster.—*Promised Papers*: Magnetic Storms and Associated Sun-spots: Rev. A. L. Cortie.—On the Possible Effect of Radiation on the Motion of Comets: H. C. Plummer.—Note on the Re-determination of the Paris-Greenwich Longitude (communicated by the Astronomer-Royal).—Observations of the Spectra of Sun-spots, Region C to D (communicated by the Astronomer-Royal).—*Probable Discussion* of Mr. Maunder's Paper in the *Monthly Notices*, on the Connection of Magnetic Storms with the Rotation of the Sun.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Theory of Electricity and Magnetism: James Swinburne.

MALACOLOGICAL SOCIETY, at 8.—A Review of the Genera of the family Mytilidæ: A. J. Jukes-Browne.—Note on the Type of Geomelania, with Description of New Species: E. R. Sykes.—On Three Species of Dyakia from Sumatra: E. R. Sykes.—Some Nudibranchs from the Pacific, including a New Genus, Chromodoridella: Sir C. Eliot, K.C.M.G.—Notes on Two Rare British Nudibranchs, *Hero formosa*, var. *arborescens*, and *Staurodoris maculata*: Sir C. Eliot, K.C.M.G.—Description of a new Achatina from the Zambesi: H. B. Preston.

MONDAY, JANUARY 16.

VICTORIA INSTITUTE, at 4.30.—The History of Rajputana: Col. T. Holbein Hendley.

TUESDAY, JANUARY 17.

ROYAL INSTITUTION, at 5.—The Structure of Animals: Prof. L. C. Miall, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The River Hooghly: L. F. Vernon-Harcourt.

ZOOLOGICAL SOCIETY, at 8.30.—On a Collection of Sipunculids made at Singapore and Malacca: W. F. Lanchester.—On a Collection of Gephyrea from Zanzibar: W. F. Lanchester.—On the Sipunculids and Echiurids collected during the "Skeat Expedition" to the Malay Peninsula: W. F. Lanchester.—On the Oral and Pharyngeal Denticles of Elasmobranchs: A. D. Imms.—A Contribution to the Anatomy of Chlamydosaurus and some other Agamidæ: F. E. Beddard, F.R.S.—A Note on the Brain of *Cynopithecus niger*: F. E. Beddard, F.R.S.

WEDNESDAY, JANUARY 18.

CHEMICAL SOCIETY, at 5.30.—(1) Nitrogen Halogen Derivatives of the Sulphonamides. Part i.: Sulphondichloroamides and Sulphonalkylchloroamides.—(2) Nitrogen Halogen Derivatives of the Sulphonamides. Part ii.: Sulphondibromoamides and Sulphonalkylbromoamides: F. D. Chattaway.—Electrolytic Oxidation of Aliphatic Aldehydes: H. D. Law.—The Diazo-derivatives of the Benzenesulphonylphenylenediamines: G. T. Morgan and F. M. G. Micklethwait.—The Molecular Condition in Solution of Ferrous Potassium Oxalate: S. E. Sheppard and C. E. K. Mees.—The Formation of Magnesia from Magnesium Carbonate by Heat, and the Effect of Temperature on the Properties of the Product: W. C. Anderson.—Transformations of Derivatives of *s*-Tribromodiazobenzene: K. J. P. Orton.—The Addition of Sodium Bisulphite to Ketonic Compounds: A. W. Stewart.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting. Address by the President, Prof. E. B. Poulton, F.R.S.

GEOLOGICAL SOCIETY, at 8.—The Geology of Arenig Fawr and Moel Llyfnant: W. G. Fearnsides.

SOCIETY OF ARTS, at 8.—Wireless Telegraphy and War Correspondence: Capt. Lionel James.

ROYAL MICROSCOPICAL SOCIETY, at 8.—What were the Carboniferous Ferns? the President's Annual Address.

ROYAL METEOROLOGICAL SOCIETY, at 7.40.—Annual General Meeting. Address on the Connection of Meteorology with other Sciences: the President, Capt. D. Wilson-Barker.

THURSDAY, JANUARY 19.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the "Blaze Currents" of the Gall Bladder of the Frog: Mrs. A. M. Waller.—The Dual Force of the Dividing Cell. Part i.: The Achromatic Spindle Figure illustrated by Magnetic Chains of Force: Prof. M. Hartog.—Note on the Effects produced on Rats by the Trypanosomata of Gambia Fever and Sleeping Sickness: H. G. Plimmer.—Further Histological Studies on the Localisation of Cerebral Function. The Brains of Felis, Canis and Sus compared with that of Homo: Dr. A. W. Campbell.

LINNEAN SOCIETY, at 8.—Botanical Collecting: Dr. A. Henry.—On the Cranial Osteology of the Families Osteoglossidæ, Pantodontidæ, and Phractolæmidæ: Dr. W. G. Ridewood.

SOCIETY OF ARTS, at 4.30.—The Gates of Tibet: Douglas W. Freshfield.

FRIDAY, JANUARY 20.

ROYAL INSTITUTION, at 9.—New Low Temperature Phenomena: Sir J. Dewar, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Some Impressions of American Workshops: A. J. Gimson.—Waterworks Pumping Engines in the United States and Canada: J. Barr.—Some Features in the Design and Construction of American Planing Machines: A. Kenrick, Jun.: Engines at the Power Stations, and at the St. Louis Exhibition: A. Saxon.

CONTENTS.

THURSDAY, JANUARY 19, 1905.

ZOOLOGICAL BOOKS FROM GERMANY.

(1) *Anthropogenie oder Entwickelungsgeschichte des Menschen; Keimes- und Stammes-geschichte.* By Ernst Haeckel. Fifth revised and enlarged edition. 2 Vols. Pp. xxviii+992; with 30 plates, 512 text figures, and 60 genetic tables. (Leipzig: Engelmann, 1903.) Price 25*s*. net.

(2) *Morphologische Studien. Als Beitrag zur Methodologie zoologischer Probleme.* By Tad. Garbowski. Pp. vii+189; 6 chromolithographic plates. (Jena: Fischer, 1903.) Price 28 marks.

(3) *Untersuchungen über den Phototropismus der Tiere.* By Dr. Em. Rádl. Pp. viii+188. (Leipzig: Engelmann, 1903.) Price 4*s*.

(4) *Graber's Leitfaden der Zoologie für höhere Lehranstalten.* Bearbeitet von Dr. Robert Latzel, k.k. Gymnasial-Direktor. Fourth revised edition. Pp. 232; illustrated. (Leipzig: G. Freytag, 1904.) Price 3.80 marks.

(1) THE first edition of Prof. Haeckel's book appeared thirty years ago, and the fourth edition in 1891. With each reappearance the book has increased in size and in stateliness, and this is particularly true of the new edition. The sequence of editions reads like a developmental process, say in crustaceans; there is some ecdysis, there is addition of new parts, there is a growing beauty, but the essence remains the same. The veteran evolutionist has gone over the whole work again; he has incorporated new discoveries, he has added fresh arguments and illustrations, but the gist of the book remains unaltered. Our familiar old acquaintances—the Monera and the Gastræadæ, the biogenetic law and its helpmate cœnogenesis, dysteleology and monism, and so on—are all as alive as ever, and with much to say for themselves. As Haeckel says, the book may have its faults; but has anyone given a better popular presentation of the concrete facts as to the position of the human organism in its place in nature, or, for that matter, has anyone else ever tried? We may object to some of his embryology and to some of his phylogeny and to all his philosophy, but here is a vivid, picturesque account of man's development and of his plausible pedigree. It is a historic document which will occupy an honourable place among the archives of biology. It is an achievement on the author's part to have made this revision now—adding about 100 pages, three score and ten figures, ten plates, and eight genetic tables; we could not expect him to change his cherished convictions. Nor, as he says, has he seen any reason to do so. The parts we like least are where he brings in new or relatively new discoveries somewhat casually, as we may illustrate by referring to the centrosome which he calls a "nicht färbares Körperchen." What is it, then, that stains so intensely with iron hæmatoxylin?

(2) Dr. Garbowski has ceased to find satisfaction in the conventional formulæ often used in seeking to interpret phylogenetic advances. He has ceased to believe in the homology of the germinal layers, in the gastræa theory, and in the cœlome theory; and he thinks that the usual application of the so-called biogenetic law is for the most part fallacious. In all this he is not so solitary a sceptic as some of his sentences would lead one to suppose.

There is a branch of ætiological inquiry in which the zoologist interprets the whole organism as a system of adaptations, and seeks to show how the various items in this system may have arisen in the course of variation, and may have persisted by enhancing the survival-value of their possessor. There is another branch of ætiological inquiry which tackles the deeper problems of morphogenesis, which inquires into the formative conditions leading to various big steps in organisation-progress—such as the origin of an enteron, the establishment of metamerism, the development of a cœlom, or the institution of a vertebral axis. It is with these morphogenetic problems that Dr. Tad. Garbowski is mainly concerned, and he wishes to find a *via media* between the use of what he believes to be obsolete verbal formulæ and the extreme of biomechanics.

"Darwin and his school sought to discover the nature of transformation without knowledge of the internal processes, and the 'Entwickelungsmechaniker' are trying to interpret the latter apart from the immanent effects of the former."

It is easy enough to say that sponges are quaintly inverted primitive Metazoa, that annelids represent ancestral Chordates on their backs, that Trochophora have sprung from Ctenophora—the illustrations are the author's—but what we must get at is an observational or experimental knowledge of the actual way in which architectural changes of moment are brought about. In short, we must deepen our physiological-morphology, getting beneath mere form-changes to the functional changes which condition them. This, so far as we can see, is what Dr. Tad. Garbowski is driving at. We are surprised, by the way, that he does not include Rauber's "Formbildung und Formstörung" in his huge bibliography.

The first chapter is devoted to a study—full of interest—of *Trichoplax adhaerens*, with subsections on Treptoplax and Salinella; the second chapter discusses the Mesozoa in general; the third chapter describes various processes of gastrulation, and ends with a rejection of the gastræa theory; the fourth chapter deals with the two primary germinal layers, the mesoderm and the cœlom, and ends with a rejection of the germ-layer theory. In conclusion, the author expounds the scope of physiological morphogenetic studies. There are six fine plates.

Dr. Garbowski is iconoclastic, and his recoil from some familiar theses is thorough-going, but his scepticism is neither unexpected nor unwelcome. The late Prof. Claus had promised to protect him if the Thames caught fire, so to speak, but the author is quite able to look after himself, and his theses will find as much acceptance as opposition. We have all been having our doubts about the homology of the germ-layers and the like; morphological concepts are every day becoming more kinetic, less static. The only question is how far we can go with the little that we know of physiological morphology. In so far as Garbowski has increased the data his memoir is very welcome.

(3) Dr. Em. Rádl has made many experiments on the phototropism of animals, that is to say, on the manner in which they orientate themselves in relation to light stimuli. Phototropic phenomena have been most studied in plants, but there is already much literature relating to their occurrence among animals, and the author begins with a historical survey. He goes on to the reactions of animals on a revolving turn-table, the compensatory head-movements of insects, nystagmus in insects, and phototropic orientation in insects with one eye blackened.

After showing that phototropic orientation or movement occurs widely among animals, *e.g.* in Cœlentera, echinoderms, planarians, annelids, arthropods, and molluscs, and that it may be exhibited in eyeless forms, Rádl discusses various phenomena which cannot be set down as simply phototropic. Thus it cannot be safely said that the movement of pigment in the eye or in the skin is phototropic, and there are many details in the behaviour of butterflies and dragon-flies in relation to light and shade which seem to be more than phototropic. A simple reflex may become complicated by the association of accessory reflexes. In unnatural conditions the established phototropic reflex may lead the animal astray, as when the moth, circling nearer and nearer, finally finds its death in the candle —an interesting and much discussed subject to which Rádl devotes some attention.

Sedentary animals, like plants, orientate themselves to the direction of the light; freely moving animals move into the direction of the light. The author discusses the question whether these two kinds of response are merely different aspects of phototropism, and comes to the conclusion that the two are not directly dependent on one another. He also regards the difference between positive and negative phototropism as a secondary matter; in both there is orientation to the direction of light, but the locomotor muscles are differently stimulated.

In the more general part of his book, Rádl discusses the relations between phototropism and other tropisms —or the more legitimate of these—geo-, stereo-, rheo-, galvano-, chemo-, and thermo-tropisms. There is a chapter, all too short, on the ethological importance of phototropism. The author is clear that organisms are systems of adaptations and that phototropism is a physiological adaptation, but he looks askance at teleological phraseology, and does not follow up the subject. The book closes with a discussion of the general theory of orientation; this must be based on study of tropisms; there is no "Orientierung überhaupt," but the organism seeks for a state of equilibrium in relation to various external stimuli—an equilibrium which consists not merely in the position of the body, but in its functioning.

Dr. Rádl is cautious in stating his own theory of phototropism; he restricts himself to the following propositions:—

(1) Phototropic orientation means the capacity of assuming a definite position of the axis of the body in the field of light.

(2) A phototropically orientated organism is in a state of physiological equilibrium in relation to the light.

(3) The orientation can only be brought about by the operation of paired or coupled forces, which are partly external, partly internal.

(4) In the orientations or tropisms of organisms there is always at least one internal force operative, and this is usually muscular.

The conclusions strike one as disappointing, for they seem to be practically summed up in the conception of "physiological equilibrium"; those who are prepared to advance other theories will find this book of great service. It summarises the subject, describes many new experiments, and criticises many untenable positions.

(4) About twenty years ago we were familiar with a little book, "Outlines of Zoology," by Graber, which had a wide use if not popularity in Gymnasien. Its features were brevity, accuracy, lucidity, and comprehensiveness. We suppose, in the absence of any prefatory note, that the volume before us is our old acquaintance in a glorified edition, in which Dr. Latzel has preserved the characteristics of the original. The book begins with a short introduction on metabolism, the cell, and protoplasm—which must be difficult pabulum for even "höhere Lehranstalten"; it proceeds to the structure and functions of the human body, and thence to a survey of the whole animal kingdom from mammals to the Protozoa. As a systematic summary to be associated with more vital studies in natural history the book is admirable; it is clear, direct, accurate, and most copiously illustrated. It is so ambitiously all-inclusive that we are almost startled to find no mention of Balanoglossus, Peripatus, or the okapi; but these will doubtless find their place in the next edition. A book of this sort, tightly packed with information, without, in many cases, even the padding of verbs to the sentences, must be judged by its intention. If that be, as we charitably suppose, to serve as a terse *index rerum* or synopsis, associated with practical work and open-air studies, it deserves to be encouraged. But if it is meant as a book to be "got up"—and there are unpleasant suggestions of the cram-book about it—then it is emphatically not in the line of progress. It stands in direct antithesis to the natural history text-books for high schools which find favour in America and are securing their place in this country. There is almost no suggestion of the evolution or affinities of the great types; there is almost no hint of initiation into scientific methods of observation and reasoning; and there is very little open-air. It seems to us more like a revisal-book for a student going up for his first professional examination in medicine or natural science than a book for schools. At the same time, it is a very effective book of its sort; the illustrations are admirable, and the coloured plates are as fascinating as the text is dry. J. A. T.

AN AMERICAN TEXT-BOOK OF GEOLOGY.

Geology. By Thomas C. Chamberlin and Rollin D. Salisbury. Vol. i. Geologic Processes and their Results. Pp. xix+654; with 24 plates and 471 figures in the text. (New York: H. Holt and Co., 1904.)

THE work of which this is the first volume, bearing the names of two well known professors in the University of Chicago, is addressed to the mature student, and is designed "to present an outline of the salient features of geology, as now developed." The present instalment, dealing with the nature and results of the processes now in operation upon the globe, will naturally prepare the way for the second volume, to be devoted to tracing the history of past ages. Agreeing with other writers in approaching the science from this side, the authors have been led by their own experience as teachers to depart somewhat from the beaten track in their general plan of treatment, as well as in the relative importance assigned to certain specific subjects. They tell us in their preface that they have laid little stress on the generally recognised divisions of geology, "dynamical," "structural," "stratigraphical," &c., but have tried rather to emphasise the historical element even in the discussion of special themes, thus bringing out the essential unity of the science. Again, some subjects, such as the development of drainage-systems, the ultimate cause of crust-movements, and others, receive here fuller treatment than has been customary in works of this scope.

Most of the original features of the book we heartily welcome. We think, too, that the authors have generally been happy in their treatment of the more dubious and debatable problems of physical geology. Their design in this has been freely to introduce the theoretical element when necessary, and at the same time "to avoid confusing the interpretations based on hypothesis with the statements of fact and established doctrines." Where important differences of opinion exist, the alternative hypotheses are set forth and their consequences compared. In some instances this candour is pushed rather far, as when the cause of vulcanism is discussed on seven distinct hypotheses. Having regard to the class of students for whom the book is primarily intended, we think that the authors have needlessly hampered themselves by trying to make it intelligible to one who has had no previous acquaintance with the rudiments of geology. How far they have succeeded in this it is not easy to judge. Thus the technical terms of the field-geologist, "dip," "anticline," "dyke" and the like, are not formally defined until we reach a late section of the volume, but the conceptions implied have necessarily been introduced much earlier. Such difficulties inevitably confront the writer of an elementary class-book, but they might safely be ignored in a work like the present.

After a preliminary outline of the general scope of geology, the authors proceed to discuss in turn the geological effects of the atmosphere, of running water, of underground water, of snow and ice, and of the ocean. Their clear exposition of the mechanism of rain- and river-erosion, with due regard to the controlling conditions, is an admirable summary of a fundamental part of geology which in most of our text-books receives very inadequate treatment. It is written on modern lines, the fertile conception of the "base-level of erosion," with its important consequences, being introduced at an early stage. The subject is one which American geologists, with their unrivalled opportunities, have made peculiarly their own, and it could scarcely have fallen into better hands. The other geological agents are discussed in the same comprehensive but concise manner, and the chapter dealing with glacial action is, as might be expected from the authors, of special interest.

The chapter on movements and deformations of the earth's body contains much material which is not elsewhere accessible to the student in a connected shape, and some originality appears in matter as well as in treatment. Consideration of the possible causes of the great crust-movements leads to an inquiry into the original and present distributions of temperature in the globe, and to a comparison of the nebular hypothesis with that of "accretion." The comparison is presented in a judicial manner, and the enunciation of the accretion hypothesis is tantalisingly brief; but a fuller discussion is promised in the second volume. Geologists sometimes need to be reminded that cosmogony is a legitimate part of their province, not to be surrendered without good reason shown. At least it is well that students should see just how much of accepted physical principles and how much of arbitrary assumptions go to the building of dogmas which have carried alarm into some quarters.

The treatment accorded to igneous action seems to us in some respects unsatisfactory. Descriptive petrography is, no doubt wisely, represented by a brief summary, an appendix to a generalised account of "the origin and descent of rocks." But what follows seems to lack due proportion. "Vulcanism" is used to include intrusive as well as extrusive action, but the chapter is occupied almost exclusively with the latter. The plutonic and other igneous intrusions, the varied forms which they assume, and their intimate relation to crust-movements and to geological history in general, are dismissed almost without notice. The full and admirable discussion of volcanoes might thus give a student the impression that these superficial phenomena are the only important effects of igneous activity.

The volume concludes with a chapter on the geologic functions of life, and a good index is added. The book is issued in handsome form; but the highly glazed paper, presumably adopted for the sake of the figures, is irritating to the reader. The abundant figures, selected from various sources, are well chosen to illustrate the text, and well reproduced. The subjects are for the most part American. A useful feature is the illustration of various types of topography by actual maps, taken from the beautifully contoured sheets of the United States Geological Survey.

A. H.

THE TOPOGRAPHY OF BRITISH INDIA.

India. By Colonel Sir Thomas Holdich, K.C.M.G., K.C.I.E., C.B., R.E. Pp. 375; 8 maps in colours. *The Regions of the World.* Edited by H. J. Mackinder. (London: Henry Frowde, Oxford University Press, n.d.) Price 7*s.* 6*d.* net.

WITH climates varying from the ice-bound deserts of the higher Himalayas and the rain-steeped forests of Tenasserim, to the desolation of Makran, where at one time of the year fire is almost unnecessary, even for cooking, and at another the cold blasts almost defy human endurance; the inhabitants of which number races unsurpassed as brave and stubborn fighters, and races among whom physical cowardice is regarded as no disgrace; where in one part music is produced by stamping on a piece of wood, and in another has been carried to a refinement which requires sixty-four tones to our octave—both extremes, it may be added, equally unmusical to the European ear; where there is found a system of laws so elaborate that the cashier who has confessed to embezzlement may yet succeed in escaping punishment, and a system of government so paternal that it imprisons the husband, whose domestic happiness has been ruined, to prevent his committing the crime of murder; the territories known as British India may be a country for political purposes, but in no proper sense of the word do they constitute a nation, they are hardly even a "region of the world," and the name is nothing but a geographical expression for the area which is administered by the British Government through the agency of the Governor-General of India in Council. To write a description which, in a book of moderate compass, will convey a clear and fairly proportioned conception, requires a master hand; not to have failed is in itself high praise, but Sir Thomas Holdich has done more than this, he has produced a topographical description of the Indian Empire which, in spite of minor errors—such as the reference to the Kasmur bund as intended for the storage of water, and a general inaccuracy where he ventures into geology—is not only interesting to read, but accurate and well proportioned on the whole.

With all its manifold diversity in detail, the Indian Empire is composed of two parts, each of which may be regarded as a geographical unit, and each geographically distinct from the other. The larger and more important of the two may be regarded as India proper, and consists of the alluvial plains of the Indo-Gangetic river system, and the triangular area known, though incorrectly, as the Peninsula. It is cut off from Burma by a tract of mountains, impassable by reason of the deep-cut network of valleys and the dense vegetation with which their slopes are covered, and on the north it is bounded by the mighty range of the Himalayas. Both these barriers have proved effective against either ethnical or military invasion, but on the west are the semi-desert hills and open plains of Afghanistan and Baluchistan, which have repeatedly been traversed by invaders. It is in the description of this region that Sir Thomas Holdich is at his best, partly, no doubt, because it is that of which he has the most intimate personal knowledge, but largely, too, because of the intrinsic interest attaching to it; for across this region came not only the great prehistoric Dravidian and the semi-historic Aryan invasions of India, but also the military invasions of Alexander the Great, and of the successive Mohammedan conquerors of India. Until the improvement of navigation brought in the nations of the west, it was the only way by which invasion and conquest were possible, and it is through this region alone that we need look for a serious attack on India, so long as we hold the command of the sea.

Of this long series of invasions all the historical ones, from Alexander onwards, have been purely military; they have left their impress, more or less deeply marked, on the religion, the administration and the political geography of India, in buildings and in public works, but they have hardly affected the great bulk of the people, who derive their origin from the earlier invasions. In these it was no mere conquering army that came, but nations, with their wives and families, their flocks and herds, their household goods and gods, who absorbed or exterminated the inhabitants of the land, and whose descendants are found over the length and breadth of India, constituting nine-tenths of the total population.

The other unit in the Indian Empire is Burma, which belongs, geographically, rather to Indo-China than to India. Cut off from the latter by a band of forest-clad mountains, which has rarely been traversed even by marauding expeditions, it received centuries ago its religion and philosophy from India, but has remained unaffected in all other respects, and maintained its ethnical distinction untouched. This isolation of Burma is now at an end; the establishment of steamer lines across the Bay of Bengal has rendered it easy of access, the Hindu prejudice against crossing the sea has given way to the stronger claims of pecuniary gain, and the gay, picturesque, pleasure-loving Burman, who had evolved an epicurean philosophy and regarded life merely as something to be enjoyed, is being ousted by the plodding, but joyless and unattractive native of Behar or Madras.

Across the north of the Empire runs the great mountain barrier of the Himalayas, the highest and greatest mountain range of the world, which separates the Mongolians of Thibet from the races of India, and has left its impress on their mythology and folklore. This naturally gets a chapter to itself, and it is satisfactory that the author recognises the futility of an attempt to trace any limited number of continuous chains in a mountain range of so great an extent, and wisely abstains from formulating any theory of the Himalayas. We cannot, however, accept the statement, repeated more than once, that the eastern Himalayas are older than the western; it is true that the rocks of which they are composed are older, but the rise of the Himalayas, as a mountain range, belongs to the great period of mountain formation which commenced at the close of the Secondary era, and there is no reason for supposing that the two halves of the range differ materially in the age of their elevation.

The book is provided with a large number of blocks in the text, nearly all maps, in which, with very few exceptions, but one method of representing relief is adopted—that of shaded areas bounded by contour lines. The method is valuable for some purposes, but as a means of representing the form of the ground is, in most cases, inferior to the much abused "caterpillar" method of delineation, and frequently conveys a misleading impression. The figure intended to represent the lower Brahmaputra valley and Gangetic delta is an instance of this, while that intended to represent the orography of the Hindu Kush looks more like an ink-maker's advertisement. In the coloured maps the complete absence of hill shading gives to the Thibetan plateau an air of flatness which it is far from possessing in reality, yet it would be unfair to conclude this notice without a word in their praise. Mr. Bartholomew has accustomed us to a high standard of workmanship, but his map of India, reproduced in this book, has seldom been equalled for intricacy and accuracy of colour printing, and for success in showing the leading features of the relief of the land.

PHYSICAL AND PHYSIOLOGICAL ASPECTS OF LIGHT.

Light Energy; its Physics, Physiological Action, and Therapeutics. By Margaret A. Cleaves, M.D. Pp. xiv+827. (London: Rebman, Ltd., 1904.) Price 21*s.* net.

WHILE this book is written primarily to further our knowledge of the properties and uses of that form of energy called light, in the treatment of disease, yet it will be found of great interest to those whose study is mainly confined to the purely physical aspects of light phenomena. The subject is treated from the modern view of energy in the form of waves of a certain length and direction, but at the same time the emission theory is not entirely ignored on account of the peculiar behaviour of some of the recently discovered radio-active substances, notably radium. About 130 pages are devoted to a description of the various kinds of rays, their origin and physical properties. The part dealing with the electric arc is very complete and clear, and embraces all one could wish to know to ensure an intelligent application of the arc lamp in the treatment of disease.

Following this is a series of chapters dealing with the action of light on the various forms of life, from the most elementary to the highly complex human subject. In this section the action of light from both natural and artificial sources is treated very thoroughly. It is quite evident that the author has devoted herself to a large amount of painstaking experiment, the valuable results of which are recorded in the present volume. According to her, the mercury vapour lamp has not justified the expectations regarding it as a therapeutic agent.

The second half of the book is taken up with the therapeutic applications of the various forms of light. This part will be of special interest to medical men, especially those who are engaged in this line of work. Sun, arc, and incandescent light baths are treated most fully, together with their use in those diseases in which the author has found them respectively useful. The indications are, in every instance, based on spectroscopic analysis, and full details of the proper technique are given for every variety of application. Several forms of bath cabinet are described, as well as arc and other lamps for local treatment with concentrated light.

While the author is rather emphatic on the necessity for employing lamps of large amperage—quantity being as essential as quality—yet she speaks highly of certain small lamps the efficiency of which was such as to necessitate their replacement by lamps of greater power in the light department of the London Hospital. The reason for this praise is seen, later on, to be related to the comparative cost of the lamps—the smaller being sold and maintained at a fraction of the cost of the Finsen, and their efficiency is at least in proportion to this cost. According to the author, the great advantage of a lamp of high amperage, like the Finsen, is that we get not only the short and high frequencies of intense chemical activity, but also the frequencies of long wave-lengths having great amplitude and penetrability—a combination which is essential to ensure the best success. In the smaller lamps these long wave-lengths of great amplitude are not present in such abundance because of the lesser amperage and smaller carbons. The results which the author has obtained in many diseases not generally subjected to light treatment will come as a surprise to those who have not kept closely in touch with modern light therapeutics.

The applications of the various coloured lights, as also those of the invisible spectrum rays, are fully discussed. A short chapter is given to the consideration of *n*-Rays and one to the Alpha, Beta, and Gamma rays of radio-active substances, their physical properties, actions, and therapeutic uses. An interesting chapter is that on fluorescence, fluorescent stimulation, and sensitisation of tissues, and the book closes with a chapter on the pernicious effect of sunlight and the pathological effects of electric lighting. The book can be confidently recommended. It will be found of great interest to most students of natural science.

REGINALD MORTON.

A BOOK ON INK.

Inks: their Composition and Manufacture. By C. Ainsworth Mitchell, B.A. (Oxon.), F.I.C., and T. C. Hepworth. Pp. xiv+251; with 46 illustrations, including 4 plates. (London: Chas. Griffin and Co., Ltd., 1904.) Price 7*s.* 6*d.* net.

LITERA scripta manet; but the permanence of the writing depends upon the quality of the ink. Certain papyri of ancient Egypt, now deposited in the British Museum, contain the earliest ink-written records so far brought to light. A roll dating from 2500 B.C. still bears decipherable characters, and fragments of papyri have been found by Prof. Flinders Petrie in a tomb to which the date 3500 B.C. is ascribed. If the origin of the use of ink is 'ost in antiquity, at least one thing is certain—the writing-fluid used by the ancient scribes for such records as the foregoing must have possessed in a high degree the property of durability.

In one form or another, the basis of these early writing-fluids was carbon. For example, Chinese ink, the so-called "Indian" ink of the modern artist, which according to the native historians has been made since 2600 B.C. or thereabouts, was at first a vegetable varnish, and later a mixture of lampblack and glue. Inks containing gallate of iron did not come into use until a much later period. Thus Sir Humphry Davy, examining some documents recovered from the ruins of Herculaneum, "looked in vain amongst the MSS. . . . for vestiges of letters in oxide of iron," and he concludes that the Romans up to the time of Pliny had never used "ink of galls and iron" for writing purposes. Gradually, however, in the early centuries of the Christian era, there came a transition from carbon inks to those containing iron; and Blagden, in "Some Observations on Ancient Inks," communicated to the Royal Society in 1787, records that the writing fluid employed in various MSS. on vellum, dating from the ninth to the fifteenth centuries, was an iron and gall ink. Somewhat earlier than the date of Blagden's paper logwood began to find employment as a constituent of inks, and soon after the middle of last century came the next notable modification, namely, the use of aniline dyes in the manufacture of both black and coloured writing-fluids.

Of these and other matters bearing upon the history, composition, and methods of preparing the various kinds of inks, Messrs. Mitchell and Hepworth have much to tell us in the volume under notice. They have brought together, and made convenient for reference, material that has been hitherto chiefly scattered amongst periodicals and isolated dictionary articles. In so doing they have saved their contemporaries some labour, and earned for themselves much gratitude.

The book is divided into three sections. The first of these deals with writing inks, including those of which carbon, tannin, logwood, and aniline respectively form the characteristic ingredients. It comprises chapters upon the sources of the tannin materials, the chemical nature of iron-gall inks, and the best methods of examining both the fluid itself and the characters on the written page. Printing inks form the subject of section ii., in which an interesting chapter treats of colour work, including three-colour printing and inks for use in the production of cheques and bank-notes. In the concluding section there is a description of inks intended for miscellaneous purposes; these comprise copying, marking, safety, and sympathetic inks, and fluids for writing on glass, wood, ivory, or leather. Many formulæ are given, some of which the authors have personally tested, and the work closes with a list of English patents relating to the subject.

Despite occasional incoherency of style, the two collaborators have produced a useful and attractive little volume. One or two slips may be pointed out; thus the equation on p. 101 is incomplete, and the specific gravity of dilute hydrochloric acid is given wrongly on p. 208. In the historical introduction we are told, *apropos* of a certain document (p. 11), that "it was probably written at the end of the sixteenth century by a man past middle age, who learned to write just about the time that Shakespeare was born (1504)." At first it seems an unnecessarily cautious understatement to call such a man "past middle age," but a little reflection shows that it is those kittle cattle the figures that are to blame.

The book is a serviceable addition to the literature of chemical technology. C. Simmonds.

OUR BOOK SHELF.

Naturbegriffe und Natururteile. By Hans Driesch. Pp. viii+239. (Leipzig: Wilhelm Engelmann; London: Williams and Norgate, 1904.) Price 4*s.* net.

This book deals chiefly with three topics. Starting on a Kantian basis, it seeks to state the *a priori* principles of pure physical science. (*A priori* is conveniently defined as "independent of the amount of experience.") Next, the leading principles of "energetics" are discussed, and their relation on the one hand to the *a priori* principles of pure physical science, and on the other hand to the ordinary laws of thermodynamics. Incidentally, the "laws" of conservation (of substance and the like) are examined, and entropy has a good deal of attention. Last of all the results attained are carried over to a discussion of biology. The point of view is neo-vitalistic. It would be hazardous to say that the author has run to earth the *x* which is the object of all our search, the vital principle or whatever other name may be applied to it; the term which he uses is the blessed word *entelechy*.

Herr Driesch is well known to be at his best a clear, original and suggestive writer. Much of the present work is excellent, but we doubt if the last eighty pages are either clear or convincing. Perhaps one would require to read the author's other works in order to accustom oneself to his point of view and his independent modes of statement. He is occasionally unsatisfactory as well when dealing with the theories of others, for example, with Prof. Clerk Maxwell's "sorting demon." The discussion occurs under the heading "Declarations of Physicists regarding Biological Subjects," and Herr Driesch almost seems at times to suppose or to imply that the conception may have been formed in order to limit the second law of thermodynamics to inanimate bodies. True, Lord Kelvin's statement of the second law has the words "in inanimate material." But Lord Kelvin's declaration is explicit ("Popular Lectures and Addresses," 1889, vol. i. p. 141):—"The conception of the 'sorting demon' is merely mechanical and is of great value in purely physical science. It was not invented to help us to deal with questions regarding the influence of life and of mind on the motions of matter." On p. 103 the accurate reference to Helmholtz's work is Ostwald's *Klassiker* Nr. 124, p. 30, Anm.

Higher Text-book of Magnetism and Electricity. By R. Wallace Stewart, D.Sc. Being vol. iv. of "The Tutorial Physics." Pp. viii+672. (London: W. B. Clive, University Tutorial Press.) Price 6*s.* 6*d.*

We have several times noticed this work as successive editions have appeared, and can speak as appreciatively of it as we have on other occasions. The present volume is based on the older one, but it has been wholly re-cast, and a very considerable quantity of new matter has been added in view of the rapid advance which has been made in electrical theory in the last few years.

In this edition the author has followed several other text-books in laying stress upon the importance of the electric field as the real seat of the energy of an electric circuit. It should be clearly brought out, however, that part of the energy must flow in the conductor, following there, as elsewhere, the direction of the equipotential surfaces; the forward flow is, however, in the dielectric itself. The figures exhibiting this flow of energy on pp. 344, 525, and 528 are very far from satisfactory. It is sufficient to point out that in every ordinary case of steady transfer the lines of force are convex *forwards;* indeed, if it be borne in mind that in accordance with Poynting's theorem the flow of energy takes place at right angles to the lines of force, there would be energy flowing out from and not into a conductor if the lines were as shown.

Too much care cannot be exercised in the construction of diagrams. They catch the eye; and just as nothing is better than a good diagram for inculcating truth, nothing can be worse educationally than one that is slipshod.

This remark applies equally to a figure illustrating the action of the keeper of a magnet on p. 227, where about twice as many lines of "force" are shown in the keeper as are represented in the magnet itself. Is the keeper supposed to be independently magnetised?

Again, on p. 401, if the equipotential lines on the plate exhibiting the Hall effect were really as shown, some of the current would flow over the edges of the conductor.

This slovenliness is almost wholly confined to the figures. The text is exceedingly lucid and painstaking in the endeavour to give a student a sound knowledge of physics. The large number of worked out examples, which have always been a distinguishing feature of the book, have no doubt contributed largely to the appreciation which it has received, especially from those who are compelled by circumstances to work without a teacher.

Life and Energy—Four Addresses. By Walter Hibbert. Pp. xiv+182. (London: Longmans, Green and Co., 1904.) Price 2s. 6d. net.

THE thesis of these four addresses—originally delivered at the Polytechnic Institute, London—is that life is not matter, is not energy, but an unceasing non-factorial directive control of energy and its transformations. "Directive control," *i.e.* in the same sense in which "temperature" in the case of heat, or "potential" in the case of electricity, controls the direction in which the energy shall flow. "Non-factorial," because while temperature, potential, and the like are factors of energy, life is not a factor.

Mr. Hibbert puts most of his points clearly, and much of what he says has considerable force. But it is doubtful if the range of ideas within which the book moves is adequate to the problem. The main position is not unassailable, and the deductions from it in regard to morals and religion are occasionally fanciful.

To descend to details. (1) It is difficult to see how the terms factorial and non-factorial describe precisely the difference between the directive control of energy manifested in inorganic and in organic bodies respectively. The discussion on p. 50 rather begs the question. (2) In describing God's directive control as being purely non-factorial, in saying (p. 144), "It is not the office of prayer to seek any direct disturbance of the course of material nature," but "its office is to secure a renewed faith in non-factorial control," Mr. Hibbert lays himself open to the retort, "Then non-factorial control is no control at all." (3) "Provided that life is a physical entity, it must be either matter or energy" (p. 16). "If it is a form of matter, it must weigh something" (p. 17). But what if it were ether? (4) "The living plant opens out a new path in which physical law can operate" (p. 39)—"it has, in a sense, directed the energy into special channels" (p. 38). But is this a differentia of life? Surely to one acquainted only with other manifestations of energy the path opened out by the dynamo is as new as anything can be.

Glossary of Geographical and Topographical Terms. By Alexander Knox, B.A., F.R.G.S. Pp. xl+432. (London: Edward Stanford, 1904.) Price 15s.

THIS work, which is intended as a supplementary volume to Stanford's "Compendium of Geography and Travel," is evidently the outcome of a vast amount of industrious research on the part of the author. The amount of labour involved in the collection of some 10,000 geographical terms derived from the most diverse languages all over the world can readily be imagined, and it can only excite our admiration that so much should have been successfully accomplished by a single individual. The book will be a decided boon to readers of works of geography and travel, who, in the absence of deep linguistic attainments, must constantly be puzzled by the terms employed in the place-names of foreign countries. It will also be valuable to the more scientific geographer as supplying a useful basis for the complete dictionary of geographical terms, which has long been felt to be a desideratum. Mr. Knox's book, useful as it is, can hardly be said to supply this need, being concerned rather with the general and popular, than with the scientific and technical usage of geographical terms. It was undertaken in the first instance, as the author explains, with a view to elucidate the terms in use in extra-European countries, and this object it certainly fulfils with success. European geographical terms, which naturally include the majority of those with which the scientific geographer is concerned, are less fully dealt with, and we not only miss many such technical terms as "Karst," "Kar," "Horst," "Schrund," "Aven" (to take a few only at random), but we find little attempt made at discrimination between the terms in use for closely allied features, or at the definition of nice shades of meaning, such, e.g., as are involved in the words "dale" and "dell," both of which are explained merely as a "valley." Many English local terms are missing, and the definition of others is not always quite satisfactory. On the other hand various Spanish topographical terms are carefully explained, and the recent definitions by the International Commission for the Study of the Sea of the main features of suboceanic relief are correctly given.

But the special value lies in the fact that the information supplied is just that which is most out of reach of the ordinary reader, terms derived from the languages of Africa, Asia, and the less known parts of the world generally, being particularly well represented. The introduction includes some useful hints, by Dr. A. H. Keane, on the laws of interchange of letters in various languages.

Blackie's Handy Book of Logarithms. Pp. 128. (London: Blackie and Son, 1904.) Price 2s.

Vier- und fünfstellige Logarithmentafeln. Pp. 24. (Brunswick: F. Vieweg and Son, 1904.) Price 0.80 mark.

IN order that mathematical tables intended for common use may serve their purpose, it is essential that great attention be paid to the labour-saving arrangements which authors have from time to time introduced, such as the careful grouping of the figures in rows and columns, the use of varied type or of differently coloured inks, marginal or thumb indexes, proportional differences, inverse functions, &c. On opening Blackie's "handy" volume, the reader will be disappointed to find that the compiler of the tables has paid little attention to the points enumerated above. A table of six-figure logarithms of four-figure numbers occupies twenty-two pages; the average difference for each row of figures is given, but there is no room found for proportional differences, so that the taking out of the logarithm of a five- or six-figure number involves an irritating calculation. Anti-logarithms are not included, but there is a table of hyperbolic logs. Sixteen pages are allotted to tables of natural and logarithmic functions of angles, for increments of one-sixth of a degree, without differences. Other tables include reciprocals, squares and square roots, cubes and cube roots, circumferences and areas of circles, heights and areas of circular segments, and rhumbs in degrees. There is an appendix giving some simple mensuration rules, some old-fashioned practical geometry, and definitions of the functions of angles, not as ratios, but as lengths.

The German tables are specially suitable for use in the chemical laboratory. The main feature is an eighteen-page table of five-figure logarithms of five-figure numbers, arranged, with proportional differences for each row of figures, like the four-figure logarithms contained in the first two pages. The collection of physical constants at the end is such as a chemist would be likely to require. There are no anti-logarithms, nor is there a marginal index. The size of page is ample, allowing of bold and effective type.

Second Report on Economic Zoology: British Museum (Natural History). By Fred. V. Theobald, M.A. Pp. x+197. (London: Printed by Order of the Trustees of the British Museum, 1904.) Price 6s.

The recent development of British Museum activities in the line of economic zoology, for which the insight of the director is largely to be thanked, is re-expressed in a second report, following quickly on the heels of the first (see Nature, January 28, 1904, vol. lxix. p. 290). We congratulated Mr. Theobald on his first report, and we repeat our congratulations, for the volume does credit to his energy and ability, and to the expertness of those inside and outside the national museum who have given him assistance. Everyone who has had even a little experience of the amount of work which is often required in order to answer apparently simple questions from outside will appreciate the skill which this report displays. The volume contains a large part of the information furnished by the director of the natural history departments of the British Museum to the Board of Agriculture and Fisheries between November, 1902, and November, 1903, besides replies to other correspondents and some special notes of present-day interest. The British Museum of Natural History is not only one of the greatest world-treasure-houses of scientific material, it has also, in its staff, an almost unrivalled wealth of learning, and we cannot refrain from giving expression to the widespread gratification that these resources of material and knowledge are now being utilised in behalf of the practical queries of the nation. The volume deals with mosquitoes, sheep scab, weevils, aphides, wire-worm, mites, leather-jackets, warbles, ring-worm, liver-fluke, and a hundred other economically interesting pests—and always in a way that leads us to respect Mr. Theobald's wide knowledge and practical shrewdness. We hope that there will be many such reports, for they are of a kind that enrich the nation as well as science. That they also contribute to art may be illustrated by the report on the grubs causing damage at Rye Golf Links.

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 Heterogenetic Origin of Fungus-germs.

An attempt has been made in Nature (December 22, 1904, p. 175), by Mr. George Massee, of Kew, to question the validity of my conclusions because of certain observations of his own of a totally different kind, which have little or no bearing upon what I have brought forward.

What he says is this:—*Dematium pullulans* of de Bary produces exceedingly minute colourless conidia which are most widely distributed and are capable of passing through "thick" filter paper. "Under normal conditions," he adds, "these minute conidia on germination form delicate hyaline hyphæ which give origin to a Cladosporium. If cultures of these conidia become infested with bacteria that form Zooglœa, the hyphæ become invested with a comparatively thick, brown cell-wall, and form either compact masses of cells or irregular hyphæ consisting of short cells, constricted at the septa, exactly as shown in Dr. Bastian's Fig. 12." He then refers to an illustrated paper in the *Kew Bulletin* for December, 1898, in which he has shown this process as it occurs in a certain disease of *Prunus japonica.* He thinks his observations exactly illustrate some of the facts which I have brought forward, while I, after carefully reading his paper and studying his illustrations, think they are altogether beside the mark.

He supposes the widely distributed conidia are not only present in the hay infusion (which of course they may be), but that they are able to pass through two layers of very fine Swedish filter paper (not merely "thick" paper, as he loosely puts it). Looking to his Fig. 5 and the size of the conidia there shown, this, I think, is more than doubtful. It is, however, altogether immaterial whether such conidia are present in the original hay infusion and are able to pass through the filter used by me or not, because the next necessary step in his suggested explanation is altogether wanting in my observations. This step is that the conidia assumed to be present shall produce delicate hyphæ, and that these hyphæ, coming into contact with masses of Zooglœa, shall "become invested with a comparatively thick, brown cell-wall, and form either compact masses of cells or irregular hyphæ consisting of short cells constricted at the septa." But I had already privately assured Mr. Massee that all the phenomena which I have described may be witnessed without its being possible to meet with a single hypha of any kind or a single one of the thick-walled, brown cells to which he refers.[1] Yet for his explanation to have any weight "delicate hyphæ" should always be seen in relation with the Zooglœa masses, and as for the "thick-walled cells" which are then formed being exactly like what I have shown in my Fig. 12, I can assure Mr. Massee he is absolutely mistaken. What I have represented in that figure are colourless products of segmentation of a Zooglœa mass (wholly unlike the colourless conidia shown in his Fig. 5) which speedily assume a brownish-black colour, and then, *without any intervention of delicate hyphae,* at once grow out into mycelial filaments of the same colour. In accordance with his explanation, the production of delicate colourless hyphæ should be the commonest thing possible, and should always be met with at an early stage of the changes that I have been describing; but, as a matter of fact, nothing is more remarkable than the rarity with which any of the myriads of Fungus-germs produced in a bacterial scum undergo a further stage of development, with the production of hyphæ either colourless or coloured, and I can assure Mr. Massee that he might work for three weeks or more with such infusions as I have described without finding a single specimen at all comparable with my Fig. 12. It seems deplorable that in regard to such an

[1] This was in reply to a private letter to me very similar to that which he subsequently sent to Nature. In this reply I asked him to come and examine my specimens for himself, which he did not do.

important subject as the reality or unreality of heterogenesis, persons like Mr. Massee, who could speak authoritatively, should not think it necessary to make personal observations, and should be content to offer in reply to real and prolonged work only loose explanations which will not bear any serious examination.

A further instance of the same lack of care is afforded in the last sentence of Mr. Massee's letter. Referring evidently to my remark (NATURE, November 24, 1904, p. 77) as to the very different products that may be met with in the scum forming on an infusion made from unripe grasses as compared with that forming on an ordinary hay infusion, he says:—"As these fungi only develop on fading leaves it was not to be expected that they would appear in infusions of young grass." This sentence must have been penned without the writer having taken the trouble to look at p. 87 of my "Studies in Heterogenesis," to which reference was made when I directed attention to the differences in question. Had he done so he would have seen how little he had explained the differences noted on that and on the following page, and he would also have seen that the most striking difference recorded is the complete absence of Zooglœa masses (spoken of there as "areas") in the scum forming on infusions of unripe grasses. Of course if the Zooglœa masses are not there it is easy for me to understand the absence of the Fungus-germs which, as I maintain, are produced therefrom.

This point, as well as others in Mr. Massee's letter, shows the great importance of bearing in mind two wholly distinct aspects of my observations, corresponding with different stages in the processes described. We have to do (1) with the growth, the individualisation, and the processes of segmentation taking place in masses of Zooglœa. We have also to do (2) with the question of the ultimate destination, or the transformation, of the products of such segmentation. These are two parts of the subject which are to some extent distinct, and are well worthy of further separate consideration.[1]

In conclusion I would ask, Why do the bacteriologists not tell us what they know about Zooglœa—whether they are or are not aware of its developmental tendencies, and why it should undergo processes of minute segmentation, unless such processes are a result of an organising tendency destined to have some definite outcome? Why, again, should it or its segments so often tend to assume a brown colour, while it is still nothing but Zooglœa, either segmented or unsegmented? Again, why, if the brown Zooglœa does not yield the brown Fungus-germs, should there be this constant association of myriads of brown Fungus-germs (in the absence of hyphæ) in association with brown masses of Zooglœa? How can they explain, other than I have done, the actual organisation of a Zooglœa mass, and the stages by which the brown Fungus-germs seem to be formed therein? What process of "infection" in a filtered hay infusion contained in a closed pot could cause thousands of small Zooglœa masses to go simultaneously through similar processes of this kind—producing myriads of brown Fungus-germs—when not a single hypha is anywhere to be found, and when at first no Fungus-germs are to be met with outside the Zooglœa masses themselves? I trust the bacteriologists will vouchsafe to give us some information on these points, or, if they cannot reasonably explain them, that they may be induced to work at the subject, and satisfy themselves that something important can be learned concerning bacteria, even though it be outside their laboratories and by methods other than their own.

H. CHARLTON BASTIAN.

[1] My further observations on this subject will be found in the February number of the *Annals and Magazine of Natural History*.

Compulsory Greek at Cambridge.

As a corrective to much vague discussion, perhaps the following record of facts may be of interest.

Entering the University of Cambridge in 1886, entirely ignorant of the Greek language, I was, of course, obliged to pass the "Little-go" in order to proceed to the natural sciences tripos. The Greek subjects prescribed were the Gospel of St. Mark, the Pluto of Aristophanes, and the usual grammar papers, and, in conjunction with a friend similarly circumstanced to myself, I set to work to "cram" these by as "scientific" methods as we could devise, in order to pass with as little waste of time as possible.

Purchasing a copy of Wordsworth's "Primer of Greek Grammar," we read the nouns, adjectives, and the active voice of τυπτω—no more, and then started on the prescribed books. These we translated by aid of a good lexicon, word by word—thus learning the parts of the irregular verbs, which form a favourite subject in the grammar papers. Having been once through the books by this method, we procured the translations, and read these through five or six times, in order to become so familiar with the subject-matter of the books that we could translate most passages easily at sight after making out the leading words in them.

The actual time expended by us in the preparation of Greek for the examination was carefully recorded, and amounted to $105\frac{1}{2}$ working hours, and we passed the examination in the second class, with, I believe, a considerable margin of safety even in Greek. I need hardly add that my present knowledge of the language is *nil*.

JOHN C. WILLIS.

Royal Botanic Gardens, Peradeniya, Ceylon,
December 28, 1904.

Polyhedral Soap-films.

THE fact that polyhedral wire frames can be used for the purpose of forming films across them is well known, but there are some features of this subject, which I have investigated, which may be of interest.

If a frame of wire representing the edges of one of the simpler polyhedra, such as a cube or octahedron, is dipped into soap solution, then on taking it out it will have films attached to its edges and meeting roughly at a point in the centre of the figure, forming a number of pyramids standing on the faces of the figure. If, however, a more complex figure, such as the rhombic dodecahedron or the eicosihedron, be taken, then the effect will be quite different; the film will then simply cover all the faces except the one which was drawn out of the solution first. The former thing will happen if the area of the $(n-1)$ faces is greater than that required to form the pyramids, while the latter will occur if the reverse is the case.

If, now, in the case of the cube, for instance, after the pyramids have been formed, a film be applied to one of the faces, then a certain amount of air becomes entirely enclosed by film, and the bubble so formed settles in the centre of the frame, forming roughly a cube suspended in the frame by twelve sheets of soap-film. On closer inspection, however, it will be seen that the faces of this cube are convex, thus showing that the air in it is compressed. By inserting a tube this cubical bubble can be inflated or reduced in size, all the time retaining its convexity, so that if thus left in communication with the air it will collapse of its own accord. A little consideration shows the reason for this, namely, that three films meeting one another cannot be in equilibrium unless their planes are inclined to one another at 120°, since the tensions in all three are equal. But since the dihedral angle of a tetrahedron, cube, or octahedron is less than 120°, therefore in these figures the internal polyhedral film must always have convex faces.

From this I expected to get an exact polyhedron with plane faces in the case of the rhombic dodecahedron, since its dihedral angles are all 120°. On trying this it was found to agree remarkably with my assumption, only, as may be gathered from what has gone before, it was not quite so simple to obtain the central bubble as in the former case. After the $(n-1)$ faces had been covered with film the figure was again immersed so as to displace about one-half the air contained in it, and while thus immersed it was turned round so as to cover the one open face with liquid. On withdrawing it there was seen the plane-faced rhombic dodecahedron. The same result can be obtained by applying a film to the nth face and then exhausting some of the enclosed air by means of a tube. By using a tube, as in the former cases, the bubble can be enlarged or reduced at will by blowing or suction, and it will retain its size constant when placed in open communication with the outer air by means of this tube. This is, of course, the only plane-faced polyhedron which can thus be formed, faces, edges and vertices being entirely made out of soap films. If, on the other hand, a figure has its dihedral angles greater than 120°, then the internal bubble will have concave faces, and will, if placed in communication with the outer air, increase in size until it coincides with the faces of the frame, and will then be kept in equilibrium by their rigidity. This I verified in the case of the eicosihedron.

There is one important law which must be mentioned. I found a certain irregularity in the behaviour of the films in the case of the octahedron and rhombic dodecahedron. This was due to the fact that two films cannot cross one another at right angles, a law which can be put to the test by placing two plane loops covered with film at right angles, when a small lanceolate film will be formed making two curved lines of intersection with the film on the loops, instead of allowing them to intersect in a single straight line. In the case of the rhombic dodecahedron this slightly modifies the form of the internal bubble, introducing a small edge and a little curvature at each of the acute vertices. This defect causes a serious convexity if the bubble is small, but in general we have double curvatures at the points in question, the remaining portion of each face being plain while the figure retains the form of a rhombic dodecahedron. W. F. WARTH.

Reversal of Charge from Electrical Induction Machines.

THE reversal of the poles of a Voss machine by giving some turns in the wrong direction, as observed in NATURE of January 5 (p. 221), is not an unknown phenomenon. It is described in my paper "Essai sur la Théorie des Machines électriques à influence" (Gauthier-Villars, Paris, 1898), p. 38, together with a much more trustworthy and simpler means—an improvement, in theory and in fact. This consists in discharging by hand, at the same time, both the inductors of the fixed disc. Then the reversal is invariably observed without stopping the machine.

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THE CONSTRUCTION OF SIMPLE ELECTROSCOPES FOR EXPERIMENTS ON RADIO-ACTIVITY.

THE electrical method, where it is applicable, is now by far the most sensitive method of detecting small quantities of matter; and the recent advances in physical science made by the method of measuring small leakages of electricity, especially in connection with the phenomena of radio-activity, have excited a very general interest in the experimental arrangements employed. The writer hopes that the following account of simple electroscopes for this kind of work will be found to be of a practical nature and of service to those who, though unfamiliar with many of the devices in general use in a physical laboratory, are nevertheless desirous of making quantitative experiments on radio-activity or some other subject where the electrical method is employed.

In general the final shape of the instrument will depend very much on the purpose for which it is required; in fact, it is one great advantage of the gold-leaf electroscope that it can usually be fixed up in any odd corner of the apparatus which happens to be convenient. There is, however, one part of the apparatus which is always the same in sensitive instruments, and that is the gold-leaf system itself. Before describing this it will perhaps make things clearer if we consider for a moment one or two points about the theory of the instrument.

What we observe usually is the rate of decrease of the deflection of a charged gold leaf from a vertical metal support to which it is attached. Now the deflection in question depends only on the shape and size of the leaf and of the metal support, and on the electrostatic potential of the system, so that the rate of collapse of the leaf measures the rate of decrease of the electrostatic potential. But what we wish to measure is the current or rate of alteration of electric charge, and this is equal to the rate of decrease of potential multiplied by the electrostatic capacity of the system. Thus for a given current the rate of movement of the gold leaves is greater the smaller the capacity of the system. For a sensitive instrument it is therefore absolutely necessary to have the parts which are metallically connected with the gold leaf as small as possible.

Cutting gold leaves is a process which requires a considerable amount of patience, especially from the beginner. The process I always adopt is to take a plate of glass and lay a sheet of smooth note paper on it. On this the gold leaf is spread out flat by blowing gently if necessary, and is cut by means of a razor. To do this, all except a narrow strip at the edge is covered with a second sheet of note paper, the straight edge of which is pressed down with the fingers so as to hold the gold leaf. A fine strip outside the edge of the paper is then cut off from the leaf by dragging the razor gently backwards parallel to itself and to the edge of the paper. It is not necessary to exert any great pressure during this operation, but a little practice will be necessary to get into the way of doing the saw-cut stroke at the proper speed. Mr. C. T. R. Wilson has succeeded in this way in cutting uniform strips one-tenth of a millimetre across, but for most purposes strips one millimetre wide are good enough. In working with gold leaf much trouble will be saved by working in a room which is free from draughts and disturbances generally.

For the metal support to which the gold leaf is attached it is convenient to use a piece of wire of about the same diameter as the thickness of the gold leaf. To fix the leaf on to the wire it is sufficient just to moisten the latter at the point of attachment with the tip of the tongue; on allowing the end of the gold leaf to come in contact with the very slightly moist wire it will be found to attach itself sufficiently firmly for all that is required of it. For obvious reasons the cutting and mounting of the gold leaf should be the very last operation in the construction of the electroscope.

In constructing an electroscope it is of the utmost importance to have trustworthy insulation. When the apparatus has not to be raised to a high temperature, and great mechanical strength is not required, sulphur is a long way better than anything else for this purpose. Generally speaking, it is better to have as small a quantity of insulating material as possible in order to diminish irregularities caused by the superficial charging up of the dielectric. Suppose we wish to insulate the wire carrying the gold leaf from another wire which supports it mechanically we should proceed as follows:—Take a porcelain crucible and gently heat a quantity of pure flowers of sulphur in it until it just melts and forms a clear yellow limpid liquid. It is important that it should not be heated so strongly as to become dark coloured and viscous, as this appears to diminish its subsequent insulating properties. The end of one of the wires is then dipped into the liquid sulphur, when a coating of sulphur forms on the wire. This is allowed to cool until it has solidified, and the operation is repeated a number of times until a bead of sulphur like that shown in Fig. 1 A has formed on the end. The end of the other wire is now heated gently in the flame and applied with a slight pressure to the point *a*, when it melts its way into the sulphur;

and if the operation has been successfully carried out the result will be as indicated in Fig. 1 B.

In this sort of work it is often necessary to make sulphur stoppers, &c., of various shapes. To do this it is only necessary to make paper models of the required shape, into which the sulphur is cast. The paper generally sticks to the sulphur, but may be taken off with a clean knife without impairing the insulation. It is advisable to do this, and also any cutting away of the sulphur that may be necessary, immediately after it has set, since it becomes very hard and brittle soon afterwards.

For ordinary work with radio-active substances it is not necessary to employ the most sensitive type of electroscope, and for such work the design shown in Fig. 2 is very convenient. It consists of a brass cylinder of about the proportions shown and 10 cm. high. The top is closed by a flat plate with a narrow tubular opening *a*, into which a sulphur stopper *b*, cast as above, fits fairly tightly. The sulphur is best cast round the wire destined to carry the gold leaf. For examining the properties of various radiations the bottom may be made in the form of a ring, as shown. This is fixed by the slot and pin indicated or some

Fig 1

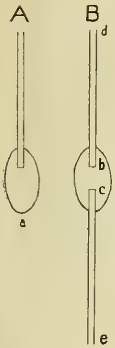
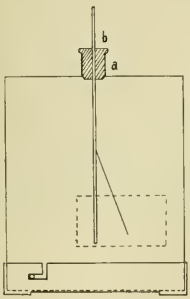


Fig 2



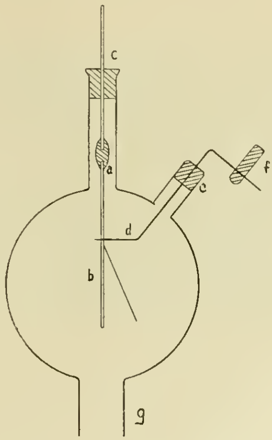
similar arrangement, and the circular hole in the base can be covered with sheets of foil, &c., if it is desired to examine the penetrating power of the rays under investigation. In all these instruments a hole has to be cut in the metal both in front and behind the gold leaf to illuminate it and to read its position. The holes are conveniently of about the relative size shown; they may be covered up with glass, mica, or transparent celluloid, whichever is most convenient. A suitable illumination is obtained by placing a sheet of white paper in front of a paraffin lamp about twelve inches behind the electroscope. The movement of the leaves is most conveniently read by means of a microscope of about 6 cm. focal length furnished with a micrometer eye-piece. It is advisable to have a microscope with as short a focal length as possible to increase the magnification, and therefore the sensitiveness.

The final appearance of the electroscope will depend very much on the appliances at the disposal of the experimenter. An instrument of this character could quite well be made out of a cigarette tin, but it would probably be more satisfactory to have the metal parts made by a competent mechanic.

If cells are not available the above instrument is readily charged by allowing a rubbed sealing wax or ebonite rod to spark to the outside wire. In measuring leaks the gold leaf should always be charged to about the same extent, as the sensitiveness depends a good deal on the amount of the deflection. The instrument will not keep its charge indefinitely, but will show a small leak even if no radio-active substances are present; this is nearly all due to the so-called spontaneous ionisation of the air. There is practically no leakage across the sulphur if the instrument is properly made.

For some purposes a more convenient arrangement is that indicated in Fig. 3, where the figure is drawn so as to exhibit the electroscope in its most sensitive form, *i.e.* with the minimum capacity. A piece about 4 cm. deep is cut off a wide brass cylinder, and the side tubes fitted on as shown. The gold leaf is carried by the wire *b*, and is insulated by the sulphur bead *a*, formed in the manner already described. Thus the insulation leak can only take place to the support *c*, and can be entirely prevented by keeping *c* at the same

Fig 3



potential as *b* by means of cells. The insulation of the wire *c* from the tube which supports it need not be of a very high order; it is sufficient to fix it in with a rubber stopper in the manner shown. So far we have all our charged system enclosed, so that there arises the difficulty of charging it. This is done by means of the wire *d*, which can be rotated about an axis through the centre of the ebonite stopper *e*. It is advisable to remove the wire *d* from the gold-leaf system when once this has been charged. By means of the sealing-wax handle *f* this may be accomplished without discharging the electroscope. The instrument is so far open. It is conveniently closed by two squares of window glass cemented on to the brass cylinder with sealing wax. The whole of the outside is then covered with thin lead sheet or tin foil to obviate effects due to the glass getting charged. Suitable windows must be cut in this to allow the position of the gold leaf to be read.

The above arrangement is as sensitive as this type of instrument can conveniently be made, since its capacity is only that of a short piece of wire and the gold leaf. Generally speaking, the capacity in electrostatic units is found to be of the same order as the length of the wire. In this or a slightly altered form, the instrument is suitable for experiments on spontaneous ionisation and the radio-activity of ordinary materials.

In experiments on emanations, induced activity, and very penetrating rays it is often convenient to increase the magnitude of the effects by allowing them to ionise a large volume of air. For this purpose the arrangement last described is particularly convenient. It is only necessary to solder a long straight wire upon the lower end of *b* and to fix *g* by means of a rubber stopper into the neck of an oil can. The leak then measured is due to the ionisation produced throughout the volume of the can. The sensitiveness, though greater than before, is not increased in the ratio of the volumes, as would otherwise be the case, owing to the increased capacity produced by the additional wire. This arrangement is especially useful for examining the induced activity which may conveniently be deposited on the wire.

A still more sensitive type of electroscope was recently invented by Mr. C. T. R. Wilson. It does not, however, appear to be an instrument which can be safely recommended to the inexperienced, so that it scarcely comes within the scope of this article. It is described in the Cambridge Phil. Soc. *Proc.*, vol. xii. p. 135, and may be bought from the Cambridge Scientific Instrument Company. Much further information about electroscopes and electrometers for radio-active work will also be found in Prof. Rutherford's book on radio-activity, chapter iii.

O. W. RICHARDSON.

GEOLOGICAL SURVEY OF CANADA.

THE Geological Survey of Canada, which was established in 1842 under the direction of Mr. (afterwards Sir) William E. Logan, commenced its labours with 1500*l.*, which was voted by the Provincial Legislature. The sum seems to have been granted without any clear idea of the length of time which the survey would take, but apparently it was expected to last about two years.

In the winter of 1844–5 the amount was expended, and Logan was more than 800*l.* out of pocket. Eventually provision was made for the continuance of the survey for five years with an annual grant of 2000*l.* Notwithstanding many difficulties and disappointments vigorous progress was made in the field work and office work, and this has been continued for upwards of sixty years under the successive directors, Selwyn, George Dawson, until now, when the survey, under Dr. Robert Bell, is provided for better than at any previous time. Thus the total votes for the present financial year amount to 22,800*l.* for general purposes, and to about 8000*l.* for the salaries of permanent officers.

We gather from the last summary report by Dr. Bell that while the Canadian Geological Survey, like that of the United States, has been engaged in palæontological, zoological, botanical, ethnological, and archæological investigations, by far the largest proportion of the work has been of an economic and practical character. Thus the justification for the increased support given to the survey is amply supplied by the investigations which have been carried on with the view of aiding the development of the mineral resources of the country. Up to the end of 1903 the publications of the survey included about 350 maps, of which 100 relate especially to mining districts; and about 250 reports and bulletins, amongst which nearly 100 are exclusively economic. During the four years of Dr. Bell's directorship, the field parties have been increased, and during the past year they have worked in many interesting districts, from the Yukon and British Columbia in the west to New Brunswick and Nova Scotia in the east, and from southern Ontario and Quebec to Lancaster Sound in the Arctic regions. Their researches have had reference to gold, silver, lead, copper, graphite, corundum and mineral pigments; to coal, peat, petroleum and natural gas; to various building and ornamental stones, clays and cement ingredients. Hitherto unknown sections of the country have been explored and surveyed, and observations have been made on the timber, soils, and water supply, as well as on the general natural history.

The palæontological work of the survey has been carried on by the veteran palæontologist Dr. J. F. Whiteaves, aided in the department of vertebrates by Mr. Lawrence M. Lambe. In the "Contributions to Canadian Palæontology" (vol. iii.), recently issued by the survey, Mr. Lambe has described some remains of the carnivorous dinosaur *Dryptosaurus incrassatus* (Cope), from the Edmonton series of Alberta, in the North-West Territory. The strata belong to the Lower Laramie (Cretaceous) formation. The importance of a more intimate knowledge of the fauna of the Edmonton series is apparent when it is borne in mind that the beds of this series in Alberta constitute the principal coal-bearing horizon of the district.

Dr. Bell himself has been partly occupied, in conjunction with other leading geologists in Canada and the United States, in investigating the crystalline rocks in Upper Michigan, in Wisconsin and Minnesota, and in the Rainy River, Thunder Bay, and other districts of Ontario, with the view of settling disputed questions. The controversies on these rocks have long been occupying attention without any definite result. A few years ago Dr. Bell urged upon the International Committee of Geologists the desirability of forming a small central committee, the members of which should go to the ground together and look at the facts. This was carried out, and as a result the members have come to an almost complete agreement on all the vexed points. The standing committee consists of Dr. Bell and Dr. F. D. Adams (professor of geology in McGill University) for Canada, and Dr. C. W. Hayes (chief geologist of the U.S. Geological Survey) and Prof. C. R. Van Hise (president of the State University of Wisconsin) for the United States. By invitation there were also associated with them Prof. Leith (of the University of Wisconsin), Dr. Lane (State geologist of Michigan), Prof. Seaman (professor of geology in the College of Mines at Houghton, Michigan), Messrs Sebenius and Merriam (geologists of the Iron Ranges), and Prof. W. G. Miller (provincial geologist of Ontario). It is anticipated that the joint report will shortly be published.

RECENT EXPLORATION IN THE MENTONE CAVES.

PROF. MARCELLIN BOULE has recently been studying the deposits in the well known caves of the Rochers rouges (Baoussé-roussé of local patois) near Mentone, and read a paper on his results before the Société géologique de France in the early part of last year, which is published in the society's *Bulletin* (No. 1). Since the original discovery by M. Rivière of a human skeleton in one of these caves, the question of the age of their deposits has been debated with much warmth, but without any satisfactory result. In recent years the caves have been carefully and systematically explored under the direction of the Prince of Monaco, with the result that a great number of fossils have been obtained. Prof. Boule's researches were conducted chiefly from the geological standpoint with the view of determining the age of the deposits, and of throwing light upon the much debated question of the oscillations of sea-level in recent times on the Mediterranean seaboard.

Prof. Boule's attention was directed in the first instance to the Grotte du Prince, which was almost intact when excavation was commenced. Here the deposits attain a thickness of more than 20 metres, and consist of basal beds of marine origin upon which strata of continental origin are superimposed. The latter can be subdivided into a number of layers, both by their physical characters and by their fossil contents, but the point of importance is that the upper and middle beds contain remains of reindeer (never previously recorded in this region), ibex, marmot, and woolly rhinoceros, that is, the fauna of the cold period of the Quaternary, while the lower beds contain quite a different fauna—*Elephas antiquus*, *Rhinoceros mercki*, and hippopotamus, that is, species belonging to the lower Quaternary fauna. The last named deposits lie upon an old raised beach which is also discernible outside the cavern, along the shore rocks, at a mean altitude of 7 metres. Almost all the contained fossils belong to the existing Mediterranean fauna, but Prof. Boule has found some beautiful examples of *Strombus mediterraneus*, which has been regarded as characteristic of the raised beaches of the Quaternary period in the Mediterranean area. But the Prince's cave contains other traces of marine action of a much earlier date. In its upper part, at a height of 28 metres, there is a calcareous encrustation due to the action of the waves, below which the wall of the cavern is perforated by boring molluscs. The sequence of events is therefore explained by Prof. Boule as follows:—

The sea formerly stood at the 28-metre level, and then gradually retired until it stood at a height of 7–8 metres. At this level the shell deposit was laid down on the floor of the cavern. Subsequently the movement of elevation was continued. Its extent is difficult to determine, but the oceanographical researches of the Prince of Monaco have shown that there extends along the rochers rouges at a slight depth an extensive submarine platform. This suggests that the movement—whether of the land or of the sea—continued until there was laid bare between the sea and the present irregular shore line a plain sufficiently extensive to become the home of such large animals as elephants, hippopotami, and rhinoceroses, for which the present topography allows no space. It is at least certain, according to Prof. Boule, that the 7-metre beach, described at other parts of the Mediterranean littoral by MM. Depéret and Caizot, and regarded by them as of late Quaternary date, really belongs to a much more distant period, for it is anterior to the subaërial deposits containing fossils belonging to the older period of the Quaternary. If this conclusion be correct, it affords a means of fixing the age of the last oscillation of sea-level in this region. It should, however, be noted that in the discussion which followed the reading of the paper M. Depéret protested against the proposed homologising of the low raised beach (height 5–7 metres) studied by him on the French coast of the Mediterranean (*e.g.* in the Bay of Pierre-Formique) with the Strombus beach in the Mentone caves. The former type of beach contains a fauna very different from that of the Strombus layers, Strombus being absent, and all the fossils belonging to living species.

At the conclusion of his paper Prof. Boule referred to the three new human skeletons which have been recently discovered in the Grotte des Enfants. The first of these has been studied by MM. Gaudry and Verneau, and proves to be markedly Australoid in type. It was obtained in a bed containing *Ursus spelaeus*, *Hyaena spelaea*, *Felis spelaea*, &c., and rested upon a bed containing molars of *Rhinoceros mercki*. It must therefore belong to the earlier part of the Quaternary period. The second skeleton was found about 0.60 metre above the first, and was accompanied by remains of the same species of mammals. The third skeleton, on the other hand, found 6 metres above the first, seems to belong to the period of the reindeer, that is, to the end of the Quaternary epoch.

Fig. 1.—Skeleton from the Grotte des Enfants.

THE SCIENTIFIC EXPLORATION OF LAKE TANGANYIKA.

THE committee for the scientific exploration of Lake Tanganyika (consisting of Sir John Kirk, Dr. Sclater, Sir W. Thiselton-Dyer, Prof. Lankester, Dr. Boulenger, and Mr. J. E. S. Moore) has lately received news of the progress of its envoy, Mr. W. A. Cunnington, who left England in March, 1904, under directions to continue the researches carried out by Mr. J. E. S. Moore during his two expeditions to Lake Tanganyika. Proceeding by the Zambesi and Shiré route, Mr. Cunnington was most kindly received at Zomba by Sir Alfred Sharpe, who granted him the assistance of two native collectors. Mr. Cunnington had instructions to devote his special attention to the lacustrine flora and fauna of Lake

Tanganyika, and, as he passed up Lake Nyassa, began his investigations in that lake, in order to be able to compare its products with those of Tanganyika. On Lake Nyassa Mr. Cunnington was able to get a good number of tow-nettings from different parts of the lake's surface, and obtained, on the whole, a large quantity of its characteristic phytoplankton, besides a considerable amount of zooplankton, consisting mostly of Copepoda, Cladocera, and insect-larvæ. The temperature of the water of Lake Nyassa was observed to fall seldom below 70°, while the temperature at 76 fathoms below the surface was ascertained to be about three degrees higher.

Mr. Cunnington arrived at Karonga, at the head of Lake Nyassa, at the end of June, 1904, and travelled on to Tanganyika by the ordinary route of the Stevenson road. His last letters from Tanganyika are dated at Vua, on October 29, 1904. He had obtained a dhow from Ujiji, which enabled him to make his stay at different places on the lake longer or shorter according as he found much or little to collect. A good series of fishes had been preserved, and many freshwater crustaceans. As regards the vegetable life, Mr. Cunnington had been much struck by the near resemblance of all the forms obtained in Tanganyika to those which he had collected in Nyassa, though he could not, of course, say that they were specifically identical. From Vua, Mr. Cunnington had arranged to cross to the east coast of the lake, and to go some distance further north before returning to the western shore. Mr. Cunnington may be expected to return to England before the end of the year.

NOTES.

SIR JAMES DEWAR has presented the proceeds of the Gunning prize, amounting to one hundred guineas, recently awarded to him by the Royal Society of Edinburgh, as a contribution to the fund for the encouragement of research, now being founded in the University of Edinburgh in memory of the late Prof. Tait.

WE regret to learn from the London branch of the Zeiss optical firm that Prof. Abbe, of Jena, died a few days ago. We also announce with regret the death of M. Paul Henry, astronomer at the Paris Observatory. His brother, M. Prosper Henry, with whom he was associated for many years in celestial photography, died about eighteen months ago.

THE Paris Société d'Encouragement pour l'Industrie nationale has awarded the grand prize of the Marquis d'Argenteuil to MM. Auguste and Louis Lumière for their photographic discoveries. M. Héroult has been awarded a grand gold medal for his works on electro-metallurgy.

THE two Antarctic ships *Terra Nova* and *Morning* were sold at Portsmouth on January 11. Messrs. W. Ziegler and Co., New York, bought the *Terra Nova* for 9600*l*., and she will probably be used for North Polar exploration. The *Morning* was sold for 1600*l*. The *Discovery* has been sold privately to the Hudson's Bay Company for 10,000*l*.

M. L. BONNAMÈRE has been elected president for 1905 of the Prehistoric Society of France.

THE death is announced of Dr. Anton Müttrich, professor of physics and mathematics in the Academy of Forestry at Eberswald.

SIR WILLIAM THISELTON-DYER, K.C.M.G., will take the chair at a lecture to be delivered at the West India Committee Rooms, Seething Lane, on Wednesday, January 25, by Mr. W. G. Freeman, superintendent of the colonial economic collections at the Imperial Institute, on "The West Indian Fruit Industry."

THE next competition for the Howard medal of the Royal Statistical Society will take place in the ensuing session. The essays must be sent in on or before June 30. In addition to the medal, a grant of 20*l*. will be awarded to the successful competitor. The subject is:—"A Critical Inquiry into the Comparative Prevalence of Lunacy and other Mental Defects in the United Kingdom during the Last Fifty Years."

THE death is announced of Mr. T. W. Shore, author of a number of papers on geological and archæological subjects. Mr. Shore was for a long time resident at Southampton, where he acted as curator of the Hartley Institution and secretary of the Hampshire Field Club. At the Southampton meeting of the British Association in 1882 he was one of the secretaries of the section of geology. On removing to London, he founded the Balham Antiquarian Society, and became its secretary; he was also secretary of the London and Middlesex Archæological Society.

WE have received a letter from Mr. C. E. Stromeyer, of Manchester, in which he suggests that irregularities of the earth's surface might be detected by special observations for determining the position of the northern and southern limits of totality during the coming total solar eclipse of August next. Unfortunately there are many practical difficulties in the way which the author has not discussed, but he makes one suggestion which might be carried out. He proposes to place soldiers at short distances along the northern and southern borders of the shadow's path, who, by marking the positions where the eclipse was total, might determine with greater accuracy than is known the breadth of the moon's shadow.

A CORRESPONDENT writes:—The death of Dr. Thomas Woods occurred on January 5 in Birr (or Parsonstown). Dr. Woods was born in February, 1815, and graduated as doctor of medicine in Glasgow in 1838. He spent all his long life as a medical practitioner and as medical officer of the union and dispensary in Birr. So it is, perhaps, not to be wondered at that his scientific work belonged largely to a former generation. He was a chemist, and as such took part in the early development of photography, originating in the 'forties a new wet plate process, the "catalysotype," a detailed description of which may be found in Hunt's "History of Photography." In 1852 and 1853 he published in the *Philosophical Magazine* some original observations on the heat developed by chemical combination, and defended with considerable success his claim of priority against Andrews and Joule. He was a man of remarkable ability and astoundingly general scientific interest, and it is much to be regretted that circumstances kept him in a small country town, and that his professional duties prevented him from adding further to scientific knowledge. He continued mentally and bodily fresh to the very end, ever eager to hear of the latest scientific discoveries, and Birr feels distinctly the poorer for his loss.

A REUTER message from Christiania states that at Nesdal, north of Bergen, on Sunday, a mass of rock slipped into the Loenvand Lake. A wave of water twenty feet high, which resulted from the fall, swept the neighbourhood, carrying away houses, people, and cattle.

As supplementary to the paragraph on the recent fall of cliff at St. Margaret's Bay, near Dover (NATURE, January 12), it may be mentioned that the cliffs at St. Margaret's Bay, which rise from 150 to 300 feet, are formed of the Upper Chalk, comprising soft chalk and harder nodular bands, with scattered flints and occasional continuous seams of flint. These beds are surmounted by chalk, with many layers of flint nodules and some continuous bands of flint; and this portion of the chalk forms the mass of the cliffs at St. Margaret's Bay, the lower beds appearing at beach level and rising southwards. The general dip of the chalk is to the north-east, corresponding to some extent with the trend of the coast from East Wear Bay to Dover and St. Margaret's. Numerous falls of cliff have taken place along this coast for many centuries, the greatest losses having occurred above East Wear Bay in the great landslip of the Warren, where notable founders occurred in 1716 and again in 1886. Such slips along the sea-front may serve for a time to protect the cliffs from further waste, until the débris is removed by the breakers. Copious springs issue along the foot of the cliffs here and there, and a powerful spring issues at St. Margaret's Bay. These probably had no direct influence on the recent falls of cliff, but rather would the slips be due to the local feeders of the springs, to their erosive action along joints in the chalk, and to the effects of frost. It is quite possible, as has been suggested, that blasting operations at the Admiralty Harbour at Dover may have accelerated the falls of cliffs at points where they were weakened by natural agencies.

THE *Victorian Naturalist* brings us news of the death, on November 18, 1904, of Mr. J. G. Luehmann, Government botanist and curator of the National Herbarium at Melbourne, at the age of sixty-one. Mr. Luehmann went to Victoria in 1862, and in 1867, on the resignation of Mr. E. B. Heyne, secretary to the late Baron von Mueller, Mr. Luehmann was offered the position, which he accepted, and he remained connected with the botanical department until shortly before his death. For many years he made the preliminary identifications of specimens for Baron von Mueller, becoming an authority on the eucalypts and acacias. His great assistance was acknowledged by Baron von Mueller in the preface to the "Key to the System of Victorian Plants." In the early days of the Field Naturalists' Club of Victoria, before the institution of the *Victorian Naturalist*, he contributed papers on the eucalypts and acacias. In 1896, on the death of Baron von Mueller, he was appointed curator of the National Herbarium, and afterwards became Government botanist. During late years he contributed several descriptions of plants to the club's proceedings, in addition to an interesting paper—observations on pre-Linnean botanists—in which he directed attention to the many valuable botanical works in the herbarium library. He was one of the earliest Victorian fellows of the Linnean Society of London.

IN a paper in the *Lancet* (January 7) Mr. G. C. Chatterjee, working under the direction of Captain L. Rogers, I.M.S., announces that he has succeeded in cultivating trypanosomes from the Leishman-Donovan body or parasite, thus confirming Captain Rogers's previous work in this direction.

WE have received the first number of the new volume of the *Journal of Hygiene* (vol. v., No. 1), which continues to maintain its previous high standard. It contains papers on piroplasmosis by Mr. Bowhill and by Mr. Ross, cultivation of trypanosomata by Mr. Smedley, epidemiology of plague by Mr. Hankin, a leprosy-like disease in the rat by Mr. Dean, &c. An introductory memoir, with a portrait, gives an account of the work of the late Sir John Simon.

MM. SALOMONSEN AND DREYER have conducted some experiments on the effect of the radium emanations on certain Protozoa and on the blood. The material consisted of fifty milligrams of pure radium bromide covered with a sheet of mica. On Nassula the radium had little effect, even with an exposure of six days. Some amœbæ were killed in less than twelve hours, but others survived four days. *Trypanosoma Brucei* was killed in from two to three hours. On blood corpuscles the radium exerted a hæmolytic power.

H.R.H. PRINCESS CHRISTIAN and Mr. Chamberlain were present on Friday last at St. George's Hall, Liverpool, on the occasion of a meeting in connection with the Liverpool School of Tropical Medicine, at which a lecture was delivered by Major Ronald Ross, F.R.S., on "The Progress of Tropical Medicine." Major Ross, in the course of his address, alluded to the discoveries which had proved that yellow fever is conveyed solely by mosquitoes, to the work of Sir William MacGregor in the suppression of malaria in Lagos, and to the anti-malarial measures of the Suez Canal Company, which had resulted in a reduction of the annual rate of malarial fevers at Ismailia from two thousand to two hundred. He also alluded to the fact that the Liverpool School had sent out no less than fourteen expeditions to investigate tropical diseases in various parts of the world.

Naturen for December, 1904, contains some realistic, and perhaps rather ghastly, photographs of a python and its prey, taken from menagerie specimens. In the first of the series we have an unfortunate rabbit "fascinated" and about to be seized by a python, in the second the rodent in the coils of the serpent, and in the third the python commencing to devour the crushed carcase.

THE most important, or at all events the longest and most fully illustrated, paper in the second part of vol. ii. of the quarterly issue of *Smithsonian Miscellaneous Contributions* is one by Mr. C. Schuchert on Silurian and Devonian cystoid echinoderms and the genus Camarocrinus, in the course of which many new forms are described, and some valuable contributions made to the morphology of the group. Among the other contents of this issue, reference may be made to a list of west Indian birds by Mr. J. H. Riley.

THE issue of *Biologisches Centralblatt* for January 1 contains an article by Dr. E. Rádl on the hearing of insects, at the conclusion of which it is pointed out that this sense is much less developed in that group than in the higher vertebrates. The hearing of insects seems, in fact, to be a muscular rather than a nervous sense. The other articles include one by Mr. H. S. Skorikow on the plankton of the Neva, in the course of which several new forms are described, and one by Dr. O. Zacharias on the light-organs of *Ceratium tripos*.

ICHTHYOSAURS, or the extinct marine "fish-lizards" of the Mesozoic epoch, form the subject of an article by Prof. H. F. Osborn in the January number of the *Century Magazine*. After tracing the ichthyosaurian paddle into a limb of the type of that of the existing terrestrial tuatera lizard (Sphenodon) of New Zealand, which is regarded as nearly related to the ancestral stock of the group, the author proceeds to point out how much we know with regard to the nature of the soft-parts and the life-history of the fish-lizards. We are aware, for instance, that they had a dorsal and a caudal fin, a naked scaleless skin, and a spiral valve to the intestine, similar to that of sharks; while, from the inclusion of skeletons of fœtuses within the ribs of full-grown individuals, we also know that they produced living young. This viviparous condition is, of course, an adaptive modification, similar to that which occurs in the sea-snakes of to-day, rendered necessary by the pelagic habits of these reptiles. The similarity in bodily form existing between sharks, dolphins, and fish-lizards is referred to as another instance of such an adaptive modification. Excellent illustrations—one showing a female ichthyosaur and her progeny—accompany the paper. Apparently the author is unaware that the name Shastasaurus, proposed for a Triassic American ichthyosaur, has been changed, on account of pre-occupation, to Merriamia.

A PAPER upon Mendel's discoveries in heredity, read by Mr. C. C. Hurst before the Leicester Literary and Philosophical Society, gives a succinct account of Mendel's experiments, and the rules which he evolved therefrom; also it contains a list of the chief experiments with different plants and animals which have been carried out subsequently. The paper is published in the *Transactions* of the society, vol. viii. (June, 1904), and in the same part will be found a useful summary prepared by Mr. H. St. J. Donisthorpe of additions to British Coleoptera during the last ten years.

IN the *Comptes rendus*, vol. xxxv., No. 6, of the Imperial Society of Naturalists of St. Petersburg, lists of new plants for the Crimea are given by Mr. K. Golde and Mr. A. Younghé. Two of the most striking mentioned by Mr. Younghé are *Crambe juncea*, a Persian plant, which grows to the height of a man, and *Lythrum nanum*, a dwarf Siberian plant. Both botanists make a special reference to the freshwater plants, which include species so familiar to us as *Zannichellia pedicellata*, *Œnanthe Phellandrium*, and species of Potamogeton.

THE first appendix to the *Kew Bulletin* for 1905, enumerating the hardy shrubs, trees, and herbaceous plants of which seed is available, has been received.

IN our issue of January 12 (p. 255) we referred to the prominent part taken by M. Leon Teisserenc de Bort in the establishment of a Scandinavian station for the exploration of the upper air by means of kites and unmanned balloons. The first results of this important enterprise have been published in a work entitled "Travaux de la Station Franco-Scandinave de Sondages aériens à Hald, 1902–1903," a large quarto volume of 160 pages. The station is situated on an extensive open domain belonging to M. Krabbe, near Viborg, in Jutland, and is due to the exertions of MM. Hildebrandsson, Paulsen, and Mascart, the official meteorological representatives of Sweden (Upsala), Denmark, and France. The necessary subscriptions for carrying out the experiments have been chiefly contributed by private persons—in Sweden, by an anonymous donor, 28,000 francs; in Denmark, 245,000 francs (including a grant of 10,000 francs by the Danish Government); in France, 66,100 francs (of which M. Teisserenc de Bort contributed 50,000 francs, and a further loan of material from Trappes valued at about 12,000 francs). The Danish Government also lent two gunboats for kite experiments; the value of kite ascents from steamers at sea has been more than ever fully established by the results obtained, some of the kites reaching altitudes varying from 3000 to 5900 metres. The difficulty of reaching such heights is well known to persons who have undertaken similar experiments.

PROF. DR. C. UHLIG contributes some notes of a journey from Kilimandjaro to Mweru to Nos. 9 and 10 of the *Zeitschrift* of the Berlin Gesellschaft für Erdkunde. The paper is illustrated by a number of excellent photographs.

THE last issue of the *Mitteilungen aus den deutschen Schutzgebieten* is entirely devoted to the region of the Pacific. Dr. Born records some observations on the ethnography of the Oleaī Islands, Herr Senfft describes a visit to some of the West Caroline Islands, and there are abstracts of meteorological observations for 1903, and maps based on recent surveys.

THE last number of the *Deutsche geographische Blätter* contains reports of two lectures delivered to the Vereinigung für staatswissenschaftliche Fortbildung at its meeting at Bremen in November last. Dr. Tetens discussed the importance of Bremen as a centre of trade, and gave an exhaustive statistical account of its development and a comparison with other seaports; his paper is illustrated by nineteen sheets of diagrams, and should be of great value to students and teachers of commercial geography. Dr. W. Hochstetter lectured on the history of the North German Lloyd.

THE Royal Geographical Society has issued, as an extra publication, a paper on recent contributions to our knowledge of the floor of the North Atlantic Ocean, by Sir John Murray and Mr. R. E. Peake. The new material dealt with consists chiefly of soundings from the telegraph ships *Minia* and *Faraday*, but the chart accompanying the paper has been fully brought up to date, and new measurements of areas at different depths have been made. An interesting correspondence with the United States Hydrographic Office about the origin of the term "telegraphic plateau" appears in the introduction.

THE first place in the January number of the *Geographical Journal* is given to a striking address delivered to the International Congress of Arts and Sciences at St. Louis in September last by Dr. H. R. Mill. Dr. Mill's address is entitled "The Present Problems of Geography," by which the author means not "the whole penumbra of our ignorance, but those problems the solution of which at the present time is most urgent and appears most promising." Many of his conclusions concerning the scope and methods of geography are of profound significance. It seems specially appropriate that the address should immediately precede a paper on geography and education in the same number, in which the recent articles and correspondence in the newspapers are summarised and discussed. Dr. Mill puts his finger on many points which have formed real obstacles to the development of geographical teaching in schools and elsewhere.

A CORRESPONDENT of the *Physikalische Zeitschrift* inquires whether any experimental or other information exists regarding the heeling over of a ship on one side caused by the turning moment on the screw shaft.

PROF. R. W. WOOD describes in the *Physikalische Zeitscrift* a simple experiment for showing the pressure due to sound waves. The waves are made to converge to a focus by reflection, and close to this point is placed a small horizontal paddle wheel almost exactly like a Crookes's radiometer. If the sound waves converge to one side of the wheel it will spin rapidly in the corresponding direction.

From the Volta Bureau of Washington we have received two reprints, one dealing with the so-called "visible speech" alphabet introduced into England by Dr. Alexander Melville Bell in 1865–7, and the other being an essay, by Dr. William Thornton, on teaching the deaf and dumb to speak, published in 1793. The reprints are illustrated by portraits of Drs. Bell and Thornton, and a biographical notice also accompanies Dr. Thornton's paper.

We have received the report for 1903-4 of the Scientific Society of St. Paul (Brazil), and have been able to gather from it that the society was founded in June, 1903, the city already having a historical and geographical, a medical and an agricultural society. It numbered in April last fifty-six effective, four contributing, one corresponding member, and two "socios ouvintes," a total of sixty-three members, of whom twenty-eight were foundation members. The membership list now, however, shows thirteen corresponding members. There have been held two preliminary, one inaugural, fourteen ordinary, and four "economic" meetings, and from the account of these meetings the papers seem to have been interesting and varied. A desirable improvement would be the publication of the reports in one of the international languages.

The question as to whether the trioxide of nitrogen, N_2O_3, is capable of existence has frequently been discussed, but until recently has remained unanswered owing to the lack of experimental data. When the brown gas produced by the action of starch or of arsenious anhydride on nitric acid is passed through a freezing mixture, it condenses to a blue liquid, which does not solidify at $-90°$. But the determination of its vapour-density shows that the gas is completely dissociated, and Ramsay and Cundall showed in 1885 that no contraction takes place when the monoxide and dioxide are mixed. The blue solution might therefore be regarded merely as a solution of NO in N_2O_4. The actual existence of the trioxide has recently been demonstrated by Wittorff (*Zeit. anorg. Chem.*, vii., 209), who has investigated the freezing point of mixtures of different composition. A liquid having the empirical composition N_2O_3 solidifies to a blue crystalline solid, which melts at $-103°$ C., and is undoubtedly the pure trioxide. As the proportion of N_2O_4 is increased the freezing point at first falls to a eutectic temperature at $-112°$ C., and then rises to the freezing point of the peroxide. In this way, by accurate work at low temperatures, it has been possible to solve one of the long-debated problems of inorganic chemistry.

It has long been suspected that in solution the dichromates might perhaps be dissociated into neutral chromates and free chromic acid, thus,

$$K_2Cr_2O_7 \rightleftharpoons K_2CrO_4 + CrO_3.$$

Purely chemical methods have given but little information as to the nature of the dissolved salt. As the result of an ingenious application of physicochemical methods, the problem has recently been solved by Abegg and Cox, and these authors have been able actually to determine the proportion of free chromic acid in dichromate solutions of different concentrations. The method, which is described in the *Zeitschrift für physikalische Chemie* (vol. xlviii. p. 725), depends on saturating a solution of a dichromate with neutral and basic mercuric chromates, $HgCrO_4$ and $HgCrO_4.HgO$. In presence of these two salts the concentration of free chromic acid in the solution is maintained constant at 0·706 mol. per litre at 50° and 0·456 mol. at 25°, and any excess of chromic acid must be combined either as chromate or as dichromate. It is calculated that in the case of potassium dichromate complete dissociation occurs at a dilution of 1000 litres, whilst at 100 litres 99 per cent. of the salt is dissociated, at 10 litres 91 per cent., and at a dilution of 1 litre 62 per cent. Even in the strongest solutions, therefore, the greater part of the dichromate is dissociated into chromic acid and normal chromate.

Messrs. Whittaker and Co. will shortly publish a new book entitled "The Insulation of Electric Machines," by Mr. H. W. Turner and Mr. H. M. Hobart.

Messrs. George Bell and Sons have published parts i. and ii. of "Elementary Algebra," by Messrs. W. M. Baker and A. A. Bourne, in one volume at 4*s*. 6*d*. The book may be had with or without answers.

The twenty-fourth volume of the *Geographical Journal* has now been published. It contains the monthly numbers from July to December, 1904. As usual, the volume is richly illustrated by means of blocks and a profusion of well executed maps. The volume should be added to the library of every geographer and teacher of geography.

Messrs. Newton and Co.'s new supplementary list of lantern slides includes several sets which should prove very valuable to science teachers and lecturers. Among these instructive slides we notice photographs by Mr. W. M. Martin illustrating the embryology of a chicken; British birds and nests photographed by Mr. R. B. Lodge; photographs of insects and other small forms of animal life; photomicrographs of rock sections; and photographs of diseases of the bone, by Dr. C. T. Holland.

A revised and enlarged edition of Dr. Arthur Keith's "Human Embryology and Morphology" has been published by Mr. Edward Arnold. This edition differs from the last in several particulars. The chapters dealing with the early development of the human embryo and the formation of the placenta and membranes have been re-written. Much of the chapter dealing with the urogenital system has been amended, and numerous additions have been made in other sections of the book.

OUR ASTRONOMICAL COLUMN.

Observations of Comets 1904 *d* and 1904 *e*.—The results of several observations of comets 1904 *d* and 1904 *e*, respectively, are published in a supplement to the *Astronomische Nachrichten*, No. 3987.

The latter object was observed at Bamberg by Prof. Hartwig on January 1 and 2, and was seen as a circular patch about 2′ in diameter, having a nucleus which was not symmetrical. The magnitude of this comet has been variously estimated. In the above observation Prof. Hartwig recorded it as 11·0, but Prof. Nijland, observing at Utrecht on January 1, estimated it as 9·5, whilst Prof. Ambronn, observing at Göttingen on January 2, found it to be 10. The brightness at the time of discovery, as given by M. Borrelly, was equal to the tenth magnitude.

The following is an extract from the daily ephemeris of comet 1904 *d* published by Herr M. Ebell:—

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

1905	α (true) h. m. s.	δ (true) ° ′	log *r*	log Δ	Brightness
Jan. 20	17 57 38	+44 57	0·3253	0·3437	0·98
,, 24	18 13 1	+47 5	0·3299	0·3446	0·95
,, 28	18 29 11	+49 10	0·3346	0·3465	0·93
Feb. 1	18 46 10	+51 9	0·3394	0·3495	0·89
,, 5	19 3 58	+53 3	0·3443	0·3535	0·86

Brightness at time of discovery = 1.

EPHEMERIS FOR COMET TEMPEL, 1904 *c*.—In No. 3986 of the *Astronomische Nachrichten* M. J. Coniel gives a daily ephemeris for Tempel's second comet extending from January 3 to March 2, which is a continuation of the ephemeris published by him in No. 3971 of the same journal. Although the southern declination of the comet is decreasing, its R.A. is so near to that of the sun, and the object itself is so faint, that observations will be difficult, and only possible immediately after sunset.

The comet's position on January 21 will be

$$\text{R.A.} = 22\text{h. } 37\text{m. } 47\text{s., dec.} = -16° \ 19'.$$

SEASONAL DEVELOPMENT OF MARTIAN CANALS.—A further contribution of observed phenomena, in support of his theory concerning the causes which produce the seasonal development of the canals on Mars, is published by Mr. Lowell in the January number of *Popular Astronomy*. The particular canal therein discussed is Brontes, which is 2440 miles in length and connects along a great circle, in nearly a north and south direction, the two important points Linus Titanum and the Propontis.

From a study of ninety drawings made during the period January-July, 1903, six of which are reproduced on the plate accompanying the paper, it was seen that the visibility of the canal increased after the summer solstice in the northern hemisphere, and, further, on dividing the canal into five nearly equal sections from north to south, the section nearest the north polar cap became strengthened first, and the others followed in order of their north polar distance. This is plainly shown on the visibility "cartouches" given by Mr. Lowell, who considers the phenomena as a further proof of his theory that the visibility of a canal is due to vegetation, quickened by the water loosened at the melting of the polar snows and flowing towards the equator. The extension south of the equator is considered as a probable proof of intelligent artificial interference in the propulsion of the water.

VARIABLE STARS AND NEBULOUS AREAS IN SCORPIO.—An examination of thirty-three plates exposed on the large nebulous regions mentioned in previous *Circulars* has led Miss H. S. Leavitt to the discovery of 105 new variable stars in the constellation Scorpio.

The positions of these, for 1900, their greatest and least observed magnitudes, and their magnitude ranges are given in No. 90 of the Harvard College Observatory *Circulars*.

The most striking result of this research has been the revelation of vast areas of diffused nebulous matter, so faint as to be beyond visual observation. One of these areas extends over a number of square degrees in the constellations Ophiuchus and Scorpio, and, like the Orion nebula, it attaches itself to individual stars, the principal condensation being about the quadruple star ρ Ophiuchi. The region is marked by an absence of faint stars, and dark lines may be traced beyond the confines of the nebulosity as yet seen on the plates.

REPORT OF THE NATAL OBSERVATORY.—The report of Mr. E. Nevill, Government astronomer of Natal, for the year 1903, gives a brief *résumé* of the work accomplished at the Durban Observatory during the period with which the report deals, and contains a mass of information respecting the meteorology of the colony.

The time signals have been sent out as in former years, and Borrelly's comet was observed regularly during its appearance, the orbit deduced from the observations agreeing with those obtained at other observatories.

It is proposed to utilise the tide observations made during the years 1884-8 in order to provide the port authorities with tide-tables, but, owing to the constructional changes in the harbour during the last few years, it will be necessary to reduce the more recent observations and this will require additional computing assistance.

In former years it has been customary to issue the meteorological data compiled from the returns of the subsidiary stations once each month, but in future the returns will be published daily. Among the numerous tables given in the report there occurs, for the first time, a summary of the meteorological observations made at the Botanical Gardens, Durban, during the period 1873–1883 inclusive, before the institution of the Government observatory.

THE JESUIT OBSERVATORY AT BELEN, HAVANA.—An interesting illustrated account of the observatory attached to the Jesuit College at Belen, Havana, has been written, in Spanish, by Father Mariano Gutiérrez, S.J., the sub-director, and contains a history of the installation of the institution in 1857, and its proceedings since that date.

The meteorological section was first founded under the direction of Father Antonio Cabré, S.J., in the year named, but its position was not secured until the installation of Father Vines as director, in 1870, to the memory of whom the author of the history pays a high tribute, and laments his death in 1893 as an irreparable loss.

The equipment of the observatory is fairly complete, and includes meteorological, seismological, magnetic, and astronomical instruments, most of which, including the 6-inch Cooke equatorial, are illustrated in the present volume.

THE DISCOVERY OF JUPITER'S SIXTH SATELLITE.

THE addition of a sixth satellite to the system of Jupiter marks another triumph in Prof. Perrine's employment of the modified Crossley reflector. As mentioned in a note published in "Our Astronomical Column" last week, Prof. Perrine first suspected the existence of the newly discovered body from observations made during December, 1904, but it was not until January 4 that a further observation confirmed his suspicion, and enabled him to open the new year with the announcement of this important discovery.

The new satellite, so far as one may gather from the meagre news yet to hand, is situated at a much greater distance from its primary than any of the five previously known. The telegram announcing the discovery gave this distance, on January 4, as 45′, whilst that of the outermost of the four satellites discovered by Galileo never exceeds 10′·5, and the fifth, the innermost of all, is not quite half the distance from Jupiter that the moon is from the earth.

Assuming, for the moment, that the above distance is the outward limit of the satellite's orbit, it should make one revolution about its primary in about half a year, whereas the time occupied by the fourth satellite is only 16·7 days; thus we see there is an immense gap between the two bodies which, according to precedent, may contain other satellites as yet undiscovered.

The recent discovery raises the number of satellites in the solar system, discovered during the past thirty years, to five, and it is worthy of note that the discovery of a satellite has usually occurred at times when a new instrument has been installed or old instruments or methods have been improved. This fact calls to mind, although beyond our thirty years' limit but still dealing with the Jovian system, that Jupiter's four moons, Io, Europa, Ganymede, and Callisto, or i., ii., iii., and iv. as they are usually designated, were the first members of the solar system to be *discovered*, resulting, as they did, from Galileo's first use of the telescope in January, 1610.

After these, and within the past thirty years, came Deimos and Phobos, the lilliputian attendants to Mars, which were discovered by Prof. Asaph Hall at Washington in August, 1877, and were the first fruits of the then recently mounted 26-inch refractor of the U.S. Naval Observatory.

The fifth satellite of Jupiter was discovered by Prof. Barnard on September 9, 1892, with the nearly new giant refractor of the Lick Observatory. It is, comparatively, a minute object and can only be seen with the largest telescopes under the most favourable conditions. Its diameter can scarcely be greater than 100 miles, whilst the diameters of the other four, in order of their distance from the planet, are 2400, between 2000 and 2200 (about the size of our own moon), 3000, and 3600 miles respectively. This object revolves between

Io—the first satellite and Jupiter in a period of 11h. 57m. 22·6s.

Following this discovery came the addition, to an already numerous family, of the ninth satellite of Saturn, which was found by Prof. W. H. Pickering. The search was commenced in 1888 with the 13-inch Boyden telescope of the Harvard College Observatory, but was not successful in bringing to light any previously unknown attendant on Saturn. On the installation of the new 24-inch Bruce telescope in the clear atmosphere of Arequipa the search, which was photographic throughout, was renewed, and on examining the plates taken on August 16, 17, and 18, 1898, Prof. Pickering was rewarded by the appearance of a short trail which apparently partook of the planet's motion among the stars, and was, therefore, to be considered as part of its system. The story of the subsequent doubts and difficulties has been too recently told (Harvard College *Annals*, No. 3, vol. liii.) to need re-telling here, but it may be recalled to mind that the subsequent observations showed that the satellite revolves in an orbit which is far more eccentric than that of any other satellite, or of any major planet, in the solar system, and that its motion in that orbit is opposite in direction to the orbital motions of the remaining eight of Saturn's moons. Like the fifth satellite of Jupiter, this object can only be observed visually with the largest telescopes and under the best conditions. As a matter of fact, it was not *seen* until its position was accurately known, and even then Profs. Barnard and H. H. Turner, using the 40-inch refractor at Yerkes Observatory, in August last, could not feel certain that they had really observed the object which had up to that time remained invisible to human eyes.

Whilst our knowledge of the most recently discovered satellite is as yet very scanty, Prof. Perrine's message tells us that on January 4 its position angle was 260°, and the daily rate of its apparent approach towards Jupiter was 45", *i.e.* about 100,000 miles.

The magnitude, 14, ascribed to it is one magnitude fainter than that of Barnard's fifth satellite, and this primarily suggests that the diameter may be less than that of the fifth, although a smaller reflecting power, or "albedo," may account for the relative faintness. Its distance from Jupiter on January 4 would probably be about 6 million miles. The statement that the motion was "retrograde" refers, of course, to the apparent motion in the sky, and must not be confounded with a retrograde orbital motion similar to that followed by Phœbe, Saturn's ninth satellite.

W. E. R.

ATMOSPHERIC AND OCEANIC CARBON DIOXIDE.

THE carbonic acid of sea-water is usually supposed to be present in combination with certain bases, which constitute the *alkalinity* of the water, partly in the form of normal carbonate and partly in the form of bicarbonate, the total amount present being insufficient to convert the whole of the base into the bicarbonate. Thus the water of the North Atlantic has been found to contain 49 c.c. of carbonic acid gas per litre, whilst 54 c.c. would be required to convert the base completely into bicarbonate. That this view is not quite correct has been shown by Dr. A. Krogh, of Copenhagen, in a series of investigations on the carbon dioxide of the air and ocean.[1]

The reaction between carbonic acid and a normal carbonate to form a bicarbonate is, like so many chemical reactions, reversible, and equilibrium is established while a certain amount of the carbonic acid is still free. This free carbonic acid exerts a definite gaseous pressure, which varies with the total amount of carbon dioxide present and with the alkalinity of the water. This pressure can very readily be determined by simply shaking the water with a small volume of air and then ascertaining by direct analysis the pressure of the carbon dioxide in this air, which is, of course, equal to the pressure of that in the water, since the two have been brought into equilibrium by the shaking. This process gives excellent results both with fresh- and sea-water, and can be carried out very rapidly by the aid of the apparatus of Haldane or Petterson and Sonden for the estimation of small quantities of carbon dioxide. As the result of a careful study of the behaviour of sea-water in this respect, it appears that a comparatively large amount of carbon dioxide may be absorbed, whilst the corresponding pressure only undergoes a very small absolute change, provided that the alkalinity remains constant. A water, for example, which has the alkalinity 23, and contains 36·7 c.c. of carbon dioxide per litre, is capable of absorbing 4·3 c.c. of the gas per litre, whilst the pressure, measured as described above, only rises from 0·015 per cent. to 0·0295 per cent. of an atmosphere. This means that the air shaken up with the original water would be found to contain 1·5 parts of carbon dioxide per 10,000, whilst after the further absorption the air similarly treated would contain 2·95 parts per 10,000.

Owing to this pressure of carbon dioxide constant interchange takes place between every water surface, whether of sea-water or of fresh-water, and the air above it, resulting in evolution from the water or absorption by it according as the pressure of carbon dioxide in the water or the air is the greater. The effect of this is that the ocean acts as a regulator on the amount of carbon dioxide in the air, tending to compensate for any deviation from the normal proportion. The pressure of carbon dioxide in the air is at present about 0·03 per cent. of an atmosphere (3 volumes per 10,000), the absolute amount in the whole atmosphere being calculated as $2·4 \times 10^{12}$ tons, whilst the quantity contained in the entire mass of the sea may be taken as twenty-seven times as great as this.

In order to increase the proportion of the atmospheric carbon dioxide to 0·04 per cent. it would be necessary, of course, in the first place to add one-third of the amount already present. The pressure thus attained would, however, be gradually decreased by absorption by the sea, and it follows from the author's experiments that in order to bring the ocean into equilibrium with the altered atmosphere a further addition of twice the amount originally present would be required, a total change involving the production of $5·6 \times 10^{12}$ tons of carbon dioxide! A calculation of this kind goes far to explain the constancy of composition of the atmosphere, which at first sight appears so remarkable, and to indicate the enormous changes required to produce any considerable variation in it.

The interchange of carbon dioxide between sea and air, moreover, is by no means a slow process, but takes place with remarkable rapidity. Thus a pressure difference between sea and air of only 0·001 of an atmosphere, *i.e.* the presence in the air of an additional 0·1 part of carbon dioxide per 10,000, leads to the absorption of 0·525 c.c. of this gas per square centimetre of ocean surface per year, or a total annual absorption of $3·85 \times 10^9$ tons.

The author considers from this point of view the effect on the composition of the atmosphere of the combustion of coal, which annually throws into the air about one-thousandth of the carbon dioxide already present in it, so that, apart from any regulating action of the sea, in a thousand years—if the coal lasted—the percentage proportion would be doubled, rising from 3 to 6 volumes per 10,000, and rendering the air almost unfit for continued respiration. Before the proportion rose to 3·1 volumes per 10,000, however, the sea would be able to absorb the gas as fast as it was produced, and, owing to the large volume required to bring the ocean water into equilibrium with the air, it is probable that at the expiration of the thousand years the proportion of carbon dioxide in the air would not be more than 3·5 volumes per 10,000.

Many other interesting questions of great importance in the economy of nature are capable of being attacked from this point of view and subjected to experimental investigation. Such are the rate of deposition of calcium carbonate from hard waters, the rate of solution of limestone and chalk in natural waters, the absorption of carbon dioxide by rocks and soils, &c.

On the great question as to whether the production of carbon dioxide is on the whole greater or less than its decomposition nothing certain is known. Indications are not wanting, however, that this constituent of the atmosphere is increasing in quantity. The chief evidence to this effect is derived from the fact that over the sea the pressure of

[1] "Meddelelser om Gronland," vol. xxvi. pp. 333, 409.

this gas is distinctly lower than over the land. This would appear to be most easily accounted for on the assumption that the pressure of carbon dioxide in the sea is constantly lower than that in the air, and that, therefore, the air must be steadily deriving supplies of the gas from some source, by means of which this difference of pressure is maintained.

A. Harden.

CONFERENCE OF PUBLIC SCHOOL SCIENCE MASTERS.

The annual meeting of the Public School Science Masters' Association was held for the second time at Westminster School on January 14, by kind permission of Dr. Gow, who had undertaken the duties of president and occupied the chair. A letter was read by the honorary secretary, Mr. W. A. Shenstone, from Sir Michael Foster explaining why he had not been able to act as president. The meeting then occupied itself with business matters, and Sir Oliver Lodge was unanimously elected president for the ensuing year.

In the short address with which Dr. Gow opened the conference, he expressed the opinion that every boy should be taught natural science, and this pronouncement, coming as it does from a classical headmaster, is of very great importance at the present moment, as Prof. Armstrong was not slow to point out. It was no doubt elicited by the subject of the first paper, namely, the importance of including both Latin and science in a scheme of general education. This was read by Mr. Douglas Berridge, of Malvern College. In the paper the necessity of a general education was discussed, and the report of the committee upon the education of army officers was taken as a guide. In this it is laid down that English, mathematics, one modern language, Latin, and science are essential to a sound general education; but what is very strange, the framers of the report proceed to propose that all future officers of our Army should be debarred from obtaining what was considered necessary by the proposal that Latin and science should be optional and alternative subjects. In addition to the injury which a one-sided education inflicts upon the individual, Mr. Berridge pointed out a greater and more far-reaching danger to our nation as a whole. He urged that the present trend of education, as represented by London University (in its matriculation and school leaving examination), by Oxford and Cambridge (in their school leaving examinations), and by the Civil Service Commissioners and the Army entrance examinations, is sharply to divide Englishmen into two classes, the one trained on literary lines, leavened only by a modicum of mathematics, the other on scientific lines, leavened only by a smattering of French. Could it be, Mr. Berridge asked, to the advantage of any nation that its future rulers and organisers should thus be grouped into two opposing camps, of which, while they mutually despise one another, neither is able to understand the very method of reasoning adopted by the other? Mr. Berridge was able to support his contention by figures, for on application to all our public schools he had found that for the Army and matriculation examinations 45·6 per cent. of the boys now learn Latin and 54·4 per cent. learn science.

The discussion showed that while the need of a literary as well as a scientific training was thoroughly recognised, many speakers did not agree with Mr. Berridge that Latin was the best means of acquiring the former. It is true that Father Cortie (Stonyhurst) found that the best classical boys were most successful in science, but Prof. Armstrong said that no honest attempt had ever been made in this country to afford a literary training through any other language, and though Latin had proved very efficient in a few instances, in the vast majority of cases it was not. He maintained, also, that Latin translation did not give style. Finally, Prof. Armstrong characterised the making of science alternative to Latin in Army examinations as illogical and preposterous. Dr. Gow said that he never regarded Latin as a literary training, but as a scientific one, and referred to his opening remarks, in which he had characterised the words as typical and exceptional genera and species, and parsing as scientific classification.

The paper dealing with recent proposals for school leaving certificates, by Mr. C. I. Gardiner, of Cheltenham, dealt with what has been done on the Continent, and afterwards with the regulations at present suggested to the Board of Education by its consultative committee. The paper welcomed, as did many of the speakers afterwards, what is not very happily expressed as State interference. Many of the Board of Education's proposals were characterised by Mr. Gardiner as too vague, upon very good grounds. In the discussion, surprise was expressed that Mr. Gardiner had not mentioned what has been done recently in Ireland. It was recommended, also, that the Board of Education should get to know the schools before it suggested too much, and that its interference should be taken in small doses. Mr. W. A. Shenstone fancied he saw the edge of red tape in some of the proposals, while Father Cortie thought there was a danger that education might become stereotyped, so that special traits of certain schools would not be given free play. He hoped that inspectors with fads or insufficient knowledge would not interfere as they had done in elementary schools, and would not say, for instance, "your 'labs' are not so good as those in the primary schools (which are built with the ratepayers' money), you must erect new ones."

The third paper dealt with the use and misuse of terms in science teaching. It was contributed by Mr. T. L. Humberstone, of Toynbee Hall, who took exception to the loose way in which words, law, theory, hypothesis, and so on were used. He pointed out what the real meanings of the words were, and objected strongly to the idea that the experiments in practical mathematics "proved" the laws that they were intended to illustrate. Prof. Tilden agreed with Mr. Humberstone in regard to the misuse of terms, and said that professional scientific men were just as much to blame as schoolmasters. He thought that if boys were taught a little logic before they left school many mistakes would be prevented. He was amazed at the statement incidentally made by Mr. Humberstone as to there being too much laboratory work done in schools, and he pointed out that every discovery of the organic chemists was additional evidence in favour of the atomic theory which Mr. Humberstone thought was tottering. Mr. Fletcher, of the Board of Education, said that there was a widespread misapprehension as to the place of practical work in geometry. It was not possible to prove anything by the experiments used, but it was most important to get approximations which could be idealised into conceptions. They were necessary to create a state of mind and to commend postulates to common sense. Mr. Sanderson thought that some of the practical work set to boys was superfluous, and might well be replaced by good experiments shown by the master. Mr. Humberstone, in answer to a question from Mr. Shenstone, said that he thought ten or twelve hours a week was longer than was required for laboratory work, and he further said, with regard to superfluous work, that when a boy had learned how to obtain one gas properly it was not necessary for him to produce all the others.

The last paper was by Mr. F. B. Stead, of Clifton, and was on the possibility of teaching scientific method to boys whose education is almost entirely literary, and who have no time for a regular course in chemistry and physics. It was suggested that older boys in the Vth form should be given some definite piece of work to be carried out in detail, in order that they might understand (1) the method of experiment and observation by which facts are ascertained; (2) the process of reasoning from particular instances to general laws; and (3) the use of explanatory theories and their verification.

Prof. Armstrong considered the paper to be one of very great value, and suggested that the term "experimental" should be used instead of "scientific," bearing in mind what Dr. Gow had said in connection with Latin as scientific training. He also asked what place there would be in the near future for boys who only had had a literary education.

Wilfred Mark Webb.

PRIZE AWARDS OF THE ROYAL SOCIETY OF EDINBURGH.

AT a meeting of the Royal Society of Edinburgh on January 9 the prizes awarded by the council were presented by the chairman, Prof. J. Geikie. We have received the following particulars of the awards :—

The Gunning Victoria Jubilee prize for 1900–4 was awarded to Sir James Dewar, LL.D., D.Sc., F.R.S., &c., for his researches on the liquefaction of gases, extending over the last quarter of a century, and on the chemical and physical properties of substances at low temperatures, his earliest papers being published in the *Transactions and Proceedings* of the society.

In 1867 Mr. James Dewar read a paper to this society on the oxidation of phenol to oxalic acid. This, his first contribution to the aromatic compounds, was followed by a more important one on the oxidation of picoline, which he gave to the British Association in 1868, and in a fuller form to this society in 1870. In this he proposed a graphic formula of pyridine, which expresses the relation between the constitution of benzene and that of pyridine, now universally recognised.

Dewar's experiments on the liquefaction of gases extend over the last quarter of a century, and have culminated in the production of liquid and solid hydrogen in large quantities, so that as thirty-five years ago he studied the chemical and physical properties of hydrogenium solidified in palladium, he has now given us the properties of the solid element, hydrogen itself. Having thus in his hands the means of preparing large quantities of liquefied gases, and having devised most ingenious arrangements for keeping these very volatile liquids for a long time with only a small loss from evaporation, he made good use of the opportunity for examining the chemical and physical properties of substances at extremely low temperatures. The results of these inquiries are of the highest interest and importance. For this long series of investigations in chemistry and physics, characterised by ingenuity, skill, and perseverance, and crowned with success, the council has awarded to Sir James Dewar the Gunning Victoria Jubilee prize.

The Keith prize for 1901–3 was awarded to Sir William Turner, K.C.B., LL.D., F.R.S., &c., for his memoir entitled "A Contribution to the Craniology of the People of Scotland," published in the *Transactions* of the society, and for his "Contribution to the Craniology of the People of the Empire of India," parts i., ii., likewise published in the *Transactions* of the society.

These memoirs, important as they are, form a comparatively small part of the work which Sir William Turner has done in the field of physical anthropology. More especially should notice be taken of the two elaborate reports which he published on the crania and other bones of the human skeleton which were collected by the *Challenger* Expedition. These reports are not only valuable on account of the information which they convey regarding the physical characters of many races of mankind, but also because they establish methods of craniological and anthropometrical research which have very generally been accepted in this country by workers in the same field.

Four great leaders have been chiefly instrumental in developing that branch of science which has received the name of physical anthropology: Broca in France, Huxley and Flower in England, Turner in Scotland.

The Makdougall-Brisbane prize for 1902–4 was awarded to Mr. John Dougall, M.A., for his paper on an analytical theory of the equilibrium of an isotropic elastic plate, published in the *Transactions* of the society.

The problem of the deformation of an isotropic elastic plate under given forces has occupied the attention of mathematicians from the time of Lamé. The solution given by Lamé himself is merely formal; the integrals by which that solution is expressed are not only very complicated, but are not convergent, and they do not lead to the approximate theory.

In his memoir Mr. Dougall makes a new departure, and develops a method that has important applications in other branches of applied mathematics. By an exceedingly skilful use of Cauchy's theory of contour integration, certain integrals, which in Lamé's solution are not convergent, are transformed into highly convergent series, and the modifications which are necessary to secure convergence lead at once to the most significant terms of the solution. The theorem of Betti is applied to develop a method, analogous to the method of Green's function in the theory of the potential, by which the properties of the solution for a finite plate can be deduced from that for an infinite plate, and here, as elsewhere throughout the memoir, numerous results are obtained which have great value both for pure and for applied mathematics. The memoir confirms the ordinary approximate theory, but extends it in various directions; for example, the edge conditions given by Kirchhoff in correction of Poisson are found directly from the mathematical investigation, without the aid of any special physical hypothesis, and are carried to a higher degree of approximation than by Kirchhoff himself. The memoir contains much acute analysis, and strikes out a new method of treating the problems of mathematical physics that seems likely to be of great value in future investigations.

The Neill prize for the period 1901–4 was awarded to Prof. John Graham Kerr, M.A., for his researches on *Lepidosiren paradoxa*, published in the *Philosophical Transactions* of the Royal Society, London.

This work includes an account of the embryological material collected during an expedition specially organised for the purpose to the Grand Chaco of South America in the years 1896–7. The general biology and habits of Lepidosiren are described, the external features of development are fully dealt with, and in a discussion of the general bearings of the phenomena considered reference is made to, amongst other things, the relations of the protosoma to the body of the vertebrate, to the origin of the spiral valve, and to the morphological significance of the external gills which it is suggested are the persisting representatives of the organs from which the limbs of vertebrates have been evolved.

After the presentation of the prizes, Sir James Dewar gave a lecture on the properties of liquid air, with special reference to charcoal vacua, being a sequel to a paper communicated to the society by Prof. Tait and himself in 1875 (see NATURE, vol. xii. p. 217). Many of the familiar properties of liquid air were demonstrated by a series of experiments. Of particular interest were its use as a calorimeter and its employment in cooling charcoal in a vacuum tube so as greatly to diminish the density of the rarefied gas. By this means the tube gradually passed through all the well known stages from the ordinary bright discharge to the condition of evident striation and so to the Röntgen ray stage, and finally to the non-conducting state. When the liquid air was removed the charcoal gradually heated up to the ordinary temperature, and the tube passed back again through the stages in the reverse order. The phosphorescence at very low temperatures of certain substances not phosphorescent at ordinary temperatures was also demonstrated; also the production of luminous effects due to the electrification of a certain crystal on being cooled down to the temperature of liquid air.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. R. H. Lock has been appointed assistant curator of the herbarium for four years from January 1. He succeeds Mr. Yapp, who was some time ago elected professor of botany at Aberystwyth.

Prof. Sorley has been appointed chairman of the examiners for the moral sciences tripos.

The Sedgwick Museum Building Syndicate has issued a final report, from which it appears that the total cost of the building and fittings is 49,389*l*. 2*s*. 3*d*., of which sum 26,125*l*. has been furnished by the Sedgwick memorial trustees, besides 1050*l*. appropriated to the bronze statue sculptured by Mr. Onslow Ford.

In connection with the recently established diploma and final examination for the degree in geography, the Board of Geographical Studies has issued a list of eight lectures which amply cover the syllabus for these examinations. Besides the lectures on geography in general by Mr. Yule Oldham, Mr. Hinks is lecturing on geographical surveying, Dr. Marr on geomorphology, and Dr. Haddon on anthropogeography.

The recently established board of anthropology announce some thirteen courses of lectures which seem to embrace the world, ancient and modern. Prof. Ridgeway deals with Greek and Roman numismatics, Mr. Green with Egyptology, Mr. Johns with Assyriology and the social customs of Babylonia, Mr. Chadwick with those of the Anglo-Saxons, whilst Dr. Haddon lectures on the ethnology of Southern Asia, Baron von Hügel on the Melanesians and Polynesians, and Mr. Minns on the ancient ethnology of eastern Europe. Special courses on the sacred character and magical functions of kings in early society, and on physical anthropology, are to be delivered by Mr. J. G. Frazer and Mr. Duckworth.

LONDON.—The Drapers' Company has voted to University College the sum of 400*l*. a year for the next five years towards assisting further the statistical work and higher teaching of the department of applied mathematics. The Mercers' Company has voted the sum of 1000*l*. for providing for the chair of physiology at the college. Dr. Atkinson has been appointed an honorary demonstrator in the department of organic chemistry.

EDINBURGH.—The Senate has submited a resolution to the University Court expressing the view that the time has come for the recognition of geography as a subject for graduation in arts and science, and requesting that the court should take steps as soon as possible to obtain such alteration of the ordinances as may be necessary to that end. It was agreed that when the framing of a new and amending ordinance in arts comes before the court, the question of giving an adequate position to geography shall be given due consideration.

DUBLIN.—The Provost and senior fellows of Trinity College have accepted an offer made by Sir John Nutting, of St. Helens, county Dublin, to endow for a period of five years ten annual entrance exhibitions each of the value of 100*l*. (50*l*. per annum for two years). The exhibitions are to be awarded without further examination, and at the discretion of the Board of Trinity College, to ten young men or women who have competed with success at the senior or middle grade examinations of the Board of Intermediate Education in Ireland. The exhibitions will be confined to pupils of Irish secondary schools (Protestant and Roman Catholic) which have no other endowment than the "results fees" of the Intermediate Board, any other endowment to act as a disqualification.

MR. STANLEY H. TURNER, assistant in political economy at Glasgow, has been appointed lecturer in political economy in the University of Aberdeen, and a full qualifying course of lectures will in future be given by him.

DR. KARL BOEHM, of Heidelberg, and Dr. Hugo Kaufmann, of Stuttgart Technical College, have been appointed extraordinary professors for mathematics and chemistry respectively.

MRS. MACLOGHLIN, of Southport, recently made an offer to the Royal College of Surgeons of England to found scholarships in memory of her husband, the late Mr. E. Percy P. Macloghlin. Mrs. Macloghlin proposes, in five years from the date of her husband's death, to give to the college a sum of 10,000*l*. for the purpose of endowing these scholarships, which are intended to assist young students in need of financial help to proceed with their professional studies. The council of the college has accepted Mrs. Macloghlin's munificent offer, and has agreed to administer the trust.

THE president of the Board of Education has appointed the Right Hon. R. B. Haldane, K.C., M.P., to be chairman of the departmental committee which is inquiring into the present and future working of the Royal College of Science and Royal School of Mines, South Kensington, in succession to Sir Francis Mowatt, G.C.B., who will, however, remain a member of the committee. It may be remembered that the terms of reference to the committee are as follows:—To inquire into the present working of the Royal College of Science, including the School of Mines; to consider in what manner the staff, together with the buildings and appliances now in occupation or in course of construction, may be utilised to the fullest extent for the promotion of higher scientific studies in connection with the work of existing or projected institutions for instruction of the same character in the metropolis or elsewhere; and to report on any changes which may be desirable in order to carry out such recommendations as they may make.

THE annual meeting of the Incorporated Association of Headmasters was held at the Guildhall on January 11 and 12. In his presidential address, the Rev. James Went said that, speaking broadly, the difference between the English and the German educational ideal has been that the Germans have recognised the paramount importance of secondary education and the English have not. It is, however, being recognised gradually that the word "secondary" connotes, not a social distinction, but one of attainment. The recognition of this fact is, Mr. Went believes, largely due to boys of ability and good character who, under the name of exhibitioners or county council scholars, have during the last thirty years been admitted freely into grammar schools, and of whom many have afterwards won the highest distinctions at the universities. It appears likely that the number of boys of this class will be increased as time goes on. The address also dealt with the education of pupil teachers at secondary schools and with the recent regulations for secondary schools issued by the Board of Education. The following resolution was adopted:—"That this association regards the new regulations for secondary schools with satisfaction in general, but regrets that the Board of Education does not provide (*a*) for the calculation of grants upon terminal attendance; (*b*) for the recognition of advanced courses to follow upon the existing four-years' course; (*c*) for ensuring comparative freedom of curricula to schools satisfying certain tests of a higher liberal education; (*d*) for an elastic percentage division of the whole school time when prescribing for groups of subjects, in place of the existing rigid minima of hours or periods in each week. A rider was adopted also declaring that the financial basis on which grants are calculated is not at all adequate, and protesting against any application of the new regulations to secondary schools hitherto earning grants from the board, which would result in such schools receiving grants on a lower basis than in the past.

AT the second day's meeting of the Incorporated Association of Headmasters the following resolutions were adopted after discussion:—(1) That in the opinion of this association it is desirable that the universities should institute a twofold entrance examination (*a*) for candidates proceeding to degrees in arts, in general as at present, but with a higher standard in literary subjects; (*b*) for candidates proceeding to degrees in mathematics and science, with a modern language, including translation at sight, composition, and an oral test, as an alternative for Greek. (2) That the provision for papers in English and history, and for the omission of Paley's "Evidences" from the Cambridge previous paper as laid down in the first report of the Cambridge Studies Syndicate, should be insisted upon in examinations under both (*a*) and (*b*) above. (3) That a new degree in mathematics and in science should be instituted, differing in title from the degree in arts, but of precisely the same university standing. The Rev. R. D. Swallow, in moving the resolutions, said he would not add anything to the arguments on either side of the vexed question as to whether the study of Greek is to be compulsory for students who sought admission to the ancient universities. It is a question which has often been debated by the association, and now in later years, as the subject has assumed a more prominent place in all questions about the curricula of the universities and the secondary schools, the association has gradually focussed its view of it in favour of relaxation for candidates for admission at the university who are able to prove themselves worthy of high honours in mathematics or natural science.

MR. ARNOLD-FORSTER, Secretary of State for War, attended on Monday the first lecture of a course on military history and strategy at the University of London; and at the conclusion of the lecture spoke on army education. In the course of his remarks, he said:—If we have had one thing more than another to admire in the great military example in the Far East, it is the way in which the officers' corps of a great and friendly nation have succeeded in combining the maximum of devotion with the maximum of intelligence in the effective service of their country. In our Army we can find officers in every rank and branch of the service who will challenge comparison with the officers of any army in the world; but the diffusion of intelligence and education throughout the officers of the Army is not so great as it ought to be. This is not peculiar to the Army; it is characteristic of every profession in the country; and what this country is now feeling acutely is that we have so long subsisted on an educational basis inadequate to the needs of modern life. The time has come for the public schools to render to the Army greater service than they do now. Numbers of young men come up for the Army from the public schools with a totally inadequate knowledge of the language of every country but their own, and with an inadequate knowledge of the history and literature of their own country, as well as of the history and literature of every other country. That must all be changed. Young men ought to come up from the public schools instructed in the great science of geography. Now they are practically without any knowledge whatever of one of the sciences which, more than any other, is the reasonable foundation for the studies of an officer in the Army. There is an extraordinary lack in this country—which of all others ought to be well posted in this branch of science—of a proper knowledge of geography. We might be compelled to establish in this country for the Army schools like those which have been already established for the Navy, or like the college at West Point in the United States. The time has almost come when it would be wise to establish a great college like West Point, where the equipment, staff, and method should be as complete as possible, and where candidates should be taken not only for the Army, but for all the great departments of the State, and where even those who have no intention of entering the service of the State may be allowed to receive instruction.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, January 9.—M. Troost in the chair.—The external or superficial conductivity representing for a given body the cooling power of a fluid current: J. **Boussinesq**.—The micrographical study of the meteorite of the Diablo Canyon: H. **Moissan** and F. **Osmond**. The micrographical study of this meteorite has shown that the metallic parts, apparently homogeneous, frequently contain irregular microscopic nuclei formed of superposed layers of phosphide and carbide of iron. A detailed examination of nodules which have not been submitted to external oxidation made it clear that they are formed of sulphide of iron surrounded by successive layers of iron phosphide and carbide. In certain cases the laminated structure of the nodules showed that they had been submitted to very considerable pressures.—Trypanosomiasis and the tsetse-fly in French Guinea: A. **Laveran**. Specimens of Glossina, or the tsetse-fly, have been found in all parts of French Guinea, and in places where the existence of diseases due to trypanosomes has been already demonstrated. These trypanosomes attack horses as well as human beings, and a detailed account of the course of the disease in a horse, together with the results of a *post-mortem* examination of the animal, are given.—Observations on the Borrelly comet (December 28, 1904) made with the large equatorial at the Observatory of Bordeaux: G. **Rayet**. Two sets of observations were made on December 31, 1904, and one on January 2. On the latter evening the sky was clear, and the comet appeared as a nearly round nebulosity of about $1'$ in diameter, possessing a stellar nucleus of the thirteenth magnitude.—On a method of reading large surfaces of mercury: A. **Berget**. A collimator with a well illuminated very narrow slit is placed behind the column to be read, and an ungraduated thermometer tube in front. A luminous line, the focal line of a cylindrical mirror, is formed, and ends with great sharpness at a fixed point, which can be read off in a cathetometer with an accuracy of 0·01 mm.—The attraction observed between liquid drops suspended in a liquid of the same density: V. **Crémieu**. Drops of olive oil, suspended in a mixture of alcohol and water of as nearly as possible the same density as the oil, ascend or descend in a vertical straight line, with extreme slowness, if precautions against changes of temperature and shaking are taken. If two or more drops are present in the dilute alcohol at the same time, there is an attraction between the two drops which is manifested by their following curved paths instead of vertically straight ones.—On the photogenic radio-active properties of calcined coral placed in a radiant vacuum and submitted to the influence of the kathode rays: Gaston **Séguy**. Amongst various substances examined calcined coral (carbonate of lime and magnesia) gave the most intense phosphorescence as measured by the action on a photographic plate. Phosphorescent coral excites the fluorescence of barium platinocyanide screens, and is very rich in ultra-violet rays.—Concerning the action of very low temperatures on the phosphorescence of certain sulphides: F. P. **Le Roux**. The maximum potential light energy which can be induced in a given phosphorescent body by a given light is independent of the temperature. Variations of temperature can only have an influence on the velocity of transformation of the potential into the actual light energy.—On a supposed demonstration of the existence of the *n*-rays by photographic methods: M. **Chanoz** and M. **Perrigot**. The authors have repeated an experiment of M. Bordier's on the photographic detection of the *n*-rays emitted by tempered steel, with contrary results. They find that two equal masses of lead and tempered steel, placed identically on screens comparable as to thickness and insolation, never give different halos, whatever may be the duration of the exposure.—The special sensibility of the physiological ear for certain vowels: M. **Marage**.—On the fluorides of indium and rubidium: C. **Chabrié** and A. **Bouchonnet**. The fluoride of indium was prepared by dissolving the hydroxide of the metal in hydrofluoric acid, and was found on analysis to possess the composition $In_2F_6.18H_2O$. It emits acid vapours, and is completely decomposed on ignition to redness. On treating rubidium carbonate with hydrofluoric acid and evaporating to dryness the acid fluoride RbF.HF is obtained.—The limit of the reaction between diazobenzene and aniline: Léo **Vignon**. Aminoazobenzene does not react with diazobenzene either in aqueous or alcoholic solution. Aniline reacts with diazoaminoazobenzene chloride in presence of potassium carbonate giving a diazoamine.—Camphene, camphenylone, isoborneol, and camphor: L. **Bouveault** and G. **Blanc**. The tertiary alcohol, methylcamphenylol, was prepared from camphenylone by Grignard's reaction. The reaction of this alcohol with pyruvic acid at 140°–150° C. has been studied.—On the diastatic coagulation of starch: J. **Wolff** and A. **Fernbach**.—The estimation of carbon monoxide in confined atmospheres: Albert **Lévy** and A. **Pécoul**. The authors utilise the reaction first indicated by M. Gautier between carbon monoxide and iodic anhydride at 80° C., modifying the method by receiving the vapours of iodine in a small quantity of pure chloroform. The amount of iodine set free is ascertained calorimetrically by comparison with a set of sealed tubes containing known quantities of iodine. It is possible in this way to measure in four litres of air only down to 1/200,000 of carbon monoxide by volume. A test analysis with an artificially prepared atmosphere is given to show the accuracy of the method.

—On the rational estimation of gluten in wheaten flour: E. **Fleurent.** It is shown that by taking certain precautions as to the temperature and lime contents of the wash water, and fixing the time of washing, it is possible to obtain results by the mechanical method which agree well with the chemical method.—Physicochemical researches on hæmolysis: Victor **Henri.**—The comet *e* 1904, discovered December 28, 1904, at the Observatory of Marseilles: M. **Borrelly.**—The provisional elements of the new Borrelly comet (1904 December 28): G. **Fayet** and E. **Maubant.**—On the isochronism of the pendulum in the astronomical clock: Ch. **Féry.** For an amplitude between 2° 13′ and 2° 29′, that is, for a variation of amplitude of about 9 mm., the variation of the rate was nil, or there was a minimum for the time of oscillation. This result is probably due to a want of isochronism of the escapement.—On the value of the magnetic elements on January 1: Th. **Moureaux.**—Osmotic communication in fishes between the internal and external media: Jean **Gautrelet.** Referring to a recent paper by M. Quinton, the author directs attention to a paper of his bearing on the same subject published in 1902.—On the infection of *Padda oryzivora* by *Trypanosoma paddae* and by *Halteridium Danilewskyi*: M. **Thiroux.**

INDIA.

Asiatic Society of Bengal, December 7, 1904.—The lizards of the Andamans, with the description of a new gecko and a note on the reproduced tail in *Ptychozoon homocephalum*: N. **Annandale.** Out of the nine geckos recorded from the Andamans, five or possibly six would seem to have been carried thither by man. The remaining three are indigenous. One of the three is very nearly related to forms on the nearest mainland, the second has Malabar affinities, and the third Madagascan. The author describes *Gonatodes Andersonii*—a new species. The scales of the reproduced part of the tail, dorsal and ventral surfaces, of *Ptychozoon homocephalum* are slightly smaller than those of the uninjured part, and the dorsal tubercles are absent; also the loose membrane is narrower, asymmetric, and not lobed. This last point is important, as Müller had thought the lobes of specific importance.—The occurrence of an aquatic glow-worm in India: N. **Annandale.** A glow-worm larva of aquatic habit has been found in a tank in the neighbourhood of Calcutta. The only other aquatic glow-worm recorded was found in Lower Siam.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 19.

ROYAL SOCIETY, at 4.30.—The Dual Force of the Dividing Cell. Part i.: The Achromatic Spindle Figure illustrated by Magnetic Chains of Force: Prof. M. Hartog.—Note on the Effects produced on Rats by the Trypanosomata of Gambia Fever and Sleeping Sickness: H. G. Plimmer.—Further Histological Studies on the Localisation of Cerebral Function. The Brains of Felis, Canis, and Sus, compared with that of Homo: Dr. A. W. Campbell.—Experiments on the Nature of the Opsonic Action of the Blood Serum: Dr. W. Bulloch and E. E. Atkin.

LINNEAN SOCIETY, at 8.—Botanical Collecting: Dr. A. Henry.—On the Cranial Osteology of the Families Osteoglossidæ, Pantodontidæ, and Phractolæmidæ: Dr. W. G. Ridewood.

SOCIETY OF ARTS, at 4.30.—The Gates of Tibet: Douglas W. Freshfield.

FRIDAY, JANUARY 20.

ROYAL INSTITUTION, at 9.—New Low Temperature Phenomena: Sir J. Dewar, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Some Impressions of American Workshops: A. J. Gimson.—Waterworks Pumping Engines in the United States and Canada: J. Barr.—Some Features in the Design and Construction of American Planing Machines: A. Kenrick, Jun.: Engines at the Power Stations, and at the St. Louis Exhibition: A. Saxon.

MONDAY, JANUARY 23.

SOCIOLOGICAL SOCIETY, at 8.—Civics: as Applied Sociology, Part ii: Prof. Patrick Geddes.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Great Zimbabwe and other Ancient Ruins in Rhodesia: R. N. Hall.

SOCIETY OF ARTS, at 8.—Reservoir, Stylographic and Fountain Pens: J. P. Maginnis.

TUESDAY, JANUARY 24.

ROYAL INSTITUTION, at 5.—The Structure and Life of Animals: Prof. L. C. Miall, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Notes on the Working of the Shone System of Sewerage at Karachi: J. F. Brunton.—The Sewerage of Douglas, Isle of Man: E. H. Stevenson and E. K. Burstal.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—Annual General Meeting. President's Address, &c.

WEDNESDAY, JANUARY 25.

SOCIETY OF ARTS, at 8.—London Electric Railways: Hon. Robert P. Porter.

THURSDAY, JANUARY 26.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Boring of the Simplon Tunnel, and the Distribution of Temperature that was Encountered: Francis Fox.—On the Comparison of the Platinum Scale of Temperature with the Normal Scale at Temperatures between 444° and −190° C., with Notes on Constant Temperatures below the Melting Point of Ice: Prof. M. W. Travers, F.R.S., and A. S. C. Gwyer.—On the Modulus of Torsional Rigidity of Quartz Fibres, and its Temperature Coefficient: Dr. F. Horton.—On a Method of Finding the Conductivity for Heat: Prof. C. Niven, F.R.S.—Exterior Ballistics. "Error of the Day" and other Corrections to Naval Range-Tables: Prof. G. Forbes, F.R.S.—The Theory of Symmetrical Optical Objectives. Part ii.: S. D. Chalmers.—On the Drift produced in Ions by Electromagnetic Disturbances, and a Theory of Radio-activity: G. W. Walker.—Coloration of Glass by Natural Solar and other Radiations: Sir William Crookes, F.R.S.—On the "Blaze-Currents" of the Gall Bladder of the Frog: Mrs. Waller.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Fuel Economy in Steam Power Plants: W. H. Booth and J. B. C. Kershaw. (Conclusion of discussion.)

FRIDAY, JANUARY 27.

ROYAL INSTITUTION, at 9.—The Life-History of the Emperor Penguin: Dr. Edward A. Wilson.

PHYSICAL SOCIETY, at 5.—Action of a Magnetic Field on the Discharge through a Gas: Dr. R. S. Willows.—Action of Radium on the Electric Spark: Dr. R. S. Willows and J. Peck.—The Slow Stretch in India-rubber, Glass, and Metal Wires when subjected to a Constant Pull: P. Phillips.—Determination of Young's Modulus for Glass: C. A. Bell.—Some Methods for Studying the Viscosity of Solids: Dr. Boris Weinberg.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Concrete-Making on the Admiralty Harbour Works, Dover: T. L. Matthews.

CONTENTS.

THURSDAY, JANUARY 26, 1905.

A MONOGRAPH OF THE HELIOZOA.

Les Heliozoaires d'Eau Douce. By E. Penard. Pp. 341; illustrated. (Geneva: Henry Kundig, 1904.)

THE Heliozoa or "sun-animalcules" have always been favourite objects with microscopists on account of their abundance, especially in fresh water, their relatively large size, and their beauty as objects for the microscope. From the scientific aspect, however, they have not attracted so much attention as many other groups of Protozoa, on account, perhaps, of their somewhat isolated position from the systematic or phylogenetic point of view, no less than from their perfect innocuousness, so far as mankind is concerned. The work before us is a monograph of the fresh-water Heliozoa, based upon investigations upon those found in the environs of Geneva. It was the author's original intention, he tells us, to have confined himself to a description of the forms occurring in that territory, but since he obtained there nearly all the species hitherto known from fresh water, he has added to his catalogue descriptions of the species which appear not to occur in the sphere of his personal investigations in order to give his monograph a wider basis.

The monograph is divided into four chapters. The first contains general considerations on the structure, reproduction, and affinities of the group; the second gives a systematic account of those fresh-water forms, the position of which among the Heliozoa is above suspicion; the third deals with the "Pseudo-Heliozoa," that is to say, with organisms commonly referred to this group, but of which the affinities and systematic position are dubious; and the fourth discusses synonymic species, namely, those which are of doubtful nature, or which have not been described in a manner adequate for identification. The work further commences with a short introduction and ends with a full bibliography, and is illustrated by numerous text figures.

In his general chapter the author gives first an account of the methods employed by him for collecting these organisms, and then proceeds to consider their body-structure. Under the latter heading he distinguishes two principal types of Heliozoa. The first, or Actinophrys-type, has a large spherical nucleus occupying the centre of the body, and lying, surrounded by a clear zone of protoplasm, in the granular and vacuolated endoplasm, which in its turn is enveloped by the very vacuolated ectoplasm containing a large contractile vacuole. The pseudopodia, seldom longer than the diameter of the body, are supported by relatively strong axial filaments, centred round the nucleus and radiating thence to the periphery of the spherical body. To this first type, which might be called the text-book Heliozoön, may be referred, besides Actinophrys, the genera Clathrulina and Hedriocystis, while Actinosphærium is derived from it by multiplication of the originally single nucleus. The second or Acanthocystis-type is much commoner; here the centre of the spherical body is occupied, not by the nucleus, but by a central granule, apparently somewhat of the nature of a centrosome, from which radiate the delicate axial filaments, each passing to the surface of the body to be continued into one of the slender pseudopodia, which usually exceed the diameter of the body in length. The central granule and nucleus are both contained in the endoplasm ordinarily so called, which itself is eccentric in position, so that the surrounding zone of ectoplasm becomes thin on one side of the body and is thickest at the pole opposite to this. The large nucleus is placed eccentrically in the endoplasm, being always near the region where the ectoplasmic zone is at its thinnest, and is therefore still more markedly eccentric in relation to the body as a whole. The author inclines to the opinion that the ordinary use of the terms ectoplasm and endoplasm is incorrect in the case of the Acanthocystis-type of Heliozoön. He thinks that the true ectoplasm is here limited to a narrow peripheral zone of the body, and that the remainder of what is commonly called ectoplasm should really be considered as endoplasm, of which that part to which the term endoplasm is usually applied is only a special region, containing nucleus and central granule, and perhaps homologous with the clear zone round the nucleus in Actinophrys.

In the classification the author keeps to the division into the four well known orders founded by Bütschli, and since repeated in every text-book, although he is decidedly of opinion that this classification "is artificial and does not always correspond to the real affinities of the species." If this is the case, it is a matter for regret that the author did not attempt to embody his ideas of the natural relationships of the Heliozoa in a scheme of classification more suited to express them. He contents himself, however, by making only minor improvements, such as transferring the genus Heterophrys from the Chlamydophora to the Chalarothoraca. He also separates from Bütschli's list certain forms which are placed by him under the heading "Pseudo-Heliozoa." This category, he is at pains to explain, is not intended to have any systematic value, but merely to serve as a mode of uniting "certain organisms which exhibit points of resemblance to Heliozoa sufficiently striking to tempt one to unite them with the latter, and which nevertheless do not belong to the group." Under the Pseudo-Heliozoa are placed various aberrant types the descriptions of which constitute one of the most valuable portions of the book to the student of Protozoa.

For the many interesting details of structure or mode of life of these animalcules described by the author the reader must be referred to the book itself. The following sentences, however, from the section headed "Psychology" merit quotation:—

"If we wish to adopt the chemico-physical theory, so much in favour now-a-days, according to which everything in the lower beings is but mechanical reaction, it is necessary to apply the theory consistently, to examine the higher animals as well as the others, and we shall then be forced to recognise that between the top and the bottom of the psychical scale there is only a descending gradation. Hence, according to this theory, the savant solving a problem should only differ from the Protist in the greater complexity of the physico-chemical reactions. If on the contrary one is led to see something more than matter in the highest manifestations of human thought, this something must likewise be admitted for the beings lowest in the scale. But then, we may add, on the supposition that the scale rests on pure matter, it is not on the lowest grade that we find the infinitely minute creatures, but already some way up, so much so that the gap separating them from the bottom is infinitely greater than that which they would have to traverse to arrive at the summit."

In conclusion, it may be said that everyone interested in the study of microscopic forms of life will welcome this work from the hand of an enthusiastic observer, who has a most intimate knowledge at first hand with the creatures about which he is writing, and who has achieved a wide reputation as an investigator of the fresh-water Protozoa. The work is weakest on the side which deals with the minuter phenomena of the cell and nucleus, especially in relation to reproduction, the study of which during the last decade has developed with such rapidity and has brought forth results of such fundamental importance in biology. The author is evidently more of a naturalist than of a cytologist, but it is perhaps too much to expect detailed cytological work in a systematic monograph even of a group of Protozoa. As a general survey of the peculiar forms dealt with it will be found most useful, not only as an exposition of the present state of knowledge, but even more as indicating how much still remains to be worked out with regard to the affinities of the Heliozoa and allied forms of life. By directing attention to the many interesting problems these lowly creatures present for solution, it may be hoped that this monograph will act as a guide and stimulus to investigators in all countries.

E. A. M.

TREES.

Trees. By Prof. H. Marshall Ward. Vol. i. Buds and Twigs. Pp. xiv+271. Vol. ii. Leaves. Pp. x+348. (Cambridge: University Press, 1904.) Price 4*s.* 6*d.* net each.

AS one might naturally expect from the scant attention which has hitherto been given to the study of forestry in this country, our literature on the subject is by no means what it ought to be. True, we have several standard works, excellent of their kind, which, however, deal with trees more from a sylvicultural than from a botanical aspect. Students of forestry, and especially students of forest botany, and all those interested in the growth and cultivation of trees, have long felt the great want of a suitable text-book or guide to their studies, but happily now, with the appearance of the above handbook from the facile pen of Prof. Marshall Ward, this want has become a thing of the past.

The work will consist of several parts—each part forming a volume—the first of which is already to hand, and treats of buds and twigs. The mere mention of buds and twigs might suggest to some a dry, uninteresting study of minute details; but never was a greater mistake made than to imagine such is the case. The study of our trees and shrubs in their winter condition has a fascination all its own, and, in addition to this, the clear and simple way in which the author treats the subject is sure to inspire many with interest and enthusiasm for the study of forest botany.

The study of the minute structure of plants in the laboratory has in many cases received the lion's share of attention, with the result that students have been taught to know the internal structure of plants before they were able to recognise these plants in the field. The author clearly recognises this fact, and plainly states that his object is to bring the student more into touch with the plant in its natural surroundings, where he may form a personal acquaintance with it and learn to observe and note facts for himself, and thereby lay a solid foundation for the further study of the biology of the living plant of whatever kind or nature. The opening chapter gives a short but clear account of the general segmentation of the plant. The next eight chapters are devoted to a consideration of buds. The different kinds, structure, position, arrangement, and function are described in a most masterly and interesting fashion. The next seven chapters deal with the different kinds of shoots—their tegumentary systems, leaf-casting and the formation of leaf scars, lenticels, twigs and other accessory characters.

The second portion of the book contains a very comprehensive classification of trees and shrubs according to characters afforded by their buds and twigs. The classification is accompanied by a complete set of illustrations, showing very clearly in pictorial form all those features by which the species may be determined in their winter condition. Most of those drawings have been done by Miss Dawson, of the County School, Cambridge, to whose artistic skill they do great credit. The other illustrations with which the volume teems have been obtained from various sources, and are all duly acknowledged by the author.

The work will be found indispensable to those students who wish to make an expert study of forest botany. At the same time it is expressed in language so clear and devoid of technicalities that the amateur who wishes to know something about our trees and shrubs will find this one of the most useful guides to which he can turn.

Succeeding volumes will deal with leaves, inflorescences and flowers, fruits and seeds, seedlings, and the habit and conformation of the tree as a whole, and each of those volumes, like the present one, will contain diagnostic tables at the end, devised for use in the field.

From the foregoing it will be seen that the work is a many-sided one, acting not only as a guide to the naturalist in the field, but also as a laboratory handbook, where the use of the lens and microscope may be employed to amplify the study of objects already observed in their natural habitats.

Botanists generally, and especially forest botanists, will welcome the appearance of this book as supplying a decided want, and filling a distinct gap in our literature of forest botany.

Since the above was written the second volume has appeared. As already stated, it deals with leaves, and, like vol. i., consists of a general and a special part.

The general part contains an admirable and exhaustive treatment of the external features of leaves, their form, composition and arrangement, together with the general characters of their venation, surface and texture; nor has the author omitted to go into the more detailed but equally important consideration of the anatomical structure and physiological functions of leaves. This part also contains many lists comprising those leaves which show the same common features as regards arrangement on the twig, form of venation, character of base, apex and margin of lamina, &c.

Part ii. of this volume, like that of vol. i., gives the classification of trees and shrubs, but, in this case, according to the character of their leaves. A useful glossary is given at the end of the volume, so that the beginner need have no difficulty in understanding the few but necessary technical terms which are used in the book.

ADVANCES IN PHYSICAL SCIENCE.

The Recent Development of Physical Science. By W. C. D. Whetham, F.R.S. Pp. xii+344. (London: John Murray, 1904.) Price 7s. 6*d.* net.

IT is now nearly thirty years since Prof. Tait published his lectures on "Recent Advances in Physical Science." The period that has since elapsed has been one of remarkable fruitfulness, and it is a suggestive fact that the fundamental problems of physical science which were dealt with by Prof. Tait have to so large an extent supplied the motive for the investigations now described by Mr. Whetham. Foremost amongst these perennial problems must be placed the structure of matter, the mutation of energy, and the nature of comets and nebulæ. Lord Kelvin's vortex-ring theory of the atom, so lucidly expounded by Prof. Tait, finds in the later volume its analogue in the electrical or corpuscular atom of Prof. J. J. Thomson, and the doctrine of the conservation of energy, which occupies the foremost position in the earlier volume, is again brought into prominence by the recent suggestions that the internal motion of the atom, be it that of a vortex ring or of a moving electron, may perhaps be drawn upon to supply the energy that is liberated from some hidden storehouse by the radio-active elements.

After an introductory chapter on the philosophical basis of the science, Mr. Whetham devotes two chapters to the liquefaction of gases and the phenomena of fusion and solidification. These two chapters afford striking examples of the way in which recent years have added to the equipment of the experimental sciences, not only by increasing the range of temperatures within which investigations may now be conducted, but also by providing the means of accurately measuring these temperatures. Under the heading of "Fusion and Solidification" Mr. Whetham has given a concise and readable account of the knowledge recently acquired with reference to the structure of metals and alloys. The examples, already classical, of the copper-tin alloys studied by Roberts-Austen and by Heycock and Neville, and the iron-carbon alloys studied by Osmond, le Chatelier, Roberts-Austen, and others are described. Photomicrographs of the former series of alloys are given. The most fascinating part of the chapter, however, is that which deals with Mr. Beilby's recent investigations of the surface structure of solids. These investigations have shown that even a brittle metal like antimony can be made at ordinary temperatures to flow like a liquid, so that when it is rubbed with fine emery paper the surface produced is not jagged or crystalline, but under the highest magnification appears rather like a freshly painted surface on which the rounded streaks left by the brush are still visible.

In the chapter on the problems of solution, the mechanism of electrolysis is discussed from the point of view of Arrhenius's theory of electrolytic dissociation, but the arguments in favour of this theory are stated with a moderation that is in marked contrast to the one-sided statements that have sometimes been put forward by ardent supporters of the theory. In considering the nature of colloidal solutions, a purely physical explanation is given of the coagulation of the proteids; the observation that "the direction of movement of certain proteids" under the influence of an electric current "could be changed by changing the solvent from a very dilute acid to a very dilute alkali" would be interpreted by the chemist as evidence of their power, as amino-acids, to function either as acid or as base, whilst the fact that "if the solvent was very carefully neutralised an isoelectric point was reached at which the solution became very unstable and coagulation seemed to occur spontaneously" would be ascribed to the tendency of the free amino-acid to condense and form a more complex molecule in the manner characteristic of this group of compounds.

The chapters on the conduction of electricity through gases and on radio-activity contain a concise account of the series of investigations that have been co-ordinated in the recently published works of Prof. J. J. Thomson and Prof. Rutherford. The chapter on atoms and æther derives its chief interest from the inclusion in it of the results of Prof. Thomson's recent investigations of the stability of a system of negatively charged corpuscles revolving in orbits within a positively charged sphere. The atomic model suggested by such a system gives, probably for the first time, a clear representation of the periodic properties of the elements, including the variation in valency, which is the most characteristic of these properties.

The final chapter, on astrophysics, contains an account of the more recent results of spectroscopic investigations of the sun and stars, and includes reproductions of three of the most striking of Prof. Hale's solar photographs. In the later part of the chapter the pressure due to radiation is considered and applied to the explanation of the curious phenomena of comets' tails, whilst the mutual repulsion of radiating particles is suggested as a possible explanation of the permanence of Saturn's rings.

The author has sought to express the results of recent physical investigations in a form which "might prove useful to students of science in general," and "also appeal to those who, with little definite scientific training, are interested in the more important conclusions of scientific thought." In the former part of his task he has been eminently successful. In his appeal to a wider public, it is to be hoped that the difficulties of "treating the wider and deeper generalisations of natural science as fit subject-matter for current thought and literature" will not deprive him of a further measure of well merited success.

T. M. L.

THE CYANIDE PROCESS.

Cyaniding Gold and Silver Ores. A Practical Treatise on the Cyanide Process; embracing Technical and Commercial Investigations, the Chemistry in Theory and in Practice, Methods of Working and the Costs, Design and Construction of the Plant and the Costs. By H. Forbes Julian and Edgar Smart. Pp. xx+405; illustrated. (London: C. Griffin and Co., Ltd., 1904.) Price 21*s.* net.

THE cyanide process is still in its teens, but it is a lusty stripling. Much of the enormous increase in the production of gold during the last few years is due to it, either directly or indirectly. There are few gold mines of any importance in the world at which the process is not installed, and it has been stated on high authority that the majority of these mines could not earn profits and pay dividends without its aid. Owing to the shortness of the time since the industry of cyaniding gold and silver ores began to spring up, there is a lack of data on the subject readily available to men at work far from centres of civilisation. There are many books on the cyanide process, but new ones are still welcome, particularly a work like that of Messrs. Julian and Smart, in which some degree of completeness is attained.

The authors were well equipped for their task, both having been engaged in the industry for a number of years. They have not, however, merely written down the results of their own practical experience, a course which usually leads to dogmatic assertion on doubtful points, but, on the contrary, have studied the voluminous literature of the subject with evident care, and displayed some judgment in their extractions. If they had added a bibliography, one shudders to think of the portentous length it would have attained.

Not content with this, they have made a number of laboratory experiments on the dissolution and precipitation of gold, and advance views based on these which are in part novel and somewhat unsatisfactory. Exception may fairly be taken to this portion of the book, for whether these views are right or wrong, they are out of place in a text-book until they have been discussed adequately. To the practical worker, for whom this book is intended, theories are useful only if they explain and elucidate phenomena with which he is confronted in the mill, or enable him to decide on a course of action in unusual cases. Much of the authors' theorising does not appear to answer this test very well.

The book begins with an interesting, if not an impartial, chapter on the early history of the cyanide process. The authors next proceed to describe the laboratory experiments which are necessary to determine the method of applying the process to any particular ore. In the useful discussion on sampling, the omission of any reference to recent work is noticeable, and the account of automatic machines is hardly adequate.

The most serious omission in this section, however, is in regard to laboratory work in connection with a mill in operation. The examination of mill solutions for gold and other metals, for available cyanide, for oxygen, or for dissolving power is not touched on. The only reference to the matter is in the sentences:—

"It must however be understood that there is no relation between the (total cyanide) found present and the dissolving action of the solution on gold and silver. For this reason two different solutions containing by the test the same quantity of cyanide may have very different dissolving effects."

This would be cold comfort to anyone who wished to learn what he could of the methods adopted to determine the condition of a mill solution. The gap should be filled in a future edition.

The later chapters, dealing with the methods and machinery used in practice, form by far the most interesting and useful part of the book. The authors seem to be quite at home in describing the design and construction of leaching vats, precipitation boxes, pumps, launders, sizing plant, and all the accessories of a modern cyanide mill. The methods of treating different classes of material are also handled with skill and judgment, and are fairly up to date. It is not the fault of the authors that progress in the industry continues to be rapid, and that any description is behind the times almost as soon as it is printed. The book ends with a couple of excellent chapters on the cost of constructing plants and of treating ores, and the index has been carefully prepared.

The volume is handsomely got up, and enough has probably been said to show that the merits of the work so far outweigh its faults that those interested in the cyaniding industry cannot do without it.

T. K. R.

OUR BOOK SHELF.

Fireside Astronomy. By D. W. Horner. Pp. 105. (London: Witherby and Co., 1904.) Price 1*s.* 6*d.* net.

"THE articles which go to make up this little book originally appeared in the 'English Mechanic and World of Science,' and caused some discussion therein." This we read in the preface of the book before us, and we are further told there that this "simple worded treatise" is intended for the "man in the street."

A perusal of these pages will, however, tend to bewilder the mind of this very practical personage considerably, for the text is not a specimen of clearness, and the illustrations are very far from being self-explanatory; in fact, the latter are as bad as it seems possible for illustrations to be.

In justification of these statements it may be remarked that the zodiac is mentioned on p. 3 and *defined* on p. 14. On p. 4 we have a very ambiguous statement about the various altitudes of the sun at different *seasons* of the year, no reference being made to the inclination of the earth's axis to the plane of the ecliptic, or to altitudes at *noon*. On p. 11 we read:—"By refraction we mean the property of the atmosphere to bend the rays of light from celestial bodies, and so make them appear at a point in the heavens some distance (greater according to the proximity to the horizon) from their true position." Such a statement, to the man in the street, could apply equally as well to a horizontal as a vertical change of position. On p. 19 is written:—". . . solid body of the Sun himself, which is probably a relatively dark body . . ."; for such readers as this book is intended a statement of this nature should have been carefully avoided.

On the same page we must conclude that for most days of the year, especially in years away from sunspot minimum, the earth is subject to nearly a continuous series of magnetic storms, for "the appearance of spots on the sun is nearly always accompanied by a 'magnetic storm' . . . ." The use here of the term "magnetic storm" is quite unnecessary and misleading.

Enough, perhaps, has been said about the text of this "simple worded treatise," and we leave intending readers to criticise the drawings themselves, their attention being specially directed to those on pp. 6, 25, 36, and 89.

Observations océanographiques et météorologiques dans la Région du Courant de Guinée (1855–1900). (1) Texte et Tableaux. Pp. iv+116. (2) Planches, viii. The Netherlands Meteorological Institute. (Utrecht: Kemink & Zoon, 1904.) Price 5 francs.

THESE volumes contain the results of a discussion of observations recorded by Dutch shipmasters. The area extends from the equator to latitude 25° N., and from the meridian of Greenwich to 40° W. The work is a revised and more complete edition, brought up to date, of "De Guinea—en Equatoriaal Stroomen," published in 1895. Currents, winds, temperature and specific gravity of the sea water, temperature and pressure of the air, frequency of rain days, records of current ripples, flying fish, phosphorescence, and of green, brown, and blue water have been tabulated for each month in spaces of 1° squares, then grouped into 5° squares for each month and the year, also for each of twelve three-monthly periods—December to February, January to March, &c.—and finally, the current and wind results in 5° squares for each month and the year for each octant. So far as they go, the results for the various elements are interesting and valuable. Unfortunately, throughout this long period of thirty-six years Dutch ships kept so very closely within the narrow limits of the recognised outward and homeward routes that the information immediately beyond has been exceedingly sparse; indeed, over an area of about 400,000 square miles in the south-western quarter of the region under discussion not a single observation was available for the four consecutive months August to November, a period of the year when the east-going counter-current would be met with in this locality. We are presented, therefore, with very incomplete results as to the seasonal extension and contraction of this important current. It is admitted that, having failed to devise a wholly satisfactory system of weighting the frequency of winds, a method "subject to some objections" has been followed, so that whether the wind has been logged from the same point once or six times in the day it has been counted as one observation, whereas if logged from six different points in the same interval six observations have been tabulated. Except in table iv., and planches vi. and vii., the absence of current or wind has been ignored.

(1) *Opere matematiche di Francesco Brioschi*. Vol. iii. Pp. x+435. (Milan: U. Hoepli, 1904.) Price 25 lire.

(2) *Opere matematiche di Eugenio Beltrami*. Vol. ii. Pp. 468. (Milan: U. Hoepli, 1904.) Price 25 lire.

THESE are the continuations of series of collected papers of which the previous volumes have already been reviewed in NATURE.

The mathematical papers of Francesco Brioschi are published under the auspices of a committee consisting of Profs. G. Ascoli, V. Cerruti, G. Colombo, L. Cremona, G. Negri, and G. Schiaparelli. Of the papers in the third volume, Nos. 90 to 100 were published in the *Annali di matematica pura ed applicata* from 1887 to 1897, Nos. 101 to 125 in the Lombardy *Rendiconti* between 1867 and 1896, the next two in the *Memorie* of the Modena Society in 1855, and the remainder (Nos. 128 to 144) in the *Atti* of the Lincei Academy between 1870 and 1886. The papers have been revised by Profs. Bianchi, Capelli, Cerruti, Gerbaldi, Loria, Pascal, Pittarelli, and Tonelli; the volume has been edited by Profs. Gerbaldi and Pascal, and the former is mainly responsible for the revision of the proofs.

The second volume of Beltrami's works, like the first, is brought out under the auspices of the faculty of science of the University of Rome, and contains nineteen papers arranged in chronological order, numbered 27 to 45, and published between the years 1867 and 1873. The series is to be completed in five volumes.

The Science Year Book for 1905. Edited by Major B. F. S. Baden-Powell. Pp. iv+393. (London: King, Sell and Olding, 1905.)

A PLACE should be found for this Year-book on the writing table of every astronomer and meteorologist, and the volume should be available for ready reference in laboratories and schools where science is studied. The first section of the work contains an astronomical ephemeris throughout the year, short notes relating to the movements of the earth, particulars as to paths of the principal planets this year, details of eclipses, many useful tables, and maps of constellations. There are also meteorological tables and diagrams, physical and chemical constants, and tables of weights and measures of various kinds. Another section is devoted to particulars of scientific societies at home and in America, and notes on prizes and awards offered for scientific research. This list, which at present occupies only two pages, might be made a very valuable part of the book; for, so far as we are aware, the information does not exist in a convenient form anywhere. Particulars might be given, for instance, of the subjects and values of the prizes offered each year by the Paris Academy of Sciences and many similar bodies. Short articles are contributed on the progress of different branches of pure and applied science last year, and there is a biographical directory which includes the names of fellows of the Royal Society and a few other men of science, but is not complete enough to be of much use as a directory.

The remainder of the volume consists of a diary with pages for every day, for monthly notes, cash account, &c. For each day astronomical particulars are printed at the top of the page, and there are columns in which to enter results of meteorological observations. It is very convenient to have all these matters brought together so handily for reference and record; and we have no hesitation in saying that all who are interested in natural phenomena or concerned with scientific progress will find this Year-book of great service.

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 Origin of Radium.

EIGHT months have elapsed since I wrote in your columns (NATURE, May 12, 1904) giving an account of some experiments designed to test the view advanced by Prof. Rutherford and myself that radium is a product of the radio-active change of uranium. I then stated that in 1 kilogram of uranium nitrate that had been under observation over a period of one year since it was completely freed from radium, the quantity of radium reproduced in that time was less than one-ten-thousandth of the quantity theoretically to be expected. This result has been widely quoted, more widely, perhaps, than I intended, for the result was a preliminary conclusion only, and, as I pointed out, obtained under very unfavourable conditions owing to the very powerful preparations of radium that had been in use in the laboratory for other researches. The necessity for publishing it was to a certain extent forced upon me by the attention the problem was beginning to attract from other investigators, and by the prospect of several months' absence abroad. I relied on the fact that the result being negative, the presence of the radium in the laboratory could have had no effect, but in this I was mistaken.

Since my return I have resumed the research in the new chemical laboratories recently erected here, into which no radium has so far been brought, and have found that the earlier result was affected by an error which invalidates the conclusion drawn. It is therefore my duty to point this out at once without waiting for any further results. I am now fairly satisfied that there is a steady production of radium from uranium, and although the quantity formed, as measured by the amount of radium emanation evolved, is of a lower order of magnitude than is indicated by the disintegration theory, it is much greater than the ten-thousandth part.

At the present time, about eighteen months since the commencement of the experiment, the kilogram of uranium nitrate in solution contains, so far as the amount of emanation evolved is a measure, about $1{\cdot}5\times10^{-9}$ gram of radium, and if the whole series of measurements from the commencement are re-calculated, eliminating the error alluded to, they are fairly consistent with there having been a steady production of radium at this rate continuously from the commencement. This gives the value 2×10^{-12} for the fraction of the uranium changing per year, whereas the most probable theoretical estimate is 10^{-9}. The new result is thus still only one-five-hundredth of the theoretical.

The error in the result published last May was not in the determination of the amount of radium emanation evolved from the uranium, but in the determination of the amount of emanation given by a known weight of radium, against which the first mentioned determination was compared. The measurements on the uranium are in good agreement with those recently obtained, whereas the comparative experiments with radium gave results too high owing to extraneous radium in the laboratory. For the effect from the uranium is so minute that to obtain a comparable effect with the radium emanation, the quantity of the latter obtainable from the smallest weighable quantity of pure radium bromide must be diluted and subdivided until only a millionth part at most remains. Thus if any emanation were present in the air of the laboratory used for the dilution, or if by mischance any of the gas apparatus, rubber tubing, or mercury had been used previously in experiments with powerful radium preparations, the results obtained would be completely false. It is now known (*vide* Rutherford, *Phil. Mag.*, November, 1904, p. 637) that even metals, as copper and silver, absorb the radium emanation appreciably and slowly evolve it. The utmost precautions have to be observed in standardising the rate of leak of the electroscope by the emanation from a known weight of radium, so that each successive dilution of the emanation is performed in an entirely new apparatus with new mercury and rubber connections. Otherwise emanation is absorbed from the gas rich in it and given out to the diluted gas, and when the final dilution should contain only one-millionth of the original emanation, as in these experiments, it will be in reality far richer. This explains the apparently paradoxical result I obtained that the determinations of the amount of radium produced were far too *low*, owing to the extraneous radium of the laboratory.

The research is being continued with the view of eliminating what appears a probable explanation of the too low rate of production. It may be that under the conditions of the experiment the greater part of the emanation is retained by the uranium solution and not evolved as gas. New methods are being tried, and it is hoped that they will give a positive answer to this question.

FREDERICK SODDY.

The University, Glasgow, January 20.

A New Radio-active Product from Actinium.

AT the suggestion of Prof. Rutherford, I have made an examination to see if there is any product in actinium corresponding to the product UrX in uranium or ThX in thorium. The investigations were made with a preparation of the emanating substance of Giesel (of activity 300 times that of uranium), which has been shown to be identical in radio-active properties with the actinium of Debierne.

Taking into consideration the similarity of actinium and thorium, both as regards their chemical and radio-active properties, I resolved to try if the method used by Rutherford and Soddy for the separation of ThX would not serve also to separate an analogous product from actinium. The experiments were at once successful. If ammonia was added to a solution of actinium in hydrochloric acid, the actinium was precipitated, while a small amount of a very active substance was left behind in the filtrate. This substance, which is so similar in properties to ThX, will be called actinium X (AcX).

The product AcX, immediately after its separation, weight for weight, was more than a hundred times more active than the original actinium. The activity increased in the first day after removal to about 15 per cent. of its original value, and then decayed with the time according to an exponential law, falling to half value in about ten days. The actinium from which the AcX had been removed, almost inactive immediately after separation, gradually recovered its lost activity. As in the case of thorium, the curve of recovery of the activity was complementary to the curve of decay of AcX.

The behaviour of the product AcX is thus completely analogous in all respects to that of ThX, only the constant of change has a different value, which is characteristic for AcX.

Special experiments, made for the purpose, showed that the emanation was produced from AcX, and not directly from the actinium. The latter, immediately after separation of AcX, gave off very little emanation, while AcX produces the emanation in large amount. The amount of emanation from AcX diminished with the time at the same rate that AcX loses its activity. At the same time the actinium gradually increased in emanating power, due to the production of fresh AcX, and finally reached an equilibrium value.

The product AcX gives out both α and β and probably γ rays. It is, however, difficult to determine whether the β rays arise directly from AcX or from the excited activity to which the emanation gives rise.

There is an interesting point of distinction between the radio-activity of thorium and actinium. After the separation of AcX, the actinium is almost completely inactive, only 4 per cent. of the maximum activity being observed. It is probable that this amount could be still further reduced by successive precipitations. Thorium and radium, on the other hand, always show a non-separable activity of about 25 per cent. of the maximum. This points to the fact that the activity from ordinary actinium is due entirely to AcX and its successive products, and that little, if any, is supplied directly by actinium itself. From the point of view of the theory of radio-active changes, this shows that the change of actinium into AcX is a "rayless" change.

A more complete account of these investigations will be published later.
T. GODLEWSKI.
McGill University, Montreal, January 2.

A Simple Model for Illustrating Wave-motion.

MACH's model for illustrating the transversal as well as the longitudinal wave is known to work in a beautiful manner. The arrangement for exciting the wave-motion is not, however, very simple. The fact that the period of a pendulum varies with the length of the string may conveniently be åvailed of for producing a wave-motion in a row of pendulum-bobs.

As shown in the annexed figure, a series of pendulums of equal length is suspended at equal intervals. Each ball hangs on two strings, each of which passes through the corresponding one in the row of holes in one of two parallel horizontal rods M and N; the strings pass through the holes from inside to outside, and are tied together to a horizontal rod L placed symmetrically above the two rods. One end of the upper rod is pivoted, while the

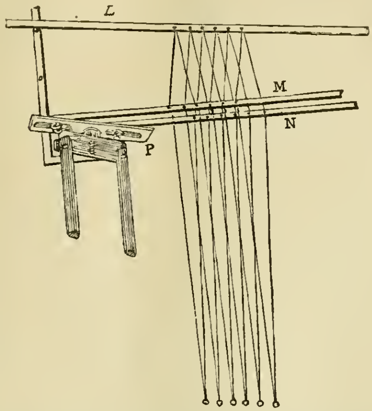


FIG. 1.

other can be raised to a suitable height. If this end be raised, the length of the pendulums increases from the end toward the other.

The two rods, M and N, can be separated or brought in contact by two links P and Q (not shown in the figure), attached to their ends. If the rods be in contact, the pendulums oscillate at right angles to the vertical plane containing the rod L; if they are separated, the pendulums oscillate in this plane. Hence, by the position of the links, the longitudinal as well as transversal oscillations of the pendulums can be excited at will.

To produce a wave-motion, the end of the upper rod L is raised, and then the two rods M and N are brought in contact. Then the pendulums are set in motion simultaneously by a long rod. After one or two minutes the phase-difference in each pendulum gradually increases, and a beautiful transversal wave-motion is produced. The wave-length becomes shorter and shorter; if a wave of a required wave-length is obtained, the rod L is lowered to its initial position. Each pendulum has then an equal length, so that wave-motion of a definite form incessantly proceeds from one end to another.

If the links be rotated, so as to separate the two bars M and N from each other, the plane of oscillation of each pendulum gradually changes, until the oscillation becomes at last longitudinal. Then a regular longitudinal wave is observed to proceed from one end to another.

On the other hand, a longitudinal wave can first be excited, and then be transformed into a transversal one. Raising the end of the upper rod, and separating the two horizontal rods M and N, each pendulum is simultaneously set in a longitudinal motion by a long rod with receiving holes for pendulum-bobs. A longitudinal wave is gradually formed; if a wave of a suitable length be obtained, the rod L is lowered to its initial position; then wave-motion of a definite form is established. By turning the links the longitudinal wave is transformed into a transversal one.
Tokyo, Japan.
K. HONDA.

Recently Observed Satellites.

MAY I ask whether the small, distant, eccentric, and possibly retrograde satellites of Jupiter and Saturn, which have been discovered and seem likely to be discovered, ought not more properly to be regarded as cometary bodies, or a shoal of meteors not yet too much drawn out for visibility at a distance? Would it not be possible for the larger planets to be attended by such bodies, the orbits of which have been made moderately elliptical by an accidental perturbation? It is known that the larger planets are able to capture comets for the sun; is it possible that with the aid of their satellites and subsequent tidal action they may be able to catch a few for themselves?
OLIVER LODGE.
The University, Birmingham, January 20.

Compulsory Greek at Cambridge.

MY experience of Greek at Cambridge is very similar to that of Mr. Willis, but the slight differences are, I think, instructive.

When I decided to go up to Cambridge to study mathematics and philosophy I was living abroad, and I crammed Greek just as Mr. Willis describes, except that I worked entirely alone. But on going in for the "Little Go," though I passed easily in translation, I failed by a few marks in Greek grammar. It was so near a thing that I thought I might pull through in December with a few hours more grind; but unfortunately I ran it too fine, and again failed by a few marks. This meant that I had to get up a complete new set of translation books for the following June, and to prevent further mistakes I went to a coach for the grammar part. I then passed, getting a second class. Like Mr. Willis, I can only say my present knowledge of the language is *nil*, although I had a double dose of it. It cannot for a moment be pretended that I got any insight into "Greek thought" which I could not have got equally well by reading a good translation. But I confess my opinion of the value of Greek thought was not raised by what I read—at best it only seemed to me creditable, considering how long ago it was written. But this may have been due to my resentment at being forced to waste time in an uncongenial study, when I was keen to get on to something else.
EDWARD T. DIXON.
Racketts, Hythe, Hants, January 20.

Super-cooled Rain Drops.

WALKING home from the university last night at about 8.45 p.m. an interesting phenomenon occurred.

Something was falling which at first appealed to one as hail, but I soon found that it was large rain drops evidently cooled below the freezing point; at the moment they struck objects such as one's hat, coat, or walking stick, &c., they instantly solidified in small hemispherical lumps; falling on the ground they gave it the appearance of a sheet of ice, but the roads were not slippery, as the solidified rain gave the road just a nice amount of roughness. The noise of the falling rain was very curious—a crackling noise, not unlike that of small electric sparks.
EDWARD E. ROBINSON.
The University, Birmingham, January 17.

Polar Plotting Paper.

MAY I be allowed to direct the attention of all interested in mathematical teaching in our schools and colleges to the polar plotting paper recently prepared by Mr. Ellice Horsburgh, lecturer on technical mathematics in Edinburgh University?

The special feature of this paper is that it is ruled radially with lines which subdivide the region about a point into aliquot parts of a radian. There are two forms of sheets now in the market. In one the origin is at the centre, and the radial subdivision is carried right round through four right angles. In the other, a reduced copy of which is here reproduced, the origin is taken near one corner, and the graduation is carried through a little more than a quadrant. Dotted radial lines show the backward continuation of the axis from which the radians are measured, and also the axis perpendicular to it. These dotted lines do not, of course, belong to the system of lines dividing the region into aliquot parts of a radian.

The radius of the fiftieth orthogonal circle is taken as the unit, and on the margins just outside the proper radian subdivisions small radial lines are drawn giving the usual division into degrees. The two circles drawn, the one on the axis as diameter and the other on the dotted perpendicular of unit length, serve to give by inspection the sines and cosines of the angles given in radians.

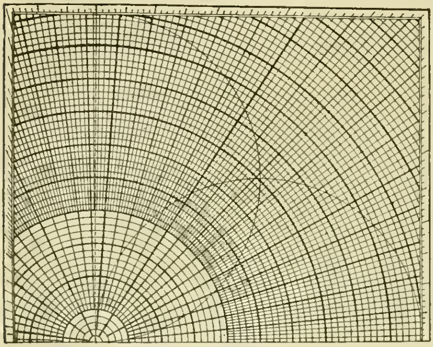


FIG. 1

Thus the paper contains on its own surface the means of plotting with great ease the polar equations of curves involving radians, sines and cosines, and a little calculation will enable the student to take account of other functions.

The first important use in the hands of the student is obviously to get a clear idea of the radian as the true scientific measure of angle; but a great many other important uses will at once occur to the teacher of practical mathematics, such, for example, as finding reciprocals, geometric means, mean proportionals, fourth proportionals, squares, square-roots, &c.

Another use is the evaluation of the integrals $\int r^2 d\theta$ and $\int r d\theta$. The former is got by simply counting the elements included in the area, and the latter by multiplying the total angle between the initial and final radius by the mean radius, the value of which may be obtained by a method similar to Simpson's rule.

From these few statements and indications the purpose of Mr. Horsburgh's patent will be readily appreciated. It is doubtful if the average student, taught along the usual lines, ever gets an accurate working knowledge of the radian or circular measure of an angle, indispensable though that is for all higher trigonometrical and analytical work. A few hours' systematised exercise with the polar paper will do more than days of arithmetical transformations in the usual academic style.

C. G. KNOTT.

Lissajous's Figures by Tank Oscillation.

THE oscillation of a rectangular water basin may be utilised for the illustration of the composition of two simple harmonic motions in two directions, perpendicular to each other.

A light pendulum was constructed of a thin aluminium rod, R (Fig. 1), 10 cm. long. The bob B was made of a disc of wood. On the upper end of the rod a light mirror M was attached. The rod could be supported at any desired point by a small gimbal G, so that the rod could oscillate as a spherical pendulum. A small brass weight W was attached to adjust the period of oscillation by raising or lowering it to a proper position.

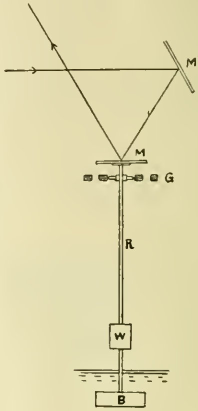


Fig. 1

The bob is sunk into the middle part of a suitable rectangular basin, filled with water to a proper depth. If the basin be tilted suddenly, and then let stand, the water is set in an oscillation which consists of two simple harmonic motions in perpendicular directions, the ratio of the periods varying as the ratio of the corresponding sides. The amplitudes of two component oscillations may be varied at pleasure. If the natural period of the pendulum is considerably shorter than that of the basin, the bob follows very nearly the motion of water, as judged by the motion of fine dust particles suspended in water. Now, if a beam of strong sun-light be sent as shown in the figure, the motion is projected on the ceiling of the room.

I have also obtained a photographic record of the motion of a small bead attached to the upper end of a small needle erected on the rod. By making the illumination intermittent by means of a perforated rotating disc, the difference of velocities at different phases may be shown.

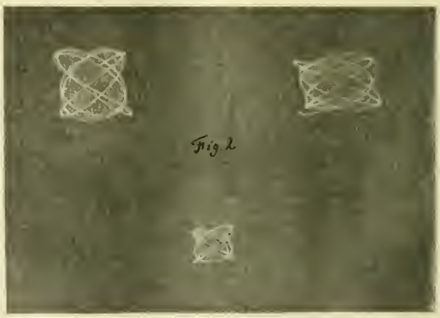


Fig 2

The motion of a kaleidophone may be projected in a similar manner.

T. TERADA.

Physical Laboratory, Tokyo, December 19, 1904.

NOTES ON STONEHENGE.

I.—CONDITIONS AND TRADITIONS.

AFTER Mr. Penrose, by his admirable observations in Greece, had shown that the orientation theory accounted as satisfactorily for the directions in which the chief temples in Greece had been built as I had shown it did for those in Egypt, it seemed important to apply the same methods of inquiry with all available accuracy to some example, at all events, of the various stone circles in Britain which have so far escaped destruction. Many attempts had been previously made to secure data, but the instruments and methods employed did not seem to be sufficient.

Much time has, indeed, been lost in the investigation of a great many of these circles, for the reason that in many cases the relations of the monuments to the chief points of the horizon have not been considered; and when they were, the observations were made only with reference to the magnetic north, which is different at different places, and besides is always varying; few indeed have tried to get at the astronomical conditions of the problem.

So far as I know, there has never been a complete inquiry into the stone circles in Britain, but Mr. Lewis, who has paid much attention to these matters, has dealt in a general manner with them (*Archaeological Journal*, vol. xlix. p. 136), and has further described (*Journal* Anthropological Institute, n.s., iii., 1900) the observations made by him of stone circles in various parts of Scotland. From an examination of a large number he concludes that they may be divided into different types, each of which has its centre in a different locality. The types are (1) the Western Scottish type, consisting of a rather irregular single ring or sometimes of two concentric rings. (2) The Inverness type, consisting of a more regular ring of better-shaped stones, surrounding a tumulus with a retaining wall, containing a built-up chamber and passage leading to it, or a kist without a passage. (3) The Aberdeen type, consisting of a similar ring with the addition of a so-called "altar-stone" and usually having traces of a tumulus and kist in the middle. In addition to these three types of circles, there are what Mr. Lewis calls sun and star circles, with their alignments of stones, and apparently proportioned measurements.

It may be useful here to state, with regard to megalithic remains generally, that they may be divided as follows:—

(*a*) Circles. These may be single or double, and either concentric or not.

(*b*) Menhirs, or single stones, in some cases still upright, but in many overthrown.

(*c*) Alignments, *i.e.* lines of stones in single, double, or in many parallel lines. If these alignments are short they are termed avenues.

(*d*) Cromlechs; this term generally means a collection of stones; the term is applied to irregular circles in Brittany. It also applies to a single stone raised on the summits of two or more pillar stones forming the end and sides of an irregular vault generally open at one end ("Dolmens of Ireland," Borlase, p. 429).

(*e*) Coves. A term applied by Dr. Stukeley and others to what they considered shrines formed by three upright stones, thus leaving one side open. I take them to be partially protected observing places. There are well-marked examples at Avebury, Stanton Drew, and Kit's Coity House.

(*f*) Dolmens, from Dol Men, a table stone. These consist of a flat stone resting on two or more upright stones forming a more or less complete chamber, which may or may not have been sepulchral. I note the following subdivisions, "Dolmen a galérie" having an entrance way of sufficient height, and "Galgal," similar but smaller. In the "Dolmen à l'allée couverte" there is a covered passage way to the centre. It is a more elaborate cove. For the relation between cromlechs and dolmens, see Borlase (*loc. cit.* and p. 424 *et seq.*).

With regard to dolmens, I give the following quotation from Mr. Penrose (NATURE, vol. lxiv., September 12, 1901):—

"Near Locmariaquer in the estuary named Rivière d'Auray, there is an island named Gavr' Inis, or Goat Island, which contains a good specimen of the kind of dolmen which has been named 'Galgal.'

"At the entrance our attention is at once arrested by the profusion of tracery which covers the walls. From the entrance to the wall facing us the distance is between 50 and 60 feet. The square chamber to which the gallery leads is composed of two huge slabs, the sides of the room and gallery being composed of upright stones, about a dozen on each side. The mystic lines and hieroglyphics similar to those above mentioned appear to have a decorative character.

"An interesting feature of Gavr' Inis is its remarkable resemblance to the New Grange tumulus at Meath. In construction there is again a strong resemblance to Mæs-Howe, in the island of Orkney. There is also some resemblance in smaller details."

While we generally have circles in Britain without, or with small, alignments, in Brittany we have alignments without circles, some of them being on an enormous scale[1]; thus at Menec (the place of stones) we have eleven lines of menhirs, terminating towards the west in a cromlech, and notwithstanding that great numbers have been converted to other uses, 1169 menhirs still remain, some reaching as much as 18 feet in height.

The alignments of Kermario (the place of the dead) contain 989 menhirs in ten lines. That of Kerlescant (the place of burning), which beginning with eleven rows is afterwards increased to thirteen, contains altogether 579 stones and thirty-nine in its cromlech, with some additional stones.

Both circles and alignments are associated with holidays and the lighting of fires on certain days of the year. This custom has remained more general in Brittany than in Britain.

At Mount St. Michael, near Carnac, the custom still prevails of lighting a large bonfire on its summit at the time of the summer solstice; others kindled on prominent eminences for a distance of twenty or thirty miles round reply to it. These fires are locally called "Tan Heol," and also by a later use, Tan St. Jean.

In Scotland there was a similar custom in the first week in May under the name of Bel Tan, or Baal's Fire; the synonym for summer used by Sir Walter Scott in the "Lady of the Lake":—

> Ours is no sapling chance-sown by the fountain
> Blooming at Beltane in winter to fade.

At Kerlescant the winter solstice is celebrated by a holiday, whilst Menec greets the summer solstice, and Kermario the equinoxes, with festivals. The adoration paid these stones yielded very slowly to Christianity. In the church history of Brittany the *Cultus Lapidum* was denounced in 658 A.D.

Many of the fallen menhirs in these alignments have been restored to their upright position by the French Government. Some of them may have been overturned in compliance with the decree of 658 A.D. above referred to. Several of the loftier menhirs are surmounted by crosses of stone or iron.

[1] "The French Stonehenge: an Account of the Principal Megalithic Remains in the Morbihan Archipelago." By T. Cato Worsfold, F.R.Hist.S. F.R.S.L. (London: Bemrose and Sons, Ltd.)

Regarding both circles and alignments in the light of the orientation theory, we may consider simple circles with a central stone as a collection of sight-lines from the central stone to one or more of the outer ones, or the interval between them, indicating the place of the rise or setting of either the sun or a star on some particular day of the year, which day will be a new year's day.

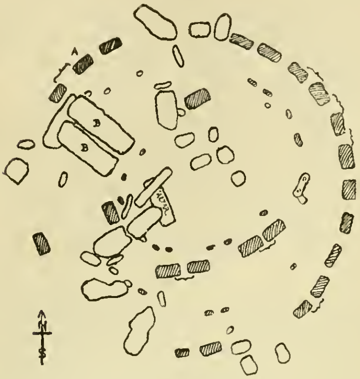


FIG. 1.—Plan of Stonehenge, standing stones shaded. A, Stone which fell in 1900; BB, Stones which fell in 1797.
(*Reproduced from "Man."*)

Alignments, on the other hand, will play the same part as the sight-lines in the circles.

Sometimes the sight-line may be indicated by a menhir outside, and even at a considerable distance from, the circle.

The dolmens have, I am convinced, been in many cases not graves originally, but darkened observing places whence to observe along a sight-line; this would be best done by means of an allée couverte, the predecessor of the darkened naos at Stonehenge, shielded by its covered trilithons.

FIG. 2.—View of Stonehenge from the west. A, Stone which fell in 1900; BB, Stones which fell in 1797.
(*Reproduced from an account of the fallen stones by Mr. Lewis in "Man."*)

In order to bring some measurements to test the orientation theory in Britain, I found that Stonehenge is the ancient monument in this country which lends itself to accurate theodolite work better than any other. Avebury and Stanton Drew are known to a great many archæologists; there are also other very wonderful stone circles near Keswick and in other parts of England; but unfortunately it is very much more difficult to get astronomical data from these ancient monuments than it is in the case of Stonehenge, one reason being that Stonehenge itself lies high, and the horizon round it in all directions is pretty nearly the same height, so that the important question of the heights of the hills along the sight-line—a matter which is very important from an astronomical point of view, although it has been neglected, so far as I can make out, by many who have made observations on these ancient monuments—is quite a simple one at Stonehenge. Hence it was much easier to determine a date there than by working at any of the other ancient remains to which I have referred.

In orientation generally, such orientation as has been dealt with by Mr. Penrose and myself in Egypt and in Greece, the question frequently was a change in direction in the axis of a temple, or the laying down of the axis of a temple, by means of observations of stars. Unfortunately for us as archæologists, not as astronomers, the changes of position of these stars, owing to certain causes, chiefly the precessional movement, are very considerable; so that if a temple pointed to a star in one year, in two or three hundred years it would no longer point to the same star, but to another one.

Acting on a very old tradition, the people from Salisbury and other surrounding places go to observe the sunrise on the longest day of the year at Stonehenge. We therefore are perfectly justified in assuming that it was a solar temple used for observation in the height of midsummer. But at dawn in midsummer in these latitudes the sky is so bright that it is not easy to see stars even if we get up in the morning to look for them; stars, therefore, were not in question, so that some other principle had to be adopted, and that was to point the temple directly to the position on the horizon at which the sun rose on that particular day of the year, and no other.

Now, if there were no change in the position of the sun, that, of course, would go on for ever and ever; but, fortunately for archæologists, there is a slight change in the position of the sun, as there is in the case of a star, but for a different reason; the planes of the ecliptic and of the equator undergo a slight change in the angle included between them. So far as we know, that angle has been gradually getting less for many thousands of years, so that, in the case of Stonehenge, if we wish to determine the date, having no stars to help us, the only thing that we can hope to get any information from is the very slow change of this angle; that, therefore, was the special point which Mr. Penrose and I were anxious to study at Stonehenge, for the reason that we seemed in a position to do it there more conveniently than anywhere else in Britain.

But while the astronomical conditions are better at Stonehenge than elsewhere, the ruined state of the monument makes accurate measures very difficult.

Great age and the action of weather are responsible for much havoc, so that very many of the stones are now recumbent, as will be gathered from the accompanying plan, for which I am indebted to Mr. Lewis, who described the condition of the monument in 1901 in *Man*.

But the real destructive agent has been man himself; savages could not have played more havoc with the monument than the English who have visited it at different times for different purposes. It is said the fall of one great stone in 1620 was caused by some excavations of the then Duke of Buckingham; the fall of another in 1797 was caused by gipsies digging a hole in which to shelter, and boil their kettle; many of the stones have been used for building walls and bridges; masses weighing from 56 lb. downwards have been broken off by hammers or cracked off as a result of fires lighted by excursionists.

It appears that the temenos wall or vallum, which is shown complete in Hoare's plan of 1810, is now broken down in many places by vehicles indiscriminately driven over it. Indeed, its original importance has now become so obliterated that many do not notice it as part of the structure—that, in fact, it bears the same relation to the interior stone circle as the nave of St. Paul's does to the Lady Chapel.

It is within the knowledge of all interested in archæology that not long ago Sir Edmund Antrobus, the owner of Stonehenge, advised by the famous Wiltshire local society, the Society for the Protection of Ancient Buildings and the Society of Antiquaries, enclosed the monument in order to preserve it from further wanton destruction, and—a first step in the way of restoration—with the skilled assistance of Prof. Gowland and Messrs. Carruthers, Detmar Blow, and Stallybrass, set upright the most important menhir, which threatened to fall or else break off at one of the cracks. This menhir, the so-called "leaning stone," once formed one of the uprights of the trilithon the fall of the other member of which was said to have been caused by the digging and researches of the Duke of Buckingham in 1620. The latter, broken in two pieces, and the supported lintel, now lie prostrate across the altar stone.

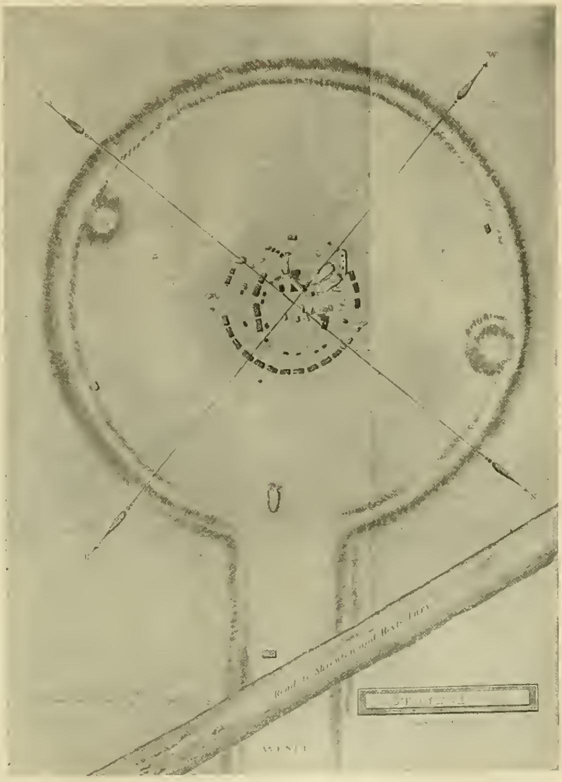


FIG. 3.—Copy of Hoare's plan of 1810, showing unbroken Vallum and its relation with the Avenue.

This piece of work was carried out with consummate skill and care, and most important conclusions, as we shall see in a subsequent "Note," were derived from the minute inquiry into the conditions revealed in the excavations which were necessary for the proper conduct of the work.

Let us hope that we have heard the last of the work of devastators, and even that, before long, some of the other larger stones, now inclined or prostrate, may be set upright.

Since Sir Edmund Antrobus, the present owner, has acted on the advice of the societies I have named to enclose the monument, with a view to guard it from destruction and desecration, he has been assailed on all sides. It is not a little surprising that the "unclimbable wire fence" recommended by the societies in question, the Bishop of Bristol being the president of the Wiltshire Society at the time, is by some regarded as a suggestion that the property is not national, the fact being that the nation has not bought the property, and that it has been private property for centuries, and treated in the way we have seen.

Let us hope also that before long the gaps in the vallum may be filled up. These, as I have already stated, take away from the meaning of an important part of one of the most imposing monuments of the world. In the meantime, it is comforting to know that, thanks to what Sir Edmund Antrobus has done, no more stones will be stolen, or broken by sledge-hammers; that fires; that excavations such as were apparently the prime cause of the disastrous fall of one of the majestic trilithons in 1797; that litter, broken bottles and the like, with which too many British sightseers mark their progress, besides much indecent desecration, are things of the past.

If Stonehenge had been built in Italy, or France or Germany, it would have been in charge of the State long ago.

I now pass from the monument itself to a reference to some of the traditions and historical statements concerning it.

Those who are interested in these matters should thank the Wiltshire Archæological and Natural History Society, which is to be warmly congratulated on its persistent and admirable efforts to do all in its power to enable the whole nation to learn about the venerable monuments of antiquity which it has practically taken under its scientific charge. It has published two most important volumes[1] dealing specially with Stonehenge, including both its traditions and history.

With regard to Mr. Long's memoir, it may be stated that it includes important extracts from notices of Stonehenge from the time of Henry of Huntingdon (12th century) to Hoare (1812), and that all extant information is given touching on the questions by whom the stones were erected, whence they came, and what was the object of the structure.

From Mr. Harrison's more recently published bibliography, no reference to Stonehenge by any ancient author, or any letter to the *Times* for the last twenty years dealing with any question touching the monuments, seems to be omitted.

It is very sad to read, both in Mr. Long's volume and the bibliography, of the devastation which has been allowed to go on for so many years and of the various forms it has taken.

As almost the whole of the notes which follow deal with the assumption of Stonehenge having been a solar temple, a short reference to the earliest statements concerning this view is desirable; and, again, as the approximate date arrived at by Mr. Penrose and myself in 1901 is an early one, a few words may be added indicating the presence in Britain at that time of a race of men capable of designing and executing such work. I quote from the paper communicated by Dr. Penrose and myself to the Royal Society:—

"As to the first point, Diodorus Siculus (ii., 47) has preserved a statement of Hecatæus in which Stonehenge alone can by any probability be referred to.

"We think that no one will consider it foreign to our subject to say a word respecting the Hyperboreans.

"Amongst the writers who have occupied themselves with the mythology of the ancients, Hecatæus and some others tell us that opposite the land of the Celts [ἐν τοῖς ἀντιπέραν τῆς Κελτικῆς τόποις] there exists in the Ocean an island not smaller than Sicily, and which, situated under the constellation of The Bear, is inhabited by the Hyperboreans; so called because they live beyond the point from which the North wind blows. . . . If one may believe the same mythology, Latona was born in this island, and for that reason the inhabitants honour Apollo more than any other deity. A sacred enclosure [νῆσον] is dedicated to him in the island, as well as a magnificent circular temple adorned with many rich offerings. . . . The Hyperboreans are in general very friendly to the Greeks.

"The Hecatæus above referred to was probably Hecatæus of Abdera, in Thrace, fourth century B.C.; a friend of Alexander the Great. This Hecatæus is said to have written a history of the Hyperboreans: that it was Hecatæus of Miletus, an historian of the sixth century B.C., is less likely.

"As to the second point, although we cannot go so far back in evidence of the power and civilisation of the Britons, there is an argument of some value to be drawn from the fine character of the coinage issued by British kings early in the second century B.C., and from the statement of Julius Cæsar ('De Bello Gallico,' vi., c. 13) that in the schools of the Druids the subjects taught included the movements of the stars, the size of the earth and the nature of things (Multa præterea de sideribus et eorum motu, de mundi magnitudine, de rerum natura, de deorum immortalium vi ac potestate disputant et juventuti tradunt).

"Studies of such a character seem quite consistent with, and to demand, a long antecedent period of civilisation."

Henry of Huntingdon is the first English writer to refer to Stonehenge, which he calls Stanenges. Geoffrey of Monmouth (1138) and Giraldus Cambrensis come next.

In spite of Inigo Jones's (1600) dictum that Stonehenge was of Roman origin, Stukeley came to the conclusion in 1723 that the Druids were responsible for its building, and Halley, who visited it in 1720—probably with Stukeley—concluded from the weathering of the stones that it was at least 3000 years old; if he only had taken his theodolite with him, how much his interest in the monument would have been increased!

Davies ("Celtic Researches," 1804) endorses Stukeley's view:—

"Amongst the pure descendants of the Celtae, the Druidism of Britain was in its highest repute. The principal seat of the order was found in Mona, an interior recess of that ancient race, which was born in the island. Into that sequestered scene, the Druids, who detested warfare, had gradually retired, after the irruption of the Belgae, and the further encroachment of the Romans. They had retired from their ancient magnificent seat at Abury, and from their *circular uncovered temple* on Salisbury Plain, in which the Hyperborean sages had once chaunted their hymns to Apollo and Plenyz."

NORMAN LOCKYER.

[1] "The Wiltshire Archæological and Natural History Magazine. Stonehenge and its Barrows." By William Long, M.A., F.S.A. (1876.)
"The Wiltshire Archæological and Natural History Magazine. Stonehenge Bibliography Number." By W. Jerome Harrison. (1902.)

PROF. ERNST ABBE.

FORTY YEARS' PROGRESS, 1866–1905.

ERNST ABBE, born January 23, 1840, was the son of a foreman in a spinning mill at Eisenach. He was a student at Jena and Göttingen, graduating at the latter university with a thesis on the mechanical equivalent of heat. After teaching for some time at Frankfort-on-Main, he established himself at Jena in 1863 as a privat docent in mathematics, physics, and astronomy, taking for a special subject of instruction the theory of errors. In 1870 he was appointed an extraordinary professor. In 1874 there was a proposal to establish a physical laboratory at Jena, and Abbe was offered the professorship of physics, but his connection with Carl Zeiss had then begun, and he was compelled to decline the offer. He had married in 1871 the daughter of Prof. Snell, and has left two daughters.

Carl Zeiss had established himself at Jena in 1846 as a manufacturer of optical instruments; for some years the business prospered, his microscopes were as good as those of other makers, probably neither better nor worse; but Zeiss was not satisfied; he felt that the microscope ought to be improved, and in endeavouring to effect improvement he realised the deficiency of his own equipment; after one other unsuccessful attempt he enlisted Abbe's help in his work.

The partnership which has had so remarkable an effect on the manufacture of optical instruments began in 1866. Abbe's task was a hard one; the theory of the microscope was at that date only partially understood; the corrections to the lenses were made by a rough trial and error method, and the results were doubtful; the first step was to solve a mathematical problem of no small difficulty, and trace the path of the light through the complex lenses of a microscope objective.

Abbe soon found out the defects of the ordinary theory, and was led in 1870 to what is now known as the Abbe theory of microscopic vision; unfortunately, no complete account of that theory from his own pen has yet been printed, though the "Collected Papers of Ernst Abbe," of which the first volume was published last year under the skilful editorship of Dr. Czapski, and noticed in these pages recently (NATURE, vol. lxix. p. 497), go far to fill the gap, and it is to be hoped that Dr. Czapski himself or some other member of the Jena staff will now be in a position to give the complete theory to the world. It is not necessary here to discuss the controversy which has arisen over the matter, due in great measure to an incomplete representation of the problem and to a misconception of the theory.

It is clear that if we can treat the object as self-luminous, or if we know the distribution of light with respect to both intensity and phase over the object plane, then we may start from the object as our source, and the principles of the wave-theory, as Lord Rayleigh has shown, will allow us to determine the distribution in the view plane. If, however, the distribution in the object plane is unknown, we must go back to the source, consider how the light from the source is modified both by the object and the lenses, and from this infer what the resulting image will be like.

Diffraction patterns will be formed practically in the second focal plane of the object glass, and the distribution of the light in the image can, theoretically at any rate, be deduced from a knowledge of the intensity and phase of the disturbance in these patterns.

This theory, at any rate, led Abbe to most valuable results, and was one source of the success of the Zeiss microscope. From it, among other consequences, he deduced the importance of what is now known as the numerical aperture, the quantity $\mu \sin \alpha$, where μ is the refractive index of the first lens of the object glass, and 2α is the angle which that lens subtends at the point where the axis of the system cuts the object plane.

But the assistance given by the new theory was not alone sufficient to solve the problem. It had long been known that when the best glasses then obtainable were combined to form an achromatic system, a secondary spectrum remained, and until this could be removed it was hopeless to look for perfection in the image.

The experiments of Stokes and Harcourt had been directed to the discovery of glasses free from this defect, and Abbe and Zeiss in their early days made many attempts in the same direction, using in some cases liquid lenses to secure the desired end.

In 1876 the South Kensington Loan Exhibition of Scientific Apparatus took place, and Abbe came over to inspect it. In his report, published in 1878, he writes:—"The future of the microscope as regards further improvement in its dioptric qualities seems to lie chiefly in the hands of the glass maker," and then he explains in what direction changes are required and how difficult it is to introduce them.

This report of Abbe's fell into the hands of Dr. Otto Schott, a glass maker of Witten, in Westphalia. Schott communicated with Abbe in 1881, and commenced his investigations into the subject. Next year he removed to Jena, and, aided by a large grant from the Prussian Minister of Education, the experiments were satisfactorily concluded, and the firm of Schott and Co. was established; in 1884 he was in a position to commence the wholesale production of optical glass. The combination was now complete. "To-day it is difficult," as Prof. Auerbach writes in his recent work on the Carl Zeiss Stiftung in Jena, "to think of the Optical Works without the Glass Works, or *vice versâ*."

From this time onwards Abbe's time was fully occupied in developing the new undertaking; the history of his life would be the history of the works, and in the Zeiss instruments, known throughout the world, his monument is to be found.

But in many ways the latter years of his life are not the least interesting. Carl Zeiss died in 1888; next year his son Roderick retired from business, and Abbe was left sole proprietor of the optical works. In 1891 he created a kind of trust known as the Carl Zeiss Stiftung, to which he ceded all his proprietary rights, both in the optical and also in the glass works.

The story of the Carl Zeiss Stiftung as told by Prof. Auerbach is a very striking one. The statutes, due to Abbe himself, which were confirmed by the Grand Duke of Saxony in 1896, and have the force of law, can up to 1906 be modified by a simple procedure; afterwards legal action is practically required to render a change valid.

The works are a great cooperative concern. "To provide a large number of people with the most favourable opportunities for labour is both the means and the end of the Stiftung. The individuals who benefit by it are at the same time those who maintain and increase it. The officials and workmen employed at the optical works, the community and the university contribute their share towards the increase of the value of the property, and these, therefore, are entitled to participate in the benefits." The university alone will shortly have received 100,000*l.* from the scheme.

The Stiftung is managed by the Stiftung Administration; on this the Saxon Government appoints a representative or trustee whose duty it is to see that the statutes are obeyed; the works are supervised by boards of management appointed by the administration.

The employés possess the right of combination; they can be represented by their own committees, which may address the administration direct on any subject relating to the affairs of the concern. They are paid by piece-work, with a minimum time wage, and there is in the scheme a proviso by which no one, even though a member of the board of management, can receive a salary greater than ten times the average yearly earnings of workers of twenty-four years and over who have been at least three years with the firm. Moreover, when an employé has once received a certain wage and drawn it for one year his wage cannot be reduced because of slackness of trade. In addition to the wages calculated on the work done, every worker receives a share of the profits depending in any year on the net sum realised. There is also a liberal pension scheme, under which every employé who enters the works before his fortieth year is entitled, after five years' service, to a pension calculated at a rate which reaches 75 per cent. of his salary at the end of forty years' service, while the widows and orphans of employés have also pension rights. Finally, the working day is eight hours, and Abbe has put it on record in an address, delivered in 1901 to the Social Science Association, that in the case of 233 piece-workers about whom accurate statistics could be taken the total output was increased by 4 per cent. in the first year that followed the change from nine to eight hours.

Such has been Ernst Abbe's work; until 1903 he remained an active member of the board of management of the optical works; then he retired, partly on account of the state of his health, partly, if his health improved, to devote himself to his scientific work. The improvement hoped for never came, and he died last week, leaving it to the trained band of workers he had gathered round him to continue his task, and to show still further what can be done by the organised application of science to industry and manufactures.

R. T. G.

M. PAUL HENRI.

ABOUT the year 1864, two brothers entered the meteorological department of the Paris Observatory, and for nearly forty years laboured with zeal and success to promote the best interests of that institution and of astronomical science generally. In the autumn of 1903, one brother, M. Prosper Henri, died suddenly on a holiday tour, and we now have the melancholy duty of chronicling the death of the second brother, M. Paul Henri. It is necessary to recall the close and intimate relations that existed between these two, because the scientific life of one was that of the other. No one has ever thought of them separately, no one has ever attempted to discriminate between their successes and their triumphs. The same day (November 8, 1889) they were both elected associates of the Royal Astronomical Society, and other instances of similar recognition of their united work might be quoted. We may quote the words of the late M. Callandreau of these two:—"si unis que nous ne voyons souvent en eux qu' une seule personne pour ainsi dire, si oublieux de faire ressortir leur mérites respectifs qu' il est difficile de distinguer ce qui peut appartenir à chacun dans l'œuvre commune."

It is an oft-told tale to recall how these brothers, with whom mechanical art was a conspicuous gift, constructed their own instruments, and laboured to complete the ecliptic charts on which Chacornac had worked, how their systematic work and diligence added to the number of small planets, and how, finally, the necessity was forced upon them of adopting improved methods in registering the places of stars in the crowded regions of the heavens. The history of the "International Chart of the Heavens," which has taxed the resources of so many observatories, was the outcome of their skill and resource. Not only did they provide the optical parts of the instruments that were employed in many observatories, but they laboured zealously on the zone allotted to the Paris Observatory, and it is believed brought their share to a successful issue. They led the way in the photographic examination of clusters like the Pleiades, and showed to others how unsuspected nebulæ might be detected.

A new era of activity opened for astronomy in the general application of photography, and few have contributed more to the harvest of results that has followed that activity than have the brothers Henri. They not only supplied the instruments with which the negatives were taken, but they suggested devices for the construction of measuring machines by which these negatives could be discussed. The reputation of one and both rests on their photographic work. Smaller work, such as the careful and accurate delineation of planetary markings, the observation of minute satellites, and the more ordinary routine of observatory work, are all forgotten in the large share taken in the application of photography to celestial measurement. His colleagues in the observatory spoke of the many excellent qualities that distinguished M. Prosper Henri as a colleague and friend, and one is sure that no less kindly expressions will be used towards M. Paul Henri, who has enjoyed the confidence and respect of all the directors of the Paris Observatory who have followed M. Le Verrier.

W. E. P.

NOTES.

THE cross of officer of the Legion of Honour has been conferred, *La Nature* states, upon Dr. Otto Nordenskjöld for his South Polar explorations. Mrs. Bullock Workman has been appointed Officier de l'Instruction publique for her travels in the Himalayas.

THE autumn meeting of the Iron and Steel Institute is to be held this year in Sheffield for the first time. Mr. R. A. Hadfield has been elected to succeed Mr. Andrew Carnegie as president of the institute. The visit will take place during the week beginning September 25. The most influential members of the Sheffield steel industry have associated themselves with the invitation to the institute, and a committee has been formed, of which the Lord Mayor of Sheffield and the Master Cutler are chairman and vice-chairman respectively. Colonel H. Hughes, C.M.G., has been appointed chairman of the reception committee, with Mr. J. Rossiter Hoyle as honorary secretary. Mr. Frank Huntsman—who is, we learn from the *Times*, a descendant of the Huntsman who founded the Sheffield industry of melting steel in pots about 170 years ago—will act as honorary treasurer, and Mr. John Wortley as honorary assistant secretary.

ON Thursday next, February 2, Prof. W. Schlich will deliver the first of a course of two lectures at the Royal Institution on "Forestry in the British Empire." The discourse on Friday, February 3, will be delivered by Prof. T. Clifford Allbutt on "Blood Pressure in Man."

The International Congress of Psychology will meet this year at Rome on April 26–30. We learn from the *British Medical Journal* that there will be four sections. The section of experimental psychology, the president of which is Prof. G. Fano, of Florence, will deal with psychology in its relations to anatomy and physiology, psycho-physics, and comparative psychology. That of introspective psychology will, under the presidency of Prof. R. Ardigo, of Padua, devote itself to psychology in its relations to philosophical sciences. The section of pathological psychology, the president of which is Prof. E. Morselli, of Genoa, will discuss hypnotism, suggestion, and analogous phenomena, and psycho-therapeutics. The programme of the section of criminal, pædagogic, and social psychology, which is under the presidency of Prof. Lombroso, of Turin, has not yet been published. The president of the congress is Prof. Giuseppe Sergi, of Rome; the general secretary, Dr. Sante de Sanctis, to whom all communications relative to the meeting should be addressed at the Istituto Fisiologico, 92 Via Depretis, Rome.

We are informed that Dr. Carl Otto Weber, the well known chemical authority on india-rubber, died suddenly on January 14 at his residence in Massachusetts, U.S.A.

On November 16 last the University of Lehigh was bereaved of its president, Dr. Thomas Messinger Drown, and a brief obituary notice is contained in the *Popular Science Monthly* for January. Dr. Drown was born on March 19, 1842, at Philadelphia, and he graduated in medicine at Pennsylvania, subsequently studying chemistry in Germany and America. He held the chair of chemistry at Lafayette College for seven years, and at the Massachusetts Institute of Technology for seven years. He was secretary and editor of the American Institution of Mining Engineers for ten years from its foundation, and was elected president in 1897. His researches in quantitative analysis were devoted in the first place to devising standard methods in the analyses of iron and steel, and in the second place to water analysis, especially in connection with the natural waters of the State of Massachusetts, and the distribution of normal chlorine. He was elected president of Lehigh University in 1895, at a time when that institution's influence was at a low ebb, and since his appointment the efficiency of the college has developed in many important directions.

Reuter's Agency has been informed by the Pacific Cable Board that by an arrangement between the Washington and Sydney Observatories, with the cooperation of the telegraph administrations concerned, time signals were sent on New Year's Eve from the Washington Observatory to the Sydney Observatory at 3h., 4h., 5h., and 6h. The mean interval between the times when these signals were sent and when they were received was 2·90s. The distance separating Sydney and Washington is more than 12,000 miles. The signals through the Vancouver-Fanning cable, the longest cable span in the world (3457·76 nautical miles), were sent by automatic apparatus, and were recorded, as they passed, at the Vancouver station on an instrument placed in the artificial line which balances the cable for the purpose of duplex working. The signals consisted of second contacts, omitting the thirtieth and last five of each minute, except the last minute of the hour, when the thirtieth and all after the fiftieth second were omitted, the circuit closing with a long dash on the even hour. The signals were sent for five minutes before the hour from 3 p.m. to 6 p.m., Sydney time; equivalent to midnight to 3 a.m. Washington time.

Writing from Amsterdam, Dr. C. M. van Deventer desires to direct attention to an interesting fact observed by a schoolboy. Two years ago, during a lesson in physics given at the high school at Batavia, one of the boys, called Van Erpecum, told Dr. Deventer, as an observation of his own, that the water in a glass, filled to the brim with water and floating ice, does not flow over when the ice melts. The observation was communicated to Profs. Van der Waals and Zeeman, who judged it worthy of being the subject of a note presented by them to the Royal Academy of Amsterdam. Dr. Deventer says that the observation of his pupil tells only the half of the phenomenon—the truth being that the water neither rises nor sinks. He therefore states the proposition that "In a vessel containing water and floating ice, the level stays at the same height when the ice melts." Or, speaking more generally, "When a vessel contains a solid floating in its own liquid, the level of the latter does not change by the melting of the solid." This proposition Dr. Deventer proposes to call the "law of the permanent level." The law can be deduced from Archimedes's principle; but it is only rigorously exact when the weight of the air is neglected.

At the meeting of the Society of Antiquaries on January 19 Mr. A. J. Evans communicated an account of the tombs of Minoan Knossos. Mr. Evans's last season's work at Knossos was devoted largely to the search for the tombs in relation with the Minoan palace and city. On a hill about a mile north of the palace a cemetery was discovered. One hundred tombs were opened, and the contents showed that the bulk of them belonged to the period immediately succeeding the fall of the palace. The character of the art displayed by the relics found showed the unbroken tradition of the later palace style. The jewelry and gems discovered were of the typical "mature Mycenæan" class, and a scarab found in one of the graves is of a late eighteenth dynasty type. The tombs were of three main classes:—(*a*) Chamber tombs cut in the soft rock and approached in each case by a *dromos*; in many cases these contained clay coffins, in which the dead had been deposited in cists, their knees drawn towards the chin. (*b*) Shaft graves, each with a lesser cavity below, containing the extended skeleton, and with a roofing of stone slabs. (*c*) Pits giving access to a walled cavity in the side below; these also contained extended skeletons. A number of skulls have been secured, and are to be sent to England. On a high level called Sopata, about two miles north again of this cemetery, an important sepulchral monument was discovered. This consisted of a square chamber, about eight by six metres, constructed of limestone blocks, and with the side walls arching in "Cyclopean" fashion towards a high gable. The back wall was provided with a central cell opposite the blocked entrance. This entrance, arched on the same horizontal principle, communicated with a lofty entrance hall of similar construction, in the side walls of which, facing each other, were two cells that had been used for sepulchral purposes. A second blocked archway led from this hall to the imposing rock-cut *dromos*. A number of relics were found scattered about, including repeated clay impressions of what may have been a royal seal. Specially remarkable among the stone vessels is a porphyry bowl of Minoan workmanship, but recalling in material and execution that of the early Egyptian dynasties. Many imported Egyptian alabastra were also found, showing the survival of middle empire forms besides others of early eighteenth dynasty type. Beads of lapis lazuli were also found, and pendants of the same material, showing a close imitation of Egyptian models. The form of this mausoleum, with its square chamber, is unique, and contrasts with that of the tholos tombs of mainland Greece. The position in which it lies commands the whole south Ægean to Melos and Santorin, and Central Crete from Dicta to Ida.

WE have to welcome an addition to the already lengthy list of American biological serials in the form of a *Bulletin* issued by the Springfield (Mass.) Museum of Natural History, of which the first number is in our hands. This is devoted to the description of the early stages in the development of the ground-beetles of the family Carabidæ, as exemplified by a member of the genus Dicælus, in which the larva is of the ordinary predaceous type, and one of Brachinus, in which the larva is parasitic and degenerate. Of the adult beetles, the more specialised seems to be Brachinus. The authors of the paper are Messrs. Dimmock and Knab.

THE Albany Museum, according to the report for the first half of 1904, continues to make steady progress, and it is satisfactory to learn that arrangements are under consideration both for augmenting the staff and for increasing the size of the building. An important part of the museum's work is the investigation of the life-history of insects injurious to agriculture and horticulture, and the discovery of the best means of checking their ravages. For this purpose a piece of ground adjoining the museum has been enclosed, and it is hoped that funds will shortly be forthcoming for erecting in this enclosure an insect-house, without the aid of which the work can be carried on only with difficulty.

THE *Field Naturalists' Quarterly* for December, 1904, strikes us as being an unusually excellent number. It includes, in the first place, the second of the series of plates illustrating the development of the frog. Later on we have the first instalment of a set of articles by the editor (Dr. G. Leighton) explaining modern investigations on heredity in a manner calculated to bring home the fundamental truths of this complex subject to every intelligent reader, the development of the germ-plasm being the text of this contribution. In a preliminary note the editor expresses the hope that his articles will induce many persons who reside in the country to take up the practical investigation of some form of heredity for themselves. A third article to which we may direct attention is one by Mr. H. E. Forrest in which simple methods of distinguishing the various species of British bats are formulated. We notice that the author adheres to the old-fashioned nomenclature for the members of this group.

WE have received the January number of *Climate*, which contains an illustrated description of the Japanese soldier's outfit, and articles on blackwater fever, water and its connection with disease, the drinking habits of native races, climate and health in hot countries, &c. The medical articles are semi-popular in character, and should be useful to missionaries and others stationed in districts remote from medical aid.

THE *Journal* of the Royal Sanitary Institute (vol. xxv., part iii.) forms a bulky volume of some 600 pages. It contains a number of interesting and important papers and discussions thereon contributed to the congress of the institute at Glasgow last year. They are on such varied subjects as disinfection in phthisis (Prof. Kenwood and Dr. Allan), prevention of diphtheria (Dr. Cobbett), sewage disposal, school hygiene and ventilation, conditions of housing, &c.

THE December (1904) number of the Johns Hopkins Hospital *Bulletin* (vol. xv., No. 165) contains an account of the opening of the new surgical building and clinical amphitheatre of the Johns Hopkins Hospital, a description of a new chromogenic bacillus, *B. cyaneum*, and various papers of medical interest. In the new buildings a tablet has been erected to the memory of Dr. Jesse Lazear, who died from an attack of yellow fever while investigating that disease in Cuba.

IT is proposed to add to Reichenbach's "Icones Floræ Germanicæ et Helveticæ" a number of extra volumes containing monographs of critical genera. The publishers, Messrs. von Zezschwitz, of Gera, announce the immediate issue of the first of these, in which the genus Hieracium is treated by Dr. J. Murr and Mr. H. Zahn.

THE cultivation of mushrooms is not such an important business in the United States of America as in Great Britain and France. With the view of extending and improving the trade, Prof. B. M. Duggar has written a pamphlet on the subject, which has been issued by the U.S. Department of Agriculture as a *Farmers' Bulletin*. The preparation of English brick spawn and French flake spawn is dependent upon the haphazard collection of what is known as "virgin spawn" in the open. Prof. Duggar has for some time attempted to discover the conditions which are necessary for the germination of mushroom spores. He has already succeeded in germinating spores in pure cultures by means of chemical stimulation, and hopes shortly to make the process more practical. This will enable the grower to produce a definite strain, and if necessary to obtain improved varieties by selection.

THE *Ani-i-Akbari*, or annals of the Emperor Akbar, written in the Persian language, contain descriptions of various customs which prevailed during the Moghul period. Amongst these was the use of perfumes in religious observances, and the emperor took a personal interest in the preparation of the ingredients. A short summary of the principal substances and their sources is contributed by Mr. D. Hooper to the October (1904) number of the *Calcutta Review*. Among vegetable products, *Aquilaria agallocha*, aloe-wood, was then as now valued for the oleo-resin agar, and an oil known as chuwah; sandalwood was used as a powder, and perfumes were distilled from the rose, orange, jasmine, and broad-leaved willow, *Salix caprea*. Ambergris obtained from the sperm whale, the moist secretion of the civet cat, and the opercula of certain molluscs, known as "fingernails," were important animal products.

PAMPHLET series No. 32, issued by the Imperial Department of Agriculture for the West Indies, gives a summary of the results on the cultivation of seedling and other canes at the Barbados experiment stations in 1904. As in previous years the investigation has been conducted by Prof. d'Albuquerque and Mr. Bovell. Sixteen sugar estates in typical localities were selected, thirteen on black soils and three on red soils. The seedlings were treated in precisely the same manner as the ordinary canes. The season was favourable, there was very little root disease, and the crop consequently was above the average. Cane B 208 again gave uniformly good results, both as plant canes and ratoons, and it is recommended for a general trial on a field scale in all red soil districts. A newer cane, B 1529, however, takes the first place in the black soil list, coming out second to B 208 in the red soil list. Its cultivation will consequently be extended to as many experimental plots as possible. Cane B 147, at one time considered the most promising of the seedling varieties, did not give such good results as in previous years, but it appears to be cultivated with some success in the rather light soils in the parish of St. Philip.

THE Barbados *Official Gazette* of December 19, 1904, contains some correspondence relating to Cassava poisoning. Mr. Briggs, one of the district coroners, noted to the Colonial Secretary that witnesses in inquest cases frequently assert that if roasting and poison cassava grow closely side by side, the roasting cassava takes up some of the poison from the poison cassava; also that the roasting cassava gets a "spring in it," and that makes it poisonous. The Colonial Secretary submitted the note to Sir Daniel Morris, who replied that (1) "there can be no direct connection between the two plants, and it is impossible that the poison can pass through the soil from the poisonous cassava to the sweet," and (2) "if by the 'spring in it' is meant that the plant starts into second growth after heavy rain, it is probable that certain changes may take place inducing an increase of the poisonous quality." What probably happens when persons die from eating sweet or roasting cassava is that it is either too old or it has not been sufficiently cooked to drive out all the acid. It is only really wholesome when the roots are not too old, and when they have been cooked until they are quite soft. If the centre is hard it is probably more or less poisonous, and should not be eaten. Even properly cooked cassava which has been allowed to become cold is not fit to eat unless it is cooked a second time.

BECKELITE, a new mineral species named in honour of Prof. F. Becke, of Vienna, is described by Prof. J. Morozewicz in the December (1904) *Bulletin* of the Cracow Academy of Sciences. It occurs as an accessory constituent of a dyke-rock composed of albite, nephelite, ægirite, and magnetite in the elæolite-syenite complex near Mariupol, on the Sea of Azov. The wax-yellow octahedral or rhombic-dodecahedral crystals resemble pyrochlore in general appearance and physical characters, though the somewhat indistinct cleavage is cubic instead of octahedral. Chemically, however, the new mineral is quite distinct from pyrochlore, containing 17·13 per cent. of silica and 65·31 per cent. of rare earths, with no niobium or tantalum. The formula is $Ca_3(Ce,La,Di)_4Si_3O_{15}$, which presents a certain resemblance to the garnet formula with rare earths in place of alumina. From analogy to calcium "alumosilicate," the new mineral is described as a calcium cero-lanthano-didymo-silicate.

FOR the twenty-second time, the climatological records of the British Empire are summarised in the current number of *Symons's Meteorological Magazine*, viz. for the year 1903. The stations number twenty-five, but, as the editor points out, it is impossible to represent the average conditions of the climate of the Empire by so small a number of stations, however well distributed. Adelaide, which has almost constantly held the first place in the summary for extreme maximum temperature, now, as in 1902, gives way to Coolgardie, in Western Australia, where the shade temperature reached 113°·4 on January 27; the lowest shade temperature was −60°·8 at Dawson on January 26. Dawson had also the greatest yearly range (150°·3). The greatest mean daily range was 23°·5 at Winnipeg, and the least 8°·5 at Hong Kong. London had the highest relative humidity (82 per cent.) and Adelaide the lowest (62 per cent.). The greatest rainfall, 93·67 inches, was recorded at Hong Kong, and the least, 10·74 inches, at Dawson. We may mention, incidentally, that the present number of the magazine is the largest since its foundation in 1866; we hope to refer shortly to another of the interesting articles that it contains.

WE have received the *Journals* of the Meteorological Society of Japan for October and November last. They contain (as we see from the English titles) several interesting articles in Japanese. There is also one in English, on the duration of rainfall, by T. Okada. The object of the author is to show that Dr. Köppen's formula for the calculation of the probable duration of rainfall in a month, or any interval of time, from three or six observations daily, holds good for all climates. The calculation is very simple, and the formula in question, $(r/n)N$, is contained in an article by Dr. Köppen in the Austrian *Meteorologische Zeitschrift* for 1880; n is the total number of observations, r that of observations with rainfall, and N the total number of hours in a month (or other period). The author shows that the duration of rainfall, computed from tri-daily observations, does not differ materially from that computed from hourly observations—in the annual mean at most 4 per cent., and in the monthly mean 18 per cent. In the majority of cases the differences are much less; the method gives more approximate results than an ordinary self-recording rain-gauge, owing to the usual want of sensibility of such instruments.

IN the *Zeitschrift für physikalischen und chemischen Unterricht*, xvii., 5, Mr. Walter Stahlberg, of Steglitz, gives an account of the Zeiss "Verant" by which photographs are made to stand out in natural relief with monocular vision. The apparatus can hardly be correctly described as a stereoscope, since one of the most important features of the stereoscope depending on binocular vision is absent. The Verant is a single lens, the focal length of which should be equal to that of the camera used in taking the photographs, and this lens is convexo-concave, so that the axes of the pencils from different parts of the picture meet in the eye. From Mr. Stahlberg's account, we think the principle of the Verant may be roughly explained by the following illustration:—When a photograph of cloisters is taken from one corner in the interior the photograph gives the impression that the two colonnades meet at a very acute angle instead of at right angles. If the picture were seen through the Verant the angles would appear correct as they would to a person standing in the cloisters themselves. The now old-fashioned graphoscope appears to have had a somewhat similar purpose.

Two papers which are of importance in the study of superfusion phenomena are published by Drs. Tullio Gnesotto and Gino Zanetti in the *Atti* of the Royal Venetian Institute (1903, vol. lxii., p. 1377). By means of a modified ice calorimeter, the variation of the specific heat of superfused liquid sodium thiosulphate at temperatures between 0° C. and the melting point of the salt, 48°·8 C., was determined, the observations being also extended above this temperature up to 100° C. On calculating the specific heat at all temperatures within this range, it is seen that in the neighbourhood of the melting point a sudden diminution in its value occurs, but that slightly above this temperature the specific heat again increases, so that the curve resumes the same direction that it had below the melting point. The latent heat of fusion of the salt at 0° C. was also determined.

A VALUABLE paper on the properties of chrome-vanadium steels was read before the Institution of Mechanical Engineers on December 16, 1904, by Captain Riall Sankey and Mr. J. Kent Smith. These steels appear to be most valuable from their power of resisting rapid alternations of stress and sudden shock, especially after they have been subjected to special thermal treatment. The temperature of their recalescence is at about 715° C., and the effect of quenching in oil from 900° C. and subsequently reheating at 600° C. is to increase enormously the resistance of the alloy to shock, as measured by an impact test, and to alternations of stress, without affecting the tensile strength. A spring of chrome-vanadium steel which was prepared was found to have double the strength of an ordinary steel spring of the same dimensions, the extension being directly proportional to the load throughout a very much wider range. Like the nickel steels, those which contain vanadium and chromium are very efficient in withstanding bending tests.

MESSRS. DAWBARN AND WARD, LTD., have added a booklet, "How to Read a Workshop Drawing," by Mr. W. Longland, to their "Home-Worker's" series of practical handbooks.

A THIRD edition of Mr. M. M. Pattison Muir's translation of Prof. Lassar-Cohn's "Chemistry in Daily Life" has been published by Messrs. H. Grevel and Co. The book has been revised and enlarged.

A TEACHERS' edition of part ii. of "Elementary Algebra," by Messrs. W. M. Baker and A. A. Bourne, has been published by Messrs. George Bell and Sons. Teachers are likely to find the plan of printing the answers on the page opposite to the examples a convenience in class work.

THE Engineering Standards Committee has just issued the "British Standard Specification for Portland Cement." The specification deals with the quality and preparation of the cement, gives particulars as to sampling and preparation for testing and analysis, and goes on to enumerate what should be its fineness, specific gravity, chemical composition, &c. The specification also considers at length the various tests which a satisfactory cement should pass. Copies of the publication may be obtained from Messrs. Crosby Lockwood and Son, price 2*s*. 6*d*. net.

THE 1905 issue of "Hazell's Annual" has now been published. Twelve pages are devoted to scientific progress during 1904, and about five to scientific societies and institutions. Education in the United Kingdom in all its branches is given some fourteen pages.

OUR ASTRONOMICAL COLUMN.

THE REPORTED SIXTH SATELLITE OF JUPITER.—A telegram from the Kiel Centralstelle gives the position of a minor planet, P.V., photographed by Prof. Wolf on January 23·135 at the Konigstuhl Observatory, at 7h. 8·8m. (Konigstuhl M.T.), as

R.A. = 1h. 31m. 59s., dec. = +8° 36′ 13″.

The daily movement of this object is +23′ in R.A. and −9′ in declination, and it is suggested that the body may possibly be identical with the object announced by Prof. Perrine as a sixth satellite to Jupiter.

PERIODICAL COMETS DUE TO RETURN IN 1905.—In the January *Observatory* Mr. W. T. Lynn directs attention to the periodical comets which are due to return to perihelion this year. There are only two, of which the first, Encke's, has already been seen, and passed through perihelion on January 4. The second is that discovered by Prof. Max Wolf on September 17, 1884 (comet iii., 1884), which has a period, variously estimated, of about 6·76 years. This object returned as comet ii., 1891, and comet iv., 1898, its perihelion being passed during the latter return on July 4, although its nearest approach to the earth did not take place until the end of November. Accordingly it should again pass through perihelion early in April next.

CHANGES ON THE SURFACE OF JUPITER.—An interesting popular exposition of the knowledge acquired during the past twenty-five years concerning the conditions of, and the changes on, the visible surface of Jupiter is given by Prof. G. W. Hough in No. 1, vol. xiii., of *Popular Astronomy*.

Prof. Hough's own observations of Jupiter have extended over twenty-five years, and the present article summarises them and the conclusions to which they have led him. He particularly refers to the determined values for the rotation periods at different latitudes, and sees no evidence for the existence of any law connecting the two, giving diagrams which illustrate the point. Two other diagrams show the variations in the latitude and the rotation period of the great red spot from 1879 to 1903, whilst yet another illustrates the changes in the position and width of the equatorial belt during the period 1895–1904. From the latter diagram it is seen, very clearly, that the changes in the northern part of the belt are much more sudden and of a greater magnitude than those which take place in the southern portion.

STARS HAVING PECULIAR SPECTRA.—During the examination of the Henry Draper memorial plates, Mrs. Fleming has discovered some additional stars which are either variable or have peculiar spectra. Thirty-one of these are announced and briefly described in No. 92 of the Harvard College Observatory *Circulars*. Of those having peculiar spectra a few are worthy of special notice. For instance, λ Cephei (mag. 5·6) was found to have a spectrum identical with that of ζ Puppis, which hitherto has been regarded as unique. The stars D.M. −11° 1460 (Monoceros) and +64° 1527 (Cepheus), amongst others, show a bright Hβ line. In the former the other hydrogen and the helium lines are double, whilst in the latter they are single but broad. The spectrum of D.M. +39° 4368 (R.A. = 20h. 51·6m., dec. = +39° 55′, mag. = 7·2), as photographed on September 15, 1904, was continuous, showing no trace of lines, although the lines in the spectra of neighbouring stars were sharply defined; on other plates the hydrogen lines show faintly, although the spectrum was not so well defined.

REAL PATHS, HEIGHTS, AND VELOCITIES OF LEONIDS.—From the observational data submitted to him by various observers, Mr. Denning has computed the real paths, heights above the earth's surface, and velocities of several Leonids seen during the last shower. From three observations of the brightest meteor seen at Greenwich, at 16h. 24m. 42s., November 16, 1904, he finds that the height of this object was from 88 to 44 miles along a path extending not more than 60 miles from near Petersfield to Hungerford. The velocity was about 46 miles per second, and the radiant point was 151° + 22°.

A second meteor recorded by two observers was seen at Greenwich, at November 14d. 10h. 26m., and at Enniscorthy (Ireland), 280 miles away. This had a long horizontal flight from over the neighbourhood of Sheffield to near Carmarthen, and was 83 to 78 miles high, the velocity being about 40 miles per second. Another meteor travelled at a height of 79 to 58 miles from over Faringdon to Stroud, its visible path being 35 miles long and its velocity 39 miles per second (*Observatory*, January).

NEW METHOD FOR MEASURING RADIAL-VELOCITY SPECTROGRAMS.—At a meeting of the International Congress of Arts and Sciences held at St. Louis in September, 1904, Prof. J. Hartmann, of Potsdam, gave a brief outline of a new method whereby he proposes to reduce considerably the labour involved in measuring the displacements of lines in stellar spectra for the purpose of determining the radial velocities of the stars. Hitherto it has been customary to measure the displacement of each line separately, and subsequently to reduce the individual measures; but in Prof. Hartmann's new method the displacement of the whole of the lines in the star spectrum would be measured simultaneously. He proposes to photograph the spectrum of the star, with the terrestrial comparison spectrum alongside it, as usual, and then to photograph the solar spectrum and the same comparison with the same instrument. The two negatives are then placed in a specially devised measuring machine, and the solar plate moved by the micrometer screw until the similar lines in both the solar and the stellar spectra coincide. Then the solar plate is again moved by the screw until the lines in the comparison spectrum on it coincide with the analogous lines in the comparison spectrum on the stellar spectrogram. The difference between the two settings gives the displacement of the stellar lines, from which the radial velocity is computed. In the reduction, which is simple, the only assumption made is that the lines have the same wave-lengths in the solar and the stellar spectra, and this is permissible, at least with second-type stars for which the method was primarily devised (*Astrophysical Journal*, vol. xx., No. 5).

MEDICAL RESEARCH IN EGYPT.[1]

AN interval of three years has elapsed since the first volume of these "Records" was published. The present series of papers would alone afford abundant evidence of the activity of the members of the staff in the intervening period. But it is still more satisfactory to recollect that this does not represent the total output of research, for many other memoirs from the same source have already appeared elsewhere. There are evidently many problems of both local and general importance which require investigation, and the standard of excellence reached in the "Records" already published arouses a desire that succeeding volumes should appear more frequently.

The papers are naturally chiefly concerned with problems of special local importance. The three scourges of Egypt are said to be the malarial parasite, Ankylostoma and Bilharzia. The last seems to bring an extraordinary number of cases under the care of the surgical staff, some 16 per cent. of all surgical in-patients suffering directly from lesions produced by this parasite. From the pathological report by Dr. Symmers, it would appear that about 7 per cent. of the deaths are directly due to Bilharzia. In 100 consecutive admissions to the medical wards, 35 were found to have the eggs in their urine, though only two of these were suffering in any way from the infection. The surgical aspects of the disease are discussed in two interesting papers by Mr. Madden and Mr. Milton; they find that many pathological conditions turn out most unexpectedly to be due to the worm. At one period of life or another practically the whole of the native population is said to be infected. Unfortunately, no material progress has been made in elucidating the extra-corporeal history of the parasite; it is therefore impossible to take any direct preventive measures.

Dr. Phillips contributes an article on the relation of ascites to malaria. In at least one-third of the cases of ascites in Kasr-el-Ainy no cause could be found other than malaria, but the ætiological connection is not very clearly established. A definite malarial cirrhosis occurs in a certain number of the cases, but it is not always present, and the conditions found appear to be very variable.

Of ankylostomiasis there is nothing in this volume beyond incidental mention. But, as is well known, the most important recent contributions to our knowledge of this destructive world-disease have come from the Cairo Medical School. Dr. Looss, in a long series of papers, has most ably carried on the investigations begun by Griesinger in the same school fifty years ago, and we are disappointed to find here no sequel to his account of the Sclerostomidæ of horses and asses which appeared in the first volume of the "Records."

Dr. Wilson follows up his observations on the poisons of spiders by a very interesting study of the venom of Egyptian scorpions. An aqueous extract of the poison gland is treated with excess of alcohol, and from the precipitate thus obtained a substance may be extracted with normal saline which possesses toxic properties of a very high order. The toxic value is about ten million, that is, 1 milligram will kill 10 kilograms of guinea-pig—a figure of the same order as that obtained for similar preparations from the venoms of the more poisonous serpents. A full-grown specimen of the common Egyptian species (*Buthus quinque-striatus*) contains about $3\frac{1}{2}$ milligrams of this (impure) "toxin." If the susceptibility of man is the same as that of the laboratory animals, it follows that a single sting can kill at the utmost 35 kilograms. These calculations correspond very well with the fact that fatal cases of scorpion sting in adults are extremely rare, though the mortality in young children reaches 60 per cent. Scorpions are in this way on a different level from many of the poisonous snakes; as Captain Lamb has shown, the amount of toxin normally injected by a vigorous cobra is many times the minimum lethal dose for an adult man. Dr. Wilson finds that certain animals living in the desert (including the hedgehog) are naturally immune (at any rate relatively) to the venom; and Dr. Tallart has immunised goats and obtained an anti-toxic serum with curative properties.

An article by Dr. Tribe shows that phthisis in Egypt does not differ very much in frequency, incidence on rural and urban populations, and type from the same disease in western Europe; and Dr. Sobhy gives a curious account of the obstetric customs of the natives, which seem to have undergone no material change since very remote times. The volume concludes with the first instalment of what promises to be a monumental contribution to the morphology of the human brain, by Dr. Elliot Smith. The present section, which is fully illustrated, deals with the occipital region, and contains a great deal of original matter on the vexed questions of the significance and homologies of the convolutions.

The general printing of the volume is excellent, though the inevitable misprint has crept in here and there. The illustrations are good and useful, but we are sorry to see that the coloured plate illustrating Dr. Symmers's case of secondary sarcoma of brain could not be printed in Egypt.

A. E. B.

[1] "Records of the Egyptian Government School of Medicine" Vol. ii., 1904. Edited by H. B. Keatinge, M.B., Director. Pp. 169+plates. (Cairo: National Printing Department, 1904.)

WIRELESS TELEGRAPHY IN WAR.

A VERY interesting account of the working of the wireless telegraphic war correspondence of the *Times* during the early part of the Russo-Japanese war was given by Captain James at a meeting of the Society of Arts last week. This is the second occasion on which the *Times* has played a prominent and important part in the practical development of wireless telegraphy. The first was when, shortly after Mr. Marconi had established communication between America and England, a regular correspondence was started between the two countries by means of wireless telegraphy—a correspondence which was not, however, destined to last for very many days. Very soon after its inception something went wrong, and though since that time the Marconi Company has greatly developed its Transatlantic signalling and has effectively demonstrated its utility and convenience for communicating with liners, the shore to shore correspondence has not been renewed.

The second case in which the *Times* intervened was also only of short duration; but here the cessation was due to its having met with too great success, the results achieved having demonstrated not that wireless telegraphy is useful for war correspondence, but that it is too effective to be permissible.

The system selected for the equipment of the *Haimun* was that of Dr. de Forest, a system which had already shown its efficiency during the yacht races of 1903; the reasons that led to the choice of this system were its freedom from interference and the speed at which it could be worked, it being possible to transmit thirty to thirty-five words a minute, as against ten to twelve words by any other system. The experiences of Captain James seem certainly to bear out the claim of freedom from interference. In spite of the fact that four other systems were at work in close proximity to the *Haimun*—the

Russian, Japanese, British, and Italian—Captain James never found his messages interfered with in any way. This notwithstanding that many of the messages sent were of considerable length, running from 1500 to 2000 words. To transmit these long messages under all the attendant difficulties was no mean achievement for wireless telegraphy and journalism alike.

Some of the incidents narrated by Captain James are both interesting and amusing. On one occasion, when the Japanese steamed in to attack Port Arthur, the *Haimun* telegraphed the news of the firing of the first shot to Wei-hai-wei, whence the message was forwarded express to London, with the result that two hours later the *Times* received the news, so that, on account of the difference in time, the journal knew that an engagement was taking place six hours before it started. On the occasion of the transmission of their first long message—one of 1500 words—which was sent from a distance of 130 miles from Wei-hai-wei, the operator listened anxiously at his telephone receiver, after the first section of 350 words had been transmitted, to know whether it had been satisfactorily received. For five minutes he waited; then his face lighted up, and he remarked, "Captain, we will deliver the goods, Wei-hai-wei says that it is coming in like a drum." It is a remarkable achievement, which journalists and men of science highly appreciate, that wireless telegraphy is capable even in adverse circumstances of transmitting messages that will "come in like a drum." Wireless telegraphy may still be in its infancy, but the results attained by its use have shown that it is no longer in an experimental stage. M. S.

FLOODS IN THE UNITED STATES.

IN our number for July 28 we gave particulars of the great flood that occurred in the Mississippi valley in 1903, and of the damage done in Kansas and other places, and also of floods in the Passaic River, the information being obtained from the reports issued by the Geological Department of the United States. We have recently received a further report on floods in other parts of the States.[1]

This report states that the year 1903 will be long remembered for its extreme local variations from normal climatic conditions. Besides the floods in the Mississippi valley already referred to, due to heavy and continuous rainfall, a cloud-burst at Heppner, in Oregon, caused the loss

FIG. 1.—Clifton before the Flood of 1903.

of 100 lives and of property valued at half a million dollars, one-third of the town being entirely destroyed. This flood was due to a very heavy storm of short duration covering a very small area, such storms being peculiar to this arid region, and locally called a "cloud burst." Such a storm is almost like a tornado in its suddenness, destructibility, and limited extent. The duration of this storm was only half an hour, and the resulting flood lasted less than an hour. It was estimated that the storm area was from two to four miles in width and eight to ten miles in length, and affected an area of twenty square miles.

This storm was accompanied by a very heavy fall of hail; some of the hailstones measured $1\frac{1}{4}$ inches in diameter.

FIG. 2.—Clifton after the flood of 1903.

Five days after the storm some that measured five-eighths by seven-sixteenths inch were removed from a house buried under silt and mud, and bodies were found in drifts of hail in nearly a perfect state of preservation.

Another destructive flood due to heavy rain occurred in South Carolina in the district situated on the southern slope of the Saluda Mountains, which includes the foothills and rolling country. About half of it is covered with timber, the remainder being cultivated and pasture land. The surface slopes are such that the water runs off rapidly, and there is very little storage.

Rain had occurred daily for some time previously, saturating the ground, and culminating in a fall of from $3\frac{1}{2}$ to 5 inches in twenty-four hours.

The greatest destruction caused by the flood due to this rainfall was the wrecking of three large cotton mills situated at Clifton (Figs. 1 and 2), on the river Pacolet. At one mill a chimney stack 137 feet high was washed down, and the mill, with shops, engine and boiler houses, and sixteen cottages, entirely destroyed. At another mill 110 feet of the main building and the wheelhouse were totally wrecked, and the machinery of the lower floors severely damaged by water, mud, and drift, and several cottages were destroyed. In another mill fifty-two women and children were drowned. Railway traffic was stopped for a week. The damage to the mills and other property was estimated at $3\frac{1}{2}$ millions of dollars.

[1] "Destructive Floods in the United States in 1903." By E. C. Murphy. Water Supply and Irrigation Papers, No. 96. (Washington.)

SEISMOLOGICAL NOTES.

THE third number of vol. x. of the *Bolletino* of the Italian Seismological Society contains the first instalment of the earthquake record for 1903. This is now in charge of Dr. G. Agamennone, and follows the same lines as in previous volumes, except that it has been found impossible to continue the attempt to reproduce all the records of earthquakes registered in Italy. This change is a consequence of the great increase in the number of stations where instruments devoted to the new seismology have been set up, and the consequent impracticability of collecting in one periodical all the records of even the limited number of great world-shaking earthquakes. Italy will, therefore, be content with publishing its own records, and at most a few lines will indicate those earthquakes which have also been recorded out of Italy.

Improvements are continually being made in the instruments used in every branch of science, and seismology is no exception. Prof. Omori publishes (*Publications* of the Earthquake Investigation Committee, No. 18) an account of a combination of light, inverted, vertical, with a heavy horizontal pendulum, with which it is claimed that a period of sixty seconds can easily be got from an instrument which does not exceed 1 metre in height and length of boom. Prof. Alippi, in the *Boll. Soc. Sismol. Ital.*, vol. x., No. 3, describes a simple device for overcoming the tendency to adherence in the electric contacts of delicate seismoscopes; it consists in placing an ordinary electric bell, without the gong, in the circuit, and fixing it so that the clapper beats against the stone slab on which the seismoscope rests. He finds that the vibration set up by this is sufficient to cause the two parts of the contact to separate, without in any way affecting the instrument, and suggests that it would be better to incorporate a small electric vibrator in the base of the seismoscope to act like the decoherer in wireless telegraphy.

The mysterious sounds known locally as mist-poeffers, barisal guns, &c., and now generally looked upon as seismic, are the subject of a short note by Prof. Alippi, who records two new localities and names. In the neighbourhood of Arezzo they are known as "baturlio della marina," and in the country between Bologna and Modena as "romba di Sassuolo." The multiplication of localities where these sounds are familiar, and of local names for them, is thought by Prof. Alippi to render a generic name desirable, and he suggests *brontid*, which has certainly the advantages of being descriptive and of implying no theory of origin (*Bol. Soc. Sismol. Ital.*, x., part iii.).

The relation between the variations in latitude at Tokio and the occurrence of earthquakes in Japan is the subject of a paper by Prof. Omori in No. 18 of the *Publications* of the Earthquake Investigation Committee; he finds that the destructive earthquakes of the last eight years all occurred during periods of high or low value of the latitude, and none at times when this was changing from one to the other. This result is said to be in harmony with the results obtained by Prof. Milne, but we may point out that this is not so; what Prof. Milne found was that the greatest frequency of world-shaking earthquakes coincided with the most rapid variation in the position of the pole, while Prof. Omori finds that the destructive earthquakes of Japan occurred at times when the latitude was stationary or only changing very slowly. What his investigation seems to show is that any connection which there may be between the occurrence of really great earthquakes and changes in the position of the axis of revolution, does not extend to local earthquakes.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

In accordance with the will of the late Mr. George Smith, of St. Louis, the treasurer of Harvard University has received, it is stated by *Science*, a payment of 51,500*l.* When this fund reaches 90,000*l.* by accumulation, three new dormitories are to be erected.

At the institute of archæology of the University of Liverpool, a course of lectures dealing with recent researches on the ancient sites of Greece and with the historical geography of western Asia, particularly Palestine, has been arranged, and will be delivered on successive Wednesdays of this spring term. The lecturers are Dr. Caton and the Rev. M. Linton Smith.

The President of the Board of Education has appointed Mr. T. S. Dymond, of the Essex County Technical Laboratories, Chelmsford, to an inspectorship under the Board, and to act as special adviser in matters of rural education, of nature-study in public elementary schools, of agricultural instruction in evening (including afternoon and Saturday) schools, and of the advancement of various forms of technical education in rural districts.

The Bucks Education Committee, under the presidency of the chairman, Lord Buckinghamshire, has decided that a communication should be issued to all school correspondents in the county requesting the managers to consider the desirability of introducing the teaching of the subjects of hygiene and temperance into the schools under their charge, and referring to the support given to the movement by 15,000 members of the medical profession.

About twenty scholarships ranging in value from 20*l.* to 50*l.* a year, and exhibitions for men and women tenable at University College, King's College, and the East London Technical College, in the faculties of arts, science, and engineering, will be offered for competition on June 27 and following days. Full particulars and forms of application may be obtained on application to the secretary of the Inter-Collegiate Scholarships' Board, King's College, Strand, W.C.

The conference on school hygiene, which will be held at the University of London on February 7–10, will be opened with an address by Sir Arthur W. Rucker, F.R.S., on "The Coordination of the Teaching of Hygiene." The subjects of papers for discussion include the following:—"Physical and Mental Development during School Life," Miss A. J. Cooper; "Physical Inspection," Dr. A. K. Chalmers; "Building and Equipment," Sir Aston Webb, R.A.; "Sanitary Inspection," Dr. J. F. J. Sykes; "Training of Teachers," Prof. C. S. Sherrington, F.R.S.; and "Training of Scholars," Prof. Findlay.

The *British Medical Journal* announces that the French Congress of School Hygiene will hold its second meeting in Paris this year at Whitsuntide. The following is the programme of discussions:—(1) the medical inspection of primary schools; (2) the education of families in school hygiene; (3) vacations and holidays; (4) tuberculosis and teachers; (5) the overloading of school courses and competitions for admission to large schools. Profs. Debove, Grancher, Landouzy, and Pinard are honorary presidents of the congress. All communications should be addressed to Dr. J. Ch. Roux, 46 rue de Grenelle, Paris.

The annual general meeting of the Association of Technical Institutions is to be held at the Manchester School of Technology on January 27. The business will include the address of the president, Sir Philip Magnus, consideration of the council's report, the election of officers, and the reading of papers. The subjects to be dealt with are:—"The Coordination of the Work of Evening Continuation Schools and Municipal Technical Institutions," "The Cooperation of Employers in the Technical Training of their Apprentices," and "The Registration of Teachers in Technical Institutions."

The annual general meeting of the members of the Association of Directors and Secretaries for Education was held in London on January 19 and 20. Mr. F. Wilkinson, the chairman for the year, presided, and in the course of his remarks dealt with the new regulations for secondary schools of the Board of Education. The following resolution was adopted by the association:—"That the policy at present pursued at South Kensington with reference to the erection, financing, and control of secondary day schools is calculated to cast a heavy burden upon the ratepayers, while at the same time depriving them of adequate control."

Mr. A. J. Gimson described before the Institution of Mechanical Engineers on January 20 his impressions of sixteen engineering workshops visited by him in America. In the course of his remarks, he said that a feature of the engineering industry that impressed him was "the close intercommunication of technical institutes and manufacturing workshops, of professors and manufacturers, and the presence, in minor positions of authority, of young men who had passed through a complete course of technical instruction." In this country, manufacturers as a rule have yet to learn the value of scientific investigation and scientific education as factors of industrial progress.

Sir William White delivered an address at the Battersea Polytechnic on January 21 on the systematic study of engineering. He expressed the opinion that in the teaching of those who have to work during the day and have only the evening in which to study, Great Britain is making progress. In many departments of technical education there is still much to learn, but in classes such as those in polytechnics England has led the way. The full value of such studies is often not attained, said Sir William White, because of the absence of a scientific method of teaching. Some teachers are uninformed themselves, and the consequences are serious to their students. The want of a good English elementary education has been recognised, but in secondary education there is much which still remains undone. He advised every student of engineering to apply himself to the study of mathematics and applied mechanics, without which an engineer must be at a disadvantage and have to work in the dark.

REFERENCE was made last week (p. 286) to the grant of 400*l.* a year, for the next five years, voted by the Drapers' Company for work in the department of applied mathematics at University College, London. The company has long taken an active part in the development of higher education, and the enlightened policy which has prompted it to make grants in aid of university work and scientific research in London will, we trust, be adopted by other city companies. No better testimony to the value of such grants could be obtained than is afforded by the memoirs which have been published containing the results of work carried on in Prof. Karl Pearson's laboratory (see, for instance, a note in NATURE of November 3, 1904, p. 15). In acknowledgment of the assistance given by the Drapers' Company to work of this kind, the council of University College passed the following resolution at its last meeting:—"That the council desire to convey to the Court of the Worshipful Company of Drapers their best thanks for the vote of 2000*l.* towards further assisting the statistical work and higher teaching of the department of applied mathematics at University College. By their original grant of 1000*l.* for this purpose the court has enabled the council to appoint an adequate staff and to purchase valuable apparatus for the work of the department. By generously continuing their aid the court will enable the work thus begun to be placed upon a more permanent footing, and will prepare the way for the establishment of a permanent statistical institute."

A RETURN showing the amount spent on technical education by local authorities in England and Wales—with the exception of four which have made no return—during the year 1902–3, has been prepared by the Board of Education and issued as a Blue-book. The return shows that the total amount of the residue received under the Local Taxation (Customs and Excise) Act, by the councils of counties and county boroughs in England (excepting the county of Monmouth), in 1902–3 was 879,405*l.*, of which 840,253*l.* was appropriated to educational purposes, and 39,152*l.* to relief of rates, the latter sum including 22,366*l.* devoted by the London County Council to relief of rates. Of the 49 county councils, 45 were applying the whole of the residue to technical education, and 3 a part of it to the same purpose. Of the councils of the 64 county boroughs, 61 were devoting the whole, and 3 a part of the residue to technical education. Further, 4 county councils and the councils of 31 county boroughs, 101 boroughs, and 211 urban districts, in England, were making grants out of the rates under the Technical Instruction Acts; and 31 local authorities were devoting funds to technical education out of the rate levied under the Public Libraries and Museums Acts. Thirty-three local authorities raised sums by loan on the security of the local rate under the Technical Instruction Acts. The total amount expended on technical education during the year was 1,149,216*l.* The total amount of the residue paid to the 13 county councils and the councils of the 3 county boroughs in Wales and Monmouth was 42,201*l.* These local authorities devoted the whole of it to intermediate and technical education, chiefly under the Welsh Intermediate Education Act, 1889. The total amount expended on technical education in Wales and Monmouth under the Technical Instruction Acts during the year was 42,781*l.*

SOCIETIES AND ACADEMIES.

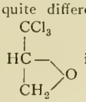
LONDON.

Geological Society, January 4.—Dr. J. E. Marr, F.R.S., president, in the chair.—The marine beds in the Coal-measures of North Staffordshire: J. T. **Stobbs,** with notes on their palæontology by Dr. Wheelton **Hind.** The stratigraphical position of the marine beds can be located with exactness *in situ.* The horizons can be utilised for the subdivision of the Coal-measures. The known horizons at which marine fossils have been obtained were enumerated, and a map of the distribution of these beds was given. The Speedwell and Nettlebank bed appears to be the most important marine bed in the coalfield. A detailed table of the beds in North Staffordshire was given to show the exact position of the marine beds. Dr. Hind, in his notes on the palæontology, remarked that from the base of the Pendleside series to the top of the Coal-measures there is an unbroken succession of beds—at one time marine, at another estuarine, without unconformity.—The geology of Cyprus: C. V. **Bellamy,** with contributions by A. J. **Jukes-Browne.** The Kyrenia Mountains rise to heights of more than 3000 feet. They are composed of rocks tilted into a vertical position, altered by compression and intrusion, and are devoid of fossils. They are referred by Prof. Gaudry to the Cretaceous period, and are compared by him with the hippurite-limestones of Attica. The Kythræan rocks (Upper Eocene) are based on breccias and conglomerates made up of fragments of the Trypanian limestones. No fossils, except a few small tests of Globigerina, have been found in this series, which consists entirely of volcanic débris. The Idalian (Oligocene) series appears to rest conformably on the last. The gypsum-beds are largely developed in the south; the white chalky marls and limestones extend over nearly one-half of the island, and are always conspicuous from their intense whiteness. Foraminifera are abundant, and other fossils have been found which indicate that the beds are mainly of Oligocene age. Igneous rocks are most conspicuous in the centre of the island. They are intrusive into the formations already mentioned. The rocks include augite-syenite, rhyolite, liparite, olivine-dolerite, basalt, augite, and several varieties of serpentine. Miocene rocks have only been recognised in the south-east of the island. The Pliocene strata lie in horizontal or slightly inclined beds, resting unconformably upon all older rocks. The Pleistocene rocks sometimes attain a thickness of 50 feet. The cave-earths have yielded *Hippopotamus minutus* and *Elephas Cypriotes* to Miss D. M. Bate. An account of the chief economic mineral products of the island is given. Descriptions of some of the rocks, a note on the Miocene rocks, and a sketch of the physical history of the island are contributed by Mr. Jukes-Browne.

Mathematical Society, January 12.—Prof. A. R. Forsyth, president, in the chair.—Basic generalisations of well known analytic functions: Rev. F. H. **Jackson.** Recent investigations have led to generalised forms of the serial expressions of certain functions. The functional characters of the new series, the domains of convergence, and the possibility of finding linear differential equations satisfied by the generalised functions are the matters that next claim attention. The author explained the degree of success which he had attained in these lines of investigation.—Current flow in rectangular conductors: H. Fletcher **Moulton.** The paper deals with the resistance of a rectangular lamina between electrodes which occupy portions of opposite sides, and the distribution of currents which flow in a conducting lamina bounded internally and externally by squares.—On the kinematics and dynamics of a granular medium in normal piling: J. H. **Jeans.** The paper is occupied with problems suggested by Prof. O. Reynolds's "Sub-mechanics of the Universe." An attempt is made to examine the question of the permanence or non-permanence of peculiarities of piling such as Prof. Reynolds interpreted as matter, electricity, magnetism, &c. The results go to show that such peculiarities would be transient, and that a universe constructed as imagined by Prof. Reynolds would suffer instant dissolution, after which particles of matter, charges of electricity, &c., would appear fortuitously at rare intervals, and have no continuous existence either in time or space. If the æther were a granular medium in normal piling, it would be æolotropic with eighteen elastic constants, and the velocity of propagation of waves of high frequency would be much greater than that of waves of low frequency. Light transmitted from distant stars would consist largely of mirages and coloured spectra.—On a class of expansions in oscillating functions: Prof. A. C. **Dixon.** The paper deals with expansions of the kind discussed by Liouville and Sturm in which arbitrary functions are expanded in series of special functions which satisfy differential equations of a certain type. These expansions are used frequently in applications of mathematics to physics. The object of the paper is to give a rigorous proof of the possibility of such expansions in the case of functions which are analytic throughout the proposed range of validity of the expansions.—Generational relations for the abstract group simply isomorphic with the group $LF[2,p^n]$: Dr. W. H. **Bussey.**—On alternants and continuous groups: Dr. H. F. **Baker.** The paper is occupied with the proof of that fundamental theorem of non-commutative algebra which is usually written in the form $e^{A}e^{B}=e^{C}$, where A and B are non-commutative quantities, and C is a series of alternants of A and B. The proof is derived from a property of a matrix called the E-matrix, which involves the structure constants, and one set of the canonical variables, of the parameter group. This property is established independently of the theory of continuous groups. It is proved, further, that every alternant of E-matrices is an E-matrix, and thence is obtained a general expression for the equations of the first parameter group.—A generalisation of the Legendre polynomial: H. **Bateman.**—Isogonal transformation and the diameter transformation: H. L. **Trachtenberg.**

Royal Astronomical Society, January 13.—Prof. H. H. Turner, president, in the chair.—The eclipse of Agathocles in the year −309: Prof. **Newcomb.** The author considered that this eclipse had been identified by Celoria with an eclipse said by Cleomedes to have been total in the Hellespont. Assuming this to be the case, it would be necessary to make a diminution of 1″.5 in the secular acceleration.—The longitude of the moon's perigee: Mr. **Cowell.**—Magnetic storms and associated sun-spots: Rev. A. L. **Cortie.** Discussing Mr. Maunder's paper (read at the November, 1904, meeting), Father Cortie considered it was still possible to consider sun-spot phenomena and magnetic storms as produced by some common cause, and brought forward evidence from the Stonyhurst observations which he thought conflicted with some of Mr. Maunder's conclusions.—A paper on the same subject: Prof. **Schuster.** From Mr. Maunder's statistics, which Prof. Schuster discussed, it appeared that in some form or other magnetic storms recur at intervals apparently identical with that of the revolution of sun-spot zones. The author was unable, however, to accept Mr. Maunder's explanation of the cause of the storms, which he considered as of terrestrial origin, the earth's diurnal rotation being the real source of the energy. The energy thus drawn away from the earth would tend to diminish its velocity of rotation, but in a million years this diminution would not amount to more than a second a year. Without forming a definite theory on the subject, Prof. Schuster suggested that there is some solar effect, propagated in straight lines, which may increase the electric conductivity of the earth's atmosphere, and thus set a magnetic storm going without supplying its energy. The author concluded that Mr. Maunder had shown the urgent importance of further investigation, but that the facts have become more difficult to understand and explain. After a discussion, followed by a reply from Mr. Maunder, the meeting adjourned, many other papers being taken as read.

PARIS.

Academy of Sciences, January 16.—M. Troost in the chair.—On the generalisation of an elementary theorem of geometry: H. **Poincaré.** The theorem that the sum of the angles of a plane triangle is equal to two right angles is extended to the case of the tetrahedron.—On some theorems relating to algebraic surfaces of linear connection greater than unity: Émile **Picard.**—On some physical constants of calcium and on calcium amalgam: H. **Moissan** and M. **Chavanne.**—On the β-methyl-ϵ-alkylcyclohexanones and the corresponding alcohols, homologues of menthone and menthol: A. **Haller.** β-Methylcyclohexanone, which can be prepared either by the decomposition of pulegone or from metacresol by Sabatier and Senderens's method, is treated with sodium amide and the alkyl iodide. A mixture of various alkyl derivatives is obtained which up to the present has not been completely separated into its constituents.—On a synthesis of menthone and menthol: A. **Haller** and C. **Martine.** Methylcyclohexanone is treated successively with sodium amide and isopropyl iodide, the mass treated with water, extracted with ether, and the latter solution fractionated in a vacuum. The physical properties of the menthone obtained, as well as those of its oxime, semicarbazone, and other derivatives show that the synthetical is identical with the natural product.—Observations of the Borrelly comet (1904 *e*) made at the Observatory of Paris with the 30·5 cm. equatorial: G. **Bigourdan.**—On irregular algebraic surfaces: Federigo **Enriques.**—On some points in the theory of numbers: Georges **Rémoundos.**—On equations of the parabolic type: S. **Bernstein.**—On fluorescence: C. **Camichel.** The author has repeated some experiments of J. Burke on fluorescence with some additional precautions. His conclusion, which is opposed to that of Burke, is that the coefficient of absorption of uranium glass for the radiations which it emits during fluorescence is the same whether the fluorescence be excited or not.—Some combinations of samarium chloride with ammonia: C. **Matignon** and R. **Trannoy.** Samarium chloride forms eight different compounds with gaseous ammonia. The range of temperatures between which each of these compounds can exist, together with the heats of dissociation, were determined.—On a colloidal hydrate of iron obtained by electrodialysis and on some of its properties: J. **Tribot** and H. **Chrétien.** A solution of ferric hydrate in ferric chloride was placed in an ordinary Graham dialyser, and the amount of chlorine remaining in the solution determined at different intervals of time, in the first place on simple dialysis, and afterwards when a current of 1 ampere was passed through the solution. In the latter case the chlorine was more quickly and more completely removed; the theory of the two cases is given in detail, and the theoretical and actual results compared.—On an isomeride of trichloracetone: G. **Perrier** and E. **Prost.** Aluminium chloride is allowed to act upon alcohol in carbon bisulphide solution, and chloral is added. A liquid product possessing the composition and molecular weight of trichloracetone is obtained. The reactions, however, are quite different from this latter substance, and the formula  is provisionally proposed.—The migration of the ethylene linkage in unsaturated acyclic acids: E. E. **Blaise** and A. **Luttringer.** The migration of the ethylene linkage has been studied in the case of six alkylacrylic acids and normal $\alpha\beta$-hexenic acid. It appears to move into the longest chain, giving either an isomeric acid or a γ-lactone.—On the combination of natural leucine with carbamic acid: M. **Hugounenq** and Albert **Morel.**—On a new method of synthesising saturated ketones by the method of catalytic reduction: M. **Darzens.** It is shown that in applying the reaction of Sabatier and Senderens the temperature at which the reduced nickel is reduced is of equal importance with the temperature at which the reduction is carried out. If the nickel is prepared at 245° C. to 250° C., and the reduction is carried out at 180° C. to 190° C., unsaturated ketones can be readily reduced to the corresponding saturated compounds without the formation of considerable amounts of secondary alcohols as by-products. The reaction has been applied to mesityl oxide, methylhexanone, and methylheptenone.—Observations on the Borrelly comet (1904 *e*) made at the Observatory of Besançon: P. **Chofardet.**—Observations of the Borrelly comet (*e* 1904) made at the Observatory of Algiers with the 31·8 cm. equatorial:

MM. **Rambaud** and **Sy.**—Orogenic sketch of the chains of the Atlas mountains to the north-west of Chott el Hodna: M. **Savornin.**—On the existence and the abnormal tectonic situation of the Eocene deposits in New Caledonia: J. **Deprat** and M. **Piroutet.**—Geological observations collected by the Chari—Lake Chad expedition: H. **Courtet.**—Contribution to the chemical study of the soil, water, and mineral products of the region of Chari and of Lake Chad: Alex. **Hébert.**—On the spring at Hammam Moussa, near Tor, Sinai: R. **Fourtau** and N. **Georgiadès.** The water from this spring approximates to the water at Wiesbaden, containing sodium chloride and the sulphates of lime and magnesia. It has a slightly acid reaction.—Man and the mammoth at the Quaternary period in the soil of the Rue de Rennes, south of Saint-Germain-des-Prés: M. **Capitan.** Excavations in this district have led to the discovery in the Quaternary strata of several roughly executed flint heads and a well preserved tooth of the mammoth. It follows from this and previous discoveries that man, the elephant and the rhinoceros lived in the Seine valley, on the actual spot where Paris now stands.—Chlorophyll assimilation in the absence of oxygen: Jean **Friedel.** It is shown that the presence of oxygen in the atmosphere surrounding the leaf is not indispensable for the process of assimilation.—A gum bearing Stereospermum in Madagascar: Henri **Jumelle.**—The physiological effects of ovariotomy in the goat: P. **Oceanu** and A. **Babes.** Amongst the advantages of this operation in the goat are the disappearance of the characteristic smell of the milk, an increased secretion of the milk, and prolongation of the lacteal period.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 26.

ROYAL SOCIETY, at 4.30.—On the Boring of the Simplon Tunnel, and the Distribution of Temperature that was Encountered: F. Fox.—On the Comparison of the Platinum Scale of Temperature with the Normal Scale at Temperatures between 444° and −190° C., with Notes on Constant Temperatures below the Melting Point of Ice: Prof. M. W. Travers, F.R.S., and A. S. C. Gwyer.—On the Modulus of Torsional Rigidity of Quartz Fibres, and its Temperature Coefficient: Dr. F. Horton.—On a Method of Finding the Conductivity for Heat: Prof. C. Niven, F.R.S.—On the Drift produced in Ions by Electromagnetic Disturbances, and a Theory of Radio-activity: G. W. Walker.—Exterior Ballistics. "Error of the Day" and other Corrections to Naval Range Tables: Prof. G. Forbes, F.R.S.—The Theory of Symmetrical Optical Objectives. Part ii.: S. D. Chalmers.—Coloration of Glass by Natural Solar and other Radiations: Sir William Crookes, F.R.S.—Note on the Cause of the Period of Chemical Induction in the Union of Hydrogen and Chlorine: C. H. Burgess and D. L. Chapman.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Fuel Economy in Steam Power Plants: W. H. Booth and J. B. C. Kershaw. (Conclusion of discussion.)

FRIDAY, JANUARY 27.

ROYAL INSTITUTION, at 9.—The Life-History of the Emperor Penguin: Dr. Edward A. Wilson.

PHYSICAL SOCIETY, at 5.—Action of a Magnetic Field on the Discharge through a Gas: Dr. R. S. Willows.—Action of Radium on the Electric Spark: Dr. R. S Willows and J. Peck.—The Slow Stretch in India-rubber, Glass, and Metal Wires when subjected to a Constant Pull: P. Phillips.—Determination of Young's Modulus for Glass: C. A. Bell. Some Methods for Studying the Viscosity of Solids: Dr. Boris Weinberg.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Concrete-Making on the Admiralty Harbour Works, Dover: T. L. Matthews.

SATURDAY, JANUARY 28.

MATHEMATICAL ASSOCIATION, at 3.—Models and their Use: E. M. Langley.—The New Geometry: W. H. Wagstaff.—Should Greek be Compulsory for Mathematicians at Cambridge? A. W. Siddons.

ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.30.—On the Occurrence of Gypsum in Essex Soils: T. S. Dymond.—The Bog-Mosses (Sphagnaceæ) of Essex, a Contribution to the Flora of the County: F. J. Chittenden.

MONDAY, JANUARY 30.

SOCIETY OF ARTS, at 8.—Reservoir, Stylographic and Fountain Pens: J. P. Maginnis.

INSTITUTE OF ACTUARIES, at 5.—On Staff Pension Funds: G. King.

FARADAY SOCIETY, at 8.—Mass Analyses of Muntz's Metal by Electrolysis, and some Notes on the Electrolytic Properties of this Alloy: J. G. A. Rhodin.—On the Equilibrium between Sodium and Magnesium Sulphates: Dr. R. Beckett Denison.—"Refractory Materials": E. K. Scott.

TUESDAY, JANUARY 31.

ROYAL INSTITUTION, at 5.—The Structure and Life of Animals: Prof. L. C. Miall, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Floating Docks: L. E. Clark.

MINERALOGICAL SOCIETY, at 8.—(1) On Danalite from Cornwall: (2) Crystallographic Characters of Barium-radium Bromide: Prof. H. A. Miers, F.R.S.—On the Regular Growth of Crystals of one Substance upon Those of Another: T. V. Barker.—Apparatus for Determining the Density of Small Grains: K. A. K. Hallowes.

WEDNESDAY, FEBRUARY 1.

GEOLOGICAL SOCIETY, at 8.—On the Sporangia-like Organs of *Glossopteris Browniana*, Brongn.: E. A. Newell Arber.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Volumetric Estimation of Reducing Sugars: A. R. Ling and T. Rendle.—The Inversion of Cane Sugar in the presence of Milk Constituents: Hon. Francis Watts.—The Colorimetric Estimation of Salicylic Acid in Food Stuffs: F. T. Harry and W. R. Mummery.

SOCIETY OF ARTS, at 8.—The Navigation of the Nile: Sir William H. Preece, K.C.B.

THURSDAY, FEBRUARY 2.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Compressibility of Gases between One Atmosphere and Half an Atmosphere of Pressure: Lord Rayleigh, O.M., F.R.S.—On the "Blaze Currents" of the Gall Bladder of the Frog: Mrs. A. M. Waller:—The Theory of Photographic Processes; on the Chemical Dynamics of Development: S. E. Sheppard and C. E. K. Mees.—On the Relation between Variation of Atmospheric Pressure in North-East Africa, and the Nile Flood: Capt. H. G. Lyons.—Note on the Determination of the Volume Elasticity of Elastic Solids: Dr. C. Chree, F.R.S.—Theory of the Reflection of Light near the Polarising Angle: R. C. Maclaurin.

ROYAL INSTITUTION, at 5.—Forestry in the British Empire: Prof. W. Schlich.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—The Mechanics of Flour Milling: A. R. Tattersall.

LINNEAN SOCIETY, at 8.—New Chinese Plants from the Neighbourhood of Hong Kong: W. J. Tutcher.—European Marine Species of Isopoda: Dr. H. J. Hansen.

RONTGEN SOCIETY, at 8.15.—Some Points in the Construction of a High Frequency Machine: Dr. Clarence A. Wright.

CHEMICAL SOCIETY, at 8.—Studies in the Camphane Series. Part xvi. Camphorylcarbimide and Isomeric Camphorylcarbamides: M. O. Forster and H. E. Fierz.

FRIDAY, FEBRUARY 3.

ROYAL INSTITUTION, at 9.—Blood Pressure in Man: Prof. T. Clifford Allbutt, F.R.S.

GEOLOGISTS' ASSOCIATION, at 7.30.—Address on Modern Methods in the Study of Fossils: the President, Dr. A. Smith Woodward, F.R.S.

CONTENTS.

THURSDAY, FEBRUARY 2, 1905.

THE QUINTESSENCE OF HAECKELISMUS.

The Wonders of Life. A Popular Study of Biological Philosophy. Supplementary volume to "The Riddle of the Universe." By Ernst Haeckel. Translated by Joseph McCabe. Pp. xiv+501. (London: Watts and Co., 1904.) Price 6s. net.

THIS new book by the indefatigable Haeckel is supplementary to his "Riddle of the Universe." That several hundred thousand copies of the "Riddle" were sold indicates the widespread interest taken in what the author calls "the construction of a rational and solid philosophy of life," or in what others would call an extremely biological way of looking at things. But the "Riddle" and its solutions raised storms of criticisms and evoked hundreds of reviews—both friendly and hostile—besides many large pamphlets and even a few books, not to speak of more than five thousand letters. To these collectively, friends and foes alike, Haeckel now replies in this "biological sketch-book," written uninterruptedly in the course of four months when he was completing his seventieth year in a vacation at Rapallo, a tiny coast-town of the Italian Riviera. He had leisure there to think over all the views on organic life which he had formed in the course of a many-sided experience of life and learning since the beginning of his academic studies (1852) and his teaching at Jena (1861). The constant sight of the blue Mediterranean, the animal inhabitants of which he knows so well, his solitary walks in the wild gorges of the Ligurian Apennines, and the moving spectacle of the "forest-crowned mountain altars," inspired him with "*a feeling of the unity of living nature*—a feeling that only too easily fades away in the study of detail in the laboratory." He hopes that his readers may be moved by his book "to penetrate deeper and deeper into the glorious work of Nature, and to reach the insight of our greatest German natural philosopher, Goethe:

> "What greater thing in life can man achieve
> Than that God-Nature be revealed to him?"

The work is described as "a popular study of biological philosophy"; it is divided into four sections—methodological, morphological, physiological, and genealogical, which deal respectively with the *knowledge* of life, the *nature* of life, the *functions* of life, and the *history* of life. It raises no end of perplexing problems—life and death, nutrition and reproduction, heredity and variation, sensation and intelligence, morality and religion. It discusses protoplasm and the cell, spontaneous generation and evolution in general, the "pro-morphology" of organisms and the intricate architecture of the brain, the recapitulation of phylogeny in ontogeny, the inheritance of acquired characters, the evolution of sensation, æsthesis, intelligence, and morality. In short, it comprises practically everything, including miracles, the religious thoughts of Mr. Romanes, the university curriculum, the increase of pauperism, the introduction of Spartan elimination-methods, the Apostles' Creed, the immaculate conception, immortality, and a belief in a personal God. A book with so large a purview is bound to be sketchy—and the author calls it "a biological sketch-book" but sketchiness in dealing with subjects so momentous is apt to be unsatisfactory, and, while Haeckel continually and quite fairly refers to what he has said elsewhere in his large family of books, the discriminating reader may justly complain that he has often to deal rather with an assertion of convictions than with a reasoned argument. What carries one on from page to page is the feeling that we have to listen to a veteran who is telling us frankly and fearlessly what he believes to be true in regard to the order of nature and our place in it.

From one point of view Haeckel's discussion of the "Wonders of Life" is an apology for "Monism" or "Hylozoism." In studies of "unequal value and incomplete workmanship," as the illustrious author confesses, an attempt is made to show how we may attain to the conception of one great harmoniously working universe—"whether you call this Nature or Cosmos, World or God"—without utilising any knowledge which is not of empirical origin and *a posteriori*. We must not allow metaphysical fictions to intrude on our philosophy—still less into our science; we may work with the "law of substance," but there is to be no hocus-pocusing with transcendental formulæ; science is sufficient unto herself, and is justified of her children; criticism of her postulates and categories is a waste of time when there is so much to do; psychology is "a branch of physiology," and it is unprofitable to think about thinking; a "theory of knowledge" is a luxury for the leisured. Everything seems to become plain sailing if we embark on the craft "Hylozoism," but we require faith to help us across the gangway.

From another point of view Haeckel's book may be taken as an expression of the outlook on man and nature which may be reached by a conscientious pursuit of the scientific method. Those who remain agnostic or positivist in regard to either monism or dualism in any of their forms will be interested in hearing once more of the order, unity and progressiveness of nature's tactics, and in considering the practical proposals which a thorough-going Darwinian has to offer in regard to incapables and incurables, pauperism and crime. We cannot do more than remark that these proposals preach elimination rather than eugenics; they are more akin to surgery than to preventive medicine. Much of the book is, naturally enough, an echo of previous works—the "Monera," the "Gastræa Theory," the "Natural History of Creation," the "Evolution of Man," and, what has always appeared to us the author's *magnum opus*, the "Generelle Morphologie" (1866); but all has been modernised and orientated afresh to illustrate what Haeckel was so much impressed with at Rapallo, *the unity of living nature*. An interesting illustration of the author's artistic enthusiasm and indifference to popularity will be found in the pages on promorphology, wherein he discusses the architectural symmetries of organisms, as he did forty years ago. The centrostigmatic, centraxonial, and centroplane types of architecture have some personal fascination for us, but they must be caviare to the general.

To illustrate more concretely the general tenor of the "Wonders of Life," we may refer, for a moment, to the first two chapters, on truth and on life. In the chapter on truth we are introduced to the "*phronema*," the organ of knowledge, a definite and limited part of the cerebral cortex, consisting of association-centres, the innumerable cells of which are the elementary organs of the cognitive process, the possibility of knowledge depending on their normal physical texture and chemical composition. *How* this august possibility depends on the organisation of the "phronetal cells" remains entirely obscure, and no amount of "bluffing" will lessen this obscurity. As to life in general, its phenomena are determined by the physicochemical organisation of the living matter; metabolism has its analogue in inorganic catalysis; reproduction is analogous to the "elective multiplication" of crystals; and sensation is a general form of the energy of substance, not specifically different in sensitive organisms and irritable inorganic objects (such as dynamite). It is unfortunate, however, for this view of things that we cannot at present interpret even the simplest vital phenomenon in terms of physical and chemical formulæ. But we must remember that while "there is no such thing as an immaterial soul," a "soul" in the atom "must necessarily be assumed to explain the simplest physical and chemical processes." It seems to us six of one and half a dozen of the other whether we recognise the soul at the top or at the bottom. In Aristotelian language, there is nothing in the end which was not also in the beginning; in plain English, we put into the beginning what we know to be in the end. In fact, when we pass from the descriptive, formulative, interpretative task of science to philosophical explanation—whether monistic or dualistic—we load our intellectual dice. The only alternative is positivism, which is not amusing, and refuses to play. Haeckel's monism, we are bound to confess, appears to us to be dualism in disguise. He predicates for his "substance"—which is from everlasting to everlasting—a trinity of fundamental attributes, matter, energy, *and* sensation.

It is one of Haeckel's pastimes to coin new words, and now and again he has hit on a term which has been really useful, and has come to stay. In his "Wonders" his verbose inventiveness is still manifest. For the sciences which deal with inanimate nature a term is needed, and we are invited to choose between abiology, anorganology, abiotik, and anorgik, each of which seems worse than its neighbour. "Ergology" we might digest, but when it comes to perilogy, metasitism, trophonomy, tocogony, gonimatology, plasmodomism, and metaplasmosisms, the suggestion of an emetic is so obvious that we cannot swallow them.

We wish to make a remark in regard to the translation. Haeckel's preface is dated June 17, 1904, and this means that the translation has been accomplished with quite remarkable rapidity. It is on the whole clear and vigorous, but it betrays inexpertness. Thus we would point out the undesirability of calling Acanthocephala "itch-worms," or Cirripedia "creeping-crabs" or "crawling crabs," or Arion "our common garden snail," or Holothurians "sea-gherkins," and we could add to this list considerably. There seems something wrong, too, in calling reproduction "*transgressive* growth," and we wonder what "wonder-snails" can be, or "the actinia among the tunicates." In regard to the articulation of the lower jaw in mammals, we learn that "this joint is temporal and so distinguished from the square joint of other vertebrates." "Square" is a quaint way of referring to the quadrate bone! The translator has not the vaguest idea what he is translating. Defective proof-reading introduces us to a number of strangers, such as an early microscopist "Crew" in England and a prominent modern biologist who is always referred to as "De Bries." We are interested also in a renowned physiologist called Felix Bernard, and in what Wilhelm Preyer did "for the plant." Such is fame! Beside these, misprints like Cecidomyca, Ichtyosauri, and diatomes are trivial. It is a very unusual proceeding to print every technical name of class, genus, or species in italics without capitals.

In conclusion, while we entirely disagree with Haeckel's treatment of philosophy, and believe that he has not justly realised what its office is, while we also disagree with some of Haeckel's science, *e.g.* the transmission of acquired characters, we desire to point out that this book expresses the sincere convictions of a veteran who has done much for biology, and that its aim is to help towards including "all the exuberant phenomena of organic life in one general scheme, and explaining all the wonders of life from the monistic point of view, as forms of one great harmoniously working universe—where you call this Nature or Cosmos, World or God." As Browning said, our reach should exceed our grasp, "else what's Heaven for?"

A USEFUL BOOK FOR FRUIT GROWERS.

The Culture of Fruit Trees in Pots. By Josh Brace. Pp. x + 110. (London: John Murray, 1904.) Price 5s. net.

IT is nearly half a century since the late Thomas Rivers built glass structures for the protection of his fruit trees in pots. He was led to do this because in several successive seasons the hardy fruit crops were almost destroyed by severe frosts, which occurred when the trees were in flower—a very critical stage in the growth of the trees. Mr. Rivers was convinced that in order to be certain of obtaining crops of first-rate fruit of peaches, nectarines, apricots, plums, cherries, and even apples and pears, it was necessary to have large glass structures to protect the trees at that period. These early houses were not provided with means of heating them artificially, because it was then thought that the extra expense this would have entailed was unnecessary; but subsequent experience proved that a flow and return hot water pipe in each house not only provided additional security against frost, but the slight heat thus obtainable, if employed in bad weather while the trees are in flower, has a good effect upon the pollen, and therefore assists in securing the fertilisation of the flowers.

Since that time the pot fruit trees cultivated in the Sawbridgeworth nurseries of Messrs. T. Rivers and Son have provided a unique object lesson to British fruit growers, and the system has been imitated in other commercial establishments and in many private gardens, a notable instance being the gardens belonging to Mr. Leopold de Rothschild at Gunnersbury House, Acton, where excellent results are obtained notwithstanding the fact that the gardens are in London. The author of the book under review has been charged with the care of the orchard houses at Sawbridgeworth for more than twenty years, and the details of cultivation he explains are those which have been practised with such conspicuous success in that establishment. It may be admitted that the orchard house is more necessary in the colder districts of midland and northern counties than in the south, but even in the south the season of ripe fruits can be prolonged by orchard house culture, and more perfectly developed apples and pears obtained for particular purposes. Who that has seen the exquisite specimens exhibited at the autumn fruit shows has not wished to cultivate fruits of similar excellence? It is the mission of Mr. Brace's book to assist the reader to accomplish this purpose.

In the first chapter the author has described very minutely the construction of the best type of houses, and the importance of commencing with suitable structures is so great that we are not disposed to complain that the subject occupies one-fifth of the book, as well as several diagrams. From every point of view houses with span-shaped roofs are best, and if Mr. Brace's instructions are studied, the cultivator, by moving his trees out of doors at suitable periods, will be able to make the most of the space afforded in the houses.

In chapter ii., in which the furnishing of the houses with trees is considered, the best methods of arranging them are described, so that as many trees may be grown as possible, and yet none be obscured by the others. If only one house is built, and this is of an appreciable size, it should be divided into sections, because peaches and nectarines can be treated more successfully when grouped by themselves, as the trees need to be syringed daily until the fruits begin to ripen, which would not be possible if cherries or plums, which ripen much earlier in the season, were associated with them in the same division.

Chapter iii. must be read very carefully, and should be frequently referred to by the inexperienced cultivator. It contains details of cultivation, explains the best forms of training for the different kinds of trees, the process of potting, methods of forcing, pruning, summer pinching, value of surface dressings to the roots, cost of trees, &c. In the cultivation of fruit trees in pots, whether half standards, or bush trees of peaches, nectarines, and plums, or pyramids of apples and pears, the work of pruning and pinching is of the greatest importance, and if it be done unskilfully not only will the trees be unshapely and the fruit spurs become longer than is desirable, but the trees will fail to contain sufficient fruitful wood to produce satisfactory crops.

The best varieties of the different kinds of fruits for pot culture are described in chapters iv. and vii., and in chapter v. the subject of insect pests is dealt with, and the measures to adopt against these and the peach mildew are explained. Chapter vi. consists of a brief calendar of operations in the unheated orchard house for each month of the year, which is sufficient to remind the practitioner of the correct time to carry out the operations which are more fully described in the previous pages.

In addition to other illustrations, the work is adorned with full-page plates representing pot fruit trees in bearing, being reproductions from photographs obtained in Messrs. Rivers' nursery. These are reproduced in the very best manner, and the printing throughout the book is clear, and the type large and distinct.

The book has little claim from a literary point of view, but the author has described in plain words a system of cultivating fruit trees in pots which, if faithfully followed, will be attended with absolute success.

R. H. P.

A TRAVELLER'S COMPANION.

Stanford's Geological Atlas of Great Britain (based on Reynolds's Geological Atlas). By Horace B. Woodward, F.R.S., F.G.S. Pp. x+140; with 34 coloured maps and 16 plates of fossils. (London: E. Stanford, 1904.) Price 12*s*. 6*d*. net.

THIS work is a re-written and revised edition of the well known atlas, which was long a familiar object to the students of shop-windows near Temple Bar, associated as it was with geological diagrams of a highly venerable aspect. It was always attractive by its very neatness and compactness, and has gained further in these respects under Mr. Stanford's care. The maps are printed in colours, and the concluding plates of fossils, reproducing for the most part Mr. Lowry's refined workmanship, are almost as delicate as the engraved originals, which were published in 1853. These plates, by the by, are not now arranged so consecutively as could be desired. Mr. H. B. Woodward has brought the text up to a modern standpoint, and we note references to the Pendleside series, to the Mesozoic rocks in a volcanic vent in Arran, and to the occurrence of Pliocene mammalian remains in a fissure in Derbyshire—all matters of very recent history. The Upper Greensand and Gault are described and mapped together as Selbornian, a combination of great stratigraphical convenience, however much it departs from the petrological and geognostic mapping of early days. Here we see at once how the philosophic view of "organised fossils," introduced by William Smith, has made two types of geological maps necessary, one for the students of the earth's history, and one for the engineers, landowners, and agriculturists, to whom Smith made his first appeal. Luckily, in our British Isles, our "drift" maps, on a reasonable scale, go far to satisfy both requirements.

Mr. Woodward's descriptions of the various counties contain rather too much matter that could be discovered from the maps themselves. Though dealing with a land of most fascinating variety, they do not always rise to the demands made by the salient scenic features. Yet these are the features that strike the common traveller, to whom this work must always be a boon. From his point of view we have read the account of Gloucestershire a second time, and, of course, discover nothing to add, while we are grateful for a good deal of graphic description, tersely worded. The matter probably only needs a new arrangement, so that the reader who descends in imagination or in memory from the steep side of the Forest of Dean, and wonders at the great scarp of the Cotteswolds, facing him ten miles off across the Severn, is not dragged aside to learn that Coal-measures were discovered in the Severn Tunnel, and the irritating fact that "sulphate of strontium is worked at Wickwar in the Keuper Marl." The traveller wants to move forward; the open landscape lies before him; when he has gained his first broad physiographic view, he will condescend to search for fossils, and to rejoice in geodes of celestine.

The exceptional knowledge of the country possessed by the author is apparent in all these careful pages. He has added, moreover, exceedingly practical descriptions of the geology that is to be learned along the main lines of British railways. His views on the nomenclature of fossils are known from his published writings; but, while most of us are sadly inconsistent, he yields perhaps too little to the purists. If Mr. Woodward goes so far as Doryderma and Cœlonautilus, where none will blame him, why does he retain Ammonites and Goniatites as unrestricted generic names? Why *Echinocorys scutatus*, which seems to surpass the historical acuteness of Mr. C. D. Sherborn (see "Index to Zones of the White Chalk," *Proc.* Geol. Association, June, 1904), and, side by side with it, *Galerites albogalerus*? We doubt also Protocardium for Protocardia; but these matters are outside the main intention of the atlas. As a companion in Great Britain, this handy book is to be recommended to every traveller. The complete revision of the Scotch map, which is now so admirable, despite its comparatively small scale, makes us hope that Ireland, as a country of equal interest and variety, may be included in the next edition. G. A. J. C.

THE TEACHING OF SCIENCE.

The Preparation of the Child for Science. By M. E. Boole. Pp. 157. (Oxford: Clarendon Press, 1904.) Price 2*s.* 6*d.*

Special Method in Elementary Science for the Common School. By Charles A. McMurry, Ph.D. Pp. ix + 275. (New York: The Macmillan Company, 1904.) Price 3*s.* 6*d.* net.

A GREAT change in the character of the books concerned with the teaching of science has taken place during the last twenty years or so. A quarter of a century ago the claims of science to a place in the school curriculum were being advocated vigorously, and men of science had still to convince reigning schoolmasters that no education was complete which ignored the growth of natural knowledge and failed to recognise that an acquaintance with the phenomena of nature is necessary to intelligent living. Speaking broadly, it may be said that most classicists even admit now that there are faculties of the human mind which are best developed by practice in observation and experiment. One consequence of the success which has followed the persistent efforts of Huxley and his followers—to secure in the school an adequate recognition of the educative power of science—has been that modern books on science teaching are concerned almost entirely with inquiries into the best methods of instructing young people, by means of practical exercises, how to observe accurately and to reason intelligently.

Mrs. Boole deals with the earliest education of the child, and gives a great deal of attention to the years which precede school life. Her book may be warmly recommended to parents anxious to adopt sane methods of educating their children and to teachers responsible for the training of the lowest classes of schools. Mrs. Boole rightly insists that the development in the child of the right attitude towards knowledge is of more importance during early years than the actual teaching. We agree with her, too, that "the best science teacher is usually a thorough-going enthusiast in the science itself, who in the intervals of regular teaching, gets his pupils to assist him in his own investigations or pursuits." But, unfortunately, the teaching profession is at present hardly attractive enough to secure the services of a sufficient number of ordinarily well educated men, and we shall have to wait a long time before we can expect to find many men of science engaged upon original research also teaching science to children in schools. Mrs. Boole's little book deserves to be read widely.

Like many other American educationists, Dr. McMurry attempts to do too much for the teacher. The larger part of his book is devoted to "illustrative lessons" and "the course of study," minute instructions being given as to what science subjects should be taught in each of the terms of each of the years spent by children in the elementary school. The teacher will deal most satisfactorily with those subjects of science he knows best, and in which he is most interested. From the point of view of the British teacher at least, it is inadvisable to attempt to impose a detailed scheme of work drawn up by somebody in another district and unfamiliar with the precise conditions and environment of the school in which the science teaching is to be done. Even if this were not the case, Dr. McMurry's scheme of work expects the class to accomplish far more in a term than can be studied satisfactorily in that period. Moreover, subjects too diverse, and hardly at all related one to the other, are prescribed for a single term. But Dr. McMurry's ideal is better than his practice; he says:—"it is easy for us to expect too much from formal method. The atmosphere which the teacher diffuses about him by his own interest and absorption in nature studies is more potent than any of the devices of method." A. T. S.

OUR BOOK SHELF.

The Basic Law of Vocal Utterance. By Emil Sutro. Pp. 124. (London: Kegan Paul and Co., Ltd., n.d.)

Duality of Voice and Speech. An Outline of Original Research. Pp. vi+224. (London: Kegan Paul and Co., Ltd., n.d.)

Duality of Thought and Language. An Outline of Original Research. Pp. viii +277. (London: Kegan Paul and Co., Ltd., n.d.)

THE first of these volumes, which was originally published in America in 1894, contains the starting point and main beliefs of the author; the second and third volumes form the amplification and illustration. Beginning with the practical problem of finding how a foreigner, especially a German, can learn to speak English correctly, Mr. Sutro has gone on until he has become convinced that he has discovered several most important scientific truths, and that he has a great mission to carry out in proclaiming them.

Among the discoveries stated in these volumes the following may be mentioned. There are two streams in the air which is breathed, which keep separate, one being for respiration, the other for sound. A person who breathed correctly might use the air supplied by the sound current in such a way as to speak for ever without taking breath, were it not for fatigue. For English speech we inspire through trachea and expire through œsophagus; for German the direction is reversed. The author has discovered a new vocal cord in the lower jaw. Air passages are diffused through the body; it is through these that the emotional nature of sound is produced. The original source of tone production has its location in the lungs, the kidneys, and the bladder for the most part. For the utterance of a word representing a flower there is an impression made on the right side of the thigh, while the expression is on the left side just opposite, the order being reversed for the corresponding German word. Just how we breathe into and out of the pelvis the author expects to explain satisfactorily in a future volume. Statements such as these, together with philosophical reflections and practical discussions as to the way in which the production of different sounds should be managed, fill the three volumes.

The volumes are not without a certain kind of interest that of observing the process by which a man, who is evidently in earnest, comes to elaborate and believe such nonsense. It is at the same time possible that there may be in the remarks regarding the way in which sounds should be produced something which would be suggestive to one engaged in the practical work of teaching in this subject. According to Mr. Sutro, America has left his works almost unnoticed, while Germany has given a more favourable reception to them. It appears that an International Physio-Psychic Society has been founded for the propagation of the views put forward in these volumes.

A Select Bibliography of Chemistry, 1492–1902. By H. C. Bolton. Second supplement. Pp. 462. (Washington: Smithsonian Institution, 1904.)

THE present volume of the "Select Bibliography" is the second supplement which has been published since the first issue in 1893, and carries the work down to 1902.

One can only admire the patient labour of the author, now unfortunately removed by death, who has placed in the hands of chemists all over the world a book of reference of such permanent value.

The supplement contains the titles of books published between 1898 and 1902 inclusive, in which the same subdivisions are preserved as in the first volume. It is just a question whether the last subdivision—academic dissertations—which fills nearly half the book, is worth the trouble it has entailed. It consists almost entirely of the titles of dissertations for the German doctorate, which in Germany often find their way into booksellers' hands, but are merely reprints of memoirs that have appeared in the scientific journals. The list is necessarily incomplete, and the trouble of indexing it must have been enormous. The proof-reading, as well as the preparation of the index, have been done by Mr. Axel Moth, of the New York Public Library. J. B. C.

Hints on Collecting and Preserving Plants. By S. Guiton. Pp. ii+55. (London: West, Newman and Co., 1905.) Price 1*s.*

THE collector of plants, whether he is merely pursuing a hobby or whether his object is to acquire specimens for reference which will enable him to get a better knowledge of systematic botany, ought to be acquainted with the best methods of preparing and arranging a herbarium. For information he will find this small book useful. Some of the suggested details are not absolutely necessary, but a little experience will soon show which are essential. In some respects Mr. Guiton tends to what one may call the collector's views, as, for instance, when he recommends gumming the specimens on cardboard; the more usual practice of fixing them by means of gummed slips on drawing paper is cheaper, and allows the specimens to be taken off for examination. The preference of iron grids in place of wooden ventilators, the advantages of cotton mattresses, and other such details which might be suggested are rather matters of individual taste; so long as a collector takes as much care as Mr. Guiton, his herbarium will be a pleasure, not only to himself, but also to kindred botanists.

Practical Retouching. By Drinkwater Butt. Pp. xv+78. (London: Iliffe and Sons, Ltd., 1904.) Price 1*s.* net

THIS book forms No. 10 of the *Photography* Bookshelf Series, and will be found a useful addition. The matter contained in it originally appeared in the pages of *Photography* in 1901, but the author has brought the information up to date and presented it in the present form, which will be found convenient for beginners. The chapters are eight in all, and after the preliminary ones dealing with things to be done and to be avoided, and the apparatus and material required for the work, we have those on general manipulations, manipulations in detail of portrait work and inanimate objects, concluding with the use of the back of the negative for further hand-work.

Stories from Natural History. By Richard Wagner. Translated from the German by G. S. Pp. viii+177. (London: Macmillan and Co., Ltd., 1904.) Price 1*s.* 6*d.*

THESE interesting stories dealing with subjects of natural history are presented in excellent English. The translator's style is graceful, and the language chosen is of a kind which will appeal to children; while the scientific information is sound as well as instructive. A young reader should learn incidentally a great deal about animal life, and at the same time be given sympathetic interest in it. The little volume is suitable for a reading book in the higher standards of the elementary school and for the lowest forms of a secondary school.

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.]*

Compulsory Greek at Cambridge.

My own experiences are somewhat different from those of your correspondents, but the result is the same. I commenced Greek when about thirteen; I passed the London matriculation, the entrance examination at Trinity, and the Little-go without any difficulty; and I have read the three synoptic gospels in the original, several Greek plays, and a certain amount of Homer, Xenophon, and Thucydides. Now, if all the knowledge I thus acquired had been of any practical value to me in after life, I should, as a matter of ordinary common sense and worldly wisdom, have kept it up; but, finding Greek absolutely useless, my acquaintance with the language has so completely faded away that I can scarcely make out the sense of a Greek quotation in a historical or theological work.

It has often been a matter of profound regret to me that the time spent on Greek was not devoted to German, for if it had I should have been able to speak the language sufficiently well to enjoy during my whole life German society, German literature, and German places of amusement.

I have never been able to discover any educational value in a training which condemns boys to grind up pages of Greek declensions and irregular verbs. In my experience of life a youth who, after acquiring some knowledge of the grammar of a modern language, is made to read easy books on the manners, customs, and history of the country where the language is spoken (and nothing is better than a well-written novel) is far better equipped for the battle of life, and is a far more agreeable companion both intellectually and socially, than a man whose boyhood has been spent in studying musty old mythologies, which nobody troubles about nowadays except the select few who have made such subjects the hobby of their lives.

By all means let the bishops continue to require a knowledge of Greek (and also of Hebrew) on the part of candidates for orders, on the ground that these subjects ought to be considered part of the professional stock-in-trade of a clergyman; but special studies of this kind, like law in the case of barristers and solicitors, need not be commenced until a youth has decided upon the profession he intends to follow. A. B. BASSET.

January 27

Can Birds Smell?

EXAMINATION of the Bird's brain shows that the sense of smell can be but little developed. The olfactory bulbs are small. No medullated nerve-fibres unite them with the rest of the brain. Yet in no birds are the bulbs entirely absent, so far as I am aware. The olfactory membrane of birds presents certain structural peculiarities which are difficult to interpret. The nasal chambers which it lines are not large in any bird, but in some they are sufficiently extensive to suggest that olfaction is not completely in abeyance. The fact that they are better developed in birds which seek their food in the sea (petrels, the tropic bird, &c.), in which pursuit smell can, one would suppose, be of little service, than they are in most other birds seems to indicate that they have some function other than olfaction. Perhaps they serve to warm the inspired air; although here again we are confronted with the difficulty that, in the frigate bird (Fregata), in which the nasal chambers are relatively large, the nostrils are obliterated. Air may, of course, enter the nasal chambers through the cleft palate, but such a mechanism cannot provide for the warming of the air on its passage to the lungs. The teachings of anatomy being so obscure, it seemed to me desirable that direct observations should be made.

A study of the habits of flesh-eating birds shows that if they possess the sense of smell at all, it is not sufficiently acute to enable them to use it in finding food. All observers are agreed that when a carcase is hidden, by never so slight a screen, it is safe from the attacks of vultures and other carrion-seekers; but the most remarkable proof of the ineffectiveness of the sense (if it exist at all) is afforded by experiences which Dr. Guillemard was good enough to relate to me. Many times it has happened, he tells me, that, having shot a wildebeest or other game which was too heavy to carry home, he has disembowelled it, and has hidden the carcase in the hole of an "ant-bear." On returning with natives to carry it to camp, he has found a circle of vultures standing round the spot where the offal had been thrown, completely unaware of the carcase within a few yards of their beaks. Of observations proving the possession of the sense I know none, unless we are willing to accept as evidence the belief, which is very general among fanciers, that birds are attached to the smell of anise, and the similar belief of gamekeepers in some parts of the country that they are attracted by valerian. It is said that pigeons may be prevented from deserting the dove-cote by smearing their boxes with oil of anise. Poachers are supposed to lure hen-pheasants from a wood by anointing gate-posts with tincture of valerian.

With the view of testing the smelling powers of graminivorous birds, I placed a pair of turkeys in a pen which communicated with a large wired-in run. The pen was closed by means of a trap-door. In the run I placed, each day, two heaps of grain, right and left of the trap-door, but so far in front of it that they made with it an angle of about 50°. Various substances which give out a powerful odour were placed under one of the heaps, alternately the right and the left. The birds were lightly fed in the morning in their pen. At two o'clock the trap-door was raised, and they were admitted to the enclosure. It was curious to note that after the first few days the hen almost always came out first (in the last ten experiments this rule was broken but once), and invariably went to the heap on her right; the cock following went to the heap on the left. The cock usually tried the hen's heap after feeding for a short time from his own, but the hen never trespassed upon the preserve of the cock. In the earlier observations I placed beneath one of the heaps a slice of bread soaked with tincture of asafœtida, essence of anise, oil of lavender, or sprinkled with valerianate of zinc or powdered camphor. When the birds, plunging their beaks into the bread, took some of the tincture or essential oil into the mouth, the head was lifted up and shaken, but they immediately recommenced to peck at the grain. They were completely indifferent to the presence of camphor or valerianate of zinc. In several cases in which these substances were used, they consumed the bread. As a turkey does not steady the thing at which it is pecking, with its foot, but, seizing it in the beak, shakes it violently until a piece is detached, it is probable that most of the powder was shaken from the bread. As these experiments gave absolutely negative results, the birds showing neither preference for nor repugnance to any of the odorous substances used, I proceeded to stronger measures. The grain was placed upon a seven-inch cook's sieve, inverted. The odorous substance was placed beneath the sieve. Each of the following experiments was repeated three times, first with a small quantity of "smell," then with a great deal, and lastly with as much as possible. It is only necessary to describe the final tests. Four ounces of carbide was thrown into a saucer of water and placed beneath one of the sieves. There was no reason to think that the birds were aware of the existence of the acetylene which was evolved. The saucer was filled with bisulphide of carbon. The hen turkey finished her meal. When the grain was exhausted she knocked the sieve over with her foot. Both birds then lowered their beaks to within half an inch of the colourless liquid, which they appeared to examine. It is, perhaps, unfortunate that they had already satisfied their thirst at the water-trough. A bath sponge soaked in chloroform was placed under the sieve, the wire of which rested upon it. The hen finished her meal without leaving the sieve. Towards the end she pecked very slowly, and frequently raised her head and stretched her wings as if partially narcotised. This experiment was repeated on the cock, but I could not detect any indications of narcosis. The saucer was filled with hot dilute sulphuric acid, into which an ounce of powdered cyanide of potassium was thrown. The evolution of prussic acid was so violent that I considered the neighbourhood unsafe. My gardener, who was working thirty yards away, spoke to me of the "smell of almonds." For some minutes the cock turkey fed with his usual eagerness; then, suddenly, he began to stagger round the enclosure, crossing his legs and holding nis beak straight up in the air. He made his way back into the pen, where he stood with head down and wings outstretched. After ten minutes he returned to the enclosure, but did not eat any more grain. His comb and wattles were deeply suffused with blood.

In all observations on the sense of smell of animals we have an obvious difficulty to face. There is no reason for supposing that an animal enjoys an odour which pleases us or dislikes one which we find disagreeable. My dog appeared to be almost indifferent to bisulphide of carbon. He showed, however, great repugnance to chloroform and prussic acid. It is difficult to think that an animal which is unable to protect itself from the injurious effects of such drugs as these can possess the sense of smell.

I shall be very grateful to any of your readers who will give me information on this subject. Especially should I be glad to learn something about the habits of wingless birds, the mode of life of which, more or less, resembles that of a terrestrial mammal. In them, if in any birds, it would seem likely that the sense of smell would be efficient. In his memoir on the Apteryx, Owen stated that "the relative extent and complexity of the turbinated bones and the capacity of the posterior part of the nasal cavity exceed those of any other bird; and the sense of smell must be proportionately acute and important in its economy."

Downing College Lodge, January 26. Alex. Hill.

The Origin of Radium.

In the issue of Nature for January 26, Mr. Soddy describes the present position of his experiments on the production of radium from compounds of uranium, and announces a positive result.

Since I wrote on May 5, 1904, pointing out that, on the theory of Rutherford and Soddy, the quantity of radium developed by a few hundred grams of uranium should be measurable in a few months, a quantity of about 400 grams of uranium nitrate has been preserved in my laboratory.

I am not yet prepared to give definite quantitative results, but Mr. Soddy's announcement may perhaps excuse a preliminary statement that the quantity of radium emanation now evolved by my uranium salt is distinctly and appreciably greater than at first.

A rough calculation of the rate of growth of radium indicates a rate of change far slower than that suggested by the simplest theory of the process, but somewhat quicker than that given by Mr. Soddy, who finds that about 2×10^{-12} of the uranium is transformed per annum. As Mr. Soddy says, it is possible that the total amount of emanation is not secured, and the fraction obtained may depend to some extent on the particular method used by each experimenter. But another possibility should be borne in mind. If a non-radio-active product, intermediate between uranium and radium, exists, the rate of appearance of radium would be slower at first, and quicker as the experiment proceeds. My uranium salt was not purified so successfully as that used by Mr. Soddy, and, when the first measurement was made a month or so after preparation, the yield of radium emanation was appreciable. It may be that Mr. Soddy is tracing the process from its inception, and that I have started at a later stage, where the rate of formation is somewhat greater. Further observation may be expected to elucidate these and other questions. W. C. D. Whetham.

Cambridge, January 30.

Fact in Sociology.

I addressed a letter to the editor of Nature replying to what I allege to be misrepresentations and misstatements in a review of three of my books by "F. W. H." (December 29, 1904, p. 193). After a delay of some weeks due to the absence of "F. W. H." abroad, the editor of Nature has written to ask me to modify and shorten my protest.

"F. W. H." told the readers of Nature that my "Food of the Gods" "claimed to forecast the future." This was untrue, and I said so.

"F. W. H." mixed up my discussion of probabilities in "Anticipations" with my general review of educational influences in "Mankind in the Making," and presented this as my ideals. I pointed out that this was an unsound method of criticism.

"F. W. H." presented the following as my opinions:—"Germany will be cowed by the combined English and American Navies, and Anglo-Saxonism will eventually triumph. There remain the Yellow Races. Their star, too, will pale before that of the Anglo-Saxons." I repudiated this balderdash with some asperity. It is violently unlike my views.

He wrote of me, "he seems unaware of the part in the national life that is played by the lower stratum of society, the 'stagnant' masses as he would call them." I denied that I should, and pointed out that no one does know what part is played by any stratum of society in national reproduction. It is a field of unrecorded facts. I commented on "F. W. H.'s" assumption that he was in possession of special knowledge.

He wrote of "the fact that this stratum is an absolute necessity." This is *not* a fact. It may or may not be true. I commented on this use of the word "fact" in view of "F. W. H.'s" professorial sneer at my "imagination unclogged by knowledge."

He declared that I want to "get rid of the reckless classes, and depend solely on the careful classes," a statement which has not an atom of justification. He not only "guys" my suggestions, but foists an absolutely uncongenial phraseology upon me.

Finally, he wrote, "we are to introduce careful parentage, *that is*, put a stop to natural selection." I quoted this in view of his statement that I had "no very thorough grasp of the principles of evolution." I discussed what appeared to be his ideas about evolution. They appeared to me to be crude and dull, and I regret I cannot condense my criticisms to my present limits.

I expressed some irritation at his method of misstatement followed by reply, and hinted a doubt whether my own style of inquiry—in spite of the fact that romances blacken my reputation—was not really more scientific than his. H. G. Wells.

The Fertilisation of Jasminum nudiflorum.

This well known plant, in accordance with its usual habit, has been flowering in my garden at Stonehaven, Kincardineshire, since the third week in December, 1904, and amidst frost and snow and cold winds. There are no leaves, but there are thousands of bright yellow flowers. It is a puzzle to me how fertilisation is effected. The two stamens are situated about half-way down the tube of the corolla, and about four or five millimetres below the style, which is, in many cases, two millimetres longer than the tube of the corolla. It seems to me to be a plant requiring the aid of insects in its fertilisation, but there are no insects to be seen at this time of the year. On January 22, as there was some sunshine, I watched the plant for about four hours, but no insect paid it a visit. At the same time I found the oblong anthers had split and pollen grains were sticking to the stigma in many flowers. The brilliantly coloured flowers, although destitute of scent, are fitted to attract insects, and the form of the flower seems adapted for their visits. But there are no insects! Can anyone offer an explanation? The plant is beautifully figured in the *Botanical Magazine*, lxxviii., tab. 4649. John G. McKendrick.

University of Glasgow, January 24.

The Moon and the Barometer.

It is an old popular belief that weather tends to be more settled about full moon. Here are some sayings from Inward's "Weather Lore":—

"The three days of the change of the moon from the way to the wane we get no rain" (United States).

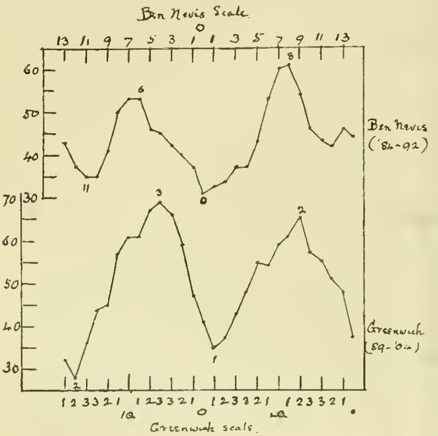
"The weather is generally clearer at the full than at the other ages of the moon" (Bacon).

"In Western Kansas it is said that when the moon is near full it never storms."

"The full moon brings fine weather." "The full moon eats clouds." (This disappearance of cloud Mr. G. F. Chambers pronounces "a thoroughly well authenticated fact.")

The following evidence in this connection seems to me instructive. It relates to Ben Nevis (1884–1892, nine years) and Greenwich (1889–1904, sixteen years), and to the summer half only (to be more exact, the six lunations commencing with that which had full moon in April).

The method was as follows:—In the case of Ben Nevis, fourteen columns were arranged for the fourteen days ending with full moon, and fourteen for those following full moon. Each day with barometer under 25·2 was re-



presented by a dot in those (graduated) columns; total 407. The dots in each column were then counted, and the sums obtained were added in groups of three (first to third, second to fourth, third to fifth, and so on). Thus we get the upper curve in the diagram.

In the case of Greenwich, the method was slightly different (see lower horizontal scale). The columns were for seven days about each of the four phases. For comparison with the Ben Nevis curve we commence with the first day after new moon. The days here considered were those with barometer under 29·6 inches; total, 476.

These two curves seem to tell much the same tale; *few* days of low barometer about (just after) full and new moon, *many* such days about (just after) the quarters. Thus, so far as the summer half in those twenty-one years is concerned, the popular belief would appear to be vindicated.

To give a fuller idea of the relations, I add a table of the maximum and minimum values (each number is, of course, the sum of three):—

	First min.	First max.	Second min.	Second max.
Ben Nevis	35	53	31	61
Greenwich	28	69	35	65

It will be seen that the chief maximum is about double the chief minimum in one case, and more than double in the other.

In a dot-diagram, where each day is represented separately according to its barometer (not merely grouped with others as below a certain limit), the contrast between the phases comes out still more clearly.

The view here given apparently finds support from various quarters. In the *Meteorologische Zeitschrift* for 1900, p. 421, Herr Börnstein gives a curve of pressure for Berlin (May to August in 1883–1900) which is of similar type to those in the diagram. Fr. Dechevrens informs me that the results above given agree with those of his own observations in China, Constantinople, and Jersey. M. Sainte Claire-Deville found the same variation at Cayenne, in French Guiana.

With regard to the winter half (October to March), the *régime* would appear to be somewhat different, but I cannot speak definitely of it at present.

Whether the facts presented be thought to indicate lunar influence or not, it may be of interest to watch future weather (in the summer half) from the point of view suggested. ALEX. B. MACDOWALL.

Reversal in Influence Machines.

THE method suggested for producing reversal on a Voss or Wimshurst will not be found always trustworthy. Atmospheric conditions make a great difference. I have been experimenting for more than a year with the view of finding a solution of the reversal problem, and think I have succeeded in tracing the cause, which is primarily connected with dielectric strain. A Wimshurst with the dischargers beyond sparking distance, working at full speed, will often reverse if the discharge is made by suddenly connecting the terminals, but there is no certainty in producing this effect. I have recently constructed an influence machine akin to the Voss except that the replenishment is from the back of the disc. Reversal is still the stumbling block, and must occur with fixed inductors, while no plan for controlling the reversal can be relied upon. I should be happy to give any of your correspondents fuller particulars of my experiments if they will communicate with me. CHARLES E. BENHAM.

Colchester, January 14.

Dates of Publication of Scientific Books.

MAY I through your columns suggest to publishers—especially of scientific and mathematical books—to give in their catalogues the dates of publication of their books? As a book often gets out of date very soon, such an addition would greatly help those who have no access to good libraries in selecting books to be purchased. I may say that this is done almost invariably in the catalogues of French and German publishers. To take an instance, the Clarendon Press still includes Price's "Infinitesimal Calculus" in its catalogue. Now, although to one who wants to study the subject in an exhaustive manner the book is very valuable, still, to one who wishes to know the principles only, the book is, to say the least, not worth the big price asked for; and if the date of publication were mentioned in the catalogue, the purchaser would at any rate know that he was not buying an up to date book. R. P. PARAIYPYE.

Fergusson College, Poona, India, January 1.

Super-cooled Rain Drops.

THE letter which appeared in your last issue (p. 295) from Mr. Robinson with reference to this interesting phenomenon reminds me of a similar case which I observed in Bournemouth during the winter of 1888, and I described in NATURE at the time under the title, "Is Hail thus Formed?" (vol. xxxvii., p. 295).

CECIL CARUS-WILSON.

PARA RUBBER.[1]

IN recent years the cultivation of rubber-yielding trees has attracted an increasing amount of notice. About 12,000 acres in Ceylon, and in the Malay Peninsula a still larger area, have been stocked with the Para rubber tree, *Hevea brasiliensis*, and other species of Hevea. The cultivation has also been successful in India and South America, and experimental plots are being tested in Uganda and the Gold Coast Colony.

In tropical Africa there are thousands of square miles of land suitable for growing the Para tree. But whilst the demand for rubber has been increasing with the development of the electrical and motor industries, the number of forest trees yielding the substance has been diminishing, year by year, as a consequence of the faulty methods of "tapping" employed by the natives. Hence a stimulus has been given to the production of rubber by cultivation; and with a view of fostering the industry in West Africa, Mr. Johnson was commissioned by Government in 1902 to visit Ceylon and study the methods employed there in the management of the plantations and the preparation of the rubber. He now gives, for the benefit of persons taking up the cultivation, some of the results of the visit in the form of such practical advice as would be likely to assist them in their undertaking.

The rubber trees are raised from the seeds, which may be obtained from Ceylon or the Straits Settlements at a cost of about 6*s*. 8*d*. per thousand. When the tree has attained a girth of twenty to twenty-four inches, the latex can safely be tapped; this may be in about five to seven years from the date of planting. The yield varies greatly, depending on the soil, the age of the tree, and the method of tapping. At present no really satisfactory data are available; but from such statistics as are given it would seem that about 1 lb. to 3 lb. of dry rubber *per annum* may be the average product of each tree. In addition, the seeds yield a drying oil somewhat resembling that obtained from linseed. As regards the latex-bearing "life" of the trees, it is stated, on the authority of the director of the Botanic Gardens, Straits Settlements, that trees are known to have been tapped, off and on, during fifty years, and to be still yielding a plentiful supply of latex.

The rubber-substance is contained in the latex of the plant in the form of minute globules, much as butter-fat exists in cow's milk. These globules can be made to coalesce by centrifugal action, just as cream is formed from milk in an ordinary separator; but the product thus obtained does not, apparently, compare favourably with the rubber given by the older methods of separation. These consist in coagulating the latex, either by simple exposure to the air or by the addition of an acid or a salt; the resulting coagulum is washed and rolled to free it from moisture and nitrogenous matters, and then dried by gently heating. The particular process suggested by the author is that of spontaneous coagulation of the latex in shallow saucers, followed, after washing and rolling, by exposure to the smoke of a wood fire as an antiseptic treatment. The price

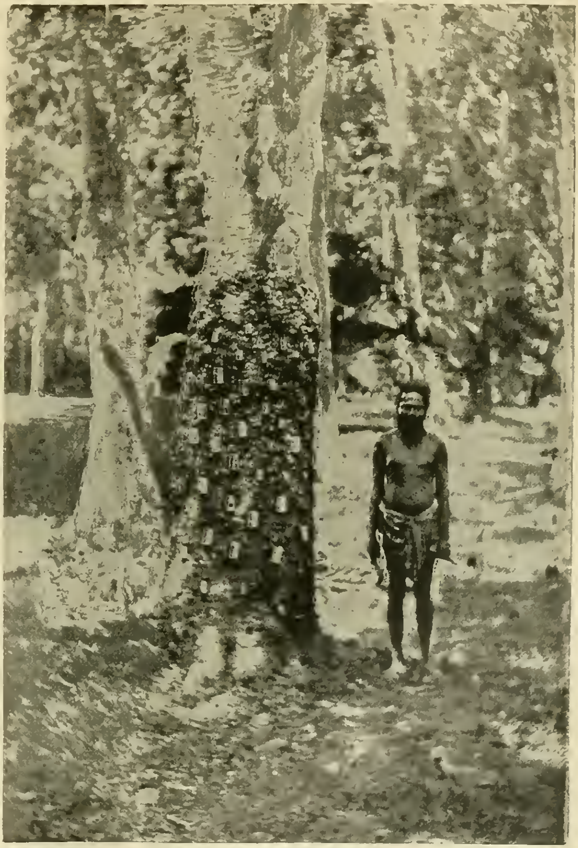


FIG. 1.—One of the Parent Trees of the Para Rubber Industry in the East, growing in the Botanic Gardens, Henaratgoda, Ceylon. (From "The Cultivation and Preparation of Para Rubber.")

obtained depends largely upon the care exercised in the preparation. For example, Congo rubbers, which some time ago realised only 1*s*. to 1*s*. 6*d*. a pound, now often fetch 4*s*. in consequence of being more carefully prepared. As showing what can be done in this direction, it is interesting to note that Ceylon Para rubber has recently commanded the "record" price of 5*s*. 6*d*. per pound.

The appurtenances required are of the simplest,

[1] "The Cultivation and Preparation of Para Rubber." By W. H. Johnson. Pp. xii+99. (London: Crosby Lockwood and Son, 1904.) Price 7*s*. 6*d*. net.

and no great demand is made upon the skill of the cultivator who desires to try his fortune in this direction. As regards the call upon his capital, some idea of the cost of opening and maintaining a plantation will be obtained from the estimates which the author supplies, showing the expenditure in Ceylon and the Malay Peninsula. As an alternative to tea-planting, orange-growing, and cattle-ranching, the production of rubber would seem to be well worth consideration by young Britons who go abroad in search of a competency. C. SIMMONDS.

PREHISTORIC ENGLAND.[1]

As this volume contains a notice by the publishers that they "will shortly begin" the issue of the series of "The Antiquary's Books," to which this belongs, it may be assumed that it is the first. For the reason that it is an earnest of the quality to be expected in its successors, the book, both in manner and matter, must be treated in somewhat more critical and judicial fashion than if the series had been already fairly launched. The responsibility of a publisher in placing an antiquarian library before the public is never light, and at the present time it suffers from the inequality of modern knowledge in respect to the various prehistoric and archæological periods. The later stages of the former class have vast floods of light thrown upon them by the constantly recurring discoveries in the Levant, and the comparative method has enabled us to classify many of our native antiquities by their means. In regard to the earlier stages of man's existence we are in the main still advancing at a painfully slow rate, and can scarcely be held to have more than a misty comprehension of the subject. In historic times the same want of balance of knowledge exists equally, though it is a far easier task to mask the difficulty, and to produce a nicely balanced tale from groups of facts of very different values.

The present volume deals only with the relics of man in Britain anterior to the coming of the Roman invaders, and in a sense, therefore, may be called prehistoric, for nothing in the nature of a native record can be quoted in support of any part of it. The author by his title, moreover, limits his field to the remains

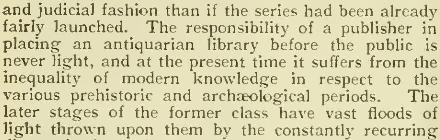


FIG. 1.—Section of Barrow with successive Interments. From "Remains of the Prehistoric Age in England."

of the dwellers in Britain, that is to say, to the monuments they raised, the implements they made, and the graves in which they deposited their dead. The racial characteristics, as shown by the physical characters, are treated very briefly, and the burning questions of the priority of Brythons and Goidels in the land, of the precise position of the Picts as an indigenous tribe, of the succeeding immigrations from the Continent bringing with them new types of people, of weapons, or of burial customs, are only incidentally mentioned.

By the elimination of all these questions Dr. Windle has set himself an infinitely lighter task; but it is to be questioned how far an intelligent reader can gain a true understanding of the conditions described without some fuller information on these points. It must be confessed, however, that the subject bristles with difficulties of all kinds and has tempting pitfalls for even the wary searcher, and, on the other hand, Dr. Windle has a right to set his own limits. Even within these limits he may be thought somewhat hardy, for to give an adequate account of all the material relics of man in Britain from the dawn of human life up to about 2000 years ago, within the compass of little more than three hundred pages, is not a thing to be undertaken with a light heart. One of the principal difficulties to be overcome is to avoid confusion in exposition and arrangement. In this matter Dr. Windle might have had more success. In

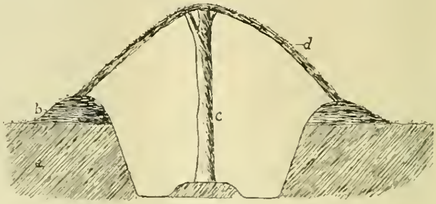


FIG. 2.—Ideal Section of Pit-dwelling. *a*, Natural soil; *b*, Bank of same heaped up around Pit; *c*, Central support of Roof; *d*, Roof of Turfs and Branches. From "Remains of the Prehistoric Age in England."

more cases than one, instances of special types of implements are quoted without giving the very necessary information that they belong to widely different periods. For instance, in dealing with "pygmy flints," a puzzling subject, Dr. Windle quotes a number of surface finds, and then goes on to say, "in France they have been discovered at Bruniquel." This can only mislead the inquirer or the student, for, so far as we know, the Bruniquel station, which is undoubtedly of the mammoth period, has no relation at all to such surface finds as have been made in Lincolnshire, Lancashire, India, or Belgium. Nothing is more certain than that mere type or form alone is the most unsafe criterion of age.

This elementary axiom may sound very like a platitude, but it is constantly neglected by men whose words carry weight, and cannot, therefore, be too much insisted upon. Such errors or vague statements affect the essentials of prehistoric science, and if persisted in inevitably retard the advance of knowledge instead of accelerating it, as Dr. Windle undoubtedly wishes to do. Again, it is very questionable wisdom to devote a chapter to "bone implements," the paragraphs dealing indiscriminately with the remains from the French caves, the Swiss lakes, and from a station like Grime's Graves. In the first place, there is again no relation between the sites quoted, and, so far as the French caves are concerned, the "bone" implements are mostly of horn. No doubt the information necessary to a proper understanding of the relative ages of the Dordogne caves, the Swiss lake dwellings, and the Norfolk flint pits is to be found elsewhere in the book; but for a popular work dealing with a difficult and complicated subject the first essential is clearness of exposition beyond all possibility of misunderstanding.

Further, Dr. Windle's authorities are occasionally antiquated. It is not treating the reader quite fairly to give him Dr. Thurnam's classification of barrows without qualification. Is it, for instance, quite certain in the light of recent knowledge that all round barrows are of the Bronze age? It is also a trifle hard to find the late Dr. Frazer quoted as an authority on

[1] "Remains of the Prehistoric Age in England." By Bertram C. A. Windle, Sc.D., F.R.S. Pp. xv + 320; illustrated. (London: Methuen and Co.) Price 7*s*. 6*d*. net.

gold in Ireland, while Salomon Reinach is not even mentioned. A little discrimination would have shown that Mr. Romilly Allen was making a curious statement (p. 293) when he said: "The bowls . . . seem to belong to the end of the Late Celtic period and the beginning of the Saxon." What becomes of the four hundred and odd years intervening between the two, when the Roman power was dominant in Britain? Such statements betray a carelessness that is not easily excused in a man of Dr. Windle's standing. The same want of precision is shown in "Hallstadt" for Halstatt, "Collie March" on one page and "Colley March" on another, the "forging" of bronze instead of "casting," and others of the same kind. In the circumstances it is a hard thing to say, but the illustrations leave much to be desired. The two figures we reproduce show diagrammatically a barrow with successive interments, and a restoration of a pit dwelling, from Mr. George Clinch's Kentish discoveries.

The book might easily have been so much better, for it has many good and useful points, that there is something exasperating in finding much to quarrel with. The index is a good and useful one, the lists of ancient remains an excellent departure, compiled with all modesty, and there is a great deal of clear treatment of some knotty questions, such as the so-called "Eolithic" period. As a series, the size of the volume is convenient and the print good, and in spite of the strictures we have felt bound to make, there is little doubt that the publishers will find a ready sale.

MEETING OF THE BRITISH ASSOCIATION IN SOUTH AFRICA.

The British Association will hold its meeting this year in South Africa. In these exceptional circumstances, the general officers of the association requested the council to appoint a strong committee to cooperate with them in carrying out the necessary arrangements. This "South African Committee" has held frequent sittings, and its work is so far advanced that it is now possible to make the following announcements.

Although the annual circular and programme have not yet been issued, pending the receipt of information from South Africa, many members have already intimated their intention of being present at the meeting. The "official party" of guests invited by the central executive committee at Cape Town, and nominated in the first instance by the council of the association, numbers upwards of 150 persons, comprising members of the council, past and present general officers and sectional presidents, the present sectional officers, and a certain proportion of the leading members of each section. To this list has yet to be added, on the nomination of the organising committees, the names of representative foreign and colonial men of science, the total number of the official party being restricted to 200, including the local officials. It is hoped, however, that many other members of the association will also attend the meeting.

The presidents-elect of the various sections are as follows:—

A (Mathematical and Physical Science), Prof. A. R. Forsyth, F.R.S.; B (Chemistry), Mr. G. T. Beilby; C (Geology), Prof. H. A. Miers, F.R.S.; D (Zoology), Mr. G. A. Boulenger, F.R.S.; E (Geography), Admiral Sir W. J. L. Wharton, K.C.B., F.R.S.; F (Economic Science and Statistics), Rev. W. Cunningham; G (Engineering), Colonel Sir Colin Scott-Moncrieff, G.C.S.I., K.C.M.G., R.E.; H (Anthropology), Dr. A. C. Haddon, F.R.S.; I (Physiology), Colonel D. Bruce, F.R.S.; K (Botany), Mr. Harold Wager, F.R.S.; L (Educational Science), Sir Richard C. Jebb, M.P.

The vice-presidents, recorders, and secretaries of the eleven sections have also now been appointed.

In view of the numerous towns to be visited by the association, and in which lectures or addresses will be given, the number of lecturers appointed is much larger than usual. The list of these, as at present arranged, is as follows:—

Cape Town: Prof. Poulton, on Burchell's work in South Africa; and Mr. C. V. Boys, on a subject in physics. *Durban*: Mr. F. Soddy, on radio-activity. *Maritzburg*: Prof. Arnold, on compounds of steel. *Johannesburg*: Prof. Ayrton, on distribution of power; Prof. Porter, on mining; and Mr. G. W. Lamplugh, on the geology of the Victoria Falls. *Pretoria* (or possibly *Bulawayo*): Mr. Shipley, on a subject in zoology. *Bloemfontein*: Mr. Hinks, on a subject in astronomy. *Kimberley*: Sir William Crookes, on diamonds.

As the wish has been conveyed to the council from South Africa that a few competent investigators should be selected to deliver addresses dealing with local problems of which they possessed special knowledge, a geologist, a bacteriologist, and an archæologist have been invited to undertake this work, involving in two cases special missions in advance of the main party. Whilst Colonel Bruce, F.R.S., will deal with some bacteriological questions of practical importance to South Africa, Mr. G. W. Lamplugh (by the courtesy of the Board of Education) will be enabled to investigate certain features in the geology of the Victoria Falls—particularly as regards the origin and structure of the cañon—and Mr. D. R. MacIver, who is at present exploring in Nubia, will proceed in March to Rhodesia in order to examine and report on the ancient ruins at Zimbabwe and also at Inyanga.

Most of the officials, and other members of the association, will leave Southampton on July 29 by the Union Castle Mail SS. *Saxon*, and arrive at Cape Town on August 15, the opening day of the meeting; but a considerable number will start from Southampton on the previous Saturday, either by the ordinary mail-boat or by the intermediate steamer sailing on that date.

The sectional meetings will be held at Cape Town (three days) and Johannesburg (three days). Between the inaugural meeting at the former and the concluding meeting at the latter town, opportunities will be offered to members to visit the Natal battlefields and other places of interest. Subsequently a party will be made up to proceed to the Victoria Falls (Zambesi); and, should a sufficient number of members register their names, a special steamer will be chartered for the voyage home, *viâ* Beira, by the east coast route, as an alternative to the return through Cape Town by the west coast route. Thus all the colonies and Rhodesia will be visited by the association. The tour will last 70 days *viâ* Cape Town, or a week longer *viâ* Beira (all-sea), leaving Southampton on July 29 and returning thither on October 7 or 14.

A central executive committee has been constituted at Cape Town, with Sir David Gill as chairman and Dr. Gilchrist as secretary; while local committees have been formed at Johannesburg and other important centres.

Prof. G. H. Darwin, F.R.S., is the president-elect, and among the vice-presidents-elect are the following:—the Rt. Hon. Lord Milner, the Hon. Sir Walter Hely-Hutchinson, Sir Henry McCallum, the Hon. Sir Arthur Lawley, Sir H. J. Goold-Adams, Sir David Gill, and Sir Charles Metcalfe.

Sir David Gill, Mr. Theodore Reunert, and others have taken a prominent part in the initial work. The South African Association for the Advancement of Science is cordially cooperating in the local organisation, and will join with the British Association in attending the meeting.

The aim of the council has been to secure the attendance of a representative body of British men of science, including specialists in various lines of investigation, and that, along with the generous support of the people and authorities in South Africa, should go far to ensure the success of the meeting and to stimulate local scientific interest and research.

THE ROYAL COMMISSION ON COAL SUPPLIES.

THE Royal Commission appointed on December 28, 1901, to inquire into the extent and available resources of the coalfields of the United Kingdom has issued its final report, which, in 38 pages, contains an able summary of the vast amount of valuable information submitted by the numerous witnesses examined. The Commission originally appointed consisted of Lord Allerton, Sir W. T. Lewis, Sir Lindsay Wood, Sir C. Le Neve Foster, and Messrs. T. Bell, W. Brace, A. C. Briggs, H. B. Dixon, J. S. Dixon, E. Hull, C. Lapworth, J. P. Maclay, A. Sopwith, J. J. H. Teall, and R. Young. Mr. A. Strahan was subsequently added to the Commission; Sir C. Le Neve Foster and Mr. Ralph Young died before the inquiry was completed.

On the whole the report is of a reassuring character. Adopting 4000 feet as the limit of practicable depth in working, and one foot as the minimum workable thickness, the commissioners estimate the available quantity of coal in the proved coalfields of the United Kingdom to be 100,914,668,167 tons, as compared with the 90,207,285,398 tons estimated by the Coal Commission of 1871, notwithstanding the fact that 5,694,928,507 tons have been raised in the meantime. The excess is accounted for by the more accurate knowledge of the coal-seams. It is also estimated that there are 39,483 million tons of coal in the concealed and unproved coalfields.

It is thought that in future thin seams will be worked more extensively than at present, and that the use of coal-cutting machines will facilitate this. The amount of unavoidable loss incident to coal-mining is a serious factor in estimating the available resources. Much coal is lost by leaving unnecessary barriers between properties, and a certain amount must necessarily remain in order to support the surface. The amount thus left might perhaps be reduced by the introduction of the methods employed on the Continent and in America of packing excavations with water-borne sand or other materials. The recovery of coal formerly abandoned might be facilitated by the establishment of central pumping stations.

The possible economies to which attention is directed comprise the adoption of coal-cutting machines, of which 483 were in use in 1902 and 643 in 1903, and the use of electricity for the transmission of power. The importance of cleaning, sizing, and sorting coal is also strongly urged, and the extended adoption of coking advocated. In this connection the advantages of by-product coke ovens are pointed out, and it is shown that washing and compression render it possible to coke many coals previously considered worthless. It is probable that briquettes will in future be more largely used for steam and domestic purposes, and there appears to be a promising field for research for the discovery of a less smoky and less costly binding material than pitch, which is now chiefly used.

In view of the dearth of statistics of coal consumption, the following estimate for 1903 is of special interest:—

	Tons
Railways ...	13,000,000
Coasting Steamers...	2,000,000
Factories ...	53,000,000
Mines ...	18,000,000
Iron and steel industries ...	28,000,000
Other metals and minerals ...	1,000,000
Brick works and potteries, glass works and chemical works ...	5,000,000
Gas works ...	15,000,000
Domestic ...	32,000,000
Total ...	167,000,000

It is calculated by Mr. Beilby that in this total there is a possible saving of 40 to 60 million tons. More particularly in connection with the raising of steam there are immense economies capable of realisation. Economy in the production of power may be effected by the combustion of gas obtained as a by-product. Information submitted by Mr. Bennett Brough points to increasing opportunities of utilising blast-furnace waste gases as a source of power Waste gases from coke ovens might similarly be utilised. Gas engines are referred to as the most economical of heat motors, but increased efficiency both thermally and mechanically is still possible. The importance of the development of producer-gas plants is strongly urged as rendering possible the utilisation of inferior coal. Interesting information is given regarding various other ways in which economies in consumption may be effected. Regret is expressed that the recommendations of the Mining Royalties Commission of 1893 and of the Departmental Committee of the Home Office in 1895 regarding mineral statistics had not been carried out. The commissioners recommend that accurate information on the coal industry should be published by one authority, and they think that it would be of great advantage if particulars of deep borings could be preserved in a Government office.

The report must necessarily attract great attention from mining engineers and economists; and it should also be carefully studied by students in mining classes. It is essentially a cautious document; and the general public will doubtless be disappointed that Lord Allerton and his colleagues have made no sensational prophecies as to the probable duration of our coal supplies, and have given no indication as to the way in which their estimate of the available tonnage of coal compares with that of other countries. Their report certainly shows that, while the coal resources are ample, the cost of coal is not likely to decrease, as the improved methods and appliances will probably be neutralised by the increased cost of working deeper and thinner seams. Where we should be glad of clearer light from the Royal Commission is on the question of the probable condition of competing coal-producing countries when the cost of production in Great Britain is considerably raised. It is futile to offer a detailed criticism of the final report until the sections containing the reports of the district commissioners, the report of the geological committee, and the minutes of evidence and appendices are published. The probable duration of the coalfields and the colonial and foreign coal resources appear to have been dealt with in special reports written respectively by Mr. R. Price-Williams and Mr. Bennett Brough, and to these the commissioners direct attention.

NOTES.

The Royal Meteorological Society has arranged for an exhibition of meteorological apparatus to be held on March 14–17. The exhibition will be chiefly devoted to recording instruments, but it will also include new meteorological apparatus invented or first constructed since the society's last exhibition, as well as photographs, drawings, and other objects possessing meteorological interest.

Science announces that Prof. Ernest Rutherford, of McGill University, has been appointed Silliman lecturer at Yale University for 1905. The previous Silliman lecturers have been Prof. J. J. Thomson and Prof. C. S. Sherrington.

As Prof. G. H. Bryan, F.R.S., is unable to lecture at the Royal Institution on Friday evening, March 24, Sir Oliver Lodge, F.R.S., will deliver a discourse on that date on "A Pertinacious Current."

A grant of 50*l.* has been awarded by the Berlin Academy of Sciences to Prof. R. Hagenbach, of Aachen, and Dr. Konen, of Bonn, for the publication of a spectrographic atlas.

The de Candolle prize of 20*l.* for the best monograph on a genus or family of plants is offered by the Physical and Natural History Society of Geneva. Papers may be written in Latin, French, German, Italian, or English, and should be sent before January 15, 1906, to M. le Président de la Société de Physique et d'Histoire naturelle de Genève, l'Athénée, Genève (Suisse). Members of the society are not admitted to this competition.

We are sorry to see in the *Athenaeum* the announcement of the death, on January 21, of Mr. E. Crossley, of Halifax, in his sixty-fourth year. Mr. Crossley published in 1879, in conjunction with Messrs. Gledhill and Wilson, a valuable "Handbook of Double Stars," which is complete in its information up to the time of publication. The Crossley reflector, with which excellent work is being done at the Lick Observatory, was presented to that observatory by Mr. Crossley, and contains one of the best mirrors made by the late Dr. Common.

Prof. J. W. Mason, professor of mathematics at the College of the City of New York from 1879 to 1903, died on January 10 at the age of sixty-nine years. The death is also announced of Dr. Guido Bodlaender, professor of physical chemistry and electrotechnics at the Brunswick Technical College.

We regret to see the announcements of the deaths of Dr. T. H. Behrens, professor of microchemistry at the Delft Polytechnic School, on January 14, at the age of sixty-two; of Dr. Albert von Reinach, the eminent geologist of Frankfurt, on January 12; of Prof. Benjamin W. Frazier, professor of mineralogy and metallurgy at Lehigh University since 1871; and of M. Joseph Chaudron, the Nestor of Belgian mining engineers, at the age of eighty-two. M. Chaudron's method of boring shafts was first employed in 1848, and its most recent application is now in progress at the colliery at Dover.

The annual general meeting of the Iron and Steel Institute will be held on May 11 and 12. The annual dinner will be held—under the presidency of Mr. R. A. Hadfield—in the Grand Hall of the Hotel Cecil on May 12. The autumn meeting will be held in Sheffield on September 25–29. Members of the institute are invited to participate in an International Congress of Mining, Metallurgy, Mechanics and Applied Geology, to be held at Liége on June 26 to July 1, in connection with the International Exhibition. The general secretary of the organising committee is M. Henri Dechamps, 16 Quai de l'Université, Liége.

Dr. F. T. Roberts will deliver the Harveian Oration of the Royal College of Physicians of London on June 21. Dr. W. H. Hamer has been appointed to deliver the Milroy lectures on State medicine and public hygiene for 1906; the lectures for this year will be delivered by Dr. T. M. Legge on "Industrial Anthrax," on March 7, 9, and 14; Dr. W. H. Allchin will deliver the Lumleian lectures, "Some Aspects of Malnutrition," on March 28, 30, and April 4; and the second Oliver-Sharpey lecture, "The Influence of Atmospheric Pressure on Man," will be delivered by Dr. L. E. Hill on April 6. Other lectures to be delivered during the year are the Croonian, by Prof. E. H. Starling, F.R.S.; the FitzPatrick, on "The History of Medicine," by Dr. Norman Moore; and the Bradshaw lecture, by Dr. G. R. Murray.

On Sunday, January 22, M. Victor Serrin died, at Neuilly-en-Tel, Department of Oise, aged seventy-five years. M. Serrin was the inventor of the first automatic regulator of the electric arc light used in the public service. The action is so satisfactory that the apparatus is still in use, after fifty years of scientific progress. M. Serrin produced other ingenious inventions, but no other has had the importance of his arc lamp. In 1852, M. Serrin was in charge of the rebuilding of the Pont St. Michel in Paris, and, as the work was urgent, men were kept busy night and day. At night an electric light, with hand-feed adjustment, was used, since no regulators existed. Provided with blue spectacles, Serrin watched the lamp and adjusted the carbons when necessary. He thus contracted ophthalmia, in consequence of which he nearly lost his sight. The idea of the regulator then occurred to him, and he made all the parts with his own hands. At the funeral the principal scientific societies of Paris sent wreaths.

The Johns Hopkins Hospital *Bulletin* for January (xvi., No. 166) contains a number of papers of pathological and medical interest, together with an interesting account by Dr. Platt of Fabricius Guilhelmus Hildanus, the "father" of German surgery, who lived in the latter part of the sixteenth and beginning of the seventeenth centuries.

We have received the January number of *Le Radium*, a monthly journal devoted to radio-activity and now commencing its second year of publication. It contains articles on Finsen's method of phototherapy, on the sensitisation of living tissues by the injection of certain fluorescent dyes whereby they become more susceptible to, and more penetrable by, the radium rays, and on the phenomena of induction, together with a comprehensive review of recent work. The publication is excellently printed and illustrated.

Messrs. Winslow and Belcher have carried out an investigation on the variations in the number of bacteria in samples of sewage kept in the laboratory (*Journal of Infectious Diseases*, i., No. 1). They find that the total number of bacteria rises rapidly during the first twenty-four hours of storage, increasing more than ten-fold, and then decreases steadily for at least six months. The rise and fall in the number of bacteria appear to affect the various organisms in an almost equal degree, there being no tendency towards the development of a pure culture of any dominant form.

A THIRD example of variation—among gold and silver pheasants—is discussed by Mr. F. Finn in the *Avicultural Magazine* for January. These variations, in the colour and markings of the plumage, would, in the author's opinion, be regarded as at least of subspecific value if the birds were wild instead of domesticated.

IN the *Proceedings* of the Royal Physical Society of Edinburgh for December last (vol. i. part i.) Dr. Gerald Leighton discusses the variation in the matter of scaling displayed by the common viper (*Vipera berus*), which he shows to be very extensive. His main thesis is apparently to demonstrate that squamation is an unsound feature upon which to rely in the discrimination of reptilian species, and consequently that the "small red viper" of the British Isles is entitled to be regarded as a distinct form. As regards mammals and birds, at all events, modern naturalists by no means accept it as "an axiom in zoological classification that morphological characters alone are to be taken into consideration."

VARIATION of another type forms the subject of a paper by Mr. O. C. Bradley in the above-mentioned issue of the *Proceedings* of the Edinburgh Physical Society. The trapezium of the carpus of the horse is the structure discussed in this communication, and it is shown that this bone is present, either in one or both limbs, in about 50 per cent. of the skeletons examined, while if each carpus be taken separately (that is, without reference to the condition in its fellow) the percentage is a little more than 40. This, in conjunction with its minute size, leads to the conclusion that in the evolution of the monodactyle foot of the horse the bone in question is following in the steps of the lateral metacarpal with which it was originally connected.

THE article on Dr. True's recent memoir on "The Whalebone Whales of the Western North Atlantic" which appeared in NATURE of November 14, 1904 (p. 84), has led Mr. F. A. Lucas, of the Brooklyn Institute Museum, to send us some results of measurements of whales made by him at Balena, Newfoundland. Mr. Lucas was one of the party sent to Newfoundland by the U.S. National Museum in 1903 to secure the skeleton and mould of a large sulphur-bottom whale in order that the skeleton and a reproduction of the whale might be prepared for the St. Louis Exposition. If whales grow slowly and require many years to reach their full size, there should naturally be examples of all sizes from small to large among those measured. As a matter of fact, Mr. Lucas remarks that, with the single exception of a female 64ft. long, all the sulphur-bottom whales examined by him were fairly large, and while some were immature and some old, the difference between the largest and smallest was, for such large animals, inconsiderable. With the exception noted the females, ten in number, varied from 68ft. 10in. to 75ft., the greatest jump being from 71ft. 8in. to 74ft. 4in. Fourteen males varied from 67ft. 7in. to 74ft. 8in., the greatest break being at the commencement of the series, from 67ft. 7in. to 68ft. 11in. No very small sulphur-bottom whale was taken during Mr. Lucas's stay, but several young humpbacks were brought in from 24ft. to 26ft. in length. These were still nursing and it seems fair to assume that a sulphur-bottom whale of the same age (a yearling?) would be from 30ft. to 35ft long. This seems to indicate that young sulphur-bottoms keep away from the coast of Newfoundland, while the fact that the 64ft. specimen was much younger than those 67ft. to 69ft. long would indicate that up to this point at least whales grow with great rapidity. As to the size of adult whales, Mr. Lucas remarks that, neglecting the wild statements of sailors and others, the length of the sulphur-bottom, *Balaenoptera musculus*, is given as being from 85ft. to 95ft. No whales so large as this were taken during the season of 1903. The largest four females ranged from 74ft. 4in. to 75ft. long, the largest three males 73ft. 4in. to 74ft. 8in., the measure being taken from the notch of the flukes, along the body, to opposite the tip of the nose. All these whales were not merely adult, but, as shown by an examination of their vertebræ, were old, the largest male, taken for a skeleton, having the epiphysial sutures obliterated save for a line or two on the thoracic vertebræ. Mr. Lucas consequently considers that it seems fair to assume that the average length of a fully grown sulphur-bottom is just under 80ft.

CONTINUING their notes on the Codiaceæ in the *Journal of Botany* (January), Mr. and Mrs. Gepp describe with figures a new species and a new variety of the incrusted alga Penicillus, also a new form of *Rhipocephalus Phoenix*, which were collected by Mr. M. A. Howe off the Bahamas. Mr. G. C. Druce publishes in the same journal a long list of flowering plants and ferns for which new localities in Berkshire have been recorded since the "Flora of Berkshire" was issued, and Mr. C. E. Salmon discusses *Limonium vulgare* and its varieties.

A LIST of the species of Compositæ from the Island of Formosa which are represented in the herbarium of Tokio University forms the concluding part of vol. xviii. of the *Journal* of the College of Science, Tokio. The author, Mr. B. Hayata, prefaces his list with an analysis of the genera, thirty-nine in number. Among these Blumea furnishes seven species, including, of course, *Blumea balsamifera*, the source of Ngai-camphor. Two new species, a Gynura and a Eupatorium, are described and figured.

THE limit of an Antarctic phytogeographical zone is discussed by Mr. C. Skottsberg, the botanist of the Swedish Antarctic Expedition, 1901–3, in an article in the *Geographical Journal* (December, 1904). It has been usual to include in the Antarctic flora the plants of Tierra del Fuego and the Falkland Islands, but Mr. Skottsberg prefers to confine the term Antarctic to a cold desert zone which comprises Graham Land and the islands lying north of it, also the South Shetlands and the South Orkneys, and to distinguish another, the Austral zone, in which the climate permits of the formation of forest or grassland. The two zones differ also with regard to their algal vegetation; the Austral flora contains algæ with floating fronds such as *Macrocystis pyrifera* and *Durvillea utilis*, but these are wanting in the Antarctic zone, where calcareous algæ predominate.

AN interesting summary of the rainfall of the British Isles for the year 1904 is given by Dr. H. R. Mill in *Symons's Meteorological Magazine* for January. Taking the British Isles as a whole, the year may be considered as a moderately dry one, the deficiency in the amount of rainfall does not seem to have exceeded 8 per cent.; the extremes noted were 120.3 inches at Seathwaite, and 16.1 inches at Shoeburyness. The whole of the Atlantic border from Cornwall to Shetland had more than the average amount; the excess was most marked in the west of Ireland, being as much as 18 per cent. in places, but the east of Ireland was so dry that the whole island exceeded the average by only 1 per cent. In England and Wales there was a deficiency of about 12 per cent. The driest region occupied the midlands and extended to the Severn on the south-west, the Humber on the north-east, and Yarmouth on the east. The whole of this area had a deficiency exceeding 20 per cent. For the whole of Scotland there was a deficiency of about 8 per cent.; this was due mainly to the exceptional dryness of the east coast. Dr. Mill loses no opportunity of enhancing the value of his published rainfall tables, and we are glad to learn that all values quoted in future will be referred to an average of thirty years, 1870–99.

PARTS xi. and xii. of vol. ciii. of the *Bulletin de la Société d'Encouragement* contain a review, by M. L. Gruner, of the metallurgical exhibits at the St. Louis Exhibition, and a general account, by M. H. Le Chatelier, of the uses of special steels in industry.

THE report for 1904 of the Board of Trade on its proceedings under the Weights and Measures Act contains particulars of a new denomination of Board of Trade standard of 50 pounds weight which has been made and verified in consequence of representations by the Liverpool Chamber of Commerce and the Mersey Docks and Harbour Board. The use in trade of this denomination of weight was authorised by an Order in Council of October 9, 1903. During the past year a number of "Board of Trade" standards, the accuracy of which is required by law to be re-determined once in each five years, have been verified in relation to the imperial and metric standards.

ALTHOUGH several investigations have been made during the past six years on the deviation of the kathode rays in an electric field, the true nature of the deviation has not yet been satisfactorily determined. In vol. xxxv. of the *Sitzungsberichte* of the Physico-medical Society of Erlangen, Mr. F. Schneider describes experiments from which, by excluding disturbing factors, he is able to decide that the deviation is of a purely electrostatic nature, and that the dark kathode space has no influence upon it. Variations in the deviation caused by differences of potential and by other circumstances were carefully measured. The same volume of the *Sitzungsberichte* also contains a discussion, by Dr. A. Wehnelt, of the production of negative ions by incandescent metallic oxides, and an interesting account, by Dr. Ferdinand Henrich, of Liebig's life as a student at Erlangen and Paris.

IN the December (1904) part of the *Bulletin de la Société d'Encouragement* (vol. ciii.), M. H. Le Chatelier criticises the method recently introduced by Mr. Gayley at the Carnegie Steel Works of using in the blast furnaces a current of air which has been freed from moisture by cooling it below 0° C. by means of an ammonia freezing machine. It is contended that Mr. Gayley's paper, recently read before the Iron and Steel Institute, contains statements which make it improbable that the alleged economy of 20 per cent. in the fuel used in this process is due solely to the mere desiccation of the air. The principal advantage of drying the air for the blast probably lies in its giving rise to a cast containing less sulphur than ordinary pig-iron, owing to the diminished formation in the absence of water of hydrogen sulphide capable of attacking the spongy iron. Preliminary experiments have shown the probability of this view.

WE have received from the firm of Ferdinand Ernecke, of Berlin, a catalogue of their lanterns for optical projection; this catalogue is noteworthy because of the description which it contains of methods for demonstrating by projection many optical phenomena, such as interference, diffraction, and the behaviour in polarised light of crystalline sections. Messrs. Ernecke, we notice, have acquired the sole right of manufacturing the various forms of the Wehnelt interrupter.

IN the course of an investigation on the anomalous dispersion of sodium vapour, Prof. R. W. Wood (*Proc. Amer. Acad.*, 1904, xl., 365) has observed that the vapour of sodium possesses a most remarkable viscosity which makes it possible to obtain at one part of an exhausted glass tube a mass of the heated vapour of great density separated by a high vacuum from the glass plates which close the ends of the tube. The tendency of the metal to distil into the colder parts of the tube is extraordinarily small; even after an hour hardly a trace of sodium vapour can be detected beyond the heated portion. The vapour appears to possess a cohesion similar to that of a liquid, and even in a vacuum tube it seems to have a free surface. Potassium, on the other hand, distils instantaneously into the colder parts of the tube. The dispersion of sodium vapour in the vicinity of the D_3-line of helium is almost incredibly great; if a prism could be constructed of sodium vapour giving the same deviation as a glass prism of 60°, two lines in the spectrum, separated by a distance equal to one twenty-third of that between the D-lines, would appear separated by a distance greater than that between the red and bluish-green of the spectrum formed by the glass prism. But even this dispersion is small compared with that which obtains within, say, one Angstrom unit of one of the D-lines of sodium. The variation of the index of refraction with wave-length is shown to conform throughout the range λ 2260–7500, except very close to the D-lines, with the simplest form of the dispersion formula developed from electromagnetic considerations for a medium with a single absorption band.

MM. H. MOISSAN AND CHAVANNE have taken advantage of the production of metallic calcium on a commercial scale to re-determine some of its physical properties. The specimens which they had under examination contained from 99.3 to 99.6 per cent. of the metal, and were only acted upon slowly by water. Calcium can be easily turned into cylinders possessing a brilliant lustre, tarnishing, however, as might be expected, in moist air. It is sufficiently tenacious to be drawn into wire as fine as 0.5mm. diameter, and these wires were utilised for the determination of the specific electrical conductivity, this proving to be about 16 per cent. of that of silver. The melting point was found to be 810° C. and the density 1.548. The metal was also utilised to prepare calcium amalgam in quantity; this is stable in dry air at the ordinary temperature, and does not absorb either nitrogen or oxygen. The crystalline amalgam corresponds very nearly to the compound Hg_nCa. It is interesting to note that, whilst in a recent list of Kahlbaum metallic calcium is quoted at 6*s*. 1*d*. for 15 grains, or about 9*l*. per oz., since its manufacture on an industrial scale it can be obtained at 1*s*. 6*d*. per oz.

THE January part of *L'Enseignement mathématique* contains a number of papers which should prove of interest to English mathematicians. Dr. J. S. Mackay, of Edinburgh, contributes an interesting account of the life and works of the late Prof. Tait. Prof. Gino Loria gives an account of the progress made and the methods adopted in Italy in the reform of teaching of elementary mathematics, and in particular geometry. Mathematical teaching for engineers forms the subject of a paper by Prof. Jules

Andrade, based on his own experiences in the University of Besançon, and finally, M. Louis Couturat, of Paris, contributes a paper on "The Definitions of Mathematics."

A SERIES of articles by Mr. E. Edser on the "Electromagnetic Theory" is appearing month by month in *Technics*, and should prove useful to students of physics. The article contributed to the January issue deals with the electric circuit. A very simple method is given of determining the force on a conductor carrying an electric current perpendicular to a magnetic field, and this result is used to obtain an expression for the electromotive force produced when a conductor cuts lines of force. The results, of course, are well known, and are used by every electrical engineer, but the reasoning by which they are obtained is not so widely understood. Most of the results are determined directly from the properties of lines of force, and the usefulness of the article is greatly increased by careful scale drawings.

MESSRS. R. AND J. BECK, LTD., supply, for one guinea, a glass trough, $4 \times 3 \times 0.8$ inches, which can be raised or depressed on a vertical metal upright a distance of from $1\frac{1}{2}$ inches to 10 inches from the table. This trough forms a simple form of light filter when filled with liquid, and will serve not only as a useful adjunct to a microscope, but for many other purposes where it is of advantage to use a screen for monochromatic light.

MESSRS. TAYLOR, TAYLOR AND HOBSON, LTD., have recently issued two series of rapid Cooke lenses that should prove of great service, not only in high-speed photography, but for the finest portraiture and for difficult subjects under fair conditions of lighting. They are known as the Series iv. and ii., and have full apertures of $f/5.6$ and $f/4.5$ respectively. The makers have fully developed in these new lenses the advantages of construction of their well-known Series iii. and v. Cooke lenses. The leaflet, which contains details and prices of these lenses, includes some striking illustrations of the work accomplished by them.

WE have received from Messrs. Burroughs Wellcome and Co. their photographic exposure record and diary, which is a most handy pocket book and contains many new features. The monthly light tables are now placed at the end of the book, and the order of the months has been reversed so that the current month faces the exposure calculator, each month being torn off as it passes. This renders the calculation of an exposure a very simple process indeed. There is also ample room for recording details of plates exposed, facts relating to positive exposures, and ordinary notes and memoranda, for each of which three separate sets of pages are available. In addition to these and other items of useful information for photographers, there is a serviceable article on exposure, giving complete instructions for using the calculator provided, a concise explanation of the factors governing correct exposure, and an up to date list of the speeds of all plates and films, including, besides British, a number of American and Continental brands. Bound in a neat cover, with pocket and pencil attached, this excellent, cheap, and compact little pocket encyclopædia of photography should be in great demand by all workers, whether amateur or professional.

MR. W. B. CLIVE has published new and enlarged editions of parts i. and ii. of Dr. G. H. Bailey's "Tutorial Chemistry." Both volumes have been edited by Dr. William Briggs.

THE Engineering Standards Committee has now issued its report on pipe flanges. It is entitled "British Standard Tables of Pipe Flanges," and is published by Messrs. Crosby Lockwood and Son at 2s. 6d. net.

THE Department of Revenue and Agriculture of the Government of India has published the agricultural statistics of India for the years 1898–9 to 1902–3, in two volumes. The first part is concerned with British India and the second with the native States. The voluminous particulars have been compiled under the supervision of the director-general of statistics.

SEVERAL catalogues of physical, chemical, and other scientific apparatus have been received from Messrs. Brady and Martin, Ltd., of Newcastle-upon-Tyne. Among interesting instruments described in a supplement that brings a larger catalogue up to date may be mentioned Sodeau's new form of gas analysis apparatus, and Seger's cones for the determination of the temperature of furnaces, kilns, &c. A special supplementary list of new apparatus for experiments in physics includes particulars of simple appliances described in recent text-books of practical physics which are largely used in the laboratories of schools and colleges.

THE story of the Zeiss works at Jena is of deep interest, both in its scientific and sociological aspects. Prof. F. Auerbach described the Jena enterprise in a volume published in 1903. This work has now been translated into English by Mr. S. F. Paul and Mr. F. J. Cheshire, and published by Messrs. Marshall, Brookes and Chalkley, Ltd., under the title "The Zeiss Works and the Carl-Zeiss Stiftung in Jena." A short account of the creation and progress of these great cooperative works was given in the obituary notice of Prof. Ernst Abbe which appeared in last week's NATURE (p. 301). Many other interesting particulars will be found in the English edition of Prof. Auerbach's book, which is a popular description of the development and importance of a concern that offers valuable lessons to students of physics, technology, and social science.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN FEBRUARY:—

Feb. 5. 9h. 7m. Minimum of Algol (β Persei).
8. 2h. Conjunction of the Moon and Venus. Venus 3° 20′ N.
,, 5h. 56m. Minimum of Algol (β Persei).
9. 18h. Conjunction of the Moon and Jupiter. Jupiter 2° 49′.
13. 5h. 12m. to 6h. 32m. Moon occults θ^2 Tauri (mag. 3·6).
,, 5h. 14m. to 6h. 29m. Moon occults θ^1 Tauri (mag. 3·9).
14. 12h. Venus at greatest elongation, 46° 41′ E
,, Venus. Illuminated portion of disc = 0·516, of Mars = 0·903.
18. 5h. 53m. to 8h. 9m. Transit of Jupiter's Satellite III. (Ganymede).
19. Partial eclipse of the Moon, partly visible at Greenwich.
,, 4h. 41m. First contact with penumbra.
,, 5h. 34m. ,, ,, shadow.
,, 7h. 0m. Middle of the eclipse.
,, 8h. 7m. Last contact with shadow.
,, 9h. 19m. ,, ,, penumbra.
Moon rises at Greenwich at 5h. 16m.
Magnitude of the eclipse = 0·410.
21. 10h. 5m. to 10h. 40m. Moon occults η Virginis (mag. 4·0).
24. Vesta 3° N. of δ Virginis.
28. 7h. 40m. Minimum of Algol (β Persei).

Jupiter's Sixth Satellite.—A further telegram respecting the recently discovered sixth satellite of Jupiter has been received from the Kiel Centralstelle. It contains a statement from Prof. Perrine that the object discovered by him is not identical with Prof. Wolf's minor planet 1905 P.V. The position of the satellite on January 17 at 8h. 44.3m. (Lick M.T.) was R.A. = 1h. 21m. 8s., dec. = $+7°\ 27'$.

A later telegram than the above, published in a supplement to No. 3990 of the *Astronomische Nachrichten*, states that Prof. Perrine observed the satellite on January 17.702 (G.M.T.), and found that its position with reference to Jupiter was 266° and its distance 36′.

Ephemeris for Comet 1904 *e*.—The following is the latter part of a daily ephemeris for comet 1904 *e* (Borrelly) published by Herr M. Ebell in No. 3989 of the *Astronomische Nachrichten.*

1905	α (true) h. m. s.	δ (true) ° ′	log r	log Δ	Brightness
Feb. 1	2 9 8	+15 17	0·2092	0·1501	0·58
2	2 11 7	+15 54			
3	2 13 6	+16 31			
4	2 15 7	+17 7			
5	2 17 8	+17 43	0·2133	0·1638	0·54

Brightness at time of discovery = 1.0 (= mag. 10.0).

From the above it will be seen that the comet is now travelling in a north-easterly direction through the constellation Aries, and is observable—although very faint—between sunset and midnight.

Solar Eclipse Problems.—In an address read at the International Congress of Arts and Sciences, held at St. Louis in September, Prof. Perrine enumerated and discussed a number of the outstanding problems which still confront solar eclipse observers.

The first problem mentioned was that relating to the existence of an intra-mercurial planet, and Prof. Perrine states that this year's eclipse ought to settle the problem so far as the existence of a body brighter than the tenth magnitude is concerned. Such a body would not be above 12 or 15 miles in diameter, and it would take about a million such to account for the anomalies in the motion of Mercury.

The movements and velocities of coronal matter are most important problems which should be settled, and, as stations situated so far apart as Labrador and Egypt may be utilised during the coming eclipse, this should offer an exceptional opportunity of solving the problem, because of the length of time between the passing of the shadow at these places. Prof. Perrine suggests the employment of cameras having focal lengths of 40 or 50 feet and pointed directly at the sun, or, where the atmospheric conditions are favourable, longer cameras, mounted horizontally, might be used. The rotational velocity of the corona as regards that of the sun's surface is another problem which he discusses. Finally, he points out the urgent need for a number of well-equipped and well-organised expeditions, and suggests that the interchange of plans and ideas before the eclipse takes place might lead to results of greater value being obtained.

The Conditions in the Solar Atmosphere during 1900–1.—An interesting discussion of the conditions obtaining in the solar atmosphere during the minimum epoch of 1900–1, as indicated by the author's eclipse photographs taken in Spain and Sumatra, is given in the January number of the *Bulletin de la Société de France* by M. N. Donitch, of St. Petersburg. He discusses in turn the spectra of the chromosphere, the prominences and the corona, the form of the corona, and the solar repulsion theory of Prof. Bredichin as applied to the latter.

In discussing the spectrum of the chromosphere, he refers to Sir Norman Lockyer's eclipse results, and, in directing special attention to the lines at λλ 5317.7 and 4233.8 (Donitch), he states that his results as to the non-agreement of these with the monochromatic coronal radiations incontestably confirm the conclusions arrived at from the English observations.

The spectra obtained by M. Donitch show that the prominences may be divided into two types, one composed entirely of calcium vapours, the second containing in addition hydrogen and helium.

Triangulation of the Pleiades Stars.—An important addition to the data concerning the positions, the intermutual distances, and the movements of the Pleiades stars is contained in parts vi. and vii., vol. i., of the *Transactions* of the Astronomical Observatory of Yale University.

During 1884–6 the director, Dr. Elkin, made a series of heliometer observations for the triangulation of the Pleiades, and published the results in part i. of the same volume of the *Transactions*. Since then, however, a new source of systematic error affecting such results has been discovered, and Dr. Elkin has, therefore, re-reduced his observations. The final values are given in part vi., and are therein compared with the similar results obtained at Königsberg in 1840 and those obtained during the more recent triangulation carried out at Yale. The results of these comparisons indicate a motion, in regard to the rest of the group, of 9 out of the 58 stars common to the three researches; the apparent displacements determined from the comparison of the Königsberg and Yale results are shown on a chart accompanying the present paper.

Part vii. of the publication contains an account of the second triangulation carried out at Yale by Mr. Mason F. Smith during the winters of 1900–1 and 1901–2, and shows the complete reduction of the observations, together with a final table in which the places of 58 Pleiades stars, for 1885.0, are given with the precession and secular variation values for each.

A Bright Meteor.—Mr. J. Ryan, writing from the Manor House, Kensal Green, N.W., states that he observed a very brilliant meteor at about 11.58 on the night of January 27. The meteor appeared about three degrees below Orionis as bright as a star of the first magnitude; it travelled slowly in a path nearly parallel to a line joining κ and β Orionis, increasing in size until it burst into a green ball when below β Orionis, and faded. The complete path was traversed in about 8 seconds.

THE GENERAL MOTION OF CLOUDS.

THE issue of the *Quarterly Journal of the Royal Meteorological Society* for October, 1904, contains a translation of the report on the international observations of clouds presented by Prof. H. H. Hildebrandsson to the Permanent International Committee during its session at Southport in 1903. It is not too much to say that this report is one of the most important contributions to our knowledge of the physics of the atmosphere which the last twenty-five years have brought forth, and the Royal Meteorological Society has rendered a substantial service by making the report accessible to English readers.

Our knowledge, from direct observations, of the average motion of the air over the greater part of the earth's surface has been in a sense complete for a considerable number of years, but of the currents in the upper air we have until recently had little or no direct information, and all schemes of a general circulation of the atmosphere as a whole have had to substitute hypothesis for fact in dealing with this part of the subject. It therefore became of the highest importance to see whether any direct evidence could be obtained on this point. The most obvious method of attacking the problem consisted in observing the direction and speed of drift of dust or water particles suspended in the atmosphere. Dust particles are seldom sufficiently numerous in the upper air to be of use in this connection, but clouds occur in all parts of the world, and their observation is comparatively easy. Even this method, however, has its limitations. Observations are clearly impossible on cloudless days, and it also frequently happens that the upper clouds are obscured by lower cloud forms.

To obtain any general results observations from every part of the earth's surface were essential, and to secure these the ponderous machinery of international cooperation had to be called into play. In the year 1878 a request was addressed to the Permanent International Committee to organise a comprehensive system of cloud observations. After some preliminary consultations a scheme, in which cloud forms were divided into two classes, viz. upper and lower clouds, was adopted, and observations on this plan were made for several years during the 'eighties. Comparison of the results, however, showed that the adopted classification was inadequate, and it became necessary to agree on a more complete subdivision of cloud forms. This task proved to be by no means an easy one, but eventually our present international classification of clouds into ten main types was adopted, and some years later, early in 1896, the international cloud atlas, which contains twenty-eight coloured plates illustrative of cloud forms, together with explanatory text in three languages, was published.

At the request of the committee, cloud observations were carried out at a large number of stations during the period from May 1, 1896, to the end of 1897. At the more important stations the height and the direction of motion of clouds were determined by means of the photogrammeter or with theodolites; at the remainder, direction only was observed with the help of nephoscopes.

The materials thus accumulated, as well as a large number of trustworthy observations of earlier date, are discussed by Prof. Hildebrandsson in the present report. The method adopted has been to work out, for each region of the earth's surface, the direction of the average monthly drift of the atmosphere at various heights with a "resultantometer" devised by Mr. Sandström. The results are set out in tables and diagrams, and in what follows attention will be directed to some of the most important points.

I.—*Tropical Zone.*

Observations at stations near the equator agree in showing a drift of the upper atmosphere from some easterly point at all seasons of the year. At Paramaribo (Dutch Guiana, lat. $5\frac{1}{2}°$ N.), out of 270 observations of upper clouds, only 6 were from south-east and five from north-east. This well marked easterly current in the uppermost regions of the air near the equator was revealed in a most singular manner during the eruption of Krakatoa in 1883. The optical effects produced by the fine dust, which was carried up to great heights, travelled round the earth from east to west in about twelve or thirteen days, indicating an upper east wind moving with the prodigious velocity of 83 miles per hour.

II.—*Trade-wind Zone.*

The generally accepted theory of the origin of the trade winds formulated by Halley and completed by Hadley teaches us to expect upper anti-trade winds from south-west or north-west in the northern and southern hemispheres respectively, and this expectation was found to be fully confirmed. At Mauritius, which lies in the centre of the region over which the south-east trade wind prevails, the cloud observations show a steady upper wind from the north-west throughout the year. We may therefore assume the existence of an upper wind from the south-west at corresponding latitudes in the northern hemisphere.

As more temperate regions are approached this south-westerly wind becomes deviated to the right, and at Teneriffe, and still more decidedly at San Fernando and Lisbon, the average drift at the cirrus level is from almost due west. No support is afforded to the assumption made by James Thomson and by Ferrel in their schemes of the general circulation of the atmosphere, that the anti-trade wind continues its course as an upper south-westerly wind until the Arctic regions are reached.

Special interest attaches to the observations from the region between the upper equatorial east wind and south-westerly or north-westerly anti-trade winds. On the northern side of the equator, at surface level, a broad band on the earth's surface is alternately covered in winter by the north-east trade wind and in summer by the tropical belt of calms. At higher levels a similar alternation is shown. In winter, when the trade wind prevails at the surface, the anti-trade from south-west blows above, but in summer the tropical upper east wind is found above the calm region at the surface. The observations from square No. 39 of the Atlantic Ocean, which is situated in 10°–20° lat. N., 20°–30° long. W., form the most complete example of this alternation in Prof. Hildebrandsson's report; some further very striking instances are to be found in the cloud results for the West Indies recently published by the U.S. Weather Bureau (*Monthly Weather Review*, vol. xxxii., No. 4, p. 166).

III.—*India.*

The wind circulation over India is exceedingly complex at the surface, but at higher altitudes a much simpler state of affairs is found to prevail. Prof. Hildebrandsson divides his observations into two groups, those from the north (Lahore to Calcutta) and those from the more central districts between Bombay and Cuttack. He finds that in the former the upper currents blow steadily from the west from December to April, but during the remainder of the year they tend to become easterly. Over Central India the upper westerly wind prevails throughout the year, except in August and September. Since the appearance of the report, Sir John Eliot has dealt with the detailed cloud observations taken at six Indian stations during the years 1896–1900 (*Indian Meteorological Memoirs*, vol. xv., part i.). These show a much steadier upper westerly current in the north. At Simla and Jaipur the average upper wind is westerly throughout the year; at Lahore and Allahabad an easterly component appears in the averages for August and September only. Further to the south we find an alternation similar to that described above. At Madras the equatorial upper current from the east prevails during the summer; in winter the upper currents vary between south and south-west.

IV.—*Temperate Zone.*

Throughout the temperate zone the direction of the average upper currents is from some westerly point all the year round in both hemispheres, though few observations are available from the south of the equator. In Europe and in North America there is thus substantial agreement between the general drift of the atmosphere at all levels, but when we turn to eastern Asia this is not the case. The excellent observations taken at the Observatory of Zikawei (Shanghai) show that at the surface and at the level of the lower clouds the prevailing direction is from the north during the winter and from the east, *i.e.* towards the low pressure system over the continent of Asia, during the summer; but already at the level of the intermediate clouds, and still more at higher levels, a steady drift from the west is found at all seasons. Similar results are shown by the observations from Japan.

Though there is substantial agreement in the mean direction of air motion over Europe at all levels, a general tendency for a component from the north to make its influence increasingly felt at higher altitudes is clearly shown. Thus at Upsala, during the winter months, the surface wind is from the south-west; the lower clouds travel from west-south-west and the intermediate ones from west-north-west, while at the cirrus level the direction of motion is from north-west. Further north, at Nora, in Swedish Lapland, cirrus moves from north-west throughout the year. Some particularly interesting results have been obtained from those of M. Teisserenc de Bort's balloon ascents in which the level of the highest cloud forms was exceeded. In all these cases the balloons were carried towards the south-east, showing that they met with a north-westerly wind in the uppermost layers of the atmosphere.

North-westerly winds at the cirrus level are also very prominent at Perpignan, Pola (Austria), Tiflis, and Madrid, stations which lie on the northern side of the tropical belt of high pressure, over which, as we have seen above, the direction of the anti-trade winds has become deviated from south-west to west.

Prof. Hildebrandsson sums up the results he has arrived at under the following headings:—

(1) Above the thermal equator and the equatorial calms there exists throughout the year a current from the east which appears to have a very high velocity at great altitudes.

(2) Above the trade winds, anti-trade winds from south-

west in the northern hemisphere and from north-west in the southern hemisphere prevail.

(3) These anti-trade winds do not extend beyond the polar limits of the trade winds; they are deviated to the right in the northern hemisphere and to the left in the southern, and become currents from the west above the tropical high pressure areas, where they descend to feed the trade winds.

(4) The air of the temperate zones is involved in vast "polar whirlpools," which rotate from west to east. This rotatory movement appears to be similar to that of ordinary cyclones; the air in the lower layers draws nearer to the centre of the whirl, while that in the upper layers recedes from it more and more as the height above the earth's surface increases up to the highest regions from which we have any observations.

(5) The layers of upper air of the temperate zones overflow the tropical high pressure areas, and there descend.

(6) The irregularities found at the surface of the earth, more particularly in the monsoon areas of India, disappear, as a general rule, at the level of the lower or intermediate clouds.

(7) The theory of a vertical circulation of the atmosphere between the tropics and the poles, which has hitherto been accepted (Ferrel, James Thomson), must be abandoned.

The report as published in the society's journal is very fully illustrated by reproductions of the diagrams of the original edition. M. Teisserenc de Bort's charts of the average distribution of pressure at the 4000-metre level for January and July are also given, and they illustrate in a very striking manner the scheme of general circulation of the upper air to which the results of Prof. Hildebrandsson's report point.

AMERICAN HYDROIDS.[1]

THE first part of this large work dealt with the plumularian hydroids. After an interval of four years, the second part, a folio of some 150 pages and 57 plates, has been issued. It appeals exclusively and intentionally to the student of systematic zoology; but owing to the wide distribution of the family—the "sea-firs" of our coasts—this account, though dealing primarily with American species, will assist students of sertularian taxonomy in almost any part of the world.

The plan of this book is that of the first part. There is first an anatomical account of the stem and its branches, then a *résumé* of the distribution, horizontal and vertical, in different seas, and finally a hundred pages of speciography. The most assiduous care has been employed in drawing up these descriptions and in illustrating them by well selected figures; and most critical and generous consideration is given to previous researches on this group of animals.

For some not very obvious reason, Prof. Nutting has decided to postpone the more interesting bearings of his subject to the final volume, and confines himself in the work before us rigidly to a consideration of the taxonomic and diagnostic features of the Sertularidæ. We look in vain for any explanation of the mode of distribution, though the occurrence of the majority in Alaskan and Arctic waters suggests a polar origin. There is no attempt to explain the absence of free medusæ, nor are we given any information as to the habits of these hydroids, their modes of growth and of repairing injury, the influence of light upon their branching and reproductive powers. There is not a single experiment recorded in the work, though it is to be expected from the plasticity of such cœlenterates that continuous and discontinuous variation may be induced by changes in environment. On the other hand, differentiating anatomical characters, such as the forms of branching, the shape of the gonidial sacs, and the opercula, are described and combined into a system with great care, and it is to be hoped that Prof. Nutting has laid the foundation of a permanent and authoritative classification.

[1] "American Hydroids. Part ii. Sertularidæ." By C. C. Nutting, Smithsonian Institution. U.S. National Museum. Special Bulletin. (Washington, 1904.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Vice-Chancellor has been informed that at a meeting of medical graduates recently held in London to consider the present provision in the university for the department of pathology, it was resolved (1) that steps should be taken to bring before the university the necessity of permanent and adequate support being received for the pathological department; (2) that a fund be started for the purpose of assisting in this object, and the primary object of this be the establishment and endowment of a professorship in pathology.

It was announced last term that the Rhodes trustees have made a grant for five years to Dr. Ritchie, the present reader in pathology, and New College has now elected him to an ordinary fellowship for seven years, provided that he continues his readership and does research work. Mr. Edward Whitley, Trinity College, has very generously given the university a thousand pounds towards the permanent endowment of a pathology chair.

CAMBRIDGE.—The Vice-Chancellor announces two important bequests which have been left to the university. The first consists of 5000*l.*, to be expended in improving the instrumental equipment of the Newall Observatory, and of a very valuable collection of illuminated manuscripts and early printed books and objects of mediæval and early art, to be placed in the Fitzwilliam Museum, left by Mr. Frank McClean, F.R.S., of Trinity College. The second bequest is left by the late editor of the *Athenaeum*, Mr. Norman Maccoll, of Christ's and Downing Colleges, and consists of 500*l.* to form some endowment for a lectureship in Spanish or Portuguese, together with a valuable library of books.

The number of commissions allotted to the university, the first half-yearly nomination to which will take place after the examination in September next, is one in the Royal Artillery, one in the Indian Army, and five in the cavalry, Foot Guards, infantry, or the Army Service Corps.

The regulations for administering the Gordon Wigan fund are announced. The revenue will be divided between the special board of physics and chemistry and the special board of biology and geology, to be used in promoting and encouraging scientific education and research. The bequest amounts to some 9000*l.*

LONDON.—Mr. William Loring, late director of education under the County Council of the West Riding of Yorkshire, has been appointed warden of the Goldsmiths' College, New Cross, and Mr. Edgar Schuster Francis Galton research fellow in national eugenics.

The Mercers' Company has voted a sum of 1000*l.* to the university for the promotion of the study of physiology at University College.

Mr. W. Williams has been awarded the degree of doctor of science through a thesis on "The Temperature Variations of the Electrical Resistances of Pure Metals," and other contributions.

Mr. H. M. Hobart has been appointed lecturer in electrical engineering design at the Northampton Institute in succession to Mr. E. K. Scott, who has been appointed lecturer in electrical engineering in the University of Sydney. Mr. M. H. Smith has been appointed chief assistant in the mechanical engineering department in succession to Mr. W. E. Curnock, who has been appointed head of the mechanical engineering department of the Technical College, Huddersfield.

MANCHESTER.—The new public health laboratories, which have been erected by the Victoria University and have cost 13,000*l.*, were opened on January 27 by Mr. W. J. Crossley. Lord Spencer, Chancellor of the University, presided at the ceremony, and the large gathering included the Lord Mayor of Manchester and the Mayor of Salford. Honorary degrees were afterwards conferred upon Prof. Calmelle, Lille University; Prof. Perroncito, Turin University; Prof. Salomonsen, Copenhagen University; and Captain R. F. Scott, R.N.

IT has been resolved to institute, in the United College, University of St. Andrews, a lectureship in organic chemistry, and to appoint Dr. James C. Irvine as the lecturer.

It is reported in *Science* that, by the will of the late Mr. E. W. Codman, of Boston and Nahant, Mass., an estate which may reach 200,000*l.* will be equally divided between Harvard University and the Massachusetts General Hospital.

The United States ambassador, Mr. Choate, has accepted the invitation of the governing body of the Battersea Polytechnic to distribute the awards and deliver an address on the occasion of the next annual distribution of prizes on Wednesday evening, February 22.

It is reported in *Science* that Harvard University and the University of Berlin have practically arranged a method by which a temporary exchange of professors will occur. It is further stated that a similar arrangement has been made between the Massachusetts Institute of Technology and the Berlin Institute of Technology.

Mr. J. D. Rockefeller has signified his willingness to contribute to the University of Chicago for the year beginning July 1, 1905, the sum of 49,000*l.* for current expenses, this being the same sum that he has contributed during the present year. Mr. Rockefeller has also contributed this year 12,000*l.* for the enlargement of the heating plant of the university.

A course of lectures and discussions has been arranged by the Childhood Society and the British Child-Study Association, to be delivered in the Parkes Museum, Margaret-street, W., and will commence on February 9. Among the subjects are :—Some physiological problems in education ; the proposed anthropometric survey ; mental faculty of the child : its growth and culture ; fatigue in children ; the health of children *qua* food and management ; and imitation.

At the annual conference of representative Mahomedans from all parts of India, held at Lucknow a month ago, it was agreed to form science faculties at Aligarh College. The list of subscriptions towards this object was headed by the Raja of Mahmudabad with a munificent donation of Rs.35,000. The aggregate subscriptions to the fund for promoting the advancement of Aligarh College to the status of a university, which will be the future university of Mahomedans in India, now amounts to Rs.1,04,000 (7000*l.*).

In connection with the fund instituted to supplement the resources of the Melbourne University, the Hon. F. S. Grimwade has given 1000*l.* for the purpose of founding an annual prize at the university, to be awarded in respect of research work in some branch of industrial chemistry. This donation, says the *Pharmaceutical Journal*, raises the fund to 11,000*l.*, and enables the university to claim a subscription of 1000*l.* promised by Mr. Andrew Carnegie. The whole of the money subscribed, which, with a Government grant of 12,000*l.*, now totals 24,000*l.*, is to be devoted to the purpose of building laboratories. The Government has promised a supplementary grant of 5000*l.* next year.

The need for a university in the south-west of England continues to be urged locally from time to time. At the recent ordinary general meeting of the governors of University College, Bristol, Mr. Henry Hobhouse said that it was unfortunate that the south-west of England was almost the only part of England and Wales that had no local university, and spoke of Bristol as the only possible centre for such an institution. Principal Lloyd Morgan, F.R.S., who returned recently from a visit to the United States, gave it as his opinion, after inspecting the equipment and work of the American university colleges, that when the amount of work done by the staff of Bristol University College is compared with the amount being done in any one of the American institutions he had visited, and the cost of the one is compared with the cost of the other, Bristol University College is ahead of them all. Several speakers urged the pressing need for more funds. In this connection we are glad to notice that the college received last year nearly 5000*l.* in donations outside the ordinary income.

The Association of Technical Institutions held its annual general meeting on January 27 at the Manchester School of Technology. Sir Philip Magnus was elected president of the association for 1905, and in the course of his address directed attention to the fact that in technical institutions the students who attend even the most elementary technological classes are too often insufficiently prepared to profit by the teaching. They are deficient in power of expression; they lack practical knowledge of arithmetic and the rudiments of science and the necessary skill in drawing. In a word, the training in the elementary schools of the country has not produced satisfactory results. The elementary teaching must be made more practical. The workroom will supersede the class room in elementary schools, continued Sir Philip Magnus, and manual training will become the central feature of the training around which other studies will be grouped. Numerous papers were read. Principal Reynolds, of Manchester, Mr. Wilkinson, of Bolton, and Principal Crowther, of Halifax, read papers on the co-ordination of the work of evening continuation schools and municipal technical institutions. The co-operation of employers in the technical training of their apprentices was the subject of a discussion opened by Principal Belcher, of Coventry, and Principal Gannon, of Norwich. The registration of teachers in technical institutions was dealt with by Principal Wells, of Battersea.

The report of the council of the Association of Technical Institutions was presented at the annual general meeting on January 27. The report states that, from the point of view of those specially concerned with technical education, the year 1904 has been marked chiefly by the development and coordination of local educational organisation and by the perfecting of matters of internal administration. It is too soon, the report states, to say what the effects of the abolition of the Technical Instruction and Local Taxation (Customs and Excise) Acts and the placing of all branches of education under one local authority may have upon the further extension of technical education. While recognising the possible danger to these interests of the large and growing demand for expenditure upon other branches of education, the association views with satisfaction the increasing recognition of the belief that technical education can only produce the best results when it builds upon the sure foundation of a sound secondary education. Among matters to which the association has given attention may be mentioned that of the possibility of obtaining a number of research scholarships, tenable by advanced students in technical institutions ; and that of the desirability of instituting a scheme for the issue by technical institutions of diplomas upon some common basis of award. This last question is of such importance that it has been referred to a subcommittee for further inquiry and report.

The annual meeting of the Mathematical Association was held at King's College on January 28. Prof. G. B. Mathews, F.R.S., was elected president for the ensuing year. Papers were read on models and their uses by Mr. E. M. Langley, and on the new geometry by Mr. W. H. Wagstaff, who does not think it is desirable to make all boys learn deductive geometry, but that some should learn logic instead, and that some training in practical geometry should be given to all. A discussion on the question : " Should Greek be Compulsory for Mathematicians at Cambridge? " was opened by Mr. A. W. Siddons, who urged that mathematicians should not have special arrangements made for them ; that, if Greek was compulsory for others, it should be for mathematicians also. Prof. A. R. Forsyth, F.R.S., said it is to his mind extraordinary that teachers of classics argue that, if Greek be made optional, therefore the subject will become extinct. The subject has a strong hold on the public schools and the universities ; every outside inducement to its continuation is still maintained, but in a large number of schools in the country Greek is now extinct. If the ancient universities maintain this barrier of Greek as a preliminary qualification for a degree, it means one of two things—either that all the boys in those schools where Greek is now extinct are cut off from the universities, and so those institutions cease to be contributing to the educational wealth of the country to the same extent as they used to do, or else that many boys often proceed to get up the subject from the point of view of satisfying a miserable minimum. What was asked for is a relaxation in favour of education in general and not in favour of any special class of people. The elimination of literary training in the country is not being sought.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 24, 1904.—"Preliminary Communication on Galvanic Cells produced by the Action of Light." By Dr. M. **Wilderman**. (From the Davy-Faraday Laboratory of the Royal Institution.)

The author finds that there is, under the action of light, a region of galvanic cells as wide and as varied as in the case of ordinary galvanic cells. He finds constant and inconstant cells, reversible and irreversible cells. The chemical reactions and chemical equilibrium in the galvanic combinations are now perfectly clear; they prove, however, to be all *sui generis*, all the phenomena being intermixed and characterised by phenomena of induction and deduction, peculiar to light cells only. The author also succeeded in placing this region of phenomena on a physico-mathematical basis, testing and proving the fundamental equations experimentally in all details. The principal results obtained are:—

(1) The total E.M.F. created by light consists of an E.M.F. produced by light at a constant temperature, owing to the increase of the chemical potential and of the solution pressure of the exposed plate, and of a thermo-E.M.F. caused by one of the plates in contact with the liquid being heated by light. Both E.M.F.'s are found to be directly proportional to the intensity of light; both give currents in the same direction, thus proving that light acts on the chemical potential as well as on the solution pressure of the electrode in the same way as does heat.

(2) The peculiar course of the induction and deduction periods enables one to distinguish constant and inconstant cells showing polarisation from one another. A consideration of the chemical composition and of the reactions going on in the systems under the action of the current leads to the same results.

(3) The induction period follows a law

$$d\pi/d\tau = c(\pi_0' - \pi)(\pi - \pi_0 + K),$$

giving at the same time also the fundamental law of photography relating to the connection between the amount of silver salts decomposed and the time of exposure. The deduction period follows a similar law

$$-d\pi/d\tau = -c'(\pi_0 - \pi)(\pi - \pi_0' + K').$$

(4) The fundamental equation for the E.M.F. of constant cells "reversible in respect of cation" (*e.g.* Ag plate in light, $AgNO_3$ solution in light, $AgNO_3$ solution in the dark, Ag plate in the dark) is

$$\Sigma E = 0{\cdot}860T\,(\log_e P_l/P_d - 2v/u + v \log_e p_l/p_d)10^{-4} \text{ volt},$$

and for constant cells "reversible in respect of the anion" (*e.g.* Ag-BrAg plate in light, KBr solution in light, KBr solution in the dark, Ag-BrAg plate in the dark) is

$$\Sigma E = 0{\cdot}860T(-\log_e P_l/P_d + 2u/u + v \log_e p_l/p_d)10^{-4} \text{ volt},$$

where P_l, P_d are the solution pressures of the electrodes in light and in dark, p_l, p_d are the osmotic pressures of the cation or anion in the solution in light and in dark, and T is the absolute temperature.

The theory of thermogalvanic cells is also given in the paper.

December 8, 1904.—"The *Rôle* of Diffusion during Catalysis by Colloidal Metals and Similar Substances." By Dr. Henry J. S. **Sand**. Communicated by Prof. J. H. Poynting, F.R.S.

This paper contains a criticism of the opinion expressed by Nernst (*Zeitschrift Phys. Chem.*, xlvii., 55) that the catalytic decomposition of hydrogen peroxide due to colloidal metals probably takes place practically instantaneously on the surface of the catalyser, so that the concentration of the hydrogen peroxide there is permanently maintained at zero, and the velocity of the reaction actually measured is that with which diffusion and convection renew the solute in contact with the catalytic particles.

As a result, it was shown that Nernst's hypothesis would lead us to expect the reaction to proceed as one of the first order, a conclusion which agrees with the experimental results found by Bredig and his pupils. The actual values of the experimental velocity-constants are, however, far too small to allow us to reconcile them with Nernst's suggestion, and the latter must therefore be rejected.

In order to arrive at this result, minimum theoretical values for the rate of the reaction were calculated on Nernst's hypothesis. For this purpose the particles were assumed to be spheres with a diameter of $0{\cdot}5\mu$, a value which, according to Bredig, is greater than any which was met with in his solutions. The particles were supposed to be in a state of continual movement, performing the so-called Brownian motions, but in travelling through the solution were assumed to take with them a film of adhering liquid. In order to obtain a minimum value for the reaction velocity the total volume of the films was supposed to be equal to that of the whole liquid. The diffusion-coefficient of hydrogen peroxide at 25° was taken as 10^{-5} cm.^{2}/sec., a value which is smaller than that of most substances with heavier molecules.

The great part played by convection due to the Brownian motions of the particles and stirring by gases, &c., was demonstrated, it being pointed out that the experimental results regarding the dependence of the velocity-constants on the concentration of the catalyser can only be reconciled with the idea of a heterogeneous reaction if convection plays an important part.

Lastly, it was shown that the experimental facts all agree with the assumption that the actual velocity of the reaction on the surfaces of the particles always has a finite value which is proportional to the concentration of the solute in immediate contact with them.

In conclusion, Nernst's views regarding reaction-velocities in heterogeneous systems were criticised from a thermodynamical point of view, and it was shown that whereas they may possibly be correct for the majority of physical processes, great caution should be exercised in applying them to processes of a chemical nature.

January 19.—"The Dual Force of the Dividing Cell. Part i.—The Achromatic Spindle-Figure, elucidated by Magnetic Chains of Force." By Prof. Marcus **Hartog**. Communicated by Sir William T. Thiselton-Dyer, K.C.M.G., C.I.E., F.R.S.

The essential points of this research are described as:—

(1) The introduction of a convenient apparatus for the study of the axial section of fields produced by isolated poles of a dual force.

(2) The formation of *chains of force* in a viscid material, the recognition of their character as a distinct type of material configuration, and the study of their properties.

(3) The application of the conception of *relative permeability*, and of the recognition of chains of force to the problem of the cell-figure.

Zoological Society, January 17.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—(1) Some notes on the cranial osteology of the mastigure (Uromastix); (2) a contribution to the anatomy of Chlamydosaurus and some other Agamidæ; and (3) a note on the brain of *Cynopithecus niger*: F. E. **Beddard**, F.R.S.—(1) A collection of sipunculids made at Singapore and Malacca; (2) a collection of gephyrean worms from Zanzibar; and (3) the sipunculids and echiurids collected during the "Skeat Expedition" to the Malay Peninsula: W. F. **Lanchester**. Four new species were described in the second paper and nine in the last.—On the oral and pharyngeal denticles of elasmobranchs: A. D. **Imms**. The author had found that these denticles were present in varied abundance over the mucous membrane lining both the oral and pharyngeal cavities in many of these fishes. Out of the specimens of the nineteen species (representing eighteen genera) examined, only five, belonging to as many genera, were found to be totally devoid of these structures.—The skull of a musk-ox from the river-gravels of the Severn Valley at Frampton-on-Severn, near Stonehouse, Gloucestershire: Dr. C. W. **Andrews.** The specimen consisted of the cranial portion of the skull of an old bull, and was found by Mr. W. T. Rennie, of Chepstow, who had presented it to the British Museum. Remains of this species were comparatively rare in Britain, and the nearest previously recorded locality to that described was Barnwood, near Gloucester.—Three new birds obtained by Colonel Waddell, C.B., on the recent expedition to Lhassa: H. E. **Dresser.** The birds exhibited and described were:—*Babax waddelli,* nearest to, but differing widely from, *Babax lanceolatus*; *Garrulax tibetanus,* a much darker and more uniformly coloured bird than *Garrulax sannio,* with the terminal part of the tail white; and *Lanius lama,* a much darker bird than *Lanius schach,* with less white on the forehead, no rufous on the back or scapulars, and no trace of an alar speculum.

Royal Meteorological Society, January 18.—Capt. D. Wilson-Barker, president, in the chair.—The **President** delivered an address on the connection of meteorology with other sciences. He said that meteorology and astronomy were doubtless the first of the sciences to attract the attention of men—which of the two exerts most influence on the well-being of humanity is a matter dependent on the position of the globe; in many regions people are but slightly affected by the weather, while the heavenly bodies, particularly the sun, exert an enormous influence on human life. Everywhere in nature we find the effects of meteorological agencies. After speaking upon the effects of evaporation, winds, rain, ice, snow, and pointing out the influence of weather on animal life, vegetation, health, &c., he said that meteorology is a science deserving more attention than it receives. He thought it ought to be recognised as a preliminary to the studies of geography, geology, and kindred subjects, and he was of opinion that meteorological observatories might very well be fitted up in schools, and pupils taught to observe. This could be done at a small cost of time or money. The tendency at present is to particularise in all scientific work, but the true path to progress lies in keeping a comprehensive outlook on the whole field of investigation. The United States have devoted much attention to meteorology with most satisfactory results. It is to be regretted that official help and encouragement are so deficient in this country. The baffling, difficult nature of meteorological problems should but serve as an incentive to their elucidation. The persistent observer gains much, not only in knowledge of the subject, but in the habits of close and accurate investigation which he insensibly acquires, and all workers in this field learn to appreciate the difficulties which confront their fellow-labourers and to recognise the value of what has been done by the meteorological organisations of the world.—Mr. Richard Bentley was elected president for the ensuing year.

Entomological Society, January 18.—Prof. E. B. Poulton in the chair.—Mr. F. Merrifield was elected president for the session 1904–5.—The president, Prof. **Poulton,** delivered an address in which he discussed the part played by the study of insects in the great controversy on the question, "Are acquired characters hereditary?" He argued that the decision whether Lamarck's theory of the causes of evolution is or is not founded on a mistaken assumption largely depends upon evidence supplied by the insect world, and finally concluded that the whole body of facts strongly supports Weismann's conclusions. At the end of his address the president urged that the study of insects is essential for the elucidation and solution of problems of the widest interest and the deepest significance.

Dublin.

Royal Dublin Society, December 20, 1904.—Mr. W. E. Wilson, F.R.S., in the chair.—Unrecognised factors in the transmission of gases through water: Dr. W. E. **Adeney.** The author has described in this communication an experimental investigation of the downward streaming which has been met with in experiments on diffusion of gases in water, when the gas is placed above the water. Hüfner has ascribed this downward streaming to the water becoming heavier as it dissolves the gas, and so forming concentration currents. The author shows from his experiments that the streaming is a gravitational effect, but that it is not due to concentrated solution currents as understood by Hüfner. He also shows that when the surface layers of long columns of water, of small cross section, are continuously agitated by mechanical stirrers, or by currents of air drawn through them, the streaming becomes very rapid, with the result that the columns of water are saturated with the gas in the course of a few hours. The streaming takes place more rapidly in sea-water than in distilled water.—Secondary radiation: Prof. J. A. **McClelland.**—The partial differential equations of mathematical physics: Prof. A. W. **Conway.** A new method of obtaining singular solutions of these equations was obtained, applicable to non-homogeneous equations. A new class of functions called "kinetic functions" was introduced.—The Primary rocks of Ireland with their intrusive rocks: G. H. **Kinahan.** The first part of the paper gave a general account of the rocks from the Permian to the Cambrian, specially mentioning their characteristic shore accumulations. The second and more important portion treated of all the occurrences of Irish Archæans with their exotic adjuncts, and their probable equivalents in England, Wales, Scotland, Canada, and the United States of America.

January 17.—Dr. W. E. Wilson, F.R.S., in the chair.—Improvements in equatorial telescope mountings: Sir Howard **Grubb,** F.R.S. The author described a new form of slow motion for large equatorial telescopes in which a small electric motor is used for actuating the differential wheels, which are ordinarily worked by an endless cord. This new form was first applied to the 24-inch photographic equatorial of the Radcliffe Observatory, Oxford, and is now being applied to the photographic equatorial at the Cape Town Observatory, which is of the same size. The working of the instrument, which was exhibited at the meeting, was demonstrated by the author, who also read a paper on a simplified form of his electrical control, which has lately been applied to several large instruments.—On the temperature of certain stars: W. E. **Wilson,** F.R.S. It seems probable that in the sun and some stars there are two quite distinct sources from which we can receive light which gives a continuous spectrum. First, the photospheric clouds, which are composed of droplets of matter in the solid form, probably carbon; secondly, layers of intensely hot gases which are under considerable pressure. Between these two sources of radiation lie principally the vapours of titanium and vanadium, and other elements of suitable atomic weight. In a sun-spot the temperature is locally so high that the photospheric clouds are volatilised, and we then get the radiation only from the gaseous layer below, the spectrum being darkened by the intervening layers, consisting principally of the vapours of titanium, &c., the lines of which are widened and darkened. It is then suggested that as a star like Arcturus, or type iv. stars, have a spectrum which is very similar to a sun-spot, in these bodies the temperature is so high that they have no photospheric clouds, and that their want of brilliancy is caused by their only receiving the radiations from the gaseous layers which lie at some depth in their atmospheres.—Mr. Richard J. **Moss** exhibited the absorption spectrum of liquid oxygen.

Manchester.

Literary and Philosophical Society, December 13, 1904.—Mr. W. H. Johnson in the chair.—Note on the dissemination of seeds by birds: C. **Oldham.** The opinion expressed by Mr. F. Nicholson at a recent meeting of the society that birds rarely act as disseminators of seeds, by voiding them in their excrement, is not in accord with the experience of many field naturalists. Nearly fifty years ago Darwin proved ("Origin of Species," chapter xii.) that certain seeds extracted from the excrement of small birds germinated, as did others from the ejected pellets and the excrement of carnivorous and piscivorous birds. The evidence of Wallace and other observers may be cited to the same effect. In mid-Cheshire, during the spell of hard weather at the end of November, 1904, an examination of the excrement of various birds showed that entire and apparently uninjured seeds are voided constantly. Redwings, fieldfares, and other thrushes were compelled during the frost to subsist largely upon hedgerow fruit, and entire seeds of the wild rose (Rosa) and hawthorn (Cratægus), among others, might have been collected from their droppings by thousands. From the excrement of smaller birds the author obtained many undigested seeds of the bramble (Rubus).—The Foraminifera from the coast of the island of Delos, part ii.: H. **Sidebottom.** Particular attention was directed to those species that are new to the Mediterranean. The dimorphic structure of many of the Foraminifera was also pointed out.

January 10.—Prof. W. Boyd Dawkins, F.R.S., in the chair.—On the supposed antagonism of Mendelian to biometric theory: A. D. **Darbishire.** The author, after referring to the conflict of the Mendelians and biometricians, explained the methods of investigation of the two schools. The biometricians apply statistical methods and deal with masses of individuals, and therefore with average characters; the Mendelians devote their attention to the study of the individual components of the mass, and endeavour by means of experiments to ascertain the nature and mode of modification of the characters of the units. Mr. Darbishire sought to show that the two views are not irreconcilable, but that the real truth was to be arrived at from a survey of both.—The cause of the period of chemical induction: C. H. **Burgess** and D. L. **Chapman.**

PARIS.

Academy of Sciences, January 23.—M. Troost in the chair.—New researches on the secular alterations of hydrocarbon of organic origin: M. **Berthelot.** Details are given of the chemical examination of a fatty substance found in an Egyptian vase of about 1600 B.C.—Some metals found in archæological excavations in Egypt: M. **Berthelot.** Analyses of two specimens of bronze dating from about the second dynasty.—On the increase of volume of molten cast iron, saturated with carbon in the electric furnace, at the moment of solidification: Henri **Moissan.** Iron which is free, or nearly free, from carbon, in passing from the liquid to the solid state, follows the ordinary law, its density increasing. On the contrary, when saturated with carbon at the temperature of the electric furnace, it increases in volume when solidifying.—Study of lunar photographs. Considerations on the course of solidification in the interior of a planet: MM. **Lœwy** and **Puiseux.** As the result of an examination of photographs of the moon's crust, the author has been led to support the geological view of the constitution of the earth, that of a thin crust with a liquid core, as against the rigid solid theory of the mathematicians.—Note on the three volumes of the *Annales de l'Observatoire de Nice*: M. **Bassot.**—On a recent ascent of Vesuvius: **J. Janssen.** Numerous specimens of gases from the fumerolles and of lava and scoria were collected, and photographs taken of the absorption spectra of the vapours issuing from the cone during an eruption. The description of a detailed examination of these is reserved for a future communication.—The calculation of ordinary and suspension bridges: M. **Considère.**—Observations of the Borrelly comet (1904 *e*) made by F. Courty with the large equatorial at the Observatory of Bordeaux: G. **Rayet.**—On families of surfaces with plane orthogonal trajectories: S. **Carrus.**—Remarks on the preceding communication: Gaston **Darboux.**—On the approximation of functions by polynomials considered in relation with the theory of partial differential equations: application to the problem of the initial state in mathematical physics: A. **Buhl.**—On a hyperelliptic surface: E. **Traynard.**—On the integrals of total differentials belonging to an irregular surface: G. **Castelnuovo.**—On linear differential equations of the second order containing one parameter: M. **Tzitzeica.**—On a theorem of M. Borel: F. **Riesz.**—On the deviation of falling bodies towards the south and on the curvature of lines of force: Maurice **Fouché.**—On the magnetic field to which a body in motion in an electric field is submitted: H. **Pellat.**—On the ions of the atmosphere: P. **Langevin.** The experiments of the author lead to the conclusion that there are only two kinds of ions present in the air, one having a mobility several thousand times smaller than the other. The apparatus used by Ebert only measures the first of these.—Contribution to the study of ionisation in flames: Pierre **Massoulier.**—On the specific coefficients of magnetisation of liquids: Georges **Meslin.**—The action of very low temperatures on the phosphorescence of certain sulphides: F. P. **Le Roux.** Remarks on a paper of MM. A. and L. Lumière dealing with the same subject.—On a new mineral containing radium: J. **Danne.** Some plumbiferous minerals, notably a pyromorphite, found in the neighbourhood of Issy-l'Évêque, have been found to contain radium, and it is a noteworthy fact that none of these minerals contain uranium. The amount of radium is variable, a ton of the mineral furnishing quantities of radium bromide of the order of a centigram.—The dissociation of strychnine salts as measured by the rotatory power. The rotatory power in homologous series. The influence of the double linkage: J. **Minguin.** The deviations were measured in the first place when the strychnine and acid were present in molecular quantities, and then in presence of an excess of acid. The differences observed point to a dissociation taking place.—On cæsium methylamide: E. **Rengade.** Cæsium dissolves in anhydrous liquid methylamine, forming at first a metal methylammonium; this soon evolves hydrogen and the methylamide is quantitatively formed. The amide detonates on heating, giving rise to cæsium cyanide and hydrogen. Water, allowed to act slowly, produces cæsium hydroxide and methylamine.—The action of phosphorus pentachloride upon some tertiary cyclic amines. Syntheses of colouring matters and formation of phosphorus: P. **Lemoult.**—The products of oxidation of anthracene octahydride: dihydro-oxanthranol and hexahydroanthrone: Marcel **Godchot.**—Thymomenthol and its derivatives: Léon **Brunel.** This is obtained from thymol by the Sabatier and Senderens reaction; its physical and chemical properties are given and the preparation of several derivatives described.—Contribution to the study of some derivatives of benzodihydrofurfurane: A. **Guyot** and J. **Catel.**—On the agricultural value of humic materials: J. **Dumont.**—On the elliptical character of the new Borrelly comet (*e* 1904): G. **Fayet.** It is shown that no parabola can satisfactorily represent all the observations, an elliptical orbit with a period of about eight years better representing the facts.—An electrical pendulum with free escapement: Ch. **Féry.** The arrangement described is remarkable for the small expenditure of electrical energy required to work it, less than 0.5 watt per annum. The diurnal variation of a clock beating half seconds fitted with the apparatus described is less than 0.3 second.—On the nitrates of potassium and ammonia and on the law of Bravais: Frédéric **Wallerant.**—The coal basin of French Lorraine: Francis **Laur.**—On the diatom-bearing level of the ravine of Égravats, near Mont Dore, Puy-de-Dôme: M. **Lauby.**—On the biology and anatomy of the suckers of *Osyris alba*: A. **Fraysse.**—On the biology of the Cestodæ: L. **James** and H. **Mandoul.**—The action of magnesium and of magnesia on micro-organisms: F. **Dienert.**

NEW SOUTH WALES

Royal Society, November 2, 1904.—Mr. C. O. Burge, president, in the chair.—Pot experiments to determine the limits of endurance of different farm crops for certain injurious substances, part iii., barley and rye: R. **Helms** and Prof. F. B. **Guthrie.** The authors describe experiments with barley and rye in continuation of those on wheat and maize (*Proc.* Roy. Soc. New South Wales, xxxvi. p. 191, and xxxvii. p. 165) to determine the tolerance of these plants to certain ingredients commonly present in the soils and water used for irrigating in certain parts of the State, namely, sodium chloride and sodium carbonate; also the effect produced upon their growth by the presence of small quantities of plant poisons occasionally met with in fertilisers, such as ammonium sulphocyanide, sodium chlorate, and arsenious acid.—The classification and systematic nomenclature of igneous rocks: H. Stanley **Jevons.** The author concludes that the most convenient general classification for the present time would be one constructed as follows:—(1) Based on alkali-lime-content of principal and minor mineral constituents. Produces two series: alkaline and calcic. (2) Based on similarity of principal mineral constituents. Produces seven sections, *e.g.* granitic, gabbroic, theralitic, &c. (3) Based on community of origin from similar parent magmas. The latter are defined by the presence of certain index minerals in the consolidated rocks (*e.g.* a granite, a granite-aplite, and a rhyolite, &c., may all be derived from one magma; other granites, rhyolites, &c., will be derived from similar magmas). Produces twelve orders, *e.g.* granates, essexates, &c. (4) Based on habit of mass. Produces seven families in each order, *e.g.* granophites, dioromicrites, gabbrolavites (basalts), &c. (5) Based on nature of minor mineral constituents. Produces a number of genera in each family, *e.g.* muscbigranophite, anaugi-hyper-peridotite (harzburgite). (6) Based on texture, but to be applied only in families where there is much variety of texture. Produces subgenera, *e.g.* spheri-mono-rhyolite, graphi-bi-rhyolite, &c. The system of nomenclature described is an elaboration of that already proposed by the author in a preliminary paper in the *Geological Magazine* (1901).

BENGAL.

Asiatic Society of Bengal, January 4.—Hierarchy of the Dalai Lama (1406–1726): Rai Sarat **Chandra Das**. The author gives a history of the origin and growth of power of the Dalai Lama.—On the prevalence of fevers in the Dinajpur district: Dr. L. **Rogers**. This paper deals with the results of a special inquiry into the causes of the very high mortality of above forty per thousand in the Dinajpur district. It is shown that the higher death rates in certain places are due mainly to malaria, the increased prevalence of which is closely related to a high ground water level due to unalterable physical conditions of the district. In the second part of the paper the varieties of fever met with and distribution of the anopheles which can carry the infection are dealt with, and the impracticability of mosquito destruction as a preventive measure in the district as a whole is pointed out. The wider distribution of quinine in each village through the agency of the primary schoolmasters so as to reach the children, who mainly die of the disease, is recommended as the only practicable method of lessening the death rates from malaria among the people of Lower Bengal.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 2.

ROYAL SOCIETY, at 4.30.—On the Compressibility of Gases between One Atmosphere and Half an Atmosphere of Pressure: Lord Rayleigh, O.M., F.R.S.—On the "Blaze Currents" of the Gall Bladder of the Frog: Mrs. A. M. Waller.—The Theory of Photographic Processes: On the Chemical Dynamics of Development: S. E. Sheppard and C. E. K. Mees.—On the Relation between Variations of Atmospheric Pressure in North-East Africa, and the Nile Flood: Capt H. G. Lyons.—Note on the Determination of the Volume Elasticity of Elastic Solids: Dr. C. Chree, F.R.S.—Theory of the Reflection of Light near the Polarising Angle: Prof. R. C. Maclaurin.

ROYAL INSTITUTION, at 5.—Forestry in the British Empire: Prof. W. Schlich.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—The Mechanics of Flour Milling: A. R. Tattersall.

LINNEAN SOCIETY, at 8.—Descriptions of New Chinese Plants (with lantern slides): W. J. Tutcher.—European Cirolaninæ (Isopoda): Dr. H. J. Hansen.

RONTGEN SOCIETY, at 8.15.—Some Points in the Construction of a High Frequency Machine: Dr. Clarence A. Wright.

CHEMICAL SOCIETY, at 8.—Studies in the Camphane Series. Part xvi. Camphorylcarbimide and Isomeric Camphorylcarbamides: M. O. Forster and H. E. Fierz.

FRIDAY, FEBRUARY 3.

ROYAL INSTITUTION, at 9.—Blood Pressure in Man: Prof. T. Clifford Allbutt, F.R.S.

GEOLOGISTS' ASSOCIATION, at 7.30.—Address on Modern Methods in the Study of Fossils: the President, Dr. A Smith Woodward, F.R.S.

MONDAY, FEBRUARY 6.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Theory of Dyeing. Part ii. Pseudo-solution and Desolution: W. P. Dreaper.—The Fading of Inks and Pigments: J. W. Lovibond.

SOCIETY OF ARTS, at 8.—Fountain Pens: James P. Maginnis.

TUESDAY, FEBRUARY 7.

ROYAL INSTITUTION, at 5.—The Structure and Life of Animals: Prof. L. C. Miall, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—On Abnormal Ranid Larvæ from Northeastern India: Nelson Annandale.—On a Second Collection of Fishes made by S. L. Hinde in the Kenya District, East Africa: G. A. Boulenger, F.R.S.—On some Points in the Anatomy of Diademodon: Dr. R. Broom.—Notes on the Mammals of Southern Cameroons and the Benito: George L. Bates.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion*: Floating Docks: L. E. Clark.—*Papers*: Alfreton Second Tunnel: E. F. C. Trench.—The Reconstruction of Moncreiffe Tunnel: Dugald McLellan.

WEDNESDAY, FEBRUARY 8.

SOCIETY OF ARTS, at 8.—Time Development in Photography, and Modern Mechanical Methods of carrying it out: R. Child Bayley.

THURSDAY, FEBRUARY 9.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: (1) On the Conversion of Electric Oscillations into Continuous Currents by means of a Vacuum Valve: (2) On a Kummeter for the Measurement of the Length of Long Electric Waves, and also small Inductances and Capacities: Prof. J. A. Fleming, F.R.S.—Report on an Area of Local Magnetic Disturbance in East Loch Roag, Lewes, Hebrides: Captain A. M. Field, R.N.—Phosphorescence caused by the Beta and Gamma Rays of Radium: G. T. Beilby.—(1) The Spectrum of Scandium and its Relation to Celestial Spectra; (2) Note on the Spectrum of μ Centauri; (3) On the Stellar Line near λ 4686: Sir Norman Lockyer, K.C.B., F.R.S., and F. E. Baxandall.—On Europium and its Ultra-Violet Spectrum: Sir William Crookes, F.R.S.

ROYAL INSTITUTION, at 5.—Forestry in the British Empire: Prof. W. Schlich, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Fuel Economy in Steam Power Plants: W. H. Booth and J. B. C. Kershaw. (Conclusion of discussion.)—The Value of Overhead Mains for Electric Distribution in the United Kingdom: G. L. Addenbrooke.

MATHEMATICAL SOCIETY, at 5.30.—General Theory of Transfinite Numbers and Order-types: Dr. E. W. Hobson.—On the Reducibility of Covariants of Binary Quantics of Infinite Order. Part ii: Mr. P. W. Wood.

FRIDAY, FEBRUARY 10.

ROYAL INSTITUTION, at 9.—The Art of the Ionian Greeks: Dr. Cecil Smith.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

MALACOLOGICAL SOCIETY.—Annual General Meeting. Address by the President, Mr. E. R. Sykes, on Variation (including Teratology) in Recent Mollusca.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Reconstruction of the Santa Lucia River Bridge, Uruguay: P. J. Risdon.

CONTENTS.

THURSDAY, FEBRUARY 9, 1905.

SCIENTIFIC RESULTS OF THE BELGIAN ANTARCTIC EXPEDITION.

Résultats du Voyage du S.Y. Belgica en 1897, 1898, 1899, *sous le Commandemant de A. de Gerlache de Gomery.* Rapports scientifiques. (1) Zoology and Botany. (2) Astronomy and Meteorology. (Antwerp, 1902–4.)

(1) THE cruise of the steam-yacht *Belgica,* organised by the Belgian Government, may be regarded as the first of the series of expeditions fitted out during the last few years to explore the Antarctic and to collect systematically its zoological and botanical products. Consequently, it fell to the lot of this expedition to be the first to bring back specimens of certain animals previously known, more or less imperfectly, by examples obtained by the early expeditions to the South Polar regions, such as that of the *Erebus* and *Terror.* The most noticeable instance of this is afforded by the seal known as *Ommatophoca rossi,* which had been previously known only by two skulls and a skin brought home by the *Erebus* and *Terror* Expedition (1839–43). Fortunately, the fasciculus of the *Rapports* dealing with the seals (by Captain Barrett-Hamilton) was published in 1902, and ante-dates the British Museum report on the *Southern Cross* Expedition, thereby securing to the *Belgica* the full credit for having been the first to increase our knowledge of this interesting species.

The comparative slowness of the rate at which it has been found practicable to issue the result of the *Belgica's* work will, however, necessarily have discounted some of its claims to priority, seeing that the aforesaid report on the collections made by the *Southern Cross* was published in 1902, while at least one small instalment of the zoological results of the *Discovery* Expedition has already been made public. On the other hand, in many of the groups the new forms discovered by the *Belgica* expedition were described at an early date in the form of preliminary notices (in the case of the fishes as early as 1900), and as the later parts of the work before us contain reviews of the species described in the report of the *Southern Cross* Expedition, an advantage rather than a disadvantage has been gained by the delay in publication. This is particularly noticeable in the fasciculus devoted to fishes, which was published in 1904.

The characteristic of the reports on the *Belgica* collections is the wealth of detail with which the descriptions are worked out and the elaborate style in which they are issued. The entire work is, for instance, published in quarto form, in large type, with no apparent limitations to the extent of the letter-press, and a fair allowance of plates, most of which are admirably executed. Each section of the subject has been assigned to a specialist, and the mere mention of the fact that Captain Barrett-Hamilton is responsible for the seals, Mr. Racovitza (the naturalist to the expedition) for the cetaceans, Mr. Dollo for the fishes, and Dr. Pelseneer for the greater part of the molluscs, will be a sufficient indication of the care and wisdom with which the selection of these specialists has been made.

A total of more than sixty separate memoirs on the zoology of the expedition is promised, and of these no less than fourteen (ranging in their subjects from seals and cetaceans to corals and sponges) are now on the table before us. Within the limits of the space at our disposal it would obviously be impossible to attempt anything like a summary—much less a criticism—of the vast amount of work contained in this mass of literature. All that can be essayed is to record a few of the more striking results of some of these investigations, and at the same time to express our opinion, so far as we are capable of forming a judgment, of the high value and importance of the work generally.

As regards Mammalia, perhaps the most important result of the *Belgica* Expedition was a negative one, namely, the practical demonstration that no large forms of terrestrial mammalian life inhabit Antarctica. In his first expedition Mr. Borchgrevink was, indeed, inclined to attribute certain marks commonly seen on the hides of the Antarctic seals to the teeth of a land carnivore, but it is now believed, with much more probability, that they are due to sharks. Mr. Racovitza, it may be added, was the first to make us acquainted with the peculiar gular pouch and strange cry of Ross's seal.

In treating of the cetaceans, Mr. Racovitza, who (like Captain Hamilton in the case of the seals) has no new species to describe, makes some very interesting remarks with regard to the mode of life and physiology of these animals. Especially important are those relating to the depths to which whales are capable of descending. These the author believes to have been exaggerated very greatly, and he puts the extreme limit at one hundred, and the ordinary range at twenty-five metres. As he well remarks, it is practically impossible to imagine an animal the organisation of which would admit of its existence alike at the surface and under the pressure of abyssal depths. His arguments are supported by certain facts in regard to the depths at which cetaceans are captured by the Japanese.

In the bulky fasciculus on the fishes Mr. Dollo has incorporated the results of Mr. Boulenger's work on those obtained during the *Southern Cross* Expedition, and has thus been enabled to present his readers with what is practically a monograph of the Antarctic forms. The most remarkable representatives of this fauna are those constituting the family Nototheniidæ, of which the author recognises no less than eighteen generic types, three of these being named by himself. Whether he is justified in proposing the name *Cryodraco antarcticus* for the fish which he apparently admits to be identical with the one captured during the voyage of the *Erebus* and *Terror* and named Pagetodes, on account of the alleged insufficient definition of the latter, may be doubtful. In our opinion the original sketch of Pagetodes is amply sufficient for the generic definition.

Very few words must, unfortunately, suffice for the parts devoted to invertebrates. In the fasciculus on brachiopods, Prof. Joubin directs attention to the apparently small bodily size of the Antarctic representatives of the group, a feature which is the more notable on account of the contrast they present in this respect to the forms from the Straits of Magellan. Another important fact in connection with the fauna of the southern ocean is brought out by Prof. Koehler in his description of the echinoderms obtained to the south of lat. 69°, the furthest point from which these organisms had at the time been obtained. Practically all these echinoderms have proved to be new forms, but whether they belong to the sub-Antarctic or the true Antarctic fauna has not yet been definitely ascertained.

The other fasciculi at present to hand include the following monographs:—molluscs, by Messrs. Pelseneer and Joubin; myriopods, by Mr. C. von Attems; collembola, by Mr. V. Willems; copepods, by Dr. W. Giesbrecht; nematodes, by Dr. J. G. de Man; nemertines, by Dr. O. Bürger; bryozoans, by Mr. A. W. Waters; hydroids, by Dr. C. Hartlaub; zoophytes, by Messrs. von Marenzeller and Carlgren; and sponges, by Mr. E. Topsent. The botanical memoirs include one by Dr. E. A. Wainio on lichens; a second, by Mr. J. Cardot, on mosses; and a third, by Mr. T. Stephani, on liverworts.

In concluding this too brief notice of a most valuable series of monographs, we may congratulate the Belgian Government on its wise liberality in authorising their publication, and the committee of the *Belgica* on the manner in which they have carried out their share of the task. R. L.

(2) In the department of astronomy we have the discussion of the rates of the chronometers employed and a description of the methods by which time was ascertained during the long confinement of the Antarctic winter. We may say, and it is admitted by the author, M. G. Lecomte, that the astronomical equipment was inadequate. It consisted at the outset of three marine chronometers, a sextant, two artificial horizons, an astronomical telescope, and a theodolite. The size of the telescope is not stated, but it was a relic of the old whaleship, the *Patria,* and was that which had been used by the captain to observe seals when at some distance from the ship. With this instrument, three phenomena of Jupiter's satellites were observed and one occultation. Lunar distances were also observed, but the rates of the chronometers were generally determined from local observations. The accumulated error on return is not clearly stated, but the rates and errors are worked out apparently with great care.

Meteorology naturally claims a large part in the scientific results. The observations were under the charge of M. H. Arctowski, and he has presented the details with very great clearness, and accompanied the whole with many excellent charts, showing graphically the behaviour of the barometer, the hygrometrical measurements, and the variations of temperature. The lowest temperature recorded was $-43°.1$ C. ($-45°.6$ F.) on September 8, 1898. The whole result is to exhibit the factors on which the climate depended during the sojourn of the expedition on the shifting ice. The observations do not refer to a particular spot, the ship drifting with the ice some sixteen degrees in longitude and two degrees in latitude. The observation of the clouds and the discussion of the results were entrusted to M. Dobrowolski, who had to encounter many difficulties, due to fog and darkness, which occasion lacunæ in the record. An appendix gives a description, as complete as possible, of a considerable number of cloud systems, divided into three stages of cirrus, clouds at a mean height, and of clouds at low altitudes. The greatest care seems to have been taken in the description of these systems during the twelve months of residence, but here again the expedition might have been better provided with apparatus. The observer had to trust entirely to eye and the compass; no nephoscope was provided, or photographic camera, or means for determining the height of cloud.

The same author discusses the formation of snow and hoar frost, but in this department he appears to have been hampered by the want of instrumental means. He had no microphotographic apparatus, and it has been difficult and sometimes impossible to reproduce the varied structure which he encountered. Hand drawings have been extensively used, and the general result of his work has been to confirm that of modern investigators who have recognised but two types of forms of structure.

An interesting memoir is that of M. Arctowski discussing the optical phenomena witnessed during the expedition. In this section he treats of the deformation of figure of the sun and moon crossing the horizon, illuminations of the sky at twilight, the green ray seen at the moment of the sun's setting, halos, and other phenomena, the peculiarities of which are best studied in polar regions. The author apologises for the popular character of some of his notes, but though greater detail might have been added if a spectroscope had been included in the outfit, these notes afford very interesting reading. The discussion of the auroræ forms a volume by itself, due to the same physicist. Only sixty-two times in thirteen months was this phenomenon witnessed, owing to the facts that the period of minimum auroræ occurred about the time of the expedition, and the region in which the *Belgica* was ice-bound was far from the locality in which auroræ pass through the zenith. Two excellent plates are given in this section.

Oceanography is represented by two memoirs. In the first, M. Arctowski describes the method by which observations were made on the passage across the Pacific to the Straits of Magellan to determine the density of the surface water. Later during the wintering of the expedition samples were drawn from considerable depths below the ice, and examined in the physical laboratory on board. In the second memoir M. Thoulet, professor at the University of

Nancy, gives the results of some experiments made on the density of sea water in the course of an inquiry entrusted to him by the commission in connection with the results derived by M. Arctowski.

W. E. P.

ITALIAN CHEMISTRY.

Trattato di Chimica Inorganica Generale e Applicato all' Industria. By Dr. E. Molinari. Pp. xxii+693. (Milan: Ulrico Hoepli, 1905.) Price 12.50 lire.

DURING the greater part of last century the progress of science in Italy was retarded by the political troubles of the country; even after the nation had achieved its independence and unity, scientific education was hampered by ecclesiastical controversies and by the poverty of the newly created Government. Taxation has always fallen heavily on the Italian people, and the industry and energy of the north have been taxed unduly owing to the poverty and thriftlessness of the south. In spite of these disadvantages, Italy gave to science in the last century many names which will long be remembered in its history. In particular, the hypothesis of Count Avogadro, enunciated in 1811, forms the basis of the whole of the modern development of chemistry; for nearly fifty years, however, its importance was overlooked, and it was the peculiar merit of another Italian, Cannizzaro, by reviving it, to establish a new epoch in the development of chemical science and to introduce order where all was confused and contradictory.

In the course of the past twenty-five years a school of Italian chemists has arisen the quality of whose work is on a high level of excellence. Side by side with this, an astonishingly rapid development of all branches of the industry of Italy has occurred. The rapidity of the advance may be gauged from a few facts. In the six years 1893–9, the value of the chemical manufactures of Italy exactly doubled itself, increasing from about 1,000,000*l.* to 2,000,000*l.* per annum. In the twenty-five years from 1875 to 1900 the value of the raw silk annually produced tripled itself, and that of the woven silk, which in 1890 was 600,000*l.*, rose in 1900 to 4,000,000*l.* The cotton and wool industries have developed almost as rapidly, and a similar progress is seen in the case of new manufactures, such as that of steel rails, which have only recently been introduced into the country. In some instances Italian manufacturers have begun to compete in foreign markets, and this development bids fair to become still more rapid as Italy converts more and more of her abundant store of water power into electrical energy.

The author of the present treatise, who holds the position of professor of chemistry at the Society for the Encouragement of Arts and Crafts of Milan, has endeavoured in it to initiate a reform in the teaching of chemistry in Italian universities, a reform which has also been recently urged by Profs. Cannizzaro and Ciamician. Hitherto the chemistry taught has been of too academical a character, little attention being given to practical applications. The title of the present work defines its nature, which is that of a treatise on inorganic chemistry, with especial reference to chemical industry. The commoner elements and their compounds are dealt with in detail, but instead of illustrating the text with time-honoured drawings of lecture apparatus, the actual plant used in the manufacture of these substances is depicted. All the more recent processes of manufacture are described concisely but sufficiently, but the book does not degenerate into a mere treatise of technology. The principal physical and chemical properties of the substances are clearly defined, as well as the relation existing between them; owing to conciseness and to the character of the type employed, a large amount of information is imparted which is not to be found in the usual elementary text-books. A novel feature is that the average market price of each commercial article is stated, whilst statistics are given of the cost of manufacture and profit of many of the more important substances. In many cases the development of an industry is traced through the patents referring to it, for instance, in the case of the manufacture of sulphuric acid and of alkali.

Before undertaking the systematic treatment of the elements, 114 pages are devoted to general chemical theory. It is this part that is most liable to criticism. A portion might very profitably have been omitted. The description, for instance, on pp. 37 to 40, of as many as eight different methods of determining vapour density, serves no useful purpose in a book of this kind, while it is doubtful whether the method of deducing the relationship (pp. 72 to 73) between the osmotic pressure and the freezing and boiling points of dilute solutions will be intelligible to the student in its present form. The historical treatment adopted throughout the work is the cause of a few misstatements which should have been avoided. Why, for instance, revive the story, which has no basis in fact, that Priestley, after languishing in poverty, died of poison? In discussing the history of valency, no mention is made of Frankland and Kolbe, Wurtz and Graham only being referred to. It is, moreover, so far from being the truth (p. 136) that in 1809 Gay-Lussac and Thénard admitted that chlorine was probably an element that even in 1811 they contested Davy's view of its elementary nature. Strangely enough, the part played by Cannizzaro in reviving Avogadro's theory is passed over in silence (p. 33), and the credit given to Gerhardt and Laurent alone.

Dr. Molinari's treatise is especially adapted and is likely to be very serviceable to the student who intends devoting himself to chemical industry; for a similar text-book at an equally low price the English student has long sighed in vain. With a few slight alterations the work could be made equally useful to the engineer. In particular, more space might be given to considering materials of construction, whilst the treatment of alloys is far too brief to be satisfactory, considering the important part which they now play in engineering. Several pages of part i. might well be replaced by a general discussion of the remarkable influence of impurities and of thermal treatment on the physical properties of metals. The phase rule, which is briefly explained, could be given a practical application by referring to the nature of alloys, particularly in the case of carbon-iron mixtures.

As is the case with all the works published by the well known firm of Ulrico Hoepli, the printing and reproduction of the illustrations leave nothing to be desired. It is, however, a pity that so many proper names are wrongly spelt; thus Graham is uniformly spelt *Grahm*, and Van der Waals *Van der Vaals*. More than ten misprints of other names are observable.

W. A. D.

A NEW CRYSTALLOGRAPHY.

Grundzüge der Kristallographie. By Prof. C. M. Viola. Pp. iv+389. (Leipzig: W. Engelmann, 1904.) Price 11 marks; bound, 12 marks.

THE opinion is rapidly gaining ground that the theory of crystallography based on the laws of rational indices and symmetry no longer suffices without modification for the classification and description of crystals. It is recognised on the one hand that isomorphism of kindred substances shows itself (as in the Humite group of minerals) more in similarity of crystalline habit and angles than in identity of optical and geometrical symmetry, and on the other hand that vicinal faces with high indices may play an important part in the economy of crystals. Prof. Viola is evidently of opinion that the old methods cannot be adapted to meet the situation, and his book is as revolutionary as it well could be. Crystals are here divided into 7 sygonies, 10 fundamental forms, and 29 harmonies; symmetry is but a particular case of harmony; twins are two similar crystals with two predominant elements in common; the number of space-lattices is reduced to 10, and of space-groups to 156. The basis of classification is descriptive, not geometrical; blende, felspar, and garnet belong to the same fundamental form, chalcopyrite and tetrahedrite to the same harmony.

If the author had merely attacked the existing theory and advocated a classification expressing the results of direct observation alone, independent of any hypothesis, he might have had some success. Unfortunately, he has tried to build up a mathematical theory of his own, with disastrous results. The average shape of all crystals of a substance grown under approximately the same conditions is its "habit"; the average shape of all habits is its "fundamental form." The rate of growth in any direction is proportional to the "cohesion" in that direction (measured, apparently, by the force needed to break a rod of the substance the length of which lies in the given direction), and cleavage takes place perpendicular to the lines in which minima of cohesion are well marked. It follows that the fundamental form has always a centre of symmetry. These assumptions are hardly justified by the cleavage and usual habit of many crystals, *e.g.* fluorite and tetrahedrite, but the mathematical development of these hypotheses is, if possible, still more unfortunate than the premises themselves. It is argued (p. 14, *cf.* Fig. 20) that if two faces grow outwards with velocities c_1 and c_2, (1) their intersection moves with the velocity c_3, compounded of c_1 and c_2, (2) therefore the face perpendicular to c_3 grows with velocity c_3, (3) c_3 is a maximum or a minimum when c_1 and c_2 are minima. Of these statements (1) and (3) are untrue, and (2) absolutely unproven. Thus the fundamental principles on which nearly the whole of the book is based are wrong. Much of the reasoning is of the same fallacious nature, or is, at best, only an appeal to probability; but one more example must suffice.

The author sets himself (p. 251) the impossible task of proving that a symmetry-axis of a homogeneous medium is 2-al, 3-al, 4-al, or 6-al without employing either the law of rational indices or a molecular structure. He accomplishes this by assuming that if the medium is brought to self-coincidence by a rotation through an angle 2γ about an axis C, it cannot be brought to self-coincidence by a rotation about C through any angle less than 2γ.

Prof. Viola apparently considers the space-lattice as only a convenient geometrical expression of the physical properties of a crystal, not as corresponding to any reality of crystal-structure. It is true that he proves (by assuming that the densities of the molecule and of the crystal as a whole are equal, see pp. 280, 335) that the unit of crystalline structure must be the same as the chemical molecule; but on pp. 322 and 334 he uses arguments which would prove the existence of an infinite number of such units in a finite volume.

Crystallographers owe a debt of gratitude to the author for his clear and complete lists of references to the literature of the various subjects with which he deals; the historical notes are also very valuable. The chapters on the two-circle goniometer and the stereographic projection contain much that is interesting and not in the usual text-books. The appearance of the book is attractive, but there is a large number of misprints, some of which quite obscure the author's meaning.

Harold Hilton.

OUR BOOK SHELF.

The Arris and Gale Lectures on the Neurology of Vision. By J. Herbert Parsons, B.S., D.Sc., F.R.C.S. Pp. 70. (London: Hodder and Stoughton, 1904.) Price 2s. 6d. net.

The two lectures delivered by Mr. Parsons in the spring of last year before the Royal College of Surgeons deal with some points on the neurology of the eye which are of extreme interest. The first lecture has for its subject the course of the afferent impulses from the retina to the central nervous system, and their final distribution in the cerebral cortex. Since the delivery of these lectures there have been several important contributions to this latter subject. The case of Dr. Beevor and Dr. Collier, reported in the summer number of *Brain*, seems to go conclusively against the more restricted visual area for which Henschen argues. In this case, despite the fact that the lingual lobe, the depths of the calcarine fissure, and the lower cuneal lobe were all affected, the restriction of the field of vision was simply quadrantic. The truth seems to be that the limits of the visual cortical area correspond to the limits of the layer of Gennari, and that this varies markedly in its relations to the surface in different cases.

The second lecture deals with an equally important subject, the nervous control of pupillary movements. A review of the work done on the question of the course of the pupillo-dilator fibres is given. These fibres pass from the cervical sympathetic as a separate tract along the carotid towards the Gasserian ganglion, and run thence with the ophthalmic division of the trigeminal along the nasal branch to the long ciliary nerves, thus avoiding the ciliary ganglion. The final portion of the lecture is devoted to a discussion of the cortical localisation of pupillary movements. We agree with Mr. Parsons that a very critical spirit is necessary in dealing with this subject. Here, more than anywhere else, is to be found the "elusive factor" which upsets all hypotheses. The term "synkinesis" seems to have a sufficiently useful application in neurological nomenclature to justify its invention. The limits of this notice do not allow of more detailed criticism. We must, however, congratulate Mr. Parsons on the singularly lucid, though necessarily inconclusive, fashion in which he has dealt with subjects of great complexity and importance.

The Twentieth Century Atlas of Microscopical Petrography. Part ii. With four plates. (London: Thos. Murby, 1904.)

Since the note on this work appeared in Nature (vol. lxxi. p. 38), we have been informed that the "editor" of it is Mr. E. Howard Adye, who is, in fact, responsible both for the text and for the very delicate plates. The second part includes two igneous rocks from Edinburgh, the Carboniferous oolite of Clifton, and the beautiful green quartzite of Ightham, described by Prof. Bonney in 1888. This last rock, we believe, usually contains altered glauconite in addition to the minerals mentioned by the author. We fancy that Mr. Adye is familiar with biological writing, which makes his descriptions rather more severely technical than is customary among English geologists. We thus read of a "dark brown fenestrated region at the periphery," "hypo-odontoid outgrowths," "biogenetic formation," and so forth. We do not know, moreover, what degree of extraordinary accuracy is suggested by the phrases "completely polarised light" and "fully-crossed Nicols." The text, however, is usually clear and graphic. The four rock-sections accompanying the part, and issued through the laboratory of Mr. J. R. Gregory, are absolutely perfect specimens of an art rarely cultivated in the British Isles. G. A. J. C.

Abbildungen der in Deutschland und den angrenzenden Gebieten vorkommenden Grundformen der Orchideen-arten. 60 Tafeln nach der Natur gemalt und in Farbendruck ausgefuhrt von Walter Müller (Gera) mit beschreiben dem Text von Dr. F. Kränzlin (Berlin). Pp. xiv+60+plates. (Berlin: R. Friedländer und Sohn, 1904.) Price 10 marks.

This is a series of sixty coloured plates representing the orchids which occur in Central Europe. The introduction and the text are from the pen of Dr. Kränzlin, who tells us at the outset that the book is not intended for professed botanists, but for those who take an interest in botany, or who possess a love of flowers. For this reason it is, we suppose, that the minutiæ of anatomical structure and the details of physiology are but lightly touched on. The reader, however, has put before him in a very clear way the principal points in the morphology of this most interesting group, together with an account of the conformation of each species.

A general statement is made as to the geographical distribution of the several plants, but no precise indications of particular localities are given. Most of our European orchids are terrestrial and have tuberous roots, but *Liparis Loeselii,* a species very rare in Britain, has a distinct pseudo-bulb such as characterises most of the tropical epiphytes of this order, and a similar form of stem occurs in *Microstylis monophyllos,* so that the formation of a pseudo-bulb is not correlated solely with the epiphytic habit. Both the tuber and the pseudo-bulb serve as food stores for the growing plant. In *Goodyera repens* there is a creeping underground stem which also recalls that of its tropical congeners. These points and others of a similar character are well represented in the plates. These illustrations were executed from life by Mr. Walter Müller, and they are so truthful that we may commend them to the notice of orchid lovers. Our field botanists will find all the British species represented, as well as a few others that are not members of the British Flora.

Intensification and Reduction. By Henry W. Bennett. Pp. xv+124. (London: Iliffe and Sons, Ltd., 1904.)

This issue, No. 15 of the *Photography* Bookshelf Series, will form a useful addition to an already valuable set of handbooks. The author has wisely restricted himself to setting forth in a clear and concise manner the better methods employed in intensification and reduction, and has not burdened the beginner with an elaborate index to all possible methods past and present. The processes dealt with are treated in some detail, so for this reason the reader should gain a good working knowledge of the manipulations he has in hand. The distinctive qualities of each method are clearly brought out, making the selection of any one for a particular negative quite an easy matter.

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.]*

Slow Transformation Products of Radium.

In a recent number of the *Philosophical Magazine* (November, 1904), I have shown that radium, after passing through four rapid changes, finally gives rise to two slow transformation products, which, on the scheme of changes there outlined, were called radium D and radium E.

These two products can be separated from each other by suitable physical and chemical methods. Radium D, which is the parent of E, gives out only β rays, while E gives out only α rays. It was calculated that D should be half transformed in forty years, and E in about one year. Evidence was also shown that radium D was the active constituent in the radio-active lead of Hofmann, and that radium E was the active substance present in both the polonium of Mme. Curie and the radio-tellurium of Marckwald.

Later work has confirmed these conclusions. I have examined the rates of decay of the activity of radium E and of radio-tellurium, and have found them to be identical. Each loses half its activity in about 150 days, instead of the calculated period of one year. The specimen of radio-tellurium was obtained from Sthamer, of Hamburg, in the form of a thin film deposited on a polished bismuth rod. I find that the same value for the decay and activity of radio-tellurium has recently been obtained by Meyer and Schweidler (*Akad. d. Wiss. Wien.*, December 1, 1904).

I was, unfortunately, unable at the same time to determine accurately the decay of the activity of polonium. A specimen of polonium (ratio-active bismuth) had been in my possession for three years, and had during that time lost a large proportion of its original activity. On testing it, the activity was found to have reached a small and nearly constant value. Rough observations, however, which I had made from time to time indicated that the rate of decay of this polonium was certainly not very different from that of radium E. More accurate experiments will be required to settle the question definitely, but I think there is little doubt but that their rates of decay will be found to be the same.

Polonium, radio-tellurium, and radium E have very similar radio-active and chemical properties. Each gives out only α rays, and each is deposited on a bismuth plate placed in the active solution. The probable identity of their rates of decay, taken into conjunction with the similarity of their radiations and chemical properties, shows that the radio-active constituent present is in each case the same. We may thus conclude that the active substance present in polonium and radio-tellurium is a decomposition product of radium and is the sixth (or, as we shall see later, probably the seventh) member of the radium family.

The main objection, in the past, against the identity of polonium and radio-tellurium has rested on the statement of Marckwald that a very active preparation of his substance did not lose its activity to an appreciable extent in six months. Unless very special methods were employed, it would be difficult to determine with accuracy the variation of the activity for such very active material. The specimen of radio-tellurium obtained both by Meyer and Schweidler and by myself undoubtedly does lose its activity fairly rapidly.

I have recently examined more carefully the product radium D, and have found strong evidence that it is not a single product, but contains two distinct substances. The parent product, radium D, does not give out rays at all, but changes into a substance which gives out only β rays, and is half transformed in about six days. Unless observations are made on the product radium D shortly after its separation, this rapid change is likely to escape detection. The work on this subject is still in progress, but the evidence at present obtained indicates that the active deposit from the emanation, after passing through the three rapid stages, represented by radium A, B, and C, is transformed into a "rayless" product D, which changes extremely slowly. D continuously produces from itself another substance—which may for the time be termed D_1—which is transformed in the course of a few weeks and emits only β rays. This product D_1 gives rise to E (polonium).

Since the activity of D_1 reaches a maximum value a few weeks after the production of D, and will then decay at the same rate as D, the conclusion, previously arrived at, viz., that D is half transformed in about forty years, still holds good.

The view that radium D is the active constituent present in the so-called radio-lead of Hofmann has been very strongly supported by some experimental results recently obtained by Hofmann, Gonder and Wölfl (*Annal. der Physik*, vol. xv., 3, 1904).

They found that preparations of radio-lead continuously produced an α ray product, which could be separated on a bismuth plate. This active product is probably radium E, for they found it lost a large proportion of its activity in one year. They found, in addition, that by certain chemical methods another distinct product could be separated which gave out only β rays, and lost much of its activity in six weeks. This substance is probably the new radium product D_1 already referred to.

Debierne recently concluded that radio-lead and polonium were identical, and proposed that the name radio-lead should be dropped in favour of polonium. In the light of the above results, this position is not tenable. There is no doubt that the preparation of radio-lead in my possession, and also that experimented on by Hofmann, contains a distinct substance which, as the parent of polonium, has certainly as much right to a name as its offspring. The radio-active substance in "radio-lead" has no more connection with lead than Marckwald's active matter "radio-tellurium" has with tellurium. The names both arose because the active matter was initially found associated with these substances.

In order to avoid confusion, I have called the new radium product "radium D_1." If no further intermediate products of radium are brought to light, it would be simpler to call it radium E and to call the α ray product (polonium) radium F.

E. RUTHERFORD.

McGill University, Montreal, January 24.

Indian and South African Rainfalls, 1892-1902.

MR. J. R. SUTTON, of Kimberley, rendered a signal service to South African meteorology in his "Introduction to the Study of South African Rainfall" (*Trans.* S.A. Philosophical Soc., December, 1903), but when he states that south-east winds are rare on the south-east coast of South Africa, and that the rainfall of the greater part of the tableland and south-east coast comes from some northern direction (NATURE, November 3, 1904), it is difficult to follow his conclusions. Most, if not all, of those who have studied South African rainfall will, I think, agree with me that the facts do not bear this interpretation. Least of all is it the case that there has been nothing that can properly be called a drought, in the sense of Sir J. Eliot's address, within the past fifteen years in South Africa. In all the summer rainfall areas of South Africa, viz., over the bulk of the subcontinent, drought has prevailed during recent years, and in some localities it has been terribly severe.

During twenty years I have travelled over every part of South Africa except the desert areas, and I have resided continuously in those parts where there is most rain and forest. I have heard the rain and its mode of arrival discussed in every locality and from every point of view, and these facts have convinced me that the summer rains have their origin in the moist winds from the Indian Ocean. The precipitation of the moisture contained in these humid air currents is caused by barometric depressions with normal cyclonic wind circulation, and it is the winds proper to these depressions that give the appearance of rains coming from the north, north-west, west, &c.

The following gives a brief account of the various storm types. In Cape Colony storms travel from west to east at all times of the year. As one would expect, they are more regular and better developed in the south than in the north, and in Rhodesia than in the Northern Transvaal. In the north during summer they may be replaced by westward travelling tropical storms. Usually it is the secondary with its thunderstorms, a whirl within a whirl, which precipitates the greater amount of moisture. In the southern portion of the subcontinent these storms in most cases pass across from west to east with their centres to the south, and thus their wind circulation shows at first winds from the north and north-west, then from the west and south-west, and finally from the south and south-east. In summer, when the south-east trade blows on to the subcontinent with a monsoon effect, the wind remains longer in the south-east quarter, and heavy rains come frequently from the south-east or the south-west quarter. The portion of the barometric depression and its accompanying circulation which brings the wind will depend on the position of the locality, but I have never known the facts not to conform more or less closely to this type of wind circulation. A range of mountains across the south-east rain-producing wind will, of course, increase the precipitation, and when once rain has started in the south-east quarter it will often continue for days with a steady south-east wind blowing like a south-west monsoon wind in India. All this takes place on the eastern side of South Africa. The rain is greatest in amount where the east wind from the Indian Ocean first strikes the highest eastern land, and the rain gradually decreases in amount until the western deserts are reached. It is generally the north-west wind which starts the precipitation, but it is quite certain notwithstanding that the humid currents do not come from the north-west. If, as Mr. Sutton has suggested, the high upper current of the north-west anti-trade were the source of South African rains, then it would be natural to suppose that the rains would be best developed on the north and western sides of South Africa, which is exactly the reverse of what actually takes place.

South Africa lies on the border of the south-east trade area. In summer South Africa, from Cape Town to the Zambezi, comes entirely under the influence of the south-east trade winds; but in winter the southern portion of

Cape Colony is subject to another type of weather, due to the passage of storms from the South Atlantic, the "roaring forties" of mariners. It is necessary very carefully to distinguish between these two weather systems. In the one the storms bring winter rains to a small part of the subcontinent, *i.e.* Cape Town and the south-west; in the other the storms precipitate the abundant moisture brought by the trade winds from the Indian Ocean, more or less over the whole subcontinent.

This much of explanation is necessary in order to understand clearly the connection between the weather of India and that of South Africa. In studying this connection we have at the outset to eliminate the winter weather of the south-west with its winter rains coming from the South Atlantic.

Sir John Eliot, in his reply to Mr. Sutton, very properly excludes the area of winter rains. I go further, and exclude what Mr. Sutton has termed the area of spring and autumn rains. The latter are areas where, with the winter storms still prevailing and the summer south-easters coming in from the Indian Ocean, there is the most marked precipitation in spring and autumn. We are not in a position to say how far these rains have been produced by the tail-end of the retreating Atlantic storms or by the head of the advancing humid south-east trade currents. The fertile country watered directly by the south-east trade is comprised in sections x. to xv. of Mr. Sutton's rainfall areas, viz. the east of Cape Colony, Kaffraria, Basutoland, the Orange River Colony and Natal, and, in addition, all the Transvaal, Rhodesia, and the Portuguese territory; in fact, it is the whole of fertile South Africa with the exception of the southern and south-west coasts. In the table below I give the mean of Mr. Sutton's figures for his sections x. to xv., comprising Eastern Cape Colony, Transkei, Basutoland, Orangia, and Natal, and I add the yearly rainfall from typical stations in the Transvaal and Rhodesia, as correct general average figures for these territories are not available.

Percentages of Rainfall in the Summer Rainfall Areas, 1891 to 1902: Mean of Sutton's Sections x. to xv.

	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902
Per cent.	136	106	132	97	103	102	74	107	89	82	98	93

And correcting Sir John Eliot's table to purely summer rainfalls it will read thus:—

Period of general excess of rain.

Year.	Percentage variation Summer rainfall. India	S. Africa.
1892	12	+ 6
1893	22	+ 32
1894	16	− 3

Period of general deficiency of rain.

Year.	Percentage variation Summer rainfall. India	S. Africa.
1895	− 5	+ 3
1896 (famine)	− 12	+ 2
1897	normal	− 26
1898	1	+ 7
1899 (famine)	− 27	− 11
1900	− 1	− 18
1901	− 10	− 2
1902	− 5	− 7

These figures show more strikingly than those already quoted by Sir John Eliot the intimate connection between the rainfall of India and South Africa during the period 1892 to 1902, and the connection would have shown better if seasonal instead of calendar years had been taken, since the calendar year cuts into two unequal portions the South African summer rainfall. It will be noted that each Indian famine year has been followed by one or two particularly bad years of drought in South Africa.

It is a somewhat remarkable coincidence that, while the number of Nature containing this discussion was on the sea on its way to the Cape, I prepared my yearly forecast of South African weather, and in that took occasion to point out the very close connection of the two rainfalls during this period. I may perhaps crave your indulgence to reproduce it, since it confirms so singularly Sir John Eliot's view. Speaking of certain typical stations I said:—

"Sir John Eliot's paper shows that 1892, 1893, and 1894 were years of good rainfall in India. These were the last years of general good rainfall we had in South Africa. In 1895 the drought set in at most South African stations. Further, in this droughty period there were two years of bad famine, viz., 1896 and 1899. These two years of famine in India were the two worst years of drought at many typical South African stations. At present we are not in a position to obtain average figures for the whole of South Africa, but nearly the same purpose will be served by taking certain typical stations thus:

"At Bulawayo (Hope Fountain), in 1890–1, there was the heaviest rain on record, viz., 45 inches; all the following years have been years of drought except three years when the rainfall was barely above the average.

"At Johannesburg there were good rains in 1894, when there were good rains in India, fair rains in 1895, and then drought, when there was drought in India. 1896 (one of the Indian famine years) was the worst year of drought in Johannesburg. The great Indian famine of 1899 was represented by a bad drought 1898–9 preceding the failure of the Indian monsoon by four months. . . .

"Natal rainfalls correspond closely with the Indian rainfalls. While 1899 was the worst famine for many years in India, 1899 and 1900 were the two worst years of drought ever experienced at Durban, in Natal, since meteorological observations were begun there in 1866. In 1900, the Durban rainfall was only 27 inches against an average of 41 inches. At Maritzburg, representing the inland Natal districts, 1899 was also a year of drought, but the greatest deficiency was registered the following year (probably chiefly due to the calendar year dividing the seasonal year).

"Again, at Grahamstown, Cape Colony, in 1899 there was under 20 inches against an average of 29 inches; at King William's Town in 1899, only 16 inches against an average of 25 inches; while at Graaff-Reinet in 1899 there was only 9 inches against an average of 15 inches. At all these South African stations, 1899, the great Indian famine year, was the worst year of drought in recent times!"

The rainfall curves for Umtata, Evelyn Valley, and Katberg show similar features, viz., severe South African droughts corresponding to the years of Indian famine, and a general deficiency of rainfall corresponding with the years of general deficiency of Indian rainfall. The rainfall curve of Evelyn Valley (Fig. 1), however, is very remarkable. This is a forest station, and the observer a particularly good one. I have elsewhere compared this station to Cherapunji, in India. I founded this station in 1887, and it has since shown the heaviest rainfall on the summer register. It lies in a *cul de sac* of the mountains facing the south-east at an elevation of 4200 feet. I have long regarded it as the typical southern station for the summer rainfalls. A study of its yearly rainfall curve shows how rain failed here in the most striking manner previous to the Indian famine of 1896, and during and after the Indian famine of 1899.

With regard to Mr. Sutton's statement that there has been no severe drought during recent years in South Africa, there is abundant evidence to the contrary.

A year ago I wrote: "In the Karoo the present drought is considered the worst during the last half-century. At Hanover (Upper Karoo) during nearly a year there has fallen only three-quarters of an inch, the normal yearly rainfall being 15 inches. The drought has lasted on and off since 1896–8, and during the worst years cattle and sheep have perished in millions. In British Central Africa the drought has lasted since about 1898; it is reported that the Shiré Lake is now nearly dry. Last summer's crops in the Transvaal, so sorely needed after the war, were a complete failure, while in Natal, Rhodesia, and the country to the north there was in many places famine, and people dying in places too remote to be reached by Government aid.

"When will the drought end? is now the great question for the country.

"Good rains have fallen recently all down the eastern side and on the south coast of South Africa. This rain has come as a precious mitigation of the drought. It may be looked on as a favourable indication for a good season —perhaps more favourable if it had come later.

"The local and other indications of an early ending of the drought are favourable. It has definitely broken up in Australia." (Weather forecast, dated November 23, 1903.)

Writing a year later, November 23rd, 1904, I said: "My weather forecast for last year (published in the *Cape Times* of November 23, 1903) indicated the expectation of a more or less complete break-up of the drought. This forecast has been fulfilled. In many parts of South Africa, particularly towards the north, the drought has broken, and good seasons were experienced last year. In other parts the rains were insufficient to really break the drought. This was the case in the fertile 'conquered territory' of Orangia, and over wide areas in Cape Colony. In the Transkei drought remains unbroken. It is described as a drought of terrible severity, and one that has stopped all ploughing and killed from 50 to 60 per cent. of the sheep in some of the districts. As was remarked by a correspondent in the *Cape Times* a few days since,

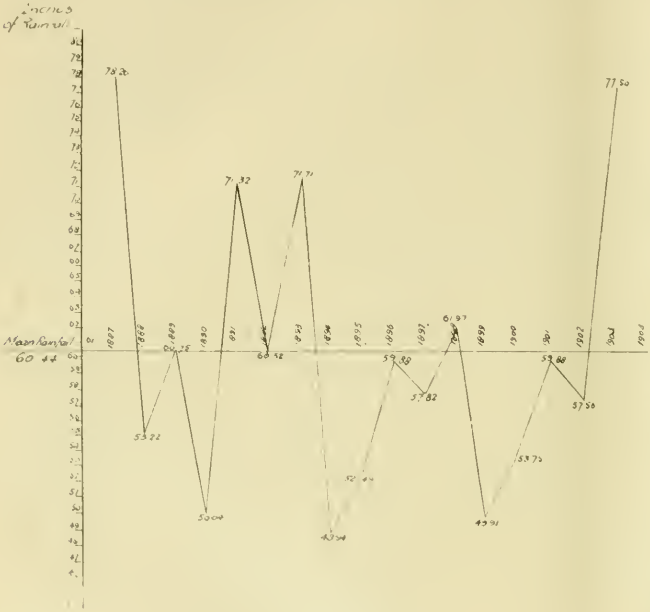


FIG. 1.—Rainfall, Evelyn Valley.

'No one not living here has any idea of the terrible condition existing in the Karoo and Eastern Province. The springs on most of the farms have utterly disappeared. On one farm in the Cradock district with large lands, orchards, and a water-mill at the junction of two kloofs in the Sneeuwberg, the river beds are as dry as a street; the farmer has sold all his stock, and I actually saw the water for household use brought some distance in a barrel. In former years the water-mill was in constant use for all the surrounding country.' "

Writing to me recently from Zomba, in British Central Africa, Mr. Clounie, the head of the scientific department, speaking of last summer's rains, says: "The wet season from November to April last has been remarkably good, and crops everywhere have been excellent. I think everything points to the end of the drought and a return to a period of good rains."

As regards the drought further north, the reader may turn to NATURE of November 3, 1904 (p. 15). I produce the extract for ready reference:—

"Appendix iii. of a report upon the basin of the Upper Nile, with proposals for the improvement of the river by Sir William Garstin, contains an interesting account of the variations of level of Lake Victoria Nyanza contributed by Captain H. G. Lyons, the director of the Survey Department of Egypt. This lake has a water surface of about 68,000 square kilometres, and is situated about 1129 metres above sea-level. It is believed to be of shallow depth, and lies for the most part of the year in the region of the equatorial rain and cloud belt, the excess water draining off at the Ripon Falls by the Victoria Nile. After reference to the geology and climate of the region, a brief historical summary is given of the early lake levels as observed by travellers and others visiting or residing by it; this is followed by a detailed study and discussion of the various gauges. Some of the results obtained are as follows:—The annual oscillation of the lake is from 0·30 metre to 0·90 metre. Between 1896 and 1902 there was a fall of 70cm. in the average level, since followed by a rise of 56cm. The epochs of high and low levels are given as:—1878, high level; 1880–90, falling level; 1892–5, temporary high level; 1896–1902, falling level; 1903, rising level."

The kernel of this quotation lies in the last six words: it shows the same correspondence with the Indian rainfall figures as the summer rainfall figures of South Africa.

D. E. HUTCHINS.

Cape Town, December 8.

Compulsory Greek at Cambridge.

SOME years ago a young lady who was studying at Girton came to Bristol to spend a part of her first vacation after passing the "Little-go." She had never learnt Greek at school, but had been coached by an elder brother, who was at that time in residence at Cambridge; in about two months she obtained a knowledge of Greek sufficient to meet the requirements of the authorities at Cambridge.

While she was with us we paid a visit to the neighbouring city of Bath, and I directed her attention to the motto which is inscribed on the Roman baths there, viz.:

ἄριστον μὲν ὕδωρ.

Remembering her recent success in the "Little-go," I jokingly asked her the meaning of this inscription—not imagining for a moment that Cambridge compulsory Greek would be unequal to such an easy task; she was, however, unable to give the meaning of the words; she did not think she had ever seen ἄριστον, but was of opinion that she had in the course of her reading met the word ὕδωρ, but did not remember what it meant.

It may be well to add that the lady in question has great linguistic ability, and in due course obtained a good place in the Modern Languages Tripos.

Do our ultra-classical friends really think that compulsory "Greek" of this type is worth preserving?

J. WERTHEIMER.

Merchant Venturers' Technical College, Bristol, January 30.

NOTES ON STONEHENGE.[1]

II.—ARCHÆOLOGICAL OBSERVATIONS AT STONEHENGE, 1901.

SOON after Mr. Penrose and myself had made our astronomical survey of Stonehenge in 1901, some archæological results of the highest importance were obtained by Prof. Gowland. The operations which secured them were designed and carried out in order to re-erect the leaning stone which threatened to fall, a piece of work recommended to Sir Edmund Antrobus by the Society of Antiquaries and other learned bodies, and conducted at his desire and expense.

They were necessarily on a large scale, for the great monolith, "the leaning stone," is the largest in England, Cleopatra's Needle excepted. It stood behind the altar stone, over which it leant at an angle of 65 degrees, resting at one point against a small stone of syenite. Half-way up it had a fracture one-third across it; the weight of stone above this fracture was a dangerous strain on it, so that both powerful machinery and great care and precautions had to be used. Prof. Gowland was charged by the Society of Antiquaries with the conduct of the excavations necessary in the work. The engineering operations were planned by Mr. Carruthers, and Mr. Detmar Blow was responsible for the local superintendence. Mr. Blow thus describes the arrangements (*Journal* Institute of British Architects, 3rd series, ix., January, 1902):—

"A strong cradle of 12-inch square baulks of timber was bolted round the stone, with packing and felt, to prevent any marking of the stone. To the cradle were fixed two 1-inch steel eyebolts to receive the blocks for two six-folds of 6-inch ropes. These were secured and wound on to two strong winches fifty feet away, with four men at each winch. When the ropes were thoroughly tight, the first excavation was made as the stone was raised on its west side."

The method employed by Prof. Gowland in the excavation should be a model for all future work of the kind. I have to express my thanks to the council of the Society of Antiquaries and Prof. Gowland for permission to use the accompanying illustrations showing the operations and results.

Above each space to be excavated was placed a frame of wood, bearing on its long sides the letters A to H, and on its short sides the letters R M L, each letter being on a line one foot distant from the next. By this means the area to be excavated was divided into squares, each having the dimension of a square foot. A long rod divided into 6-inch spaces, numbered from 1 to 16, was also provided for indicating the depth from the datum line of anything found. In this way a letter on the long sides of the frames, together with one on the short sides, and a number on the vertical rod, indicated the position of any object found in any part of the excavation.

FIG. 4. The arrangements for raising the stone.

Excavations were necessary because to secure the stone for the future the whole of the adjacent soil had to be removed down to the rock level, so that it could be replaced by concrete.

All results were registered by Prof. Gowland in relation to a datum line 337·4 feet above sea level. The material was removed in buckets, and carefully sifted through a series of sieves 1-inch, ½-inch, ¼-inch, and ⅛-inch mesh, in order that the smallest object might not be overlooked.

From the exhaustive account of his work given by Prof. Gowland to the Society of Antiquaries (*Archaeologia*, lviii.), I gather three results of the highest importance from the point of view I am considering. These were, first, the finding of an enormous number of implements; secondly, the disposition and relative quantities of the chippings of the sarsen and blue stones; and thirdly, the discovery of the method by which the stones were originally erected.

I will take the implements first. This, in a con-

[1] Continued from p. 300.

densed form, is what Prof. Gowland says about them:—

More than a hundred flint implements were found, and the greater number occurred in the stratum of chalk rubble which either directly overlaid or was on a level with the bed rock. They may all be arranged generally in the following classes:—

Class I.—Axes roughly chipped and of rude forms, but having well-defined, more or less sharp cutting edges.

Class II.—Hammerstones, with more or less well-chipped, sharp curved edges. Most may be correctly termed hammer-axes.

Class III.—Hammerstones, more or less rounded. Some specimens appear to have once had distinct working edges, but they are now much blunted and battered by use.

In addition to the above flint implements were found about thirty hammerstones, consisting of large pebbles or small boulders of the hard quartzite variety of sarsen. Some have been roughly broken into convenient forms for holding in the hand, whilst a few have been rudely trimmed into more regular shapes. They vary in weight from about a pound up to six and a half pounds. To these we have to add mauls, a more remarkable kind of hammerstone than those just enumerated. Their weights range from about 40 lb. to 64 lb.

FIG. 5.—Some of the flint implements.

How came these flints and stones where they were found? Prof. Gowland gives an answer which everybody will accept. The implements must be regarded as the discarded tools of the builders of Stonehenge, dumped down into the holes as they became unfit for use, and, in fact, used to pack the monoliths as they were erected. We read:—"Dealing with the cavity occupied by No. 55 before its fall, the mauls were found wedged in below the front of its base to act together with the large blocks of sarsen as supports (p. 54)." Nearly all bear evidence of extremely rough usage, their edges being jagged and broken, just as we should expect to find after such rough employment. We evidently have to deal with builders doing their work in the Stone and not in the Bronze age. But was the age Palæolithic or Neolithic?

Prof. Gowland writes:—

"Perhaps the most striking features of the flint implements is their extreme rudeness, and that there is not a single ground or polished specimen among them. This, at first sight and without due consideration, might be taken to indicate an extremely remote age. But in this connection it must be borne in mind that in the building of such a stupendous structure as Stonehenge, the tools required must have been numbered by thousands. The work, too, was of the roughest character, and for such only rude tools were required. The highly finished and polished implements which we are accustomed to consider, and rightly so, as characteristic of Neolithic man, would find no place in such work. They required too much labour and time for their manufacture, and, when made, could not have been more effective than the hammer-axes and hammerstones found in the excavations, which could be so easily fashioned by merely rudely shaping the natural flints, with which the district abounds, by a few well directed blows of a sarsen pebble."

On this ground Prof. Gowland is of opinion that, notwithstanding their rudeness, they may be legitimately ascribed to the Neolithic age, and, it may be, near its termination, that is, before the Bronze age, the commencement of which has been placed at 1400 B.C. by Sir John Evans for Britain, though he is inclined to think that estimate too low, and 2000 B.C. by Montelius for Italy.

Prof. Gowland guardedly writes:—

"In my opinion, the date when copper or bronze was first known in Britain is a very remote one, as no country in the world presented greater facilities for their discovery. The beginning of their application to practical uses should, I think, be placed at least as far back as 1800 B.C., and that date I am inclined to give, until further evidence is forthcoming, as the approximate date of the erection of Stonehenge."

Now the date arrived at by Mr. Penrose and myself on astronomical grounds was about 1700 B.C. It is not a little remarkable that independent astronomical and archæological inquiries conducted in the same year should have come so nearly to the same conclusion. If a general agreement be arrived at regarding it, we have a firm basis for the study of other similar ancient monuments in this country.

I have previously in these "Notes" referred to the fact that the trilithons of the naos and of the outer circle are all built up of so-called "sarsen" stones. To describe their geological character, I cannot do better than quote, from Mr. Cunnington's "Geology of Stonehenge,"[1] their origin according to Prestwich:—

"Among the *Lower Tertiaries* (the Eocene of Sir Charles Lyell), are certain sands and mottled clays, named by Mr. Prestwich the Woolwich and Reading beds, from their being largely developed at these places, and from these he proves the sarsens to have been derived; although they are seldom found *in situ*, owing to the destruction of the stratum to which they belonged.

"The abundance of these remains, especially in some of the valleys of North Wilts, is very remarkable. Few persons who have not seen them can form an adequate idea of the extraordinary scene presented to the eye of the spectator, who, standing on the brow of one of the hills near Clatford, sees stretching for miles before him, countless numbers of these enormous stones, occupying the middle of the valley, and winding like a mighty stream towards the south."

These stones, then, may be regarded as closely associated with the local geology.

The exact nature of the stones, called "blue stones," can best be gathered from a valuable "Note" by Prof. Judd which accompanies Prof. Gowland's paper. These blue stones are entirely unconnected with the local geology; they must, therefore, represent boulders of the Glacial drift, or they must have been brought by man, from distant localities. Prof. Judd inclines to the first opinion.

The distinctions between these two kinds of stone are well shown by Prof. Gowland:—

"The large monoliths of the outer circle, and the trilithons of the horse-shoe are all sarsens—sandstones, consisting of quartz-sand, either fine or coarse, occasionally mixed with pebbles and angular bits of flint, all more or less firmly cemented together with silica. They range in structure from a granular rock resembling loaf sugar in internal appearance to one of great compactness similar to quartzite."

"The monoliths and trilithons all consist of the granular rock. The examples of the compact quartzite variety were, almost without exception, either hammerstones that had been used in shaping and dressing the monoliths, or fragments which had been broken from off them."

"The small monoliths, the so-called 'blue stones,' which form the inner circle and the inner horseshoe, are, with the undermentioned exceptions, all of diabase more or less porphyritic. Two are porphyrite (formerly known as felstone or hornstone). Two are argillaceous sandstone."

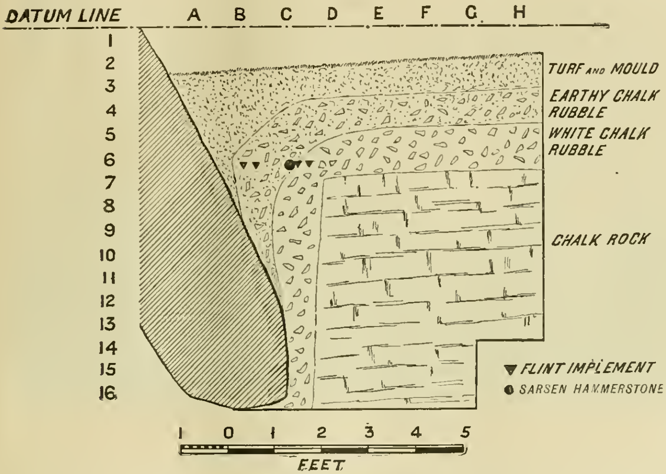


Fig. 6.—Face of rock against which a stone was made to rest.

"Mr. William Cunnington, in his valuable paper, 'Stonehenge Notes,' records the discovery of two stumps of 'blue stones' now covered by the turf. One of these lies in the inner horseshoe between Nos. 61 and 62, and 9 feet distant from the latter. It is diabase. The other is in the inner circle between Nos. 32 and 33, 10 feet from the former, and consists of a soft calcareous altered tuff, afterwards designated for the sake of brevity fissile rock.

The altar stone is of micaceous sandstone."

I now come to the second point, to which I shall return in subsequent "Notes."

In studying the material obtained from the excavations, it was found in almost every case that the number of chippings and fragments of blue stone largely exceeded that of the sarsens; more than this, diabase (blue stone) and sarsen were found together in the layer overlying the solid chalk (p. 15). Chippings of diabase were the most abundant, but there were few large pieces of it. Sarsen, on the other hand, occurred most abundantly in lumps (p. 20); very few small chips of sarsen were found (p. 42). Hence Prof. Gowland is of opinion that the sarsen blocks were roughly hewn where they were found (p. 40); the local tooling, executed with the small quartzite hammers and mauls, would produce dust.

Finally, I reach the third point of importance from the present standpoint; the excavations produced clear evidence touching the mode of erection. Prof. Gowland's memoir deals only with the leaning stone, but I take it for granted that the same method was employed throughout. This method was this:—

(1) The ground on the site it was to occupy was removed, the chalk rock being cut into in such a

[1] *Wilts Archaeological and Natural History Magazine*, xxi. pp. 141–149.

manner as to leave a ledge, on which the base of the stone was to rest, *and a perpendicular face rising from it, against which as a buttress* one side would bear when set up. From the bottom of this hole an inclined plane was cut to the surface, down which the monolith which had already been dressed was slid until its base rested on the ledge.

(2) It was then gradually raised into a vertical position by means first of levers and afterwards of a ropes. The levers would be long trunks of trees, to one end of which a number of ropes were attached (this method is still employed in Japan), so that the weights and pulling force of many men might be exerted on them. The stronger ropes were probably of hide or hair, but others of straw, or of withes of hazel or willow, may have been in use for minor purposes.

(3) As the stone was raised, it was packed up with logs of timber and probably also with blocks of stone placed beneath it.

(4) After its upper end had reached a certain elevation, ropes were attached to it, and it was then hauled by numerous men into a vertical position, *so that its back rested against the perpendicular face of the chalk which had been prepared for it.* During this part of the operation, struts of timber would probably be placed against its sides to guard against slip.

As regards the raising of the lintels, and imposts, and the placing of them on the tops of the uprights, there would be even less difficulty than in the erection of the uprights themselves.

It could be easily effected by the simple method practised in Japan for placing heavy blocks of stone in position. The stone, when lying on the ground, would be raised a little at one end by means of long wooden levers. A packing of logs would then be placed under the end so raised, the other extremity of the stone would be similarly raised and packed, and the raising and packing at alternate ends would be continued until the block had gradually reached the height of the uprights. It would then be simply pushed forward by levers until it rested upon them.

I shall deal later on with several interesting conclusions to which these investigations lead.

NORMAN LOCKYER.

FIG. 7.—The present aspect of the monument with the leaning stone raised.

GEOLOGY OF THE MOON.

FOR many years past geologists have turned wistfully to the moon in the hope of gaining from a study of its surface some insight into planetary evolution, and more especially into some of the stages in the history of our own globe. It must be confessed, however, that as yet few satisfactory data have been obtained, either in the facts observed or in the deductions drawn from them. The great majority of those who have studied the subject have formed the opinion that our satellite was once a liquid mass, such as we believe the earth itself to have also been, and that its so-called "craters" represent extensive and prolonged volcanic activity, when the gases and lava of the heated interior escaped to the surface, probably on a scale of magnitude greatly surpassing that on which subterranean energy has ever been manifested in the geological history of our planet. But another explanation has been proposed for these lunar features, according to which, as worked out by Mr. G. K. Gilbert, of the United States Geological Survey, the moon was formed by the aggregation of a ring of meteorites which once encircled the earth, and the "craters," instead of arising from the escape of volcanic energy from within, were produced by the impact of the last meteoric bodies that fell from without. These bodies, arriving with planetary velocity, would be melted or reduced to gas, while a portion of the lunar surface around them would also be liquefied. Mr. Gilbert believes that the lunar topography bears witness to such a meteoritic bombardment rather than to gigantic volcanic explosions.

The latest contribution to the discussion was recently presented to the Academy of Sciences of Paris by MM. Lœwy and Puiseux. These eminent astronomers direct attention to the evidence furnished by the latest photographic charts of the "Atlas Lunaire" in regard to the conditions in which a planetary body passes from the liquid to the solid state, and to the stage in this transformation which has been reached respectively by the earth and the moon.

With respect to the evolution of the earth two opposite theories have been propounded. The great body of geologists have maintained that the interior of the planet is an incandescent mass which is slowly cooling and consolidating from the surface inward, and is enclosed within a comparatively thin solid crust. Some distinguished physicists, however, have contended that the first formed crust would break up, sink down, and be re-melted; and thus that permanent consolidation would begin at the centre, and would gradually extend outwards, until eventually the whole globe became practically solid, with only here and there large vesicular spaces whence active volcanoes are supplied. The densest and least fusible materials would thus tend to accumulate towards the centre, and the lightest and most fusible towards the outside. The geological belief rests upon a large body of evidence from the structure of the terrestrial crust, which it is difficult or impossible to explain except on the supposition of an internal mass which at least in its outer parts is sufficiently liquid to emerge at the surface as molten lava. The physical argument rests on certain mathematical assumptions the validity of which has been contested. One of these assumptions is that if the interior were liquid, tides would be set up in its mass, and the crust would rise and fall with the passage of the internal tidal wave. Another objection is based on the supposition that huge mountain-chains could not possibly be supported by a thin crust, but would sink down into the interior. More recently the idea has been suggested that the internal core of the earth is gaseous. At the high temperatures and enormous pressures in the interior of the planet, gaseous iron or lava must be more incompressible than steel is at the surface. On the outside of this gaseous mass it is believed that the materials pass into the liquid form or magma which extends as a comparatively thin envelope round the gaseous core, and shades off outward into a solid crust which may not be more than twenty-five or thirty miles in thickness. The most recent earthquake observations have been quoted in support of this view.

Messrs. Lœwy and Puiseux approach the subject impartially from a study of the phenomena presented by the surface of the moon as recorded in a series of photographs. They accept the general belief that our satellite was once a liquid globe, and that traces of its passage from that condition to its present state of consolidation can be clearly recognised. They cannot say whether its temperature increases with depth from the surface, or if there is any variation in density, but they find in their photographs various particulars which, in their opinion, show that the solidification started from the surface.

The differences of level on the surface of the moon are relatively greater and more abrupt than those on the surface of the earth, and they display in many ways the dynamic effects which a liquid when in movement exerts on its solid containing walls, such as the superficial outpourings which have covered two-fifths of the visible lunar surface and have turned these tracts into continuous plains, round the margins of which numerous remains of the previous relief have been left. Other effects are seen in the traces of instability in the mountain ranges, the fractures, sharply-defined terraces and marginal fissures so often observable. The neighbourhood of a great sheet of liquid material is required to account for the undulations and horizontal displacements which have affected large tracts of the surface, such as the breaking down of the crest of the Apennines, the separation of the rectangular blocks of the Caucasus, and the formation of the rectilinear valleys of Rheita, the Alps, and Ariadæus.

The most decisive argument in favour of the gradual cooling of the moon from the outside towards the interior appears to be furnished by some facts which are brought out with great clearness by the recent photographs. Thus the two French astronomers have satisfied themselves that after the first establishment of a thin crust the inward retreat of the liquid took place gradually, until the fatal moment arrived when it partly lost connection with the overlying solidified crust, so that an intermediate vacant space was left between them. This temporary interval, being filled with gas at a high pressure, formed a cushion which was sufficiently elastic to prevent any falling-in, but was too limited in extent to affect isostatic compensations, so that the internal tides might be developed without endangering the external figure of the moon. When, for some unknown reason, as happens also on our globe, the lunar eruptive forces assumed special vigour, the crust, yielding to the pressures along its least resisting parts, was overflowed by the liquid interior. Such local subsidences gave rise to the great cirques and various other features in the polar region, where the cooling was most rapid, and where, for easily intelligible reasons, the crust reached a considerably greater thickness. But in the equatorial zone, where the tides and the centrifugal force are most powerful, these violent perturbations led to vast subsidences which now form the lunar "seas." The survival of remains of the earlier topographical relief, still visible along the borders of these tracts, bears witness to the nature of the gigantic changes. Each eruptive movement has marked, by the level bottom of the formations, the height of the level of the subjacent liquid. Five such stages in the subsidence of the molten matter are displayed in the photographs. We can understand that the process would be repeated with diminishing energy until the gradually thickening crust presented too great an obstacle to the eruptive action. Various striking examples are cited by the authors; in particular one where the five platforms are separated from each other by a step-like interval of several thousand metres. Had the consolidation begun at the centre of the moon, it is contended, the result would have been altogether different, for then only the latest level should have been seen, and the eruptive forces would have had neither an opportunity of manifesting themselves nor the means of leaving permanent traces at very different stages.

MM. Lœwy and Puiseux examine the argument from the tides in favour of the consolidation of a planet from the centre outwards, and remark that it must be considered as doubtful, because we do not know how far the coefficient of viscosity or internal friction, which has been employed in the calculations, agrees with the reality. They suggest that as the materials in the interior are under enormous pressure they may quite possibly have such viscosity, and yield so slowly to planetary influences, which are continually changing in direction in consequence of the diurnal movement, that no appreciable tidal deformation may result. In the case of the moon it is admitted that the tides in the still liquid mass would for a long time delay the formation of an outer crust, which before its final establishment must have undergone many violent disruptions, when its broken-up sheets were overflowed by the molten matter from within. But in the course of time it has ended by attaining a great thickness in consequence of continual cooling and the contraction of the outer layers.

The argument that on the supposition of a comparatively thin crust the existence of mountainous masses would be impossible is less applicable to the moon, where the force of gravity is six times less than on the earth. But in the opinion of the two French astronomers the argument need not be seriously considered, either for our planet or for our satellite, inasmuch as it depends on a problematic theory which is entirely based on an inaccurate hypothesis of homogeneity. Mountainous excrescences, so far from weakening the general stability, really conduce to it; they are not only held up by the tenacity of the neighbouring parts, but, as Airy suggested, they probably have roots which plunge down into material of greater density and permit them to float.

The authors affirm, in conclusion, that their detailed study of the moon appears to them to confirm geologists in their preference for the theory of a thin crust and to indicate that the transition to solidity, still incomplete for the moon, is far from having reached its end upon the earth. ARCH. GEIKIE.

NOTES.

WE regret to announce that Prof. G. B. Howes, F.R.S., died on Saturday last, February 4, at fifty-one years of age.

IT is proposed to erect a monument at Laibach, in Austria, to the memory of Vega, author of the well-known table of logarithms, which is now in its eightieth edition.

FROM the American Mathematical *Bulletin* for January we learn of the death of Dr. Francesco Chizzoni, professor of geometry at Modena, and of Prof. Achsah M. Ely (Miss Ely), head of the department of mathematics at Vassar College, U.S.A.

THE Wilde medal of the Manchester Literary and Philosophical Society has been awarded to Prof. C. Lapworth, F.R.S. The medal will be presented on February 28, when the Wilde lecture of the society will be delivered by Dr. D. H. Scott, F.R.S., on "The Early History of Seed-bearing Plants, as recorded in the Carboniferous Flora."

FOR the past year, a station for solar research has been maintained on Mount Wilson, California, by the Yerkes Observatory, with the aid of a grant from the Carnegie Institution of Washington. This station has now been replaced by a new solar observatory which has been established by the Carnegie Institution, and the following staff, formerly of the Yerkes Observatory, has been appointed:—Prof. G. E. Hale (director), Prof. G. W. Ritchey, Mr. F. Ellerman, and Mr. W. S. Adams.

PROF. VALDEMAR STEIN, leader of a well known Copenhagen analytical and chemical laboratory, where for a number of years official and private tests and investigations in Denmark have taken place, died on February 1, aged 69 years. He took over in 1863 the laboratory founded by H. C. Örsted and altered it to its present shape, making it a valuable public institution. Beside his work there Stein was Government adviser in chemical agriculture, and wrote many scientific articles on chemical and agricultural subjects.

THE Imperial Academy of Sciences, St. Petersburg, at the last annual meeting, awarded the Lomonosoff prize of 100*l.* to Prof. N. A. Menschutkin for his well-known and extensive researches in the domain of theoretical chemistry. The Ivanoff prize was awarded to Prof. P. N. Lebedeff, of Moscow, for his remarkable experimental researches on the pressure of light. At the same meeting, Prof. S. Th. Oldenburg declared, in his yearly review of the work of the academy, that the Polar Committee had given up all hope of the return of Baron Edward Toll, F. G. Seeberg, and their two companions. The party was probably lost during the Arctic night while trying to cross the ice-fields lying between Bennett Island and the New Siberian archipelago.

A NATIONAL exhibition of brewing materials and products will be held in Paris during March, 1906.

AT the meeting of the French Physical Society on January 20, under the presidency of M. d'Arsonval, the following officers were elected:—Vice-president, M. Amagat; general secretary, M. Henri Abraham; treasurer, M. de la Touanne. The office of president falls on M. Dufet.

THE *Times* correspondent at Colombo states that Sir H. A. Blake, Governor of Ceylon, announced at the last meeting of the Asiatic Society that Sinhalese medical books of the sixth century described 67 varieties of mosquitoes and 424 kinds of malarial fever caused by mosquitoes.

AT the meeting of the Anthropological Institute to be held on Tuesday next, February 14, Dr. A. C. Haddon, F.R.S., will exhibit a series of kinematograph pictures of native dances from the Torres Straits, taken by him when in New Guinea. Applications for admission should be addressed to the Secretary of the Institute at 3 Hanover-square, W.

A LARGE and influential international committee has been formed in Heidelberg, under the presidency of His Excellency Dr. A. Freiherr von Dusch, Minister of Education, &c., of the Grand Duchy of Baden, with the object of honouring the memory of the late Prof. Carl Gegenbaur, who for nearly thirty years was the director of the Anatomical Institute of Heidelberg. The committee has decided upon a life-size bust of Gegenbaur, to be executed in marble by Prof. C. Seffner, Leipzig. The bust will be placed in the vestibule of the Anatomical Institute, probably in the early summer, at a date not yet fixed. The committee invites former pupils of the deceased master, and all those who have benefited from his epoch-making works on human and comparative anatomy, to send monetary contributions, with their addresses and titles, to Prof. M. Fuerbringer, or to Prof. E. Goeppert, both in Heidelberg. Every contributor will receive a picture of the bust, and casts may be obtained, on special application, from Prof. C. Seffner.

AFTER an interval of two years the fifth conference of West Indian agriculturists was held at Port-of-Spain, Trinidad, from January 4 to 13. It was attended by official, scientific, commercial, and practical representatives from all parts. In his presidential address, Sir Daniel Morris gave an interesting survey of the great economic change which is in progress. Taken in the aggregate, sugar cultivation must still be regarded as the backbone of the colonial industries, but in some of the islands it has already become of comparatively little or no importance. Trinidad is now a cacao-producing island, its exports of this commodity having risen to the value of a million sterling per annum. Grenada's cacao exports are valued at 250,000*l.*, and Jamaica's at 80,000*l.* Cotton growing, too, has been successfully re-established in several islands, and remunerative prices for the raw cotton are being obtained from Lancashire merchants. The exportations of fruit far exceed in value those of the staple industry. The development of the tobacco, rubber, sisal hemp, fish-curing, and other industries also came under review, and Sir Daniel dwelt upon the importance of agricultural shows and on the provision made by his department for teaching elementary science and the principles of agriculture in the various colleges and elementary schools. Numerous papers were read and discussed, Prof. d'Albuquerque, Dr. Watts, Prof. Harrison, and others supplying valuable information relating to sugar; Mr. Hart, Mr. de Gannes, &c., on cacao; Mr. Bovell, Mr. Sands, &c., on cotton; and so on.

For practical purposes visits were paid to several cacao and sugar estates. Owing to its more than usually representative character the conference is declared to have been the most successful of the series.

THE very high barometric readings over the British Isles during the latter part of January last are noteworthy. The weather report for the week ending January 28 issued by the Meteorological Office stated that on Wednesday (25) the eastern edge of an anticyclone had appeared over the west of Ireland; this system, moving slowly eastward, and continually increasing in intensity, covered the whole kingdom by Thursday, its maximum pressure being about 30·7 inches. It subsequently moved southward and south-westward, and continued to increase in energy until Saturday (28), when the barometer rose to 31 inches or more over the south-western parts of the United Kingdom. The highest reading was reported from Scilly, at 2h. p.m. on January 28, 31·06 inches, and appears to have been the highest on record for that part of the kingdom. Very high readings also occurred over the eastern portion of the North Atlantic. Recent cases of very high readings occurred in January, 1902, January, 1896, and January, 1882. The highest reading on record in the British Isles is 31·11 inches at Ochtertyne (Scotland), in January, 1896, and the lowest 27·33 inches at the same place, in January, 1887. It will be observed that all these extreme readings have occurred in the month of January.

WE have to acknowledge the receipt of a copy of the *Transactions* of the Hull Scientific and Field Naturalists' Club for 1904 (vol. iii. part ii.). The most important item in its contents is a list, with references, of the land and freshwater molluscs of the East Riding, drawn up by Mr. T. Petch, occupying fifty-two pages.

THE salmon and trout of Japan form the subject of an article by Mr. T. Kitahara in vol. v. part iii. of *Annotationes Zoologicae Japonensis*. In place of the nine species of these fishes admitted by Messrs. Jordan and Evermann, the author recognises only seven from Japanese waters, of which the majority belong to Oncorhynchus.

THE contents of the *Biologisches Centralblatt* for January 15 include an article on the structure of certain ants' nests, by Mr. C. Ernst, and a criticism, by Dr. C. Schröder, of Mr. C. Schaposchnikow's theory of the colouring of the hind-wing of the butterflies of the genus Catocala, to which allusion has been already made in our columns.

THE *Zoologist* commences the year well with an excellent article on budding in animals by Prof. McIntosh, of St. Andrews, in which the various forms of propagation by gemmation are described in a clear and popular manner. In the same issue appears Mr. Southwell's account of sealing and whaling for 1904. Eleven right whales were captured during the season by British vessels and at British stations; but the Americans are reported to have taken no less than forty-nine. The price demanded for sizable whalebone is 2500*l*. per ton. Fin-whale hunting is being pursued with great energy, and as the demand for the products of these whales is limited, the author suggests that the market may be glutted.

THE *Nature Study Review* is the title of a journal published in New York of which the first volume is before us. "The aims and plans of the editorial committee," it is stated in the introduction, "are based upon an interpretation of nature-study in its literal and widest sense as including all phases, physical as well as biological, of studies of natural objects and processes in elementary schools." Several eminent writers have united to give their views as to the scope and limitations of nature-study; while others have done their best to refute hostile criticism of the movement. "Faddism," the bane of the movement, is strongly deprecated. In wishing the new venture a successful career, we may take the opportunity of recording our full sympathy with the effort to make scholars actually acquainted with natural objects, instead of attempting to learn about them through books alone. But the interpretation of the movement must be a liberal one, and it must be realised that a visit to a museum is just as much nature-study as is a saunter through a country lane.

THE double number of the *American Naturalist* for November and December last contains a suggestive article by Mr. W. D. Matthew on the arboreal ancestry of mammals. Strong arguments have been brought forward during the last few years by Mr. Dollo in Belgium and by Mr. Bensley in America to show that the ancestors of marsupials were probably arboreal; and in the present communication the author seeks to show that the same holds good for mammals in general. It is urged that the mammals of the Cretaceous were all of small size and mostly of a primitive type from which both marsupials and placentals might well have been derived. These early mammals were probably arboreal; and if so, the opposable thumb and hallux of certain living types is an archaic and not an acquired feature. Support to the view as to the arboreal habits of the ancestral mammals is afforded by the Upper Cretaceous upland flora, which first permitted the existence of an extensive terrestrial land mammalian fauna. If the theory be true, it entirely upsets the old idea that arboreal mammals had taken to their distinctive mode of life to escape persecution on the ground.

WE have received a copy of an important memoir by Dr. O. Abel, published in the *Abhandlungen* of the Austrian Geological Survey (vol. xix. part ii.), on the fossil sirenians of the Mediterranean formation of Austria, into the merits of which the limitations of space do not admit of our entering so fully as we desire. The title of the memoir scarcely does justice to its contents, for although the prime object is the description of the species known as *Metaxytherium krahuletzi*, the author also describes a number of remains of the much more primitive genus Eotherium, from the Eocene of the Mokattam Range, near Cairo. The most important feature connected with the latter (if the remains be rightly identified) is the discovery that Eotherium possessed a complete pelvis, showing a well-marked obturator foramen. In this respect the genus differs from all other known members of the order, and is thus brought into connection with less specialised mammals. The three Egyptian Eocene genera Eotherium, Eosiren, and Protosiren (new) are regarded as the earliest known ancestors of the dugong group; and to these succeed Halitherium in the Oligocene, Metaxytherium in the Miocene, and Felsinotherium in the Pliocene. In seeking to illustrate the origin of the downward flexure of the muzzle of the dugong by a malformed horse skull, we think the author has been ill-advised, as there is a much simpler and more natural explanation of the feature. In connection with the memoir by Dr. Abel, we may refer to a paper on the pelvis of Steller's sea-cow (*Rhytina stelleri*) by Dr. L. von Lorenz, published in part iii. of vol. xix. of the *Abhandlungen* of the Vienna Geologisches Reichsanstalt. The description and figure of this rudimentary bone supplement Dr. Abel's account of sirenian osteology in general.

Dr. Strong, the director of the Biological Laboratory, Manila, has published a valuable experimental study of the subject of protective inoculation against Asiatic cholera (No. 16, Bureau of Government Laboratories, Manila). After detailing the various methods of producing experimentally immunity against the cholera microbe, he discusses the use of Haffkine's prophylactic, which has been extensively employed in India with encouraging results, but an objection to which is the marked reaction that follows the inoculation, causing the inoculated person to be somewhat ill for two or three days. To remove this objection, Dr. Strong has obtained a prophylactic fluid by suspending the cholera microbes obtained from agar cultures in sterile water, keeping this suspension at 60° C. for several hours, then incubating at 37° C. for three or four days, and finally filtering through a porous porcelain filter. The fluid so obtained (a product of the autolytic digestion of the cholera microbes) was found to produce a high immunity in animals against cholera, and when injected into man was found to be free from danger, and to produce practically no general or local disturbance.

In the *Victorian Naturalist* for November, 1904, it is mentioned that, at the October meeting of the Field Naturalists' Club in Melbourne, a number of collections of wild flowers were sent from State schools in the country, including some so far away as Hawkesdale. Dimboola, and Mansfield. These were of great interest to teachers and children from the schools in Melbourne, who were allowed to take away named specimens for study. Would it not be possible to include in one of the exhibitions, such as the Grand Horticultural Exhibition held last June in the gardens of the Royal Botanic Society, similar collections from country schools for the benefit of schools in the metropolis?

It is remarkable how many comparative experiments conducted in tropical countries, with some or all of the established rubber plants, have demonstrated the superiority of *Hevea brasiliensis*, the source of Para rubber. One of the latest accounts is that by Mr. W. H. Johnson, director of agriculture, Gold Coast, issued as one of the miscellaneous series of *Colonial Reports*. Experiments in the Botanic Gardens, Aburi, were unsuccessful with the West African vine, *Landolphia owariensis*, Ceara, *Manihot glaziovii*, Assam, *Ficus elastica*, and Central American rubber, *Castilloa elastica*; fairly satisfactory results were obtained with the indigenous *Funtumia elastica*, but Hevea excelled in quantity and quality of rubber, in its rate of growth, and has been remarkably free from insect and fungus pests.

There seems to be good reason to believe that exploration of the more remote parts of Eastern Asia will add very considerably to the number of botanical species already known. In vol. iv. of the *Records* of the Botanical Survey of India, Sir Joseph Hooker states that the number of species of Impatiens, the second largest genus of Indian flowering plants, recorded for India has increased from 124 to 200 in thirty years, and that many more may be expected from the less accessible districts of Burma, Nepal, and the Eastern Himalayas. In the hope of inducing forest officers or other officials in India to take up the collection, or better, the study of this genus, Sir Joseph Hooker is publishing in the *Records* an epitome of the known species, and he also directs attention to two points of interest, the anomalous structure of the flower, and the remarkable details of segregation of the species.

It is always of interest to note a distinct novelty in the photographic line, but in the new Lambex system of daylight loading and film and plate changing, which has been introduced by Messrs. R. and J. Beck, Ltd., in a new class of cameras called the Lambex cameras, we have quite a new invention. The makers have sent us for inspection one of these cameras with the so-called Lambex skeleton and its envelope. The method of exposing is most simple and ingenious, and is one that will no doubt find considerable favour among photographers. The skeleton, less than half an inch thick, is the name of the folded strip of paper with a tag attached at each fold; in each of the folds, twelve in number, a film or plate, of any description or make, is held by a flap at the top and two corner slots at the bottom, and an opaque card is attached to the front. This skeleton is contained in a double length opaque envelope, the unexposed films remaining in the lower portion, and the exposed films being pulled one by one into the upper portion by the attached tags. The lower portion of the envelope is provided with an opening to correspond to the size of the film through which the exposure is made, and surrounding this opening is a stiff projecting edge of card into which the envelope with its skeleton is slid into a frame in the camera. The makers claim many advantages for this system, such as daylight loading, any plates or films may be used, the skeletons can be recharged, no scratching of films, no mechanism, &c. The compactness of this system renders it applicable to both folding, pocket, and box cameras, and the makers have now prepared a series of well-made Lambex cameras, constructed in several forms and sizes, and fitted with their well-known lenses. Limitations of space prevent us from entering more into detail, but the handbook of instructions in the form of a neat pocket-book contains all the necessary information.

To the February number of the *Monthly Review*, Sir William Ramsay contributes an article having the title "What is an Element?" It contains a popular account of the changes introduced into conceptions of the nature of elements owing to the discovery of the inert gases of the atmosphere and of radium and the radio-active elements.

The remarkable power of aluminium to absorb completely the vapour of mercury even when highly diluted with air, and at the ordinary temperature, is the subject of a paper by N. Tarugi in the *Gazzetta* for January 14. This property is made the basis of an extremely delicate test for mercury, and of a preventive measure against poisoning by mercury vapour. A species of respirator has been patented in which the air that is inhaled is made to pass through a mass of finely divided aluminium; in this passage every trace of mercury is absorbed, the action being so complete that the dense vapours evolved by heated mercuric chloride may be breathed with impunity. The respirator has already been introduced with good results into the mercury mines of Monte Amiata.

A striking instance of the intimate connection existing between the configuration of chemical substances and their susceptibility to fermentation is to be found in a paper by C. Ulpiani and M. Cingolani in the *Gazzetta* for January 14. The *Bacillus acidi urici*, which has the property of decomposing uric acid into carbon dioxide and urea by a process of successive hydrolysis and oxidation, is without action on the closely allied substances α-methyluric acid, guanine, caffeine, and theobromine. On the other hand the bacillus is capable of rapidly and completely oxidising such acids as tartronic, malonic, and mesoxalic acids, which contain the same carbon chain as that constituting the central axis of uric acid, whilst, in addition, the ureides of these acids, namely, barbituric acid, dialuric acid, and alloxan, are converted by the ferment quantitatively into urea and carbon dioxide. Moreover, just as in the case of the sugars only the hexoses are capable of undergoing fermentation, the bacillus of uric acid is indifferent to acids containing fewer or more than three carbon atoms.

THE *Psychological Bulletin* (vol. ii., No. 1) for January contains a notice of the meeting of the north central section of the American Psychological Association which was held at Chicago on November 26, under the presidency of Prof. W. D. Scott, of the North-western University. The following papers were read:—Is subjective idealism a necessary point of view for psychology? by Mr. Stephen S. Colvin; the genesis of meaning, by Mr. I. E. Miller; relation of sensation and revived mental processes, by Messrs. T. H. Haines and J. C. Williams; the vehicle of cognition, by Mr. B. H. Bode; psychological method, by Mr. C. A. Blanchard; an Iowa case of complete congenital cataracts cured after twenty-two years, by Mr. James Burt Miner; the relations of psychology to logic, by Miss Harriet S. Penfield; the functional theory in psychology and the concept of transcendence, by Mr. J. H. Farley; the psychology of linguistic development in the individual, by Mr. M. V. O'Shea; is the beauty of art a higher type than that of nature? by Mr. George Rebec; the reality and the symbol in education, by Miss Julia H. Gulliver; and a motor theory of rhythm, by Mr. R. H. Stretton

THE Walter Scott Publishing Company will shortly issue a translation of "Science and Hypothesis," by Prof. Poincaré. Prof. J. Larmor, Sec.R.S., has written a preface to this edition of Prof. Poincaré's work.

A COPY of the report of the librarian of the U.S. Congress for the fiscal year ending June 30, 1903, has been received from Washington. The report runs to 600 pp., and includes elaborate details concerning every department of the library's activities. A select list of recent purchases during 1901–1903 constitutes part ii. of the volume, and a third section is devoted to a report on copyright legislation.

MR. JOHN A. BERGSTRÖM, of Indiana, writing in the *Psychological Bulletin*, describes a spring suspension for laboratory motors used for driving colour mixing or other experimental apparatus, with the object of reducing the noise and vibration produced by motors resting on a fixed base.

THE third English edition of Prof. Mendeléeff's "Principles of Chemistry" has been published in two volumes by Messrs. Longmans, Green and Co. The new volumes are a translation from the seventh Russian edition by Mr. George Kamensky, edited by Mr. Thomas H. Pope. There are three appendices to the work. The first of these is the Royal Institution lecture delivered by Prof. Mendeléeff on May 31, 1889, entitled "An Attempt to apply to Chemistry one of the Principles of Newton's Natural Philosophy"; the second, on the "Periodic Law of the Chemical Elements," is Prof. Mendeléeff's 1899 Faraday lecture to the Chemical Society; the last is entitled "An Attempt towards a Chemical Conception of the Ether," and its contents were described in an article which appeared in NATURE on November 17, 1904 (vol. lxxi., No. 1829). The work is one of the classics of chemical science, and the new edition will be widely welcomed

OUR ASTRONOMICAL COLUMN.

EPHEMERIS FOR COMET 1904 *e*.—Given below is an extract from a daily ephemeris computed by Dr. E. Strömgren from the elliptic elements calculated by M. Fayet for comet 1904 *e*.

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

1905	α (h. m. s.)	δ (° ′)	log r	log Δ
Feb. 9	2 29 38	+21 14	0·1582	0·0816
,, 11	2 34 23	+22 27		
,, 13	2 39 14	+23 38	0·1613	0·0940
,, 15	2 44 10	+24 47		
,, 17	2 49 12	+25 54	0·1647	0·1067

On February 7 the comet was very near to, but south-west of, ν Arietis (*Astronomische Nachrichten*, No. 3991, supplement).

EPHEMERIS FOR COMET 1904 *d*.—The following is an extract from the daily ephemeris for comet 1904 *d* published in No. 3991 of the *Astronomische Nachrichten* by Herr M. Ebell.

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

1905	α (true) (h. m. s.)	δ (true) (° ′)	log r	log Δ	Brightness
Feb. 9	19 22 32	+54 50	0·3492	0·3584	0·82
,, 13	19 41 49	+56 28	0·3542	0·3643	0·78
,, 17	20 1 45	+57 57	0·3593	0·3710	0·74
,, 21	20 22 13	+59 17	0·3645	0·3784	0·70

Brightness at time of discovery = 1·0.

An observation made by Herr Pechüle at 16h. 24·3m. (Copenhagen M.T.) on January 14 gave corrections to this ephemeris of −4s. and −0′·5.

On February 9 the comet will be to the north-west of, and near to, κ Cygni, then, travelling in a north-easterly direction, it will pass into the constellation Cepheus.

ORBIT OF COMET 1904 *e* (BORRELLY).—From the observations made at Königsberg on December 31 and at Paris on January 11, M. Fayet has made an investigation of the probable orbit of Borrelly's comet (1904 *e*). In the first place three different sets of parabolic elements were computed, but, although the arc traversed by the comet whilst under observation was very small, and the results obtained were therefore not very trustworthy, the non-agreement of the parabolic elements with the observational results was too great to be admitted. M. Fayet therefore computed a set of elements on the assumption that the orbit was elliptical, and these were much more satisfactory, indicating a short period of about six years.

The following set of elliptic elements was finally adopted as giving a fairly satisfactory agreement between the observed and computed positions:—

$$T = 1905 \text{ Jan. } 15{\cdot}77425 \text{ (M.T. Paris)}$$

$$\left.\begin{aligned} ☊ &= 76^\circ\ 6'\ 43''{\cdot}97 \\ i &= 30^\circ\ 55'\ 21''{\cdot}25 \\ \omega &= 351^\circ\ 35'\ 27''{\cdot}11 \end{aligned}\right\} 1905$$

$$\log q = 0{\cdot}149236$$

$$\log e = 9{\cdot}818195$$

These results give a value for μ of 423″·915, and therefore indicate that the comet is of the short-period type, making one revolution in its orbit in about eight years (*Comptes rendus*, No. 4, 1905).

OBSERVATIONS OF THE LEONID SHOWER OF 1904.—In a note published in No. 3989 of the *Astronomische Nachrichten*, Mr. Denning gives a few details of his observations of the late Leonid shower at Bristol.

During a watch of about one and a half hours between 13h. 30m. and 15h. 45m. on November 14, 55 meteors, of which 33 were Leonids, were seen, and Mr. Denning estimated that, at that time, the latter were appearing at the rate of about 25 per hour, for one observer, from a radiant situated at R.A. = 151°, decl. = +23°. No increase in the horary rate was apparent at 16h., and as the fog became denser the observations were discontinued.

Two of the Leonids seen were as bright as Jupiter, whilst several others were as bright as, or brighter than, first magnitude stars. One of these flashed out in the north-west at 14h. 38m., traversed the path $315^\circ+57^\circ$ to $318^\circ+50\frac{1}{2}^\circ$, and left a short streak which lasted for about 30 seconds.

A few slow, yellow meteors from a radiant in Aries at $43^\circ+21^\circ$, and some swift streaking meteors from a radiant in Leo Minor at $144^\circ+37^\circ$, were also seen.

SPECTRA OF γ CYGNI, α CANIS MINORIS AND ϵ LEONIS.—In part vii. vol. cxiii. of the *Sitzungsberichte der Kais. Akad. der Wissenschaften*, Herren E. Haschek and K. Kostersitz publish the results of the reductions of the spectra of γ Cygni, Procyon and ϵ Leonis. After discussing in detail the methods of measurement and identification employed in the reduction, and the general and specific characteristics of each spectrum studied, the authors give a table of the wave-lengths and intensities of the lines for each star. The coincidences of each line with lines in the arc and spark spectra of terrestrial elements, as determined by Exner and Haschek, are also given, and in the last column of each table the "probable origins" of many of the lines are set down. Amongst the latter may be noted the rarer elements Yb, Pr, Sa, Nd, La, Pt, Wo, Gd, Eu, &c.

About 140 lines between λ 4250 and λ 4534, 190 lines between λ 4126 and λ 4550, and about 270 lines between λ 4215 and λ 4702 are given in the spectra of γ Cygni, α Canis Minoris and ϵ Leonis respectively.

SYSTEMATIC SURVEY OF DOUBLE STARS.—No. 99, vol. xvi., of the *Publications* of the Astronomical Society of the Pacific is devoted to an address on double stars read before the International Congress of Arts and Sciences at St. Louis by Prof. R. G. Aitken.

After discussing the work already performed in this field, Prof. Aitken described a systematical survey undertaken by Prof. Hussey and himself. All stars down to the ninth magnitude as given in the Bonn Durchmusterung were placed on the observing list, and the sky from the North Pole to -22° declination was equally divided for observation between the two observers.

The programme arranged for the observation of each star on the list on at least one good night, and all double stars discovered with a separation of 5″ or less were to be measured on at least two nights and catalogued. On September 10, Prof. Hussey had discovered 1035 and Prof. Aitken more than 875 new pairs. Seventy-three per cent. of these are separated by 2″ or less, and 142 are very close pairs in which the separation does not exceed 0″·25. Of similar pairs to the latter the previously published catalogues do not contain 100.

Prof. Aitken has examined, during this research, more than 12,000 stars, and finds that the doubles discovered form about 3 per cent. of this total. Including those previously discovered, the ratio of double stars, with distances of less than 5″, to the whole of the stars down to the ninth magnitude is apparently 1 : 18 to 1 : 20. This ratio is not, however, the same for all parts of the sky, for whilst in some regions observed double stars are very scarce, in others the ratio increases to about 1 : 8.

Other details concerning the survey, its prosecution and the reasons for carrying it out are given in Prof. Aitken's interesting paper.

REPORT OF THE YALE OBSERVATORY, 1900–4.—Dr. Elkin's reports to the board of managers of the Yale University Observatory for the years 1900–4, inclusive, occupy eight pages, and briefly describe the large amount of work performed at the observatory during that period.

Heliometer observations are the chief feature of the work and special attention has been paid to the determination of the parallaxes of stars having large proper motions. Practically all the stars in the northern hemisphere having known motions of 0″.5, or more, have now been observed at Yale. A second triangulation of the Pleiades and determinations of the parallax of Arcturus have also been made. Another feature of the work is the photography of meteor trails, and numerous trails of meteors from the principal showers have been obtained.

PRIZE SUBJECTS OF THE BATAVIAN SOCIETY OF EXPERIMENTAL PHILOSOPHY.

AT a recent general meeting of the Batavian Society of Experimental Philosophy of Rotterdam the following subjects were proposed for competition. The gold medal of the society, of the weight of thirty ducats, or its value, will be awarded for the best answer to one or other of the suggested questions. Answers may be written in the Dutch, French, English, German, or Latin languages, in another handwriting than that of the competitor, and must reach the secretary, Dr. G. T. W. Bremer, at Rotterdam not later than February 1, 1906.

Chemistry.—An experimental investigation of the atomic weight of an element which has not yet been satisfactorily fixed; a research on the causes of departure from Ostwald's dilution law; measurements of the osmotic pressure in solutions at concentrations corresponding with deviations from the simple gas laws; a study of the origin and physiological significance of the green pigment in the body of green articulated animals; experiments elucidating the formation and transformations of the sap in india-rubber plants; a re-investigation of the variations from the laws of electrolytic dissociation observed by Kahlenberg in 1901; an explanation of the thallioquinic test for quinine.

Physics.—An investigation of the electrical properties of some metallic alloys; of the variation with temperature of the specific heat of mercury; of the specific heat of sulphur and phosphorus in their various allotropic forms; of the indices of refraction of substances showing anomalous dispersion; of the cause of phosphorescence, particularly in the case of the lower organisms.

Biology.—A description of the life-history and properties of one or several species of moulds, ferments, or bacteria which are of industrial importance; the action of sulphur and of copper salts on plant parasites, and of mineral salts on the development of fungi; the *rôle* of micro-organisms in the formation of humus in the soil.

Physiology.—An investigation of the permeability of red blood corpuscles to the ions of NaCl, $NaNO_3$, Na_2SO_4; and of the localisation of functions in the cerebellum.

Geology.—An exposition of the theory of the origin of the Netherlands; a critical investigation of the volcanoes of the East Indian Archipelago.

Civil Engineering.—Statistical investigations of the Dutch "polders"; or an investigation of one of the principal rivers of Holland.

THE PIC DU MIDI OBSERVATORY.

IN a recent number of *La Nature*, M. L. Rudaux gave an interesting account of the present condition and operations of this important mountain station. France is well provided with high level stations, and the observations from seven of them are published daily in the *Bulletin International* of the French Meteorological Office. An account of the very favourable position of the Pic du Midi station, and of the almost insuperable difficulties experienced by its original founder, General de Nansouty, was given, in considerable detail, by M. R. Radau, in his useful little work on "Mountain Observatories" (Paris, 1876), and has been summarised by Mr. A. L. Rotch in the *American Meteorological Journal*. The summit, which has an elevation of 2877 metres (the observatory being 17 metres lower), is situated on the outskirts of the Pyrenees, in lat. 42° 56′ N., and long. 2° 12′ W. of Paris, and affords one of the finest views in Europe. Towards the north an immense plain stretches as far as the eye can see, and to the north-west, on very clear days, the blue waters of the Atlantic are visible, at a distance of 160 km. It lies directly in the path of the great atmospheric disturbances which traverse the Bay of Biscay, while the summit mostly enjoys a clear and luminous atmosphere, being some 200 metres above the level at which thunderstorm clouds usually gather. These advantages early attracted the attention of astronomers and scientific men; M. F. de Plantade died in 1741 while observing at the ridge which has since taken his name.

The project of a permanent meteorological station was first mooted in 1869, and provisional observations were commenced by General de Nansouty and his coadjutors in 1873, at the foot of the Pic, about 2300 metres above the sea, and were continued under great hardships, and at considerable personal expense for about eight years. The present station was established in 1880, by public and private subscriptions. The accompanying illustration gives a general view of the station as it now exists. On the left the thermometer screen may be distinguished near the erection on which the anemometer and actinometer are placed; at the other end of the terrace is the equatorial building, and the apparatus for celestial photography. The magnetic instruments are placed in vaults underneath the terrace. The meteorological observations are regularly published in the annals of the Central Meteorological Office; useful predictions have been given to the inhabitants of the plains of impending thunderstorms, and of probable floods owing to the sudden melting of the snow on the mountains. Amongst the miscellaneous observations undertaken under the able direction of M. Marchand, we may specially mention those relating to the zodiacal light, to solar phenomena, and the connection of the latter with magnetic disturbances. His observations in this direction have shown that whenever a terrestrial magnetic disturbance occurs, spots or faculæ exist on the central meridian of the sun. Important spectroscopic results have also been obtained respecting the atmospheres of Venus and Mars.

Fig. 1.—General View of the Pic du Midi Observatory in 1904.

AGRICULTURAL NOTES.

An important new feature of the annual report on the distribution of grants for agricultural education and research is a return giving the character of the instruction in agriculture provided by the county councils of England and Wales. The return shows that most counties are now spending considerable sums on agricultural education—altogether 88,893*l.* in 1902–3, and to this sum 9200*l.* was added by the Board of Agriculture in the form of grants to collegiate centres. It is estimated that some 22,000 persons have attended the various local lectures provided, while 1000 students entered for the courses offered by agricultural colleges. The expenditure of the counties is given in detail, and presents some curious anomalies; thus the London County Council assigned to agricultural education 742*l.*, while the authorities of one of the most fertile divisions of Lincolnshire, in which agriculture is practically the only industry, voted 65*l.* for the purpose! Again, East Sussex, with a total income from the "Residue Grant" of 7773*l.*, spent 6116*l.* in grants to agricultural colleges or schools, while West Sussex, with an income of 4503*l.*, gave nothing for collegiate instruction, and was satisfied with an expenditure of 275*l.* upon horticulture and poultry keeping. Conditions vary from county to county, but differences in the needs of the agriculturist do not explain the widely different educational policy of the local authorities. Under the new committees, it is to be hoped that the unsystematic and spasmodic efforts that have been too common in the past may disappear, and though it is probable that in the immediate future less money will be spent on agricultural education, it is likely to be expended to greater advantage. The Board of Agriculture's report should be studied by all members of county education committees who are interested in agricultural education.

A piece of work which has just been completed in the library of the U.S. Department of Agriculture has greatly enhanced the value of the leading Continental agricultural journals for English-speaking students. Complete card catalogues of "Annales de la Science agronomique," "Landwithschaftliche Jahrbücher," and "Die landwithschaftlichen Versuchs-stationen" have been prepared. Each index card gives author's name, title of article, and a brief outline of the scope of the article. The catalogues may be purchased in two series, either "author entry" sets, permitting papers to be indexed under the authors' names, or "complete" sets, furnishing two or more cards for each paper, which may then be indexed under the author's name, and also under the subject or subjects to which the article relates. The cost of the three sets of catalogues in the latter and more useful form is about 12*l*. The sets now issued bring the indexing down to 1903, but the work will be continued, and supplementary sets will be printed from time to time. Students who do not desire references to all branches of agricultural science may obtain sets of cards dealing with special subjects, such as soils, plant diseases, or forestry. Particulars of the eighteen subject-groups under which the cards are classified are given in *Bulletin* No. 9, issued by the Catalogue Division of the Library of Congress, Washington, D.C.

In the fourth report on the Woburn fruit farm, the Duke of Bedford and Mr. Spencer Pickering, F.R.S., discuss the results of several years' experiments in the manuring of fruit crops. In an introduction the soil of the fruit station is described, and chemical and mechanical analyses are given; the report then describes experiments on strawberries, gooseberries, currants, raspberries, and apples. For various reasons the experiments on currants and raspberries were unsatisfactory, but trustworthy data were obtained in the work on the other crops. It was found that 12 tons of farmyard manure per acre increased the strawberry crop by 12 per cent. to 15 per cent., and that the size and quality of the fruit were greatly improved. A mixed artificial manure supplying about the same quantities of nitrogen, phosphoric acid, potash and magnesia as the dung similarly increased the yield, but did not improve the quality. Farmyard manure much increased the gooseberry crop, but the artificial mixture failed to do so, and it is explained that the increase in the former case was probably due to the greater quantity of moisture retained by the dunged soil. Nitrate of soda applied in summer was found to benefit apples in certain seasons, but with this exception no kind of manure had any marked effect on the apple crop.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Mr. Chamberlain, the Chancellor of the University, presided at the annual meeting of the Court of Governors held on February 6. Speaking after the adoption of the annual report, Mr. Chamberlain said that when the governors of Mason College met some five or six years ago and came to the decision that the time had come to give Birmingham its own university, it was thought that the least sum of money which would justify them in applying for a charter was 100,000*l*. But very shortly afterwards they found that there was a great opportunity, not only for themselves, but for other great provincial cities, to create a series of universities which in the first place would bring home to all the population the advantages of the highest education, and in the second place, would specialise this highest education with some more definite idea of its application to science than hitherto had been found to be possible. The moment they decided on a departure of that kind they found that it meant something quite different from what they had previously supposed. New buildings had to be specially devised, a very large and expensive equipment had to be provided, and new chairs had to be created; altogether a completely new ideal had to be developed. And then they put their demand—a demand which, indeed, they did not strictly limit themselves to, but they thought it would probably be sufficient for the present generation—they put their demand at the expenditure of one million of money. They had received at once nearly half that sum, largely from Birmingham. And he might say in passing that the liberality of the local contribution was a ground for the claim which they made for some further State support. "It is something," he said, "that we have found that the Government are becoming alive to our needs and to our deserts, and that they have been able to double the sum previously given for the university education. But we may bear in mind at the same time that the present Chancellor of the Exchequer has promised to double it again in his next Budget, and, therefore, I anticipate that from that source we shall receive a very considerable addition. I do not at all accept it as in any way a satisfaction of our demands, because it is my conviction that public opinion will soon insist upon larger sums being devoted to this purpose. When I think that we are spending 13 millions a year at least on primary education I say the sum now given for the purpose of the highest education, the most profitable of all the investments we can make in that direction, is altogether inadequate."

CAMBRIDGE.—The voting on the report of the Studies and Examinations Syndicate will take place on Friday, March 3, and on Saturday, March 4, on both days from 1–3 p.m. and from 5–7 p.m. No votes will be taken after 7 p.m. on Saturday, March 3.

In view of the discussion on the report the syndicate has issued the report in an amended form. The chief changes include as alternatives in the papers in classical languages (1) passages for translation from a selected book or books; (2) unprepared passages for translation, a vocabulary of unusual words being supplied, also the abolition of distinct grammar papers, although questions on syntax and accidence will be set in connection with the translation papers; further, one of the Synoptic Gospels is Greek, is now proposed as an alternative to one of the Synoptic Gospels, together with the Acts of the Apostles in English, and logic is included amongst the optional subjects in part iii. These proposals are embodied by the Council in five graces. It is on the second of these, which deals with the question of compulsory Greek, that attention will be centred.

LONDON.—Sir Michael Foster has consented to offer himself for re-election to the next Parliament as member for the University of London. He seeks re-election as a representative of science and higher education; if re-elected he will take his seat as a member of the Liberal Party. A committee, with Sir Thomas Barlow as chairman, has been formed to promote his election. This committee comprises graduates belonging to different political parties who are supporting Sir M. Foster on the ground of his many public services and in the belief that his special knowledge will continue to prove of great value to the House of Commons.

OXFORD.—Mr. George Longstaff, New College, has presented 50*l*. to the Hope Department of Zoology, and has offered to provide an extra assistant in the department for the years 1905 and 1906.

A SHEFFIELD gentleman, who does not wish his identity to be disclosed, has, says the *Sheffield Telegraph*, intimated in connection with the Sheffield University movement that he is prepared to subscribe 10,000*l*. towards the endowment fund, provided four other sums of 10,000*l*. are contributed. As an alternative, he is willing to give 5,000*l*. provided nine similar donations are promised. Under either condition a sum of 50,000*l*. would be raised, and, roughly, this is the amount still required to complete the fund.

AT a public meeting held under the auspices of the University of Leeds on February 6th, Mr. Alfred Mosely, C.M.G., gave an address on "Some Lessons learned by the recent Mosely Commission of Educationists to the United States." In the course of his remarks he said: Much remains in England to be done so that she may be brought into line with the United States and Germany in the matter of education. In America the people realise that if the nation is to be made and saved it must be through the medium of education. The time has come for us to reconsider our position, and above all to realise that the Board schools and the primary schools are but the prelude to secondary education, which in the United States has made such satisfactory strides—as it has also in Germany. The great difference in the education of the United States and that in our own country is the appreciation there of everybody, from the highest to the lowest, of the value of education. The Government has realised its obligations, and private citizens pour out their money like water. The University at Chicago, for instance, has been built up through the liberality of one man, who has given millions of pounds sterling. Why is there not the same spirit in England?

THE current number of the *Quarterly Review* contains an article entitled "The Direction and Method of Education." The writer passes in review many of the official publications of the English Board of Education and the

Scotch Education Department, Prof. Sadler's report on secondary education in Liverpool, and other publications. Men of science would do well to note what is given as the sum and substance of official activity in education since the passing of the recent Education Act. The writer says, "If we were asked to describe in one word the whole tendency of English education as manifested at the present time, we should speak of a humanistic renaissance." And again later, "English education, we believe, is working round to the humanistic ideal." Literary studies are included in every satisfactory scheme of elementary and secondary education, and the man of science recognises fully the value of the humanities in the work of schools and colleges. But whatever "humanistic renaissance" there may be dawning upon the world of education, it is to be hoped that the danger of a return to the conditions of fifty years ago, when instruction in the methods of science was unknown in our schools, and no opportunity to become acquainted with natural objects was offered, will be borne in mind by all education committees and other authorities.

THE Hon. Maude Lawrence has been appointed to a newly-established post of Chief Woman Inspector under the Board of Education. Miss Lawrence will direct a staff of women inspectors of special qualifications and varied experience, who will assist the Board in dealing with many questions for the treatment of which they have hitherto been somewhat imperfectly equipped. Instruction in various domestic subjects, such as needlework, cookery, laundry work, household management, and hygiene, has for some time past been given under the regulations of the Board for schools of different grades. But the report of the Inter-Departmental Committee on Physical Deterioration points to the need of a reform in the methods now commonly employed in the teaching of these subjects. It is considered that this instruction has been less effective than it should have been, because it has been too theoretical and has not been kept sufficiently in touch with the needs and habits of daily life. The new branch of the inspectorate will be employed to assist local authorities in providing, as part of their educational system, ample opportunities for girls of various ages to obtain a training for home life simple, practical, and adapted, where necessary, to the special circumstances of each locality. There are also many questions of importance involving the national physique, as affected by the studies, the life, and the treatment of children, and especially of very young children, from day to day in elementary schools, which women inspectors are specially qualified to investigate and to advise upon.

THE council of the Association of Technical Institutions has published its report of an inquiry, undertaken in May, 1904, as to the conditions of admission to evening classes in technical institutions and evening continuation schools throughout the country. The council considers that the returns and expert opinions recorded in this report justify the following conclusions:—(1) That it is undesirable to establish any general system of free admission to evening continuation schools, or of free admission or admission at specially reduced fees to evening classes in technical institutions. (2) That it is unnecessary to grant entirely free admission, to evening classes in technical institutions, to any special class or body of students or workers engaged in skilled industries, such as apprentices or persons under twenty-one years of age. (3) That there is need for the establishment in all technical institutions of sufficient "free studentships" or "scholarships" to secure the admission of all qualified and deserving students who are unable, by reason of their limited means, to pay the usual class fees without more sacrifice than should reasonably be expected of them. The plan to secure information adopted by the council was to issue a letter and form of inquiry to the education authorities and technical institutions throughout the United Kingdom asking for information as to the existence of the following conditions of admission to evening classes: (*a*) entirely free, (*b*) at less than normal fee, (*c*) by scholarships, (*d*) by arrangement with employers. Replies were received with reference to sixty evening continuation school areas and from eighty-three technical institutions. Of the technical institutions, fifty-five are not in favour of free admission, and one only in favour of it. The remaining institutions gave no definite answer. Thirty-eight education committees are against free admission to evening continuation schools, two are in favour of it, sixteen expressed no opinion, and four suggest scholarships.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 24, 1904.—"The Flow of Water through Pipes.—Experiments on Stream-line Motion and the Measurement of Critical Velocity." By Dr. H. T. **Barnes** and Dr. E. G. **Coker**. Communicated by Prof. Osborne Reynolds, F.R.S.

In a brief note published in the *Physical Review* (vol. xii. p. 372, 1901), the authors described a thermal method of observing the change from stream-line to eddy motion for water flowing through pipes of different diameters.

The impossibility of heating a column of water uniformly throughout while flowing in stream-line motion has been previously observed. It was shown that, when water is heated electrically while flowing through a tube of two or three millimetres diameter by a central wire conductor, the heat is carried off by the rapidly moving stream, which forms a cloak of hot water around the wire, and leaves the walls of the tube almost entirely unheated.

The change from stream-line to eddy motion can be very clearly observed in a tube heated on the outside, since the temperature of the emerging stream immediately increases when the flow rises above the critical point. The point of change is very sharp, and the disappearance of the stream-lines instantaneous.

It is clear from a study of the work of Osborne Reynolds that the change from stream-line to eddy motion may take place within a wide range of velocities. Critical velocity is measured in two ways: either by observing the velocity at which the stream-lines break up into eddies, or by obtaining the velocity at which the eddies from initially disturbed water do not become smoothed out into stream-lines in a long uniform pipe. The first change may be at any velocity within certain limits depending on the initial steadiness of the inflowing water, while in the second, the change can take place at only one velocity.

Osborne Reynolds's experiments were carried out by the method of colour bands in a long rectangular tank. By using a very much larger tank under a high head of water the authors were able to obtain a higher degree of steadiness than was obtained in the comparatively small tank used by Reynolds. A large number of experiments were obtained, an account of which forms the main part of the present paper.

Briefly, the result of the work may be summarised as follows:—

(1) The attainment of exceedingly high velocities of stream-line flow for certain sizes of pipes fed by perfectly quiet water under a high head.

(2) The re-formation of stream-lines in certain cases after eddies had formed, with a subsequent breaking up of the stream-lines at a very much higher velocity.

(3) A small divergence from the law of the change in viscosity with temperature for the upper-limit of stream-line flow.

(4) A verification of the viscosity temperature law for the lower-limit of stream-line flow by separate methods.

January 19.—"Further Histological Studies on the Localisation of Cerebral Function.—The Brains of Felis, Canis, and Sus compared with that of Homo." By Dr. A. W. **Campbell**. Communicated by Prof. Sherrington, F.R.S.

This addendum to a work on cerebral localisation, presented by the same author to the Royal Society in November, 1903, aims at elucidating certain obscure functional analogies and structural homologies pertaining to the brain.

The points emphasised are as follows:—Giant cells characterise the cortex of the lower mammalian cruciate zone, and this represents the motor area, as defined by Profs. Sherrington and Grünbaum in the anthropoid ape, and by the author in man. The compensatory ansate and coronal sulci are respectively interchangeable with the upper and lower constituents of the primate fissure of Rolando. The common sensory area forms a morphological buffer behind the cruciate zone. Quite one-sixth of the lower animal's brain surface is allotted to visual cortex. The "true calcarine" fissure is the antecedent of the human anterior calcarine, the intercalary sulcus undergoes retrograde changes, and the suprasplenial sulcus is the derivative of the "sulcus intrastriatus lateralis." In the limbic region, human types of cortex are repeated, and the genual fissure is the homologue of the calloso-marginal. Parietal cortex is older, in the sense of phylogeny, than frontal. The lateral sulcus is the forerunner of the intraparietal. Out of the ectosylvian region of lower animals is developed the Sylvian region, including the insula, and much of the temporal lobe of primates.

It is concluded that the stability of the architectural plan of any given field of cortex is directly related to the phylogenic age of that cortex, and to the importance, as a means to survival, of the function it subserves; and, that while the human brain has expanded more decisively in some parts than in others, yet that expansion, if we except the visual and olfactory areas, has been general in kind.

January 26.—"On a Method of Finding the Conductivity for Heat." By Prof. C. **Niven**, F.R.S.

The first part of the paper contains a detailed account of the methods employed for finding the difference of temperature, and a description of the apparatus used. The results of some experiments made with it are also given, and compared with those found by other observers. The second part of the paper contains a solution of the mathematical problem of the diffusion of heat in an infinite solid from a line at which it is supplied at a constant rate, and the solution of some other allied questions. One result of the investigation suggests a method of finding the diffusivity directly, when the substance is of sufficiently great extent.

"The Boring of the Simplon Tunnel, and the Distribution of Temperature that was encountered." By Francis **Fox**. Communicated by C. V. Boys, F.R.S.

February 2.—"On the Compressibility of Gases between One Atmosphere and Half an Atmosphere of Pressure." By Lord **Rayleigh**, O.M., F.R.S.

The present memoir contains a detailed account of the observations referred to in the Preliminary Notice of February, 1904. In addition, results are now given for air, carbonic anhydride, and nitrous oxide. In the following table are recorded the values of B for the various gases at specified temperatures, B denoting the quotient of the value of pv at half an atmosphere by the value at the whole atmosphere:—

Gas	B.	Temperature
Oxygen	1·00038	11·2
Hydrogen	0·99974	10·7
Nitrogen	1·00015	14·9
Carbonic oxide	1·00026	13·8
Air	1·00023	11·4
Carbon dioxide	1·00279	15·0
Nitrous oxide	1·00327	11·0

By means of a formula given by D. Berthelot the compressibilities at 0° C. are inferred, and applied to deduce the ratio of densities as they would be observed at 0° C. under very low pressures. According to Avogadro's law these are the relative molecular weights. From the densities of nitrogen and oxygen we get N = 14·008, if O = 16. Again, from the densities of oxygen and nitrous oxide we find N = 13·998. The former is probably the more trustworthy.

Chemical Society, January 18.—Prof. W. A. Tilden, F.R.S., president, in the chair.—Nitrogen halogen derivatives of the sulphonamides: F. D. **Chattaway**. A number of the nitrogen halogen derivatives of the sulphonamides, which are obtained by the action of hypochlorous acid on the suphonamides and the alkylsulphonamides, were described, and the ease with which they can be prepared and crystallised demonstrated.—Electrolytic oxidation of the aliphatic aldehydes: H. D. **Law**. The chief product of oxidation of the lower members of the saturated aliphatic aldehydes is the corresponding organic acid, but small quantities of carbon dioxide and monoxide and saturated hydrocarbons are also formed in some cases.—The diazo-derivatives of the benzenesulphonylphenylenediamines: G. T. **Morgan** and F. M. G. **Micklethwait**. A description is given of the substances produced by the interaction of nitrous acid with the benzenesulphonyl derivatives of *o*-, *m*- and *p*-phenylenediamines, illustrating the different behaviour of these isomerides with this reagent.—The molecular condition in solution of ferrous potassium oxalate: S. E. **Sheppard** and C. E. K. **Mees**. Ferrous oxalate was shown to dissolve in alkali oxalates forming double salts, such as $K_2Fe(C_2O_4)_2$, which dissociate according to the scheme $2\overset{+}{K} + \overset{-\ -}{Fe(C_2O_4)_2}$. Spectrophotometric measurements indicated that the formation of ferrous ions at moderate dilutions was negligibly small.—A further analogy between the asymmetric nitrogen and carbon atoms: H. O. **Jones**. The author showed that, during the formation of an asymmetric nitrogen atom in a compound containing an asymmetric carbon atom, two isomerides, which are called the α- and β-compounds, are produced. For this purpose methyl-*l*-amylaniline has been combined with allyl and benzyl iodides.—The formation of magnesia from magnesium carbonate by heat and the effect of temperature on the properties of the product: W. C. **Anderson**. Experiments were made with native and artificial magnesium carbonates to ascertain (1) the lowest temperature at which the evolution of carbon dioxide could be distinctly recognised; (2) the comparative rates at which the expulsion of the gas takes place at higher temperatures under atmospheric pressure; and (3) the extent to which the magnesia obtained dissolves in water after being kept at different known temperatures for a fixed period. It is inferred from the results that polymerisation takes place when magnesia is heated, and that this goes on more quickly in the "heavy" oxide than in "light" magnesia.—Transformations of derivatives of *s*-tribromodiazobenzenes: K. J. P. **Orton**.—The addition of sodium hydrogen sulphite to ketonic compounds: A. W. **Stewart**.—The reduction products of anisic acid: J. S. **Lumsden**. When anisic acid, dissolved in amyl alcohol, is reduced by sodium, the products are hexahydrobenzoic acid and δ-keto-hexahydrobenzoic acid.—The physical properties of heptoic, hexahydrobenzoic, and benzoic acids and their derivatives: J. S. **Lumsden**.—The influence of solvents on the rotation of optically active compounds. Part vii. Solution-volume and rotation of menthol and menthyl tartrates: T. S. **Patterson** and F. **Taylor**.

Royal Microscopical Society, January 18.—Dr. Dukinfield H. Scott, F.R.S., president, in the chair.—The **President** delivered his annual address, the subject of which was an inquiry as to "What were the Carboniferous Ferns?"

Geological Society, January 18.—Dr. J. E. Marr, F.R.S., president, in the chair.—On the geology of Arenig Fawr and Moel Llyfnant: W. G. **Fearnsides**. This paper contains a detailed description of the succession of beds in Sedgwick's typical area of development of his Arenig series. The author discusses the relationship of the various divisions he describes to corresponding beds of other areas. He gives a description of the intrusive igneous rocks, and some account of the structure of the district and the nature of its glaciation.

Physical Society, January 27.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—Action of a magnetic field on the discharge through a gas: Dr. R. S. **Willows**. It has been shown previously that a transverse magnetic field, if applied at the kathode, may in some cases reduce the potential difference at the terminals of the tube. It is shown in the paper that the pressure at which this decrease commences corresponds to the pressure at which the voltage required to maintain this discharge, under normal conditions, is a minimum. This is also found to be the pressure at which the positive column is first completely striated. Reasons why such action takes place are given.—Action of radium on the electric spark: Dr. R. S. **Willows** and J. **Peck**. In certain cases the authors have found that the spark from a Wimshurst machine is extinguished by the action of the radiations from radium and that the current passing is decreased. The action is altogether different according to the direction of the discharge. Using a spark-gap longer than 2 cm. and making the larger knob, of the machine used, positive, the radiations had practically no influence. With the smaller knob positive the radium, in most cases, extinguished the spark. The phenomenon is found to be due to the action of the β rays. Röntgen rays do not produce this effect, even if their ionising power at the spark-gap is some thousands of times greater than that of the radium. Lenard rays are, however, effective.—The slow stretch in indiarubber, glass, and metal wires subjected to a constant pull: P. **Phillips.** When indiarubber is subjected to a sustained pull of constant amount it yields at quite a large rate, the stretch at any time (t), after the establishment of the pull, being given by $x=a+b \log t$, a and b being constants for the particular pull exerted. For different pulls b is proportional to the pull. When the pull is removed the indiarubber slowly returns to its original length, the extension still remaining at a time t_0 after the removal being given by

$$x=b \log (t/t_0),$$

t being the time which has elapsed since the pull was established. These two results, for the slow stretching and slow recovery of indiarubber, have also been established for glass fibres subjected to sustained pull, but the magnitude of the slow yielding is very much smaller. When annealed wires of copper, silver, gold, or platinum are subjected to a sustained pull they behave in some ways similarly to indiarubber and glass, but there are some very decided differences. If the pull is greater than a certain amount (in the actual experiments about one-third to one-quarter of the breaking weight) the stretch at any time (t) after the establishment of the pull is given by the same law $x=a+b \log t$, but below this value of the pull b is zero. This law obtains up to the breaking strain of the wire, b increasing very rapidly a little before the breaking strain is reached. When the pull is removed, there is no appreciable slow recovery like that occurring in indiarubber and glass. Iron and steel wires show themselves to be exceptions to these rules.—Determination of Young's modulus (adiabatic) for glass: C. A. **Bell,** with an appendix by Dr. C. **Chree,** F.R.S. In this paper it is shown that errors in the acoustical determination of Young's modulus for glass, due to irregularities in the rods or tubes employed, may be eliminated by applying to the measured length of each free-free rod a correction given by the formula

$$\Delta l=\int_0^l \frac{\delta S}{S_0} \cos \frac{2\pi z}{l}\, dz,$$

in which δS is the difference between the cross section at the point z and its mean value, S_0, for the whole rod.—Some methods for studying the viscosity of solids: Dr. Boris **Weinberg.** The author has been carrying out investigations similar to those described by Prof. Trouton and Mr. Andrews in their paper on the viscosity of pitch-like substances (*Proc.* Phys. Soc., 1903). The details of his experiments are, however, different. He has worked principally with lead and has employed three distinct methods for determining the coefficient of viscosity.

PARIS.

Academy of Sciences, January 30.—M. Troost in the chair.—On some new experiments relating to the preparation of the diamond: Henri **Moissan.** In connection with the study of the Cañon Diablo meteorite, it appeared desirable to repeat the experiments on the formation of diamonds in rapidly cooled cast iron, with especial reference to the effect of sulphur and silicon in the ingot. The results obtained with an ingot to which iron sulphide had been added immediately before cooling were similar to those of the earlier experiments, except that the yield of diamonds was slightly greater. The addition of silicon had the same effect, except that the formation of the dense silicon carbide rendered the separation of the microscopic diamonds rather more difficult. Drawings of four typical crystals are given.—Synthesis in the anthracene series: MM. **Haller** and A. **Guyot.** γ-hydroxy-γ-triphenyl-dihydroanthracene condenses very readily with amines and phenols, giving compounds of the type

$$(C_6H_5)_2C\begin{matrix} \diagup C_6H_4 \diagdown \\ \diagdown C_6H_4 \diagup \end{matrix}C(C_6H_5)(C_6H_4R),$$

in which R may be $N(CH_3)_2$, $N(C_2H_5)_2$, NH_2, or OH. A description of these substances is given.—The mixed treatment of trypanosomiasis by arsenious acid and trypan-red: A. **Laveran.** The injection of these substances has caused the disappearance of the *Tr. gambiense* in certain animals, and hence the author regards this disease as curable in certain cases, the most efficacious treatment being the successive injection of arsenious acid and trypan-red. As the curative doses of these substances are not far removed from their toxic doses, this toxicity being variable with the animal species, the doses to be prescribed must be rigorously determined. This will be especially difficult for man.—On the faculty possessed by cement strengthened with iron of supporting large elongations: M. **Considère.** Some doubt having been thrown on the earlier work of the author on this subject by German and American writers, details are given of some further experiments, the results of which are in complete accordance with those of the earlier work.—On the new short period comet 1904 *e* (Borrelly, December 28, 1904): G. **Fayet.** Observations on this comet having now been carried on for a month, the calculation of its orbit can be made with more certainty. The results confirm those previously published, the time of revolution being now determined at about seven years.—A secondary shadow observed on the rings of Saturn in October, November, and December, 1904: M. **Amann** and Cl. **Rozet.** Between October 20 and the end of December, besides the shadow of Saturn projected on its ring a second shadow, narrower and less well marked than this, was observed. It traversed the rings throughout in the form of a curved line, and it was noted that the portion of the rings between the shadow of the planet and that now described appeared to be more brilliant than the other illuminated portions of the rings. It is not clear to what this extra shadow can be due.—Remarks on a generalisation of M. Riesz: Émile **Borel.**—On the zeros of integral functions of infinite order, not transfinite: Ed. **Maillet.**—On the precision of geographical positions obtained in the field with the prism astrolabe: M. **Driencourt.** This instrument, invented by A. Claude, has already been tested in the Observatory of Montsouris, with very satisfactory results; it remained to be seen whether the same accuracy could be maintained in field observations. Details are given of some measurements made in Madagascar showing the remarkable saving of time, without loss of precision, resulting from its use.—On the self-registration of the ions of the atmosphere: P. **Langevin** and M. **Moulin.** Owing to the existence of two kinds of ions in air differing greatly in mobility, it is not possible to register these on the same apparatus, although the same principle is applicable. The theory of the apparatus with some details of its construction are given.—On the tempering of bronzes: Léon **Guillet.** The mechanical properties of bronzes of varying content of copper, and after tempering at varying temperatures, correspond very closely with the changes of constitution brought out by the experiments of Heycock and Neville.—A brown modification of colloidal ferric oxide: P. **Nicolardot.**—On the chlorination of methyl-ethyl-ketone: André **Kling.** After trying the various methods of chlorination of ketones, the method found to give the best yield is described in detail, the action of chlorine in the presence of water and marble. The chief product was $CH_3.CHCl.CO.CH_3$, boiling at 114° to 117°, and furnishing the glycol $CH_3.CH.(OH).CH(OH).CH_3$ on reduction.—The action of dilute nitric acid upon vegetable fibres: M. **Jardin.** The use of a weak solution of nitric acid, 5 parts of acid in 1000, is suggested for bleaching flax. It presents certain advantages in regard to the time and the amount of labour required, and leaves a fibre which takes the dye in a perfectly homogeneous manner.—On fiedlerite: A. **de Schulten.** This mineral is a hydrated oxychloride of lead, of a composition corresponding to $2PbOHCl,PbCl_2$.—On the salts of the Tchad region: H. **Courtet.**—On the parasitism of *Osyris alba*: A. **Fraysse.** In a preceding note some conclusions have been given on the biology of *Osyris alba* and on the anatomy of its suckers. In the present note is an account of the general physiology of these suckers and the relations existing between the parasite and its host.—On the changes of composition of the fruit of the Cucurbitaceæ: Leclerc **du Sablon.**—On the chemical composition and the signification of the aleurone grains: S. **Posternak.** The analyses of aleurone grains obtained from four different species of plants showed practically the same composition, noteworthy points being the invariable presence of silicon and the absence of sodium and chlorine. The manganese was more variable in amount than the other elements.—The preparation of practically sterile musts from apples: G. **Perrier.**—The mode of dorsal fixation of *Lernaeenicus Sardinae* on its host: Marcel **Baudouin.**—The existence of intra-uterine rickets: MM. **Charrin** and **Le Play.**—On the folded layers near Saint-Jean-de-Buèges (Herault): René **Nicklès.**—On the ascents of captive balloons carried out on the Mediterranean and on the Atlantic Ocean from the yacht of the Prince of Monaco in 1904: H. **Hergesell.** A study of the atmospheric conditions above the ocean, measurements being taken of the temperature, relative humidity, and direction of the wind at varying heights above the sea level.—On the existence of high terraces in the North Ural: L. **Duparc** and F. **Pearce.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 9.

ROYAL SOCIETY, at 4.30.—(1) On the Conversion of Electric Oscillations into Continuous Currents by means of a Vacuum Valve: (2) On an Instrument for the Measurement of the Length of Long Electric Waves, and also small Inductances and Capacities: Prof. J. A Fleming, F.R.S.—Report on an Area of Local Magnetic Disturbance in East Loch Roag, Lewes, Hebrides: Captain A. M. Field, R.N.—Phosphorescence caused by the Beta and Gamma Rays of Radium: G. T. Beilby.—(1) The Spectrum of Scandium and its Relation to Celestial Spectra; (2) On the Stellar Line near λ 4686; (3) Note on the Spectrum of μ Centauri: Sir Norman Lockyer, K.C.B., F.R.S., and F. E. Baxandall.—Europium and its Ultra-Violet Spectrum: Sir William Crookes, F.R.S.

ROYAL INSTITUTION, at 5.—Forestry in the British Empire: Prof. W. Schlich, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Fuel Economy in Steam Power Plants: W. H. Booth and J. B. C. Kershaw. (Conclusion of discussion.)—The Value of Overhead Mains for Electric Distribution in the United Kingdom: G. L. Addenbrooke.

MATHEMATICAL SOCIETY, at 5.30.—General Theory of Transfinite Numbers and Order-types: Dr. E. W. Hobson.—On the Reducibility of Covariants of Binary Quantics of Infinite Order. Part ii: Mr. P. W. Wood.

FRIDAY, FEBRUARY 10.

ROYAL INSTITUTION, at 9.—The Art of the Ionian Greeks: Dr. Cecil Smith.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

MALACOLOGICAL SOCIETY.—Annual General Meeting. Address by the President, Mr. E. R. Sykes, on Variation (including Teratology) in Recent Mollusca.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Reconstruction of the Santa Lucia River Bridge, Uruguay: P. J. Risdon.

PHYSICAL SOCIETY, at 8.—Address on Radiation Pressure by the President-elect, Prof. J. H. Poynting, F.R.S.

MONDAY, FEBRUARY 13.

SOCIETY OF ARTS, at 8.—Internal Combustion Engines: Dugald Clerk.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geographical Results of the Tibet Mission: Sir Frank Younghusband, K.C.I.E.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Results of Force Measurements with Cutting Tools, and their Application to Lathe Design: Dr. J. T. Nicolson.

TUESDAY, FEBRUARY 14.

ROYAL INSTITUTION, at 5.—The Structure and Life of Animals: Prof. L. C. Miall, F.R.S.

SOCIOLOGICAL SOCIETY, at 4.—(1) Restrictions in Marriage: (2) Studies in National Eugenics: Communicated by Dr. Francis Galton, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Alfreton Second Tunnel: E. F. C. Trench.—The Reconstruction of Moncreiffe Tunnel: D. McLellan.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Kinematograph Exhibition of Native Dances from Torres Straits: Dr. A. C. Haddon, F.R.S.—The Dog-motive in Bornean Art: E. B. Haddon.

WEDNESDAY, FEBRUARY 15.

SOCIETY OF ARTS, at 8.—The Decline of the Country Town: Arthur H. Anderson.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Practical Micro-Metallography with Experimental Demonstration: J. E. Stead, F.R.S.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1904: E. Mawley. Observations made during a Balloon Ascent at Berlin, September 1, 1904: Dr. Hermann Elias and J. H. Field. The Winds of East London, Cape Colony: J. R. Sutton

CHEMICAL SOCIETY, at 5.30.—The Condensation of Anilino-acetic Esters in Presence of Sodium Alcoholate: A. T. de Mouilpied.—Nitrogen Halogen Derivatives of the Aliphatic Diamines: F. D. Chattaway.—Nitration of Substituted Azophenols: J. T. Hewitt and H. V. Mitchell.

THURSDAY, FEBRUARY 16.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Polarised Röntgen Radiation: Dr. G. C. Barkla.—The Effects of Momentary Stresses in Metals: Prof. B. Hopkinson.—The Halogen Hydrides as Conducting Solvents. Part I. The Vapour Pressures, Densities, Surface Energies, and Viscosities of the Pure Solvents: D. McIntosh and B. D. Steele.—The Halogen Hydrides as Conducting Solvents. Part II. The Conductivity and Molecular Weights of Dissolved Substances: D. McIntosh and E. H. Archibald.—The Halogen Hydrides as Conducting Solvents. Part III. The Transport Numbers of Certain Dissolved Substances: B. D. Steele.—The Halogen Hydrides as Conducting Solvents. Part IV.: B. D. Steele, D. McIntosh, and E. H. Archibald.

ROYAL INSTITUTION, at 5.—Recent Work of the Geological Survey: Prof. J. J. H. Teall, F.R.S.

SOCIETY OF ARTS, at 4.30.—The Indian Census of 1901: Sir Charles A. Elliott, K.C.S.I.

LINNEAN SOCIETY, at 8.—A Revised Classification of Roses: J. G. Baker, F.R.S.—The Botany of the Anglo-German Uganda Boundary Commission: E. G. Baker, Spencer Moore, and Dr. A. B. Rendle.

FRIDAY, FEBRUARY 17.

ROYAL INSTITUTION, at 9.—High Power Microscopy: John W. Gordon.

GEOLOGICAL SOCIETY, at 8.—Anniversary Meeting.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—The Protozoa in Relation to Disease: Prof. E. J. McWeeney.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.—Adjourned Discussion on the American Visit, 1904.—The Strength of Columns: Prof. W. E. Lilly.

CONTENTS.

THURSDAY, FEBRUARY 16, 1905.

THE HISTORY OF COAL MINING.

Annals of Coal Mining and the Coal Trade. Second Series. By R. L. Galloway. Pp. xvi+409. (London: Colliery Guardian Co., Ltd., 1904.)

IN a former volume (noticed in NATURE, vol. lix. p. 337) the author carried his annals of coal mining down to the period of the Select Committee of the House of Commons on Accidents in Mines in 1834. He now continues the subject to the passing of the Coal Mines Inspection Act of 1850, and to the establishment of the Royal School of Mines. This volume, like its predecessor, is comprehensive and accurate, and a monument of industry and of thorough technical knowledge.

The period of fifteen years reviewed is one of much interest. After ten years of stagnation came a remarkable increase of activity in the coal and iron industries. The chief causes that imparted the impetus were the rapid extension of steam navigation and the mania for constructing railways. Fresh life had been given to the manufacture of iron by the introduction of hot blast, and, owing to its increasing cheapness, the metal was being more largely used in collieries. Steel, however, was still a scarce commodity. The chief seat of mining operations at this period was in the Wear and South Durham district. In South Wales a considerable development of the steam-coal district took place, owing largely to the opening of the West Bute Dock at Cardiff in 1839. In Yorkshire the greatest depth attained in 1841 was at Barnsley, where the coal lay 594 feet below the surface. In Lancashire two pits were begun in 1838 at Pendleton, which reached the coal at 1392 feet, whilst at Apedale, in North Staffordshire, there was a mine with the exceptional depth of 2177 feet. Frequent instances of spontaneous issues of fire-damp are recorded. Full details of the various explosions are given by the author, and the gradual improvements in mining operations are traced. The author's records show that the men who did most to advance mining progress at this period were John Buddle, of Wallsend (1773–1843), Dr. W. R. Clanny (1776–1850), Sir Henry De la Beche (1796–1855), Michael Faraday (1791–1867), Sir Goldsworthy Gurney (1793–1875), Lord Playfair (1818–1898), Sir Warington Smyth (1817–1890), and James Young, of Bathgate (1811–1883), the founder of the Scotch mineral oil industry.

Incidentally, Mr. Galloway gives interesting etymological details of some local terms the origin of which is uncertain. Thus, in South Staffordshire and Scotland the word "butty" signifies a comrade or associate. Assuming neighbourhood to have been the original idea, a root for the word is suggested by the author in the term "but" as used in the expression "but and ben," applied to a divided house shared by two occupants. Again, what appear to be traces of a primitive state of servitude existed in Staffordshire, where the labourers employed in the haulage of coal continued to be known as "bondsmen"—a name probably coming down from a remote period; a supposition which receives support from a peculiar service required of them, known as "buildases." This consisted in working at times in the morning without receiving any payment beyond a drink of ale. This custom of exacting labour without pay is supposed to represent some ancient service required from their tenants by the monks of the Abbey of Buildwas, in Shropshire, whence the name was derived. Another etymology would have buildas, a contraction of build-house, because the money obtained by means of this unpaid labour enabled the butties to build rows of cottages. Another curious term was that applied to the small stools which in the north of England formed a regular part of the collier's accoutrements. This stool was known as a "cracket," a word which appears to be a variety of cricket.

In reviewing the history of this interesting period it is surprising to find what a large number of recent inventions had been anticipated. For example, the pneumatic system of haulage, successfully applied by Blanchet at Epinac, in France, in 1877, was patented in 1845 by Knowles and Woodcock in Lancashire. The use of reciprocating rods to raise vessels containing coal adopted on the Continent by Méhu, and subsequently by Guibal, was made the subject of a patent by Slade in 1836. The process of raising mineral in successive stages, proposed for working the deep-level mines of the Witwatersrand, appears to have been not uncommon during the first half of the nineteenth century. Winding by endless chain, as proposed by O. C. von Verbo in a book published a few months ago, was patented as early as 1789; and in 1839 an automatic arrangement for cutting off the steam and applying the brake, invented by John Wild, was in operation in Lancashire. The well known ventilator patented by W. P. Struvé was identical in principle with the hydraulic air-pump used in the Hartz mines since the Middle Ages. Iron props, adopted in France in 1880, were used in Derbyshire collieries in 1811, as were also pieces of timber built up two and two crosswise so as to form a square pillar. This so-called pig-sty timbering was introduced as a novelty by the Australian miners at the Day Dawn mine, in Queensland, ten years ago.

In one respect the work is open to criticism. The title "Annals of Coal Mining" should more properly have been "Annals of British Coal Mining," inasmuch as Continental and American practice is barely mentioned. This is to be regretted, as during the period under review several events happened abroad to which reference might usefully have been made. Thus, the first Belgian railway was opened in May, 1835, the first German railway in December, 1835, the first French railway in 1837, and the first Austrian railway in 1838. The first railways made in the United States were coal roads to the mines. In 1835 Thomas and Laurens suggested heating boilers with blast-furnace gas. In 1835 Kind improved the methods of deep boring. In 1846 Schönbein discovered gun cotton, and nitroglycerin was invented in the following year. In 1830 the modern mine-theodolite was invented by F. W. Breithaupt, of Cassel, and in 1845, in France, the trust-like company of the Loire was formed, that was the prototype of the coal trusts and syndicates of to-day. Events such as these had a far-reaching influence on the development of the coal-mining industry.

Special commendation is due to the author for the scrupulous accuracy with which references to original authorities are given, and for the care with which the proof-sheets have been read. Two trifling misprints have, however, escaped detection. Freiberg appears as "Freyburg" (p. 292), and Sir Marc Isambard Brunel as "M. J. Brunel" (p. 291).

BENNETT H. BROUGH.

MATHEMATICS OF BILLIARDS.

Billiards Mathematically Treated. By G. W. Hemming, K.C. Second edition. Pp. 61. (London: Macmillan and Co., Ltd., 1904.) Price 3s. 6d. net.

MORE fortunate, or more careful, than most authors, Mr. Hemming, whose recent death will be regretted by many, did not find it necessary in his second edition to make any material alterations in his original work. He added two appendices, iii. and iv., with which alone it is necessary to deal in the present notice.

Appendix iii. discusses the comparative advantages of fine and through strokes, with regard to the margin of error permissible in the respective cases. In the figure opposite p. 47, A is the player's ball, O the object ball, and the stroke is to make A, after striking O, pass within a distance of the point P depending on the nature of the stroke, namely, for a cannon a distance equal to the diameter of a ball, for a losing hazard the necessary distance from the centre of the pocket, which may vary between different tables. The angle AOP is given by the conditions of the problem, and in the notation adopted is $\pi-\Delta$. The angle of aim, OAS, is the thing to be determined. It shall be denoted by α, as in appendix ii. of the first edition. In the present appendix A_1 is also used for the same angle. S denotes the position of the centre of the striking ball at impact, SO being the common normal. If $ASO=\pi-\theta$, θ and α are connected by the relation $\sin\theta/\sin\alpha = AO/OS = AO/2$ if we denote OS, the diameter of a ball, by 2; and in the special case considered of $AO=PO=30$, or 15 diameters, we might to a very near approximation use α instead of $\sin\alpha$. Further, the angle OPS is denoted by P_1, and the angle of deviation, $\pi-ASP$, by δ. It is then shown that as the equation connecting δ and θ,

$$\tan(\theta+\delta)=p\tan\theta,$$

where, for reasons given in the former edition, $p=3\cdot5$. From this last equation δ may be obtained in terms of θ or α. In fact,

$$\tan\delta=(p-1)\sin\theta\cos\theta/(\cos^2\theta+p\sin^2\theta)$$

is easily found.

The complete method, were it practicable, would be to find an equation in θ or α having two roots, one of which, say θ_1, should correspond to the fine, the other, θ_2, to the through, stroke, and thence the margin of error might be found for each stroke. This analysis being difficult, a practical solution is obtained by means of a diagram in which the ordinate y represents $\sin\Delta$, given by the conditions, and the abscissa x represents $\sin\theta$ in an actual stroke in which, for given Δ, the ball A passes over or very near to P. A series of values of $\sin\theta$ being found corresponding to a series of values of $\sin\Delta$, we draw a freehand curve through them. In general, a line parallel to x for given y cuts this curve in two points, namely, P_y, in which θ has the smaller value (the through stroke), and Q_y, in which it has the greater value (the fine stroke). It comes next in order to find for any y the margin of error for P_y and for Q_y. This is done by using the formula of appendix ii., first edition. The linear error on the object ball is (AO being 30) $30\delta\alpha$. The consequent linear error at P ($PO=30$) is denoted by E. Then $30\delta\alpha/E$ gives the margin of error. A new curve, called the blue curve, is then drawn, having for abscissa $x=\sin\theta$, and for ordinate $y=30\delta\alpha/E$, in the same way, by a series of trials, as the first curve. The blue curve has two branches. Then the margin of error for any of the points P_y or Q_y of the first curve is that ordinate of the blue curve which has the same abscissa. As the result of this method it is found that the margin of error is the same for the through as for the fine stroke, when $\sin\Delta=0\cdot320$, and $\sin\theta=0\cdot132$ for the through, and $\sin\theta=0\cdot960$ for the fine stroke. For smaller values of Δ the through stroke has the advantage; for larger values of Δ the fine stroke, until a certain maximum is reached.

In appendix iv., f, the coefficient of friction between two balls at impact, formerly taken as zero, is assumed to have the values 0·01 or 0·02, and it is found that, instead of $p=3\cdot5$, as above assumed, we should have

$$\text{for } f=0\cdot01\quad p'=3\cdot445+0\cdot0625\cos\theta$$
$$\text{for } f=0\cdot02\quad p'=3\cdot391+0\cdot125\cos\theta.$$

It will be observed that both these values of p' give very approximately $p'=3\cdot5$ when $\theta=30^\circ$, that is, for the half-ball stroke.

Before this notice was in type Mr. Hemming was taken from us by death, to the sincere regret of his many friends, including the present writer.

S. H. BURBURY.

A MORPHOLOGY OF THE ALGÆ.

Morphologie und Biologie der Algen. By Dr. Friedrich Oltmanns. Vol. i. Special part. Pp. vi+733; illustrated. (Jena: Gustav Fischer, 1904.)

THE charming little university town of Freiburg has been the birthplace of important ideas in an obscure department of natural history. De Bary began there his researches into the life-history of the lower fungi, and afterwards continued them at Halle and Strassburg. Owing to his great work and inspiration we botanists owe a germ-theory of disease—a theory which was in time to bear fruit in practical, medical and surgical form in the mighty hands of Lord Lister. To Freiburg, then, we come again for a morphology of the kindred group of the Algæ.

There is a difficulty in understanding how even an assiduous German professor, living so remote from the sea as Freiburg is, can have obtained the inspiration which has guided his research for years past. The study of organisms, which in a living state are for the most part many hundreds of miles from his door, must have presented a task in conquering which his zeal and power of work can find no better example than the volume before us. To a great extent this work must have been book work, and excellent book work it is, the purely bibliographical work especially; and with the aid of herbarium specimens Dr. Oltmanns has succeeded in giving us a general morphology of the Algæ—a treatise to have been expected only from one with abundant leisure and a microscope near the sea. To approach, then, in a spirit of criticism an encyclopædic book of this kind, to try to gauge its worth, seems in the circumstances scarcely "sportsmanlike," if I may use such a term, on the part of one who has had so many greater opportunities of observation.

The De Bary of the subject is, of course, Dr. Bornet, and no student can for a moment question his pre-eminent claims to instruct us. Schmitz, of Greifswald, whose loss we can never cease to deplore, seemed destined to employ his indomitable industry in a work of this kind. Happily we have Dr. Oltmanns, and happily he has had the courage to undertake a task so full of use and pleasure to all students of this fascinating group of plants.

I do not wish for a moment even to seem to detract from the great performance of Dr. Oltmanns. One irresistibly comes back to the Freiburg and De Bary standard. One hoped for a general morphology of the Algæ as De Bary gave us one of the fungi. Dr. Oltmanns has given us an encyclopædic book—an admirable one—but not the reasoned work of genius botanists have dreamt of.

According to personal prejudice, very possibly, I mean prejudice in the right sense of the word, I turned first to the obscure groups of primitive Algæ, groups that I have had so many opportunities of studying on the sea, and of which Dr. Oltmanns can have had few chances of seeing living specimens. It so happened that while writing this review the present writer was engaged in describing a new generic form of pelagic Alga obtained on the outward voyage of the *Discovery*. The point was put to the test by consulting Dr. Oltmanns's descriptions and bibliography. From that, of course, the original sources were taken and verified, not so much for the immediate purpose, as was natural in any case, as for the aim of doing justice in reviewing Dr. Oltmanns's book. The result was triumphant for Dr. Oltmanns—every reference and every description having been pursued to its original source. It is difficult to establish a negative, but no reference was found wanting.

Naturally one turned next to the group Dr. Oltmanns has made his own—the Fucaceæ. It may seem presumption, but it was dutiful, and here, again, the book stood every test. The other groups of Algæ were not made the subject of such rigorous treatment, but they were examined with scrutiny enough to warrant the expression of a very warm and hearty recommendation of this great book to the consideration of botanists and cultivated readers.

George Murray.

OUR BOOK SHELF.

Game, Shore and Water Birds of India: with Additional References to their Allied Species in Other Parts of the World. By Colonel A. Le Messurier, C.I.E., F.Z.S., F.G.S. Fourth edition. Pp. xvi+323. (London: Thacker and Co., 1904.)

The first edition of this work was a modest little volume, printed for private circulation only, on the birds of Sind. This appeared so far back as 1874. Four years later, with some additions, it was issued to the public. Hume and Marshall's epoch-making work on the game birds of India appearing at the same time made a third edition imperative. This in due time appeared, and large additions were made thereto, taken, with acknowledgments, from this formidable rival. Meeting with a well merited success, a fourth edition has now been issued, which differs from the earlier volumes in that it "includes references to all species in other parts of the world that are allied to the Game, Shore, and Water Birds of India."

This addition is made on the curious plea that "owing to the facilities of travel, Anglo-Indians are now engaged in most countries either on business or pleasure." It is to be supposed that Anglo-Indian sportsmen are here specially referred to, and further, that, save for this volume, no information concerning the avifauna of the countries they propose to visit is obtainable. That this is not the case it is needless to say, and the traveller-sportsman would be ill advised who started on his journey with this volume for his only guide and counsellor.

In so far as it concerns the birds of India likely to interest the sportsman, this book will do very well; but it would have been vastly improved if the space now devoted to extra-Indian birds had been utilised for fuller descriptions of the native species, and for the description of the geographical and climatic conditions of the several regions of this vast hunting ground.

The introduction to this book contains, we venture to think, not a little that is out of place in a work of this kind. Much of it is admittedly compiled from abstruse scientific treatises, or from the labels of the Natural History Museum at South Kensington.

There can be no doubt but that the author, during his long residence in India and his wide experience in the field, must have accumulated a vast store of facts concerning Indian birds which would be well worth recording. For this reason, therefore, we regret that he decided on including in this edition matter really foreign to the scope of his book. His first-hand observations would have been of infinitely more interest and value than the compilation now presented.

The illustrations are numerous, and mostly very crude. W. P. P.

The Species of Dalbergia of South-Eastern Asia. By Dr. D. Prain. (Annals of the Royal Botanic Gardens, Calcutta, vol. x., part i.) Pp. iv+114; and plates. (Calcutta, 1904.) Price 1*l.* 13*s.*

The stages in the evolution of the genus Dalbergia are sketched in the early pages of this memoir. After removal of the extraneous species, the genus was delimited by Bentham in 1851, and four subdivisions, Selenolobium, Dalbergaria, Sissoa, and Triptolomea, were mapped out. Although Bentham himself pointed out that there was overlapping in these subdivisions, the grouping has been maintained by later systematists down to and including Taubert, who undertook the Leguminosæ for the "Pflanzenfamilien" in 1894. Dr. Prain, who had previously reviewed the genus when collating the Leguminosæ in connection with "Materials for a Flora of the

Malayan Peninsula," has, after a study of several years, introduced a new arrangement with two main sections, Sissoa, which includes the greater part of Bentham's Triptolomea and Sissoa, and Amerimnon, called after an American type. Dr. Prain's classification differs from Bentham's, since he adopts the shape and orientation of the corolla and the form of the style as the criteria of his subdivisions instead of the characters of the inflorescence, stamens, and fruit.

The genus is distributed through the tropics of Africa and America as well as Asia, and it seems a pity that the author did not see his way to extend his monograph to all the known species. The distribution in Asia is considered for five provinces, East China, Indo-China, Indo-Himalaya, Malaya, and Papuasia; the number of endemic species in each is large, and amounts to 72 per cent. for East China. Very few species are found in more than two of these provinces; *Dalbergia tamarindifolia* occurs in four, and *Dalbergia torta* (= *D. monosperma*), which has pods well suited for dispersal by ocean currents, is the only species found in all five provinces. Owing to the inclusion of recent specimens from Malay and China, the total number of authenticated species amounts to eighty-six; a few, including the *Dalbergia laccifera* of Lanessan, still remain unidentified. The memoir is illustrated with diagrams of groupings and maps of distribution, as well as with figures of each species, and issued as the first part of the tenth volume it forms a valuable addition to the *Annals* of the Royal Botanic Gardens, Calcutta.

The Process Year Book. Penrose's Pictorial Annual, 1904–5. Edited by William Gamble. Pp. xvi + 160. (London: Penrose and Co.)

EVERY year we receive this annual, and each time it is our pleasure to point out the very high standard which the volume attains. The current issue bids us to repeat the opinions expressed in our previous notices, and to supplement them with the statement that the standard has again been changed to one of a higher order.

To gain some idea of the possibilities of process work of to-day, when the best work and materials are employed, the reader has only to take up this book and examine the contents, which will at once indicate the high state of efficiency and the variety of methods that are available. In the first place we have a series of instructive articles, covering 160 pages, most of which are from the pens of well-known workers. These deal with manifold portions of a far-reaching subject, and give the advice, results of experience, and views of these workers on numerous points of interest. Of the illustrations, which form such a conspicuous feature of this annual, much could be written, for it is in them that we see the practical results of the processes in use to-day. If we sum up the plates, colour prints, supplement illustrations, and illustrations in the text, we have a collection which for variety of subjects and excellence of reproduction is unique. The photogravure, as a frontispiece by J. J. Waddington, Ltd., the "Turner" reproduced by the three-colour process of André and Sleigh, and the interlayed half-tone by the Arthur Cox Illustrating Co., Ltd., are three amongst a host of other good samples that are met with.

Apart from the large number of process workers who await annually the appearance of this year book, this handsome volume will appeal to a wide circle of readers who are in any way connected with the artistic or utilitarian side of the art of reproducing pictures. The editor and his contributors, together with the publishers and printers, all deserve great credit for such an admirable result of their combined efforts.

LETTERS TO THE EDITOR.

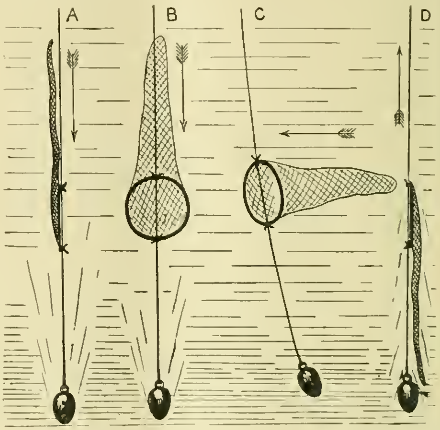
[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

On a Method of Using the Tow-net as an Opening and Closing Tow-net.

EVERY naturalist who has engaged in marine research is aware of the great difficulties which attend upon research in the intermediate depths.

Great ingenuity has been displayed in the invention of very elaborate instruments—many of them hopeful, some of them successful. It had appeared to me, as the result of observations, and after conversation with Mr. J. Y. Buchanan, who had made similar observations, that a solution of this problem might be found easily in experiments with the ordinary tow-net.

Our joint experience was this. If an ordinary tow-net were lashed at two opposite points of the rim to a rigid sounding-wire, and so plunged at speed into the depths, the net would fold over and close. It might then be towed at the required depth and afterwards reeled in by the sounding engine at express speed—again closing in its upward course.



Through the great kindness and sympathy of Mr. M. H. Gray, of the Silvertown Submarine Telegraph Company, I was afforded an opportunity of putting this theory to the test on board the *Dacia*.

The conditions of the experiment appeared to me at the time adverse, since my tow-nets and other apparatus were missing at Gibraltar; but this was a blessing in disguise. I set to work and made a tow-net out of old bunting and the rim out of a barrel hoop. This tow-net was so flimsy that in towing it alongside at little more than mere steerage-way it frequently burst. To plunge it into the depths would be a supreme test, since not even No. 20 Miller's Silk in an open net could stand the strain I proposed. Off the north-west coast of Africa I had three days' opportunity of experiments, the absurd tow-net being in ludicrous inverse proportion to the magnificent sounding crew and sounding engine. A reference to the diagram will show A, the descent of the net folded over; B, the net opening at the required depth; C, the net being towed at the required depth; and D, the net being reeled in closed as in its descent.

I confess that when the first experiment was made I had faint hope of seeing that flimsy tow-net again, but it emerged with many organisms we had not captured on the surface. To cut matters short, these experiments were repeated for three days without a hitch at from 200 to 300 fathoms, the flimsy net emerging from its trials on every occasion with success.

There are two practical points. The first is the art of plunging the net at the surface, the next that of whipping it out on reeling in, so that there may be no contamination of surface organisms during the critical moments. With a highly expert sounding crew such as I had at my service this was easily done.

My repeated experiments were also addressed to this point, viz. to ascertain the best rate of descent and ascent of the net, and my experience was 100 fathoms a minute. The flimsy net stood all tests.

To the modern marine naturalist, whose complicated (and expensive) opening and closing tow-net is an object of worship, this simple advice may seem like telling him to "bathe seven times in Jordan"; he wishes to do a great thing. GEORGE MURRAY.

February 5.

The Sixth Satellite of Jupiter.

THE author of the article on the sixth satellite of Jupiter in NATURE of January 19 has obviously made a slip in assuming that the "retrograde" motion ascribed to the satellite means retrograde in the sky, and not in the orbit. According to the ephemeris, Jupiter on January 4 was moving direct, *i.e. eastward,* about 225″ daily. The satellite was *west* of the planet (position angle 269°), approaching Jupiter at the rate of 45″ a day, and, therefore, moving eastward (direct) about 270″ daily.

The position angle on January 17, according to the latest bulletin from Mount Hamilton, was 266°, having decreased 3°; the distance of the satellite had decreased from 45′ to 36′. If the object is really a satellite this necessarily indicates a retrograde orbital motion, unless the plane of its orbit is so much inclined to that of the other satellite-orbits as to make the new one pass north of the planet at inferior conjunction instead of south as the others now do.

The observations thus far published would, however, apply equally well to an asteroid a little within or beyond the orbit of Jupiter, and near perihelion in an orbit of some eccentricity and with a mean distance from the sun somewhat greater than that of Jupiter. We must wait for further observations to determine the truth. C. A. YOUNG.

Princeton, N.J., U.S.A., February 3.

The Circulation of the Atmosphere.

I HAVE read with great interest your review of Prof. H. H. Hildebrandsson's report on "The General Motion of Clouds" (NATURE, February 2, p. 320).

All his observations appear to support the theory of my father, the late Prof. James Thomson, as set forth in the Bakerian lecture on "The Grand Currents of Atmospheric Circulation" (*Phil. Trans.*, vol. clxxxiii. p. 653, 1892) and in his earlier paper read before the British Association in 1857.

Is it possible that Prof. Hildebrandsson has not seen these papers, and has accepted theories put forward as Prof. James Thomson's instead of referring to the originals? Anyone who takes the trouble to read these papers carefully must see that it is distinctly stated that the main direction of the upper current of the atmosphere is from west to east while moving steadily and gradually towards the Poles, and that the air keeps this west to east motion as it sinks to a lower level, and becomes the great return current towards the equator. This motion can hardly be termed "vertical circulation." As for Prof. Hildebrandsson's assumption concerning Hadley's theory, I should like to quote the following passage from my father's paper:—

"In 1735 George Hadley submitted to the Royal Society the paper of which I have made mention already as supplying for the first time a substantially true theory of the primarily dominant conditions of atmospheric circulation. The paper is entitled 'Concerning the Cause of the General Trade Winds,' and it is right here to notice that Hadley applied the name 'General Trade Winds' not merely to those winds of equatorial regions to which the name Trade Winds is ordinarily restricted, but uses it as including also the west to east winds known to be prevalent in higher latitudes, and used in trade by mariners for ocean passages from west to east. Thus the scope of his theory must be understood as being much wider than what would be conveyed in ordinary nomenclature by the name Theory of the Trade Winds."

So far then from opposing Hadley's theory, my father's amplifies and completes it. JAMES THOMSON.

22 Wentworth Place, Newcastle-on-Tyne, February 6.

Remarkable Temperature Inversion and the Recent High Barometer.

DURING Friday and Saturday, January 27 and 28, the barometric pressure over the south of England was exceptionally high, readings of 31.00 inches being observed at 6 p.m. on Saturday in the extreme south-west of the country. In the neighbourhood of London the barometer rose to 30.90 during the night of January 26, and remained at about that height until the morning of January 29, a well marked anti-cyclone with readings over this value being shown on the morning and evening weather charts of January 27 and 28.

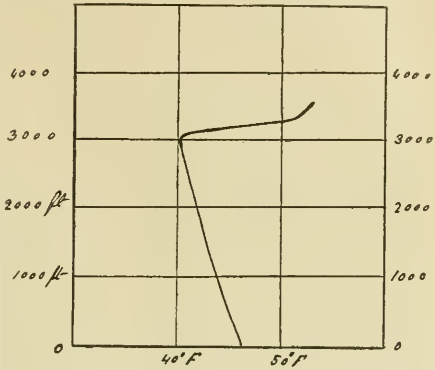


FIG. 1—Temperature inversion on January 28 at Oxshott, Surrey.

During such conditions it is in general impossible to raise a kite, owing to the want or lightness of wind; but on January 28, during the afternoon, there was sufficient breeze from the west to start a kite carrying recording instruments, and to take them to a height of 3600 feet. A very remarkable temperature inversion was found to exist, the details of which are shown in the accompanying chart. At 3.40 p.m. the surface temperature was 47°.0 F.; at 4.45 p.m. it had fallen to 45°.0 F. The temperature decreased steadily to 40° F. at 3000 feet; a little higher a rise of 12° took place, the temperature at 3300 feet being 52° F. At 4.28 p.m., at 3600 feet, the temperature was 53° F. Unfortunately, the humidity trace on the meteorograph partially failed, but it suffices to show that the temperature inversion was, as such inversions in my experience always are, accompanied by extreme dryness of the air.

The wind was west at the surface, and shifted gradually to north-west at the highest point reached, but there was no sudden change of direction at the height where the temperature inversion occurred.

I do not wish to imply that the high barometer and the temperature inversion are necessarily correlated phenomena, but the coincidence is interesting. W. H. DINES.

Dates of Publication of Scientific Books.

WITH reference to the complaint of Mr. R. P. Paraiypye (p. 320) that a big sum is still asked for Price's "Treatise on Infinitesimal Calculus," I should be obliged if you would allow me to point out that the price of this work is, and has been for some time, 5s. a volume.

HENRY FROWDE.

Oxford University Press Warehouse, Amen Corner, London, E.C., February 8.

A National University Library.

It must be the experience of any graduate of Oxford or Cambridge who is residing at a distance from those university towns that a serious obstacle to the prosecution of research arises from the impossibility of consulting the university libraries, and the absence of any provision for borrowing volumes, or obtaining references under arrangements similar to those pertaining at the libraries of the Royal and other scientific societies. Moreover, while Oxford and Cambridge possess the special privilege of acquiring free copies of books copyrighted in England, there are now many universities in this country which are far too poor to keep up even a decently respectable library in any branch of science.

The conditions of modern times have created a need for a National University Library, enjoying the same privileges as the Oxford and Cambridge libraries, and which should be available for graduates of any British university; persons engaged in any specified branch of research to have the opportunity of borrowing books through the post as in the case of the Royal Society. G. H. BRYAN.

Mutation.

THE term mutation is applied in biology to that sort of variation in which the equilibrium of the organism seems to be disturbed, and a new position of equilibrium is found, which is markedly different from the original one. This may apply to a whole organism or merely to some one organ, so far as external appearances show.

In all the discussions regarding mutation which have lately taken place, the difficulty has been felt that it is impossible by any methods yet known to perceive and measure the internal changes and influences leading to mutability. It is certainly not supposed that mutability is without cause, but it is obviously difficult to detect the causes which bring it about.

It occurs to me that some help may be obtained from analogies derived from psychology and sociology. What mutation is in biology, conversion is in psychology, and revolution in sociology. It may be said that to assume such parallels is merely to beg the question, but I think that the apparent parallelism cannot be without significance. Now the phenomena leading towards conversion have been studied subjectively (*cf.* James, "Varieties of Religious Experience"), and those leading towards revolution have been studied objectively, with certain well-defined results. If the supposed analogy is a valid one, it appears to follow that mutability is due to the same general causes as ordinary variability (just as change of opinion and reform are due to the same general causes as conversion and revolution), but that there is this difference—mutability represents an explosion of energy, as it were, in a given direction, and therefore differs from ordinary variation somewhat as the firing of a gun differs from the explosion of a loose heap of powder. It also follows that the cause of the explosion is not plasticity in the organism, but in some measure the reverse; that is, the power of being influenced, and at the same time of withstanding the expression of the influence until it had acquired considerable force. This implies a certain rigidity of type, quite comparable with a type of mind familiar to all. It further appears to follow that the chance of mutations succeeding from the first is comparatively remote, though such a thing is quite possible; but since they are the result of general causes, the sort of changes the mutations exhibit are likely to come about in due course, just as the sort of changes represented by a revolution are likely to prevail ultimately, though the revolution itself may appear to fail.

T. D. A. COCKERELL.

University of Colorado, Boulder, Colorado, January 25.

Fact in Sociology.

MR. WELLS is a dangerous man to criticise. Such thunderbolts as "crude," "dull," "balderdash," come hurtling at one's head even from his modified letters (NATURE, February 2). But I prefer to regard it all as meant only for sheet lightning. Indeed, when I consider the courtesy that characterised my article (NATURE, December 29), plain-spoken though it was on some points, I cannot take any other view.

Now to Mr. Wells's points in order.

(1) "'The Food of the Gods' does not claim to forecast the future." My mistake was natural. It only shows the risk Mr. Wells runs in appearing before the world in two entirely different characters. Still, I hit upon a weak point. He pictures an ideal State, but cannot show us how it is to be realised. Archimedes had no fulcrum for the lever with which he would have moved the world. Mr. Wells has no power to apply to his.

(2) "*I have mixed up 'Anticipations' and 'Mankind in the Making.'*" Why keep them separate? "Anticipations" also deals largely with ideals.

(3) *Re* the question—Which of the great national "syntheses" will attain predominance, see "Anticipations," chap. viii. *passim*, and especially pp. 100, 101 (6d. ed., 1904). This chapter seemed to me an interesting speculation, but Mr. Wells describes what I thought, and, on re-reading, think is to be found in it as "balderdash." True, through inadvertence I wrote "Anglo-Saxon" instead of "English-speaking," for which I am sorry.

(4) *Re* the recruiting of the upper strata of society from the lower, nothing, he says, is known about this. Still, those who have studied human evolution think they know something. Prof. Karl Pearson even says that there are "class statistics" for the population of Copenhagen, and writes, "the population would accordingly appear to be ultimately, and in the long run, reproducing itself from the artisan classes" (*Natural Science*, May, 1896). Dr. Mercier (see the Sociological Society's papers, 1904, p. 55) regards "a civilised community in the light of a lamp, which burns away at the top and is replenished at the bottom." As to "stagnant" classes, I find in "Anticipations," p. 121, "It (the new Republic) will tolerate no dark corners where the people of the Abyss may fester, no vast diffused slums of peasant proprietors, no stagnant plague preserves." See especially p. 117 for Mr. Wells's plan for getting rid of undesirable types. As to careful parentage, see "Mankind in the Making," p. 99:—"The first step to ensuring them (the ends aimed at) is certainly to do all we can to discourage reckless parentage."

In conclusion, let me describe myself as a much-battered but not unfriendly critic of the New Republic.

F. W. H.

The Melting of Floating Ice.

MAY I suggest that Dr. Deventer, of Amsterdam, whose letter to you is referred to in your issue of January 26 (p. 303), has discovered a "mare's nest"?

His observant pupil, who noticed that in a glass filled to the brim with water and floating ice the melting of the latter did not cause overflow, was apparently totally ignorant of the laws of flotation, or he would not have expected otherwise. Why should the level of the water change? The ice in melting must of necessity just fill with water the space that it displaced when floating, and so the level remains unaltered. So Dr. Deventer's statement that "when a vessel contains a solid floating in its own liquid, the level of the latter does not change by the melting of the solid" appears quite superfluous.

As to making this a "general" law applying to *solids floating in their own liquids*, surely the rule is that solids do *not* do so, but sink. Why make a general law which only applies in the case of a very few exceptional substances, such as ice, cast iron, and bismuth? HEAT.

February 8th.

A Lunar Rainbow.

LAST night, after 10 p.m., a thunderstorm passed over this town, travelling from west to east. When the storm had passed and the rain had almost ceased, a bright quarter-moon shone brilliantly almost overhead. To the east the clouds were still very heavy and dark, and in that direction there appeared a perfect rainbow. The arc of the bow was low; it appeared as a grey band with a certain suggestion of colour, against the dark leaden sky.

I should be glad to know from any of your readers if such moon rainbows are of common occurrence, as the one of last night is the first which I have seen.

Pretoria, Transvaal, January 15. J. MCCRAE.

NOTES ON STONEHENGE.[1]

III.—THE EARLIEST CIRCLES.

WHEN we come to examine Stonehenge carefully in relation to the orientation theory, it soon becomes clear that its outer circle of upright stones with lintels and the inner naos, built of trilithons, oriented in the line of the "avenue" and the summer solstice sunrise, are not the only things to be considered. These stones, all composed of sarsen, which, be it remarked, have been trimmed and tooled, are not alone in question. We have:—

(1) An interior circle broken in many places, and other stones near the naos, composed of stones,

FIG. 8.—Map of the Stones made by the Ordnance Survey. A, N.W. stone; B, S.E. stone; C, Friar's Heel; D, Slaughter stone.

"blue stones," which, as we have seen, are of an entirely different origin and composition.

(2) Two smaller *untrimmed* sarsen stones lying near the vallum, *not* at the same distance from it, the line joining them passing nearly, but not quite, through the centre of the sarsen circle. The amplitude of the line joining them is approximately 26° S. of E. and 26° N. of W. Of these the stump of the N.W. stone is situated 22 feet from the top of the vallum according to the Ordnance plan. The S.E. stone has fallen, but according to careful observations and measurements by Mr. Penrose, when erect its centre was 14 feet from the top of the vallum. The centre of the line joining the stones is therefore 4 feet to the S.E. of the axis of the present circles, which, it may be stated, passes 3 feet to the N.W. of the N.W. edge of the Friar's Heel (see Fig. 8).

There are besides these two large *untrimmed* sarsen stones, one standing some distance outside the vallum, one recumbent, lying on the vallum, both nearly, but not quite, in the sunrise line as viewed from the centre of the sarsen circle. These are termed the "Friar's Heel" and "Slaughter Stone" respectively.

I will deal with (1) first, and begin by another quotation from Mr. Cunnington, who displayed great acumen in dealing with the smaller stones not sarsens.

"The most important consideration connected with the smaller stones, and one which in its archæological bearing has been too much overlooked, is the fact of their having been brought from a great distance. I expressed an opinion on this subject in a lecture delivered at Devizes more than eighteen years ago, and I have been increasingly impressed with it since. I believe that these stones would not have been brought from such a distance to a spot where an abundance of building stones equally suitable in every respect already existed, unless some special or religious value had been attached to them. This goes far to prove that Stonehenge was *originally a temple,* and neither a monument raised to the memory of the dead, nor an astronomical calendar or almanac.

"It has been suggested that they were Danams, or the offerings of successive votaries. Would there in such case have been such uniformity of design or would they have been all alike of foreign materials? I would make one remark about the small impost of a trilithon of syenite, now lying prostrate within the circle. One writer has followed another in taking it for granted that there must have been a second, corresponding with it, on the opposite side. Of this there is neither proof nor record, not a trace of one having been seen by any person who has written on the subject. This small impost, not being of sarsen, but syenite, must have belonged to the original old circle; *it may even have suggested to the builders of the present Stonehenge the idea of the large imposts and trilithons, with their tenons and mortices.*"

In Prof. Gowland's examination of the contents of the holes necessarily dug in his operations, it was found that the quantity of blue stone chippings was much greater than that from the sarsen stones. While the sarsen stones had only been worked or tooled on their surface, the blue stones had been hewed and trimmed in extraordinary fashion; indeed, it is stated by Prof. Judd that some of them had been reduced to half their original dimensions in this process, though evidence of this statement is not given.

It seems, then, that when the sarsen stones were set up, the sarsen and blue stones were treated very differently. This being so, the following quotation from Prof. Judd's "Note" is interesting (*Archaeologia*, lviii., p. 81):—

[1] Continued from p. 342.

"I may repeat my conviction that if the prevalent beliefs and traditions concerning Stonehenge were true, and the 'bluestone' circles were transported from some distant locality, either as trophies of war, or as the sacred treasures of a wandering tribe, it is quite inconceivable that they should have been hewed and chipped, as we now know them to have been, and reduced in some cases to half their dimensions, *after having been carried with enormous difficulty over land and water, and over hills and valleys.* On the other hand, in the glacial drift, which once probably thinly covered the district, the glacial deposits dying out very gradually as we proceed southwards, we have a source from which such stones might probably have been derived. It is quite a well-known peculiarity of the glacial drift to exhibit considerable assemblages of stones of a particular character at certain spots, each of these assemblages having probably been derived from the same source.

"I would therefore suggest as probable that when the early inhabitants of this island commenced the erection of Stonehenge, Salisbury Plain was sprinkled over thickly with the great white masses of the sarsen-stones ('grey wethers'), and much more sparingly with darker coloured boulders (the so-called 'blue-stones'), the last relics of the glacial drift, which have been nearly denuded away. From these two kinds of materials the stones suitable for the contemplated temple were selected. It is even possible that the abundance and association of these two kinds of materials, so strikingly contrasted in colour and appearance, at a particular spot, may not only have decided the site, but to some extent, have suggested the architectural features of the noble structure of Stonehenge."

If we grant everything that Prof. Judd states, the question remains why did the same men at the same time treat the sarsen and blue stones so differently in the same place?

I shall show subsequently that there is a definite answer to the question on one assumption.

I next come to (2). The important point about these stones is that with the amplitude 26°, at Stonehenge, a line from the centre of the circle over the N.W. stone would mark the sunset place in the first week in May, and a line over the S.E. stone would similarly deal with the November sunrise. We are thus brought in presence of the May-November year.

Another point about these stones is that they are not at the same distance from the centre of the sarsen stone circle, which itself is concentric with the temenos mound; this is why they lie at different distances from the mound. Further, a line drawn from the point of the Friar's Heel and the now recumbent Slaughter Stone with the amplitude determined by Mr. Penrose and myself for the summer solstice sunrise in 1680 B.C. cuts the line joining the stones at the middle point, suggesting that the four untrimmed sarsen stones provided alignments both for the May and June years at about that date.

Nor is this all; the so-called tumuli within the vallum may merely have been observation mounds, for the lines passing from the northern tumulus over the N.W. stone and from the southern tumulus over the S.E. one are parallel to the avenue, and therefore represent the solstitial orientation.

So much, then, for the stones. We see that, dealing only with the untrimmed sarsens that remain, the places of the May sunset and June and November sunrises were marked from the same central point.

Statements have been made that there was the stump of another stone near the vallum to the S.W., in the line of the Friar's Heel and Slaughter Stone, produced backwards, at the same distance from the old centre as the N.W. and S.E. stones. This stone was not found in an exploration by Sir Edmund Antrobus, Mr. Penrose, and Mr. Howard Payn by means of a sword and an auger. But the question will not be settled until surface digging is permitted, as a "road" about which there is a present contention passes near the spot.

But even this is not the only evidence we have for

FIG. 9.—The rod on the recumbent stone is placed in and along the common axis of the present circle and avenue. It is seen that the Friar's Heel, the top of which is shown in the distance, would hide the sunrise place if the axis were a little further to the S.E.

the May worship in early times. There is an old tradition of the slaughter of Britons by the Saxons at Stonehenge, known as "The Treachery of the Long Knives"; according to some accounts, 460 British chieftains were killed while attending a banquet and conference. Now at what time of the year did this take place? Was it at the summer solstice on June 21? I have gathered from Guest's "Mabinogion," vol. ii. p. 433, and Davies's "Mythology of the British Druids," p. 333, that *the banquet took place on May eve "Meinvethydd."* Is it likely that this date would have been chosen in a solar temple dedicated exclusively to the solstice?

Now the theory to which my work and thought have led me is that the megalithic structures at Stonehenge—the worked sarsens with their mortices and lintels, and above all the trilithons of the magnificent naos—represent a re-dedication and a re-construction, on a much more imposing plan and scale, of a much older temple.

NORMAN LOCKYER.

ANIMAL LIFE.[1]

WITH the appearance of this half-volume we have to congratulate the author and his publishers on the completion of a work which must have involved an enormous amount of labour, and which, in this country at any rate, is unique. The great impulse which has of late years been given to "nature-teaching" rendered a work of this class almost essential (for the mode of treatment could not have been adopted in a systematic natural history), and Prof. Davis has realised the want, and done his best to supply what was required.

In spite of certain errors and blemishes, to some of which we have directed attention on previous occasions, and bearing in mind the magnitude of the task for a single individual, it may be safely said that, on the whole, the author has been successful in his efforts, and that when a second edition is called for, and the necessary emendations and corrections have been made the work will take its place as an important popular text-book of bionomics.

The half-volume now before us includes some of the most interesting sections of the whole subject, discussing as it does the economic aspect of zoology, the natural history of sport, animals as pets, geographical distribution, the palæontological record, and the doctrine of evolution and heredity. Unfortunately, the author has not allowed sufficient space for some of these subjects. Fur-bearing animals are, for instance, very imperfectly described, no mention being made of such important furs as Arctic and silver fox, otter and nutria; and if only the author had left out the "old wives' tales" about the shrew on pp. 319 and 320 he would have had ample room for proper treatment.

Neither is the volume altogether free from downright errors. For instance, the statement on p. 313 that Lake Baikal was recently connected with the sea is totally opposed to modern views; and it is equally untrue that the great Indian rhinoceros "bites" (p. 373), while the statement (p. 421) that there are no wild oxen in Africa at least requires qualification. On p. 469 we find the usual exaggerated statement of the size of dinosaurs (115 instead of 60 or 70 feet!). Among misspelt names it must suffice to mention (p. 430) *Pudus* for *Pudua*, and (p. 432) *Euneces* for *Eunectes* (we can guess whence the author copied the latter); but it may be added that Saccomyidæ is not the proper title for the pocket-gophers, or Euspongia for the typical sponges. An expression on p. 375 leads one to believe that the author is unaware of the existence of the Devon and Somerset staghounds; while (p. 379) the term "hunting," as applied to fishes, seems somewhat misplaced.

FIG 1.—Mexican Poisonous Lizard (*Heloderma horridum*). From "The Natural History of Animals."

The section on geographical distribution may perhaps be best described as feeble, the author "wobbling" on the subject of "Wallace's line," and being apparently unacquainted either with the works of Max Weber or with a certain text-book published by the Cambridge University Press. In fairness to his readers the author should have told them that there are distributional divisions of the globe other than those adopted by Dr. Wallace; and also that such divisions are based on the range of mammals and birds, and do not accord with that of several other groups.

The coloured plates render this and its fellow volumes attractive to the general reader, and most of the other illustrations (one of which is here reproduced) are well chosen and well executed.

R. L.

[1] "The Natural History of Animals; the Animal Life of the World in its various Aspects and Relations." By J. R. A. Davis. Half vol. viii. Pp. xviii+261–555. (London: The Gresham Publishing Co., 1904.) Price 7s. net.

THE CONDITION OF CHEMICAL INDUSTRIES IN FRANCE.

THE results of an inquiry into the present condition of French chemical industries are described in the *Revue scientifique* of January 28. The upshot of this inquiry is the recommendation that a society should be founded for France, having its headquarters in Paris, with branches in all large towns in France, with a council consisting of the heads of industrial enterprises, the professors in universities and "lycées," of independent persons, and of all interested in industrial chemistry. The duties of this society should be (1) to suggest and press on the Government solutions of the great economic problems of importance to chemical industry; (2) to collect statistics abroad and to endeavour to gain markets for French products by aid of the consular service; and to devise means to prevent competition between French manufacturers, and to promote combination among them against their foreign rivals; and (3) to act as an advisory body to industrial chemists, and to take steps to direct the education of young chemists into channels helpful to the progress of chemical industry. It is suggested that the work of the society should be aided by congresses in certain towns, which should be attended by the local manufacturers, as well as by those who carry on the same or similar processes elsewhere. In conclusion, the future president, it is suggested, should be Prof. Haller, who has done so much for the industrial progress of the town and University of Nancy, and who is now professor at the Sorbonne, the University of Paris.

Such are the recommendations of the report. The reasons annexed to these recommendations, which form the earlier part of the report, are derived from numerous letters from and interviews with members of some eighty-two representative firms. The opinions of some of these form amusing reading. Thus we learn from the manufacturers of "eau de Javel," the precursor of bleaching-powder, that Monsieur B., "suffit à l'exploitation." In another case "The brewery has no chemist at all, and gets all its analyses made at the brewing-school." Another firm which produces "some rare bodies" (one would like to know what they are) dismisses the question in almost the historical words which preceded the decapitation of Lavoisier—"Aucun besoin de la collaboration des savants"! Another intelligent manufacturer, designated as X, (1) ventures the daring statement that "the candle industry and chemistry have nothing in common." Oh, shade of Dumas! X (10) does not think that the collaboration of "savants" would be useful in the extraction of dyeing stuffs from wood; and a soap-maker, X (16), who confesses himself ignorant of chemistry, thinks that "chemistry can contribute nothing of use to the soap industry, seeing that soap is always made in the same way"!

These examples show that some educative action is necessary in France. The necessity is also apparent when recent statistics are considered. For while the raw materials exported from Germany have remained practically stationary for the last twenty years, those imported have doubled in value; and while the imports of manufactured products have barely increased in value during the same interval of time, the value of the exported manufactured chemical substances has risen from 200 million marks in 1880 to 352 million marks in 1900. The progress in France, accordingly, is much behind that of Germany. To add insult to injury, the red trousers, so conspicuous in the French Army, were designed originally to encourage the cultivation of the madder plant; the plant is commercially as extinct as the dodo, and the trousers are now dyed with artificial alizarin supplied from Germany! Sacre nom de tonnerre!

As this article is written in the hope of reaching the ignorant, the author, M. Jean Jaubert, has taken some pains to show how many-sided the industrial chemist should be if he is to direct his enterprise intelligently, and he sketches the steps taken by the Germans to secure such general knowledge. The collaboration of manufactories and university professors, the give and take, the university training of the scientific heads of departments in chemical works, account for an increase between 1887 and 1900 in the number of works in Germany from 4235 to 7169; in the number of workmen from 82,000 to 153,000; and for *an increase in the average wage of these workmen from 38l. to 50l. a year;* and the average percentage dividend of 121 joint-stock companies, obliged by law to publish their accounts, has risen from $9\frac{3}{4}$ per cent. in 1888 to $13\frac{1}{2}$ per cent. in 1899. Evidently German chemical industry is prosperous, and profitable to all classes concerned. Indeed, the dividend of artificial colouring companies shows a still better figure; the increase in dividend is from 15 per cent. in 1888 to $20\frac{1}{2}$ per cent. in 1900.

Unfortunately, similar statistics are not furnished for France, either because they do not exist or because they are better concealed.

How can this distressing state of affairs be remedied? To what is industrial France to turn? The opinions of many manufacturers are quoted, and some shall be adduced here. First, secondary education is at fault; all initiative is crushed in the secondary schools, and all pupils are turned out of one uniform mould. But, it is acknowledged, an attempt is being made to remedy this. Second, it is said nearly unanimously, by all those asked for their opinions, that the training of young chemists is not sufficiently practical. There is in the universities too much tendency to train teachers rather than industrial men; and the professors often look down on the commercial side of their science. The union of science and industry is recommended. Like ourselves, the French manufacturers, ignorant themselves, often engage a young chemist, and expect him at once to know all about their work and to be able to devise improvements; when they find out that he is of little value they contemn chemistry, as we have seen in what precedes. Others complain that they have to pay their chemists for a year or a year and a half while he is learning their needs; and yet it is acknowledged that no education in a technical school can be of any value; for the teacher cannot teach anything worth knowing about the really important dodges employed by the manufacturer, nor is he welcomed in the work if he lectures on any special process. In a minority of works the German system is followed; young men are engaged as juniors, and work under the supervision of seniors; according to the ability and tastes which they show for routine work, for management, or for invention, they are kept as analysts, made managers, or left in the research laboratory. But it is justly remarked that this excellent plan is impossible for small manufacturers.

In many (most?) cases the difficulty lies in the smallness of the remuneration. It appears common for a chemist to receive 48l. to 72l. a year, rare for the pay to exceed 100l. Now that is little more than workmen's wages; and it is the reward of an expensive education. Yet the manufacturer often grumbles at having to teach such young men their business, and says that they should pay for his tuition; and on the other hand, the chemist who has survived the kicks, cuffs and insults from the foreman, and hard work of the first year, and has acquired some practical knowledge, does not see why he should not better himself if he can.

Again, German firms employ chemists in many walks of life. A man who is a chemist makes a much better traveller for a chemical firm than an ignoramus who can only tout his goods; and their chemists, if they show commercial ability, often take to the business side of the concern, and they know chemistry is a recommendation, not a drawback.

In spite of the low pay, France, according to all reports, is overcrowded with chemists. Some pity them; others think that this plethora will lead to the survival of the fittest. The old-fashioned foreman is as undying in France as here, however, and as opposed to any attempt at innovation. Yet he is being displaced by chemists in some works; and this, common in Germany, is one of the chief causes of her industrial prosperity. The foreman, knowing some tips of importance, looks askance at anyone who attacks experimentally the problems of his manufactures; for he knows if they are once discovered his use is past. On the other hand, if foreman work is done by a chemist, trained in experimental methods and anxious to improve his product (and his position), reforms can be made, and are willingly undertaken. We in England are in a similar plight; one of the greatest preventives to progress is the foreman. Why, many chemists would be glad of his $3l.$ a week, and would be infinitely more useful.

A closer intimacy between professor and manufacturer is strongly urged. But in France there is apparently mutual distrust. The standing of the professors is low, for one thing, the best paid post (at Paris) bringing in only 800*l.* a year; in the provinces the salaries run from 240*l.* to 400*l.* This contrasts unpleasantly with German salaries, which seldom fall below 600*l.*, and may amount to 3600*l.* In France, many men have a taste for the career of professor, and will work cheap for glory; "that is the French character." Most French professors, according to one of them (rashly named in this article), do nothing and care nothing for industry. In short, collaboration between manufacturer and chemist is wanting owing to jealousy of the latter towards colleagues who meddle with industrial problems, to ignorance and shyness of both parties, and to the want of any intermediary who can bring them into contact.

Besides the recommendations stated in the outset, it is advised that special schools be created, *e.g.* for perfumes, for colours, for soaps, where young chemists shall receive special training.

Now what can we in England learn from this exhaustive discussion? We have many of the same defects; we suffer from the supremacy of the foreman; from the want of interest in industry of the professors (although this is lessening); from the want of intelligence and scientific training of many manufacturers; and from the lack of special schools. In the old days of the Le Blanc soda process the works served as schools for young chemists; now things are too specialised. In prosperous times, the manufacturer does not see the need of a chemist; when bad times come, the luxury of a chemist cannot be afforded. What we want, what the Germans have got, and what the Americans are rapidly getting, is a race of scientifically trained manufacturers; combinations of those engaged in the same industry, so that common laboratories of research may be kept running; the replacement of rule-of-thumb foremen by chemically trained submanagers of a better class, who have had something in the nature of a scientific education, and who are imbued with the spirit of research, leading them to keep their eyes open to every possible improvement; this they would gain first in actual educational establishments, under the guidance of capable professors, and later in the special laboratories mentioned above; and lastly, thorough cooperation between teachers and manufacturers, so that problems capable of being solved in a university laboratory, and of scientific interest, should be transferred there, with the prospect of an ultimate reward should they prove commercially useful; and a liberal attitude of mind on the part of manufacturers, so that they would take a little trouble to become acquainted with the progress of scientific chemistry, with the view of its utilisation for money-making purposes, and a readiness to consider any problems suggested in the university laboratory, with the view of their being worked out industrially. We are moving slowly towards attaining this ideal. Is it any comfort that France appears on her own showing to be more backward? Until the people concerned learn to view such problems from a scientific standpoint, little more can be done. The only thing is for those who can to preach, and above all to practise.

W. R.

NOTES.

The new session of Parliament was opened on Tuesday by the King, who was accompanied by the Queen, with the customary ceremonial. The King's speech to the House of Commons announced that provisions for amending the laws relating to education in Scotland will again be brought forward, and that a proposal for establishing a Minister of Commerce and Industry will be introduced.

At the annual meeting of the Royal Astronomical Society on Friday last, the gold medal of the society, awarded by the council to Prof. Boss, director of the Dudley Observatory, Albany, New York State, was received by Mr. Choate, the United States Ambassador, for transmission to Prof. Boss. The president afterwards handed to the secretary the Jackson-Gwilt bronze medal for transmission to Mr. Tebbutt, who for many years has carried on astronomical research in his observatory in New South Wales.

At a meeting of the trustees of the Percy Sladen fund, held at the Linnean Society, Burlington House, on February 3, grants varying in amount were made to Mr. W. R. Ogilvie Grant, toward the expenses of a collector for the British Museum in Central Africa; to Miss Alice L. Embleton, to enable her to continue her investigations in insect cytology; and to Mr. J. Stanley Gardiner, toward the expenses of an expedition to the Indian Ocean.

M. Radau has been appointed president, Vice-Admiral Fournier vice-president, and M. Bigourdan secretary of the Bureau des Longitudes, Paris.

M. F. J. P. Folie, honorary director of the Royal Observatory at Brussels, died at Liège on January 29 in his seventy-second year.

We regret to see the announcement of the death of Mr. Robert Tucker, who was for thirty-five years (November, 1867–November, 1902) honorary secretary of the London Mathematical Society.

Reuter states that the Argentine sloop of war *Uruguay*, last reported at Punta Arenas, has returned to Buenos Ayres after her voyage in the Antarctic seas, having failed to obtain any news of the French Antarctic Expedition under Dr. Charcot.

It is proposed to establish an International Association of Anatomists at a meeting to be held at Geneva on August 7–10. The initiative has been taken by the anatomists of the Swiss universities and has the support of the anatomical societies of Germany, Great Britain, France, Italy, and America.

The *Athenaeum* announces the death, on January 29, of Prof. H. Landois, professor of zoology and director of the Zoological Garden at Munster, in his seventieth year. Prof. Landois was the author of "Der Mensch und das Tierreich," "Das Pflanzenreich," "Das Mineralreich," and other works.

Captain John Donnell Smith, of Baltimore, has given, says *Science*, to the Smithsonian Institution his private herbarium consisting of more than 100,000 mounted sheets and his botanical library of nearly 1600 bound volumes. Captain Smith's collection is probably the largest private herbarium in America, being very rich in tropical plants.

A TELEGRAM has been received at the office of the Scottish National Antarctic Expedition in Edinburgh announcing the safe arrival at Buenos Ayres of Mr. R. C. Mossman, who was left in charge of the meteorological station at Scotia Bay, South Orkneys, last February. Mr. Mossman has spent two continuous years in the Antarctic regions.

THE Treasury has agreed to make a contribution from public funds toward the cost of establishing and maintaining a national museum and a national library in Wales, on the condition that sufficient local support is forthcoming. The Lord President of the Council has appointed a committee of the Privy Council to consider and determine the place at which each of the two institutions should be established and other matters relating to their foundation and future maintenance.

M. JACQUES FAURE accomplished a successful voyage in a balloon from London to Paris on February 12. He left the Crystal Palace at 6.45 p.m. on February 11 with M. Hubert Latham, and they at once rose to a height of 500 metres, which they kept until within sight of the sea, near Hastings. They then descended until the guide-rope touched the water, when they travelled at the rate of 110 kilometres an hour. At 10 p.m., seeing a lighthouse, they rose to 2000 metres, and soon passed over Dieppe. The balloon descended at St. Denis, outside Paris, six hours after starting.

WE regret to see the announcement of the death of Mr. William Sellers, the eminent mechanical engineer of Philadelphia. When president of the Franklin Institute in 1864, he read a paper on screw-threads and nuts, and his form of thread subsequently became the standard for the United States. He had many friends in this country. He was a member of the Institution of Civil Engineers, and as chairman of the Philadelphia committee took an active part in the reception of the Iron and Steel Institute in its recent visit to America.

THE new Premier diamond-mine, situated about twenty miles W.N.W. of Pretoria, in the Transvaal, produced in January of this year an enormous diamond far surpassing in size the largest previously known. It measures $4\frac{1}{2} \times 2\frac{1}{4}$ inches, is said to be of excellent quality, and weighs 3032 carats ($=676\frac{1}{2}$ grams, or nearly $1\frac{1}{2}$ lb. avoirdupois). The largest diamond previously discovered is the "Excelsior," which was found in 1893 in the Jagersfontein mine, Orange River Colony, and was valued at 1,000,000*l*. It was as large as a hen's egg, weighed $971\frac{3}{4}$ carats, and has been cut into nine brilliants. The world-famous Indian diamonds, the "Koh-i-noor" and "Great Mogul," are considerably smaller than the "Excelsior," and compared with this huge latest-found diamond their size sinks into insignificance. An account of the Premier mine was recently published in the report for 1903 of the Geological Survey of the Transvaal (NATURE, 1904, lxxi., p. 55). The mine was opened up in 1902, since when it has produced a rich yield. It is of the same type as the Kimberley mines, but considerably larger in size. The pipe containing the "blue-ground" has an oval-shaped cross-section; its longer diameter measures just over half a mile, and its area is estimated at 350,000 square yards. The pipe breaks through felsitic rocks, which were earlier intruded in the quartzites of the Pretoria series.

"NOTES on Phosphorescence in Plants and Animals" is the title of a paper by Miss Bage in the *Victorian Naturalist* for November last, of which the author has been good enough to send us a copy. Special attention is directed to the occurrence of phosphorescence in butchers' meat, since a remarkable prevalence of this has been recently noticed in Melbourne. So far as the author could ascertain, no cultures have been taken from phosphorescent meat, so that the bacteria by which the phenomenon is produced are still unknown.

The Times of February 9 devotes nearly a whole column to the collection of giraffes in the Natural History Museum, which has recently been enriched by examples of the Kilimanjaro and Nigerian races. The article mentions the names of the various donors of the series in the national collection, which is altogether unrivalled. Brief reference is made to the earlier specimens of giraffes brought to this country, and to the history of the evolution of our knowledge of the local variations of the species. In conclusion, special attention is directed to the importance of ascertaining the reason for these and analogous colour-variations in animals.

WE have received copies of Nos. 1 to 3 of the fourth volume of the Goeldi Museum at Para, the first of which is dated February, while the other two were published in December, 1904. The catalogue of Para mammals in No. 1, by Messrs. Goeldi and Hagmann, has been already noticed in our columns. Among the contents of Nos. 2 and 3, mention may be made of a list of the mosquitoes of Para by Dr. Goeldi, with an account of the measures taken to exterminate *Stegomyia fasciata* and *Culex fatigans*, and also of Dr. Hagmann's synopsis of the birds described by Spix, Wied, Burmeister, and Pelzeln. Considerable interest attaches to a paper on a disease which has recently affected domesticated animals in the Island of Marajo.

THE *Scientific American* of January 21 contains an illustrated account of the setting-up in the American Museum of Natural History, New York, of a skeleton of the dinosaur Brontosaurus, obtained from the deposits near the famous Bone Cabin Quarry in 1898. The skeleton, which is the largest and at the same time the least incomplete specimen of its kind, is being set up under the immediate direction of Prof. Osborn, and will be the only mounted example of the bony framework of the brontosaur. Its estimated length is sixty-two feet. Contrasted with that of Diplodocus, the skeleton of Brontosaurus is characterised by its relatively shorter body and limbs, and its more massive general structure, the arrangements for lightening its weight being more specialised than in any other member of the group. From the rough terminal surfaces of the limb-bones it is inferred that the creature was largely aquatic in its habits; and when sitting down it is supposed that the weight of the body was partly supported by the extremities of the ischia and pubes, which may have been furnished with elastic pads of cartilage or connective tissue.

THE "One and All" Annual, 1905, contains a number of articles connected with gardening, among which are some practical notes on growing mushrooms, celery and herbs.

THE Japanese have a malted preparation, known as ame, which is a kind of candy or barley-sugar, made by the action of barley malt on glutinous rice. Midzu-ame, or liquefied ame, a syrup, forms the subject of an article by Prof. F. H. Storer and Mr. G. W. Rolfe in vol. iii. part iv. of the *Bulletin* of the Bussey Institution, Harvard University. The preparation of ame dates back many centuries, and it is interesting to compare it with *must*, or the more modern wort. Prof. Storey also describes some experiments made with pop-corn which bear out the opinions of previous investigators that popping is caused by bursting of the starch grains.

THE experiments described by Dr. M. Koernicke in the October (1904) number of the monthly journal *Himmel und Erde* prove that both Röntgen and radium rays can produce a very marked action on plants. The general result of exposure of seedlings was to cause retardation and eventually cessation of growth of stem and root; in some cases growth was resumed after an interval, in others the plants never recovered. The first effect of the rays on dry bean and turnip seeds was to accelerate germination, but while the beans ceased to develop after a time, the turnips did not even show signs of retardation; had the exposure been longer, then undoubtedly the turnips would also have reacted.

THE latest number of the *Izvestia* of the Russian Geographical Society (1904, i. and ii.) contains a further report by Colonel Novitsky on his explorations of the range of Peter I., and an interesting and detailed geographical sketch by A. Dunin-Gorkavitch of the northern portions of the government of Tobolsk and its inhabitants. The latter paper is accompanied by a new map of the province, on a scale of 27 miles to the inch, which gives with special detail the inhabitable portions of this immense region. M. Dubyago gives the results of new pendulum observations in the Urals.

A "CONFERENCE NUMBER" of the *West Indian Bulletin* has just been published (46 pp.). It relates to the agricultural conference held at Trinidad on January 4–13, and contains the list of the representatives from the several West Indian colonies who attended; an account of the reception by Sir Henry Jackson, the Governor of Trinidad; a verbatim report of the presidential address by Sir Daniel Morris; and an abstract of the proceedings at the conference and social gatherings. A full account of the papers and discussions will form No. 4 of vol. v. and No. 1 of vol. vi. of the *Bulletin*, and afford valuable information on the great progress made in scientific agriculture in the colonies since the Imperial Department was called into existence by Mr. Chamberlain a few years ago.

WE have received a copy of the meteorological observations made at the Adelaide Observatory and other places in South Australia during the years 1900–1901, under the direction of Sir Charles Todd, Government astronomer. Although the rainfall of some districts is still unrepresented, the monthly and yearly results are published for 463 stations in 1900, and for 474 in 1901, and these are compared with the averages for previous years. This represents a very large amount of valuable work, in addition to that entailed by the usual tables of meteorological results for a large number of stations distributed over the colony. A table is given showing the approximate mean monthly rainfall over the whole of the agricultural districts from the year 1861, and the average yield of wheat per acre. It is pointed out that wheat-growing can only be successfully prosecuted where the percentage of winter rains is largely in excess of that for the summer months, which is only usually the case in the southern districts.

WE are glad to be able to announce the issue of part i. of the new edition of Dr. Hann's excellent "Lehrbuch der Meteorologie." Although so short a period has elapsed since the publication of the first edition, the science has made such important advances, owing to the results obtained from international balloon and kite observations, and from the study of the movements of the upper air by means of cloud observations, that some of the older theories have to be modified, and a new edition has been rendered necessary. We learn from the notice accompanying the part in question that while many details not considered essential to ordinary readers will be omitted, the principles of the theories adopted in recent investigations by men of science, *e.g.* Prof. Bigelow, in the United States, Dr. Shaw, in this country, and Dr. Hildebrandsson, in Sweden, will be included. The work will consist of about six parts; the first deals with air-temperature generally, and with the amount of heat received by and radiated from the solid and fluid surface of the earth. From a communication from Dr. Hann which we lately published we learn that his elaborate meteorological charts will, so far as possible, be extended and include the important additions to our knowledge made by recent expeditions to the Antarctic regions.

FROM Dr. Carmelo Scrivanich we have received a short pamphlet, printed by the Tipographia sociale of Spalato (Italy), dealing with the question of the origin of matter, a subject on which the author invites discussion.

AT the present time investigations of the law of force between two elements carrying currents (Ampere's and allied laws) are commonly regarded as chiefly of academic interest. Several papers on this subject have been written at various times by Dr. Franz Kerntler, of Budapest, and a further paper dealing with the "correct law" as claimed by the same author has just been issued by him. It is published by the Budapester Lloyd Press, and bears the date 1905.

THE internationalisation of scientific literature is well illustrated by the publication in the *Proceedings* of the Academy of Amsterdam of a paper in English by Prof. Sommerfeld, of Aachen, on a simplified deduction of the field and the forces of an electron moving in any given way. The paper is supplementary to one published in the *Göttinger Nachrichten*, and leads to the conclusion that the motion of an electron with velocity exceeding that of light is impossible, as it would require an infinite expenditure of force and energy to maintain it, if the electron be regarded as a sphere with a uniform surface-charge. On the contrary, in the case of a sphere with a bodily-charge the force remains finite. In this problem the electron moves faster than the field of force which it propagates outwards, and a "shadow of motion" is produced. A simple illustration might be afforded by comparison with the effects produced on a sheet of still water by a disturbance moving with a velocity greater than that with which the ripples which it produces radiate outwards.

IN the "Publicationen des astrophysikalischen Observatorium zu Potsdam," No. 41, Dr. Lohse gives the results of a detailed study of the photographic spark spectra of the metals titanium, vanadium, chromium, manganese, iron, nickel, cobalt, molybdenum, palladium, tungsten, iridium, bismuth, lead, uranium, zirconium, lanthanum, cerium, thorium, and didymium. In the majority of cases the region investigated is from λ 340 to λ 400, but for a few metals the record is extended towards the red. Thus, the record for iron goes to λ 446, uranium to λ 431, zirconium to λ 471, lanthanum to λ 567, cerium to λ 467, and didymium to λ 569. The wave-lengths are given to the nearest hundredth of a tenth-metre, and a comparison of these with Rowland's wave-lengths for corresponding solar lines indicates that they are probably correct to within 0·03 tenth-metre in the mean. Lohse has adopted the awkward intensity scale of 0·1 to 10, thus allowing for a hundred gradations. Such a large range is neither necessary nor practicable, and it would have served a better purpose to have kept to the scale 1 to 10 which he used in a previous publication on the same subject. A thorough and detailed knowledge of the spark spectra of the chemical elements is of primary importance in the proper study of celestial spectra, and Dr. Lohse's record will be very useful in that connection. It seems to us, however, that his work would have been greatly enhanced in value if he had confined his attention to the same region of spectrum for each metal, and had included the portion from λ 400 to λ 486 (F), say, especially as that is the region of stellar spectra most ordinarily investigated.

INDEXES to the literature of gallium (1874–1903) and germanium (1886–1903), prepared by Dr. P. E. Browning, have been issued as parts of vol. xlvi. of the Smithsonian *Collections*.

THE general occurrence of radium in association with uranium has formed an important argument in connection with current views relative to the formation of radium. In a recent note M. Danne states that certain plumbiferous earths in the neighbourhood of Issy-l'Évêque contain radium, but are completely free from uranium. Certain facts seem, however, to indicate that the radium has made its appearance in the pyromorphite at a comparatively recent date through the medium of radio-active water from springs in the neighbourhood.

THE International Committee on Atomic Weights has issued its annual report and a table of numbers for use during 1905. On the basis of new determinations, changes are recommended in the atomic weights of indium, iodine, rubidium, and samarium. As the result of several independent investigations on the atomic weight of iodine, there can now be no reasonable doubt that the value 126·85 given by Stas is too low, and 126·97 is adopted in the new table. The atomic weight of nitrogen would also appear to be much closer to the round number than is represented by the value 14·04 at present in use, and further investigations of this element are needed.

AN interesting paper on the production of calcium cyanamide and its employment in agriculture as fertiliser was recently read by Prof. Frank before the "Klub der Landwirte" in Berlin. As manufactured at present, 250 kilograms of atmospheric nitrogen can be obtained per year in the form of calcium cyanamide for each electric horse-power. The efficiency of the substance as fertiliser has been established by experiments at a large number of agricultural stations, and the combined nitrogen is stated to be as effective as an equal quantity in the form of ammonium sulphate or Chili saltpetre.

THE much discussed question as to the nature of the hydrosulphites has been subjected to further experimental investigation by Messrs. Baumann, Thesmar, and Frossard, and an account of these experiments is given in the *Revue générale des Matières colorantes*, vol. viii., p. 353. The view of Schützenberger that hydrosulphurous acid is to be represented by the formula H_2SO_2 receives strong confirmation. As is pointed out, the crystalline sodium salt $Na_2S_2O_4.2H_2O$ obtained by Bernthsen may be written $NaHSO_2.NaHSO_3.H_2O$, and the behaviour of the mother liquors, from which this salt separates, corresponds with this view. In fact, two formaldehyde compounds corresponding to $NaHSO_2.CH_2O.2H_2O$ and $NaHSO_3.CH_2O.H_2O$ have been separated and analysed.

A NEW booklet has been added by Messrs. Dawbarn and Ward, Ltd., to their "Country House" series of practical handbooks. It is by Mr. D. Grant McIver, and is entitled "Pruning, Training, and Trimming Trees and Shrubs."

MR. JOHN MURRAY has published an attractive English edition of Prof. W. H. Pickering's work on "The Moon," the American edition of which was reviewed in NATURE of May 5, 1904. The work contains a summary of the existing knowledge of our satellite, and the statement of Prof. Pickering's observations and arguments in favour of lunar activities, illustrated with a complete photographic atlas of the moon. The price is two guineas net.

THE second volume of "Papers of the British School at Rome" has been published by Messrs. Macmillan and Co., Ltd. The volume is by Mr. T. Ashby, jun., and is concerned with sixteenth-century drawings of Roman buildings attributed to Andreas Coner. The drawings are preserved in Sir John Soane's Museum at Lincoln's Inn Fields, London. The contents of the sketch-book in which the original drawings are preserved include ground plans, plans and elevations of tombs, elevations, architectural details, Doric entablatures, Ionic and Corinthian entablatures, plain mouldings (cornices and plinths), Doric capitals, and plain and ornate bases. The reproductions of these sixteenth-century drawings which are now available will be of great service for the purposes of study and criticism.

OUR ASTRONOMICAL COLUMN.

EPHEMERIS FOR BROOKS'S COMET, 1904 I.—On a photograph obtained at Greenwich in January the image of Brooks's comet (1904 I.) was quite strong, and indicated that the object was, probably, not fainter than the eleventh magnitude. The following is an ephemeris for this object as given in No. 354 of the *Observatory*.

Ephemeris 12h. M.T. Greenwich.

1905	R.A. h. m. s.	Dec.
Feb. 17	9 55 56	+64 37
,, 23	9 34 55	+64 25
Mar. 1	9 15 34	+63 55
,, 7	8 58 27	+63 11

This ephemeris required corrections of −5s. and −0′.8 on December 7, and shows that the comet is travelling in a westerly direction through the constellation Ursa Major. On March 7 it will be very near to, but S.W. of, τ Ursæ Majoris.

OBSERVATIONS OF COMETS.—A number of photographic and visual observations of Encke's comet were made by M. Quenisset at Nanterre during December. The photographs obtained show that the comet gradually became brighter during the period covered by the observations, and that the coma was extensive and fan-shaped, its extension being in a W.S.W. direction, *i.e.* turned away from the sun. On the photographs this coma was about 4′ in diameter and contained a nucleus which was not at the centre. Visual observations made on December 7 showed the fan-shaped coma to be 5′ or 6′ in diameter with the nucleus situated near to its E.N.E. edge and having a position angle of about 70°, reckoned from the centre of the coma. On this date the comet was at the limit of naked-eye visibility, its estimated stellar magnitude being about 6.5.

Borrelly's comet (1904 *e*) was also observed, photographically and visually, on January 1 and 2 by M. Quenisset, and was seen as a faint nebulosity of 1′.5 to 2′ diameter with ill-defined boundaries. A very faint nucleus of magnitude 11.5 occupied the centre of the coma, and the photograph obtained on January 2 showed a faint tail extending in an E.S.E. direction (*Bulletin de la Société astronomique de France*, February).

ADDITIONAL PERIODICAL COMETS DUE THIS YEAR.—In addition to those periodical comets previously mentioned by Mr. W. T. Lynn as being due at perihelion this year, Mr. Denning, writing to the *Observatory*, mentions Tempel's 1867 comet, which should pass through its perihelion point in April. This object has suffered considerable perturbations from Jupiter, which have lengthened its period from 5.982 to 6.530 years, and have changed its perihelion distance from

1.56 to 2.07. The comet was re-observed on its return in 1873 and in 1879, but has not been seen since.

Wolf's 1884 comet is also due at perihelion in April, but the conditions for its observation will be very unfavourable.

Another comet which may return towards the end of this year is the faint one discovered by Prof. Barnard in 1892. It was not seen, however, in 1899, and, as its exact period is doubtful, although probably about 6½ years, it may again escape detection.

CASTOR A QUADRUPLE STAR.—In a communication to the Astronomical Society of the Pacific (*Publication* No. 99) Prof. Campbell discusses the multiple character of Castor, and states that Dr. Curtis, using the Mills spectrograph attached to the 36-inch refractor of the Lick Observatory, recently discovered that the brighter component of the system is attended by a faint companion. The fainter component was shown by M. Belopolsky, in 1896, to be similarly double, so that in Castor we have a quadruple system in which each component of a visual double is attended by a faint companion. The period of the fainter system is about three days, but further observations of the brighter double will have to be made before its period can be determined.—(*Popular Astronomy*, No. 2, vol. xiii.)

BLOOD PRESSURES IN MAN.[1]

THE lecturer began by contrasting Galen's conception of the oscillation of the blood, about the liver as a centre, with the cardiac circulation of Harvey. The pulmonary circulation—for the purposes of this lecture—was omitted, and attention directed exclusively to that in the systemic arteries.

The physical characters of the flow of fluids were briefly described by the example of water in an open stream. A stream might well up from a spring in a flat country, and swim with very low pressure to its mouth; or, falling from a mountain, might have pressure enough to carry men and horses off their legs. If the volume were also great, as in the sea, it might exercise a pressure of many tons to the square yard, and smash great bulwarks to pieces. But in the higher animals the blood flows in closed channels, so that in such a scheme as theirs the dimensions of the channels assume a very important value. Moreover, in mammalia the circulating fluid is not water, but a thicker fluid—the blood—which (in man) has at least four times the viscosity of water. The enormous value of friction in the circulation was then considered, and it was shown that in this factor the kind of vessel wall does not signify much, as the wall is lined by a practically stationary layer of the fluid; friction, therefore, which uses up 99/100ths of the heart's power, depends on the factor of viscosity together with that of the dimension of the channels, or closed bed. It may be said that the blood pressures—that is, the arterial pressures—in man depend on viscosity and dimension of stream bed.

Now so far the closed tubes had been regarded as rigid. But if in animals the tubes were rigid the circulation would be carried on under great difficulties. For instance, there would be no accommodation; only so much blood could be driven into the system as issued at the periphery; the stream, too, would be quite intermittent, with very high maximum and very low minimum pressures, which would not serve for continuous nutrition, and by its extremes of pressures would soon wear down the arteries. For instance, in the bagpipes, were it not for the air reservoir the sound would issue in spasmodic screams; whereas the air-bag turns the intermittent blowing into a continuous feed of air. In the arterial system of man the same provision is made; its tubing is highly elastic, and a chief part of it—namely, the aorta—being relatively wider than other branches of the tree, contains, like the bagpipe reservoir, accommodation for very variable supplies of output from the heart pump. Thus a very large part of the heart power is used in dilatation of the vessels, and by these is given back to the blood. The valves of the heart serve a like purpose of regulating the pressure of the supply to the vascular system.

The lecturer in the next place dealt with the pulse, contrasting the travel of the wave with the travel of the blood itself. The wave due to the shock of the heart beat travels, ordinarily, about twenty times as fast as a given particle of the blood itself. The tenser the walls of the arteries the faster the wave travels along the taut vessels, but the slower the passage of the blood itself. Herein lies one of the chief evils of a morbid rise of arterial pressure; more stress on the vessels, less distribution of their contents. Many of these processes were illustrated by lantern slides and demonstrations by Dr. Dixon, demonstrator of pharmacology in Cambridge.

After these principles Dr. Dixon exhibited the various instruments in use for measuring blood pressures in man, and the means by which their curves may be recorded on a revolving drum (kymograph).

The lecturer then entered upon the vital properties of the arteries—that they are not only elastic, and so accommodate themselves to the varying pressures, but are endowed also with nervous governance, whereby they effect a large economy in work and material. Several functions of the human body cannot, save within small limits, work together. If we are digesting we are not apt for thought; the Alpine climber is mercifully unable to worry over affairs—his mind is put into abeyance; and so on. Thus the arterial system, by the means of its nervous connections, contracting in some areas and dilating in others, automatically diverts its fertilising streams hither or thither as needs arise. Moreover, it can enlarge or diminish its bed according to the total quantities of blood temporarily in circulation—a quantity which is very variable. By contracting the arteries in considerable areas and correspondingly dilating them in others, the fields of the various functions of the body can be used alternately, as we see in the irrigation of Alpine meadows. By the same means the very various pressures of the blood can be counteracted. When under muscular effort, for instance, the pressure is raised, a corresponding area outside the muscles is dilated, and pressure more or less equalised; thus the heart is enabled to do the most work with the least disturbance of stresses. So in a bath, cold or very hot, the crimping up of the large cutaneous areas is compensated by large dilatations in internal areas, and pressures return to the normal in two or three minutes. The chief area in which blood can be accommodated, and thus for a time put out of circulation, is a large abdominal area.

By these considerations the lecturer was led to explain why the blood in the body does not drop down into our feet and legs, and leave the brain and other vital parts. Indeed, the blood has a strong disposition thus to obey the action of gravitation, and one of the events of approaching death is the falling of the blood into lower parts of the body, deserting the heart and brain. Obviously this is especially the case in upright animals, as in man chiefly, and in apes in some measure. It is by the vigilance of the nervous governance that the blood is held up, by the contraction of the abdominal vascular fields; and it is the failure of these mechanisms which appears as shock, syncope, or collapse. The lecturer, assisted by demonstrations by Dr. Dixon, illustrated these dispositions, citing especially the researches of Prof. Leonard Hill on the distribution of the blood in various positions of the body. He also referred to the bearing of these principles on the researches of Prof. Waller and others on the dangers of anæsthetics. By some most interesting experiments by Dr. Cushing he showed how enormously the arterial pressures may be raised in case of danger of failure of supply of blood against gravity when, as in apoplexy or a depressed fracture of the skull, the blood-vessels, in the parts of the brain where all these mechanisms find their centres, are compressed and thus more or less liable to be emptied.

In the last part of the lecture the lecturer apologised for occupying time with so much physiology, in which subject he is not an investigator. But it was necessary to make manifest to his audience how great is the importance of the integrity of the arteries themselves, and of their nervous governance in function, an integrity which is a matter of life and death; for if the circulation fails in the nervous centres or heart, life must cease. Now the arteries are subject to many injurious conditions, as of certain poisons and infec-

[1] Abstract of a lecture delivered by Prof. T. Clifford Allbutt, F.R.S., at the Royal Institution on February 3.

tions, or of hard muscular labour; there are also the unexplained deteriorations of age. His personal investigations had been into the effects on the arteries of gradual increases of blood pressure. Normally, arterial pressures, as taken in the arm, rise somewhat from childhood to age—say from 80–90 mm. Hg. to 140° or perhaps 150°. These upper limits are not inconsistent with health at the age of three score, though no doubt they signify some loss of mechanical efficiency. A demonstration was given by Dr. Dixon of the difference in vascular efficiency under muscular effort between a young and an elderly man. Into the effect of certain poisons and infections on the arteries he could not enter. Senile degenerations of the arteries are not essentially allied to rise of blood pressure, though in such subjects, as in others, high pressures may arise, and must be, of course, the more dangerous. Still, senile arterial degeneration is compatible with very long life, even if with diminution of function, as the vessels silt up rather than burst.

The lecturer's own observations, now extended over many years, had been upon rise of pressure in middle life beyond, often very far beyond, that which he had regarded as normal for elderly persons. The reasons of this morbid tendency cannot yet be given, but fortunately, by medicinal and dietetic means, it can be abated, and in early stages abolished. If permitted to persist, and it is not rarely consistent with fair general health or but vague indisposition, it slowly ruins the vascular system by overstretching it. It is in such persons that the arteries may break, as in apoplexy, a catastrophe which, by timely precautions, can be prevented. The lecturer strongly urged upon all persons of middle and advancing years to have their arterial pressures tested by their physicians every four or five years, so that any disposition to excessive pressures may be averted and the integrity of the arterial tree preserved.

RADIATION PRESSURE.[1]

A HUNDRED years ago, when the corpuscular theory held almost universal sway, it would have been easier to explain the pressure of light than it is to-day, when it is certain that light is a form of wave-motion. The means at the disposal of early experimenters were inadequate to detect so small a quantity; but if the eighteenth century philosophers had been able to carry out the experiments of Lebedeff and of Nichols and Hull, and had they further known of the emission of corpuscles revealed to us by the kathode stream and by radio-active bodies, there can be little doubt that Young and Fresnel would have had much greater difficulty in dethroning the corpuscular theory and setting up the wave theory in its place. The existence of pressure due to waves, though held by Euler, seems to have dropped out of sight until Maxwell, in 1872, predicted its existence as a consequence of his electromagnetic theory of light. The first suggestion that it is a general property of waves is probably due to Mr. S. T. Preston, who in 1876 pointed out the analogy of the energy-carrying power of a beam of light with the mechanical carriage by belting, and calculated the pressure exerted on the surface of the sun by the issuing radiation. It seems possible that in all cases of energy transfer, momentum, in the direction of transfer, is also passed on and that there is, therefore, a back pressure on the source. Though there is as yet no general and direct dynamical theorem accounting for radiation pressure, Prof. Larmor has given a simple indirect mode of proving the existence of the pressure which applies to all waves in which the average energy density for a given amplitude is inversely as the square of the wave-length. He has shown that when a train of waves is incident normally on a perfectly reflecting surface, the pressure on the surface is equal to $E(1+2u/U)$, where $E/2$ is the energy density just outside the reflector in the incident train, U is the wave-velocity, and u the velocity of the reflector, supposed small in comparison with U. In a similar manner it can be shown that there is a pressure on the source, increased when the source is moving forward, decreased when it is receding. It is essential, however, that we should be able to move the reflecting surface without disturbing the medium except by reflecting the waves.

[1] A lecture delivered before the Physical Society on February 1[illegible] by Prof. J. H. Poynting, F.R.S., president of the society.

Though Larmor's proof is quite convincing, it is interesting to realise the way in which the pressure is produced in the different types of wave-motion. In the case of electromagnetic waves, Maxwell's original mode of treatment is the simplest. A train of waves is regarded as a system of electric and magnetic tubes transverse to the direction of propagation, each kind pressing out sideways, that is, in the direction of propagation. They press against the source from which they issue, against each other as they travel, and against any surface on which they fall. In sound-waves there is a node at the reflecting surface. If the variation of pressure from the undisturbed value were exactly proportional to the displacement of a parallel layer near the surface, and if the displacement were exactly harmonic, then the average pressure would be equal to the normal undisturbed value. But consider a layer of air quite close to the surface. If it moves up a distance, y, towards the surface, the pressure is increased. If it moves an equal distance, y, away from the surface, the pressure is decreased, but to a slightly smaller extent. The excess of pressure during the compression half is greater than its defect during the extension half, and the net result is an average excess of pressure on the reflecting surface. Lord Rayleigh, using Boyle's law, has shown that this average excess should be equal to the average density of the energy just outside the reflecting surface. In the case of transverse waves in an elastic solid, it can be shown that there is a small pressure perpendicular to the planes of shear, that is, in the direction of propagation, and that this small pressure is just equal to the energy density of the waves. The experimental verification of the pressure of elastic solid waves has not yet been accomplished, but the pressure due to sound-waves has been demonstrated by Altberg, working in Lebedeff's laboratory at Moscow, the pressure obtained sometimes rising to as much as 0.24 dyne per sq. cm. By means of a telephone manometer it was found that through a large range the pressure exerted on a surface was proportional to the intensity of the sound.

Both theory and experiment justify the conclusion that when a source is pouring out waves, it is pouring out with them forward momentum which is manifested in the back pressure against the source and in the forward pressure when the waves reach an opposing surface, and which, in the meanwhile, must be regarded as travelling with the train. It was shown that this idea of momentum in a wave-train enables us to see the nature of the action of a beam of light on a surface where it is reflected, absorbed, or refracted without any further appeal to the theory of the wave-motion of which we suppose the light to consist. In the case of total reflection there is a normal force upon the surface, in the case of total absorption there is a force normal to the surface and a tangential force parallel to the surface; while in the case of total refraction there is a normal force which may be regarded as a pull upon the surface or a pressure from within. In any real refraction there will be reflection as well, but with unpolarised light, in the case of glass, a calculation shows that the refraction-pull is always greater than the reflection-push, even at grazing incidence. An experiment, made by the president in conjunction with Dr. Barlow, was described to serve as an illustration of the idea of a beam of light being regarded as a stream of momentum. A rectangular block of glass was suspended by a quartz fibre so that the long axis of the block was horizontal. It was hung in an exhausted case with glass windows, and a horizontal beam of light was directed on to one end of the block so that it entered centrally and emerged centrally from the other end after two internal reflections. Thus a stream of momentum was shifted parallel to itself, or in this particular case a counter-clockwise couple acted on the beam. By suitable means the clockwise couple on the block, due to the pressures at the two internal reflections, was distinctly observed and approximately measured. The result obtained was of the same order as that deduced from the measurement of the energy of the beam by means of a blackened silver disc.

The extreme minuteness of these light forces appears to put them beyond consideration in terrestrial affairs, but in the solar system, where they have freer play, and vast times to work in, their effects may mount up into importance. On the larger bodies the force of the light of the sun is small compared with the gravitational attraction, but as the ratio of the radiation pressure to the gravitation pull varies inversely as the radius if the density is constant, the pressure will balance the pull on a spherical absorbing particle of the density of the earth if its diameter is about a hundred-thousandth of an inch. The possible effects of radiation-pressure may be illustrated without going to such fineness as this. In the case of a particle of the density of the earth, and a thousandth of an inch in diameter, going round the sun at the earth's distance, there are two effects due to the sun's radiation. In the first place, the radiation-push is 1/100 of the gravitation-pull, and the result is equivalent to a diminution in the sun's mass. In the second place, the radiation absorbed by the particle and given out again on all sides is crushed up in front as the particle moves forward and is opened out behind. There is thus a slightly greater pressure on the advancing hemisphere than on the receding one, and this appears as a small resisting force in the direction of motion. Through this the particle tends to move in a decreasing orbit, spiralling in towards the sun. As there is good reason to believe that some comets, at least, are composed of clouds of dust, there is hope that some of their eccentricities may be explained by the existence of radiation pressure. If the particles of a dust cloud circling round the sun are of different sizes or densities, the radiation accelerations on them will differ. The larger particles will be less affected than the smaller, will travel faster round a given orbit, and will draw more slowly in towards the sun. Thus a comet of particles of mixed sizes will gradually be degraded into a diffused trail lengthening and broadening, the finer dust on the inner and the coarser on the outer edge. If a planet, while still radiating much energy on its own account, captures and attaches to itself, as a satellite, a cometary cloud of dust in which there are several different grades, with gaps in the scale of size, it may be possible that in course of time the radiation-pressure effects will form the different grades into different rings surrounding the planet. Such may possibly be the origin of the rings of Saturn.

GEOGRAPHICAL RESULTS OF THE TIBET MISSION.

The paper read by Sir Frank Younghusband at the Royal Geographical Society on Monday, February 13, was one of the most interesting and instructive that the fellows of that society have been privileged to listen to for many years. It afforded a striking exemplification of the advantages of a due coordination of geographical facts and their combination, by a master-hand, into a well-arranged whole. The country traversed by the Tibet mission was by no means a *terra incognita* to the geographer, for its main features had long been known through the labours of the zealous native explorers of the Survey of India. But it is none the less true that Sir Frank Younghusband's admirable descriptions of the conditions of nature and man in that romantic region enabled his audience to realise those conditions in a way that was never before possible, and brushed away many false ideas which had been previously entertained. The speaker was also able to touch briefly upon some of the results obtained by the scientific experts who accompanied the mission, as well as by the survey party under Captains Rawling and Ryder, which in the late autumn did excellent work along the whole course of the Upper Brahmaputra, proving definitely that no peaks higher than Everest exist on this flank of the Himalayas.

In regard to the general nature of the country traversed, Sir F. Younghusband was able to correct the current idea that the whole of Tibet is more or less barren and worthless. This may be true for northern Tibet, the part traversed by recent European explorers, but not for the southern third, which is dotted over with thriving villages and well-built residences. The valleys in which Lhasa, Gyantse, and Shigatse are situated, as well as that of the Brahmaputra, are neither barren plateaux nor narrow, V-shaped gorges, but flat valleys covered with good soil, well irrigated, and richly cultivated. The passage to Tibet, as made by the Kongra-lama Pass, involves, however, a sudden change from the deep-cut valleys and luxuriant vegetation of Sikkim to wide plains on which not a tree is to be seen, while if, in some secluded nook, a plant a foot high is met with it is a curiosity. The summer climate of Khambajong was described as charming, while the unrivalled panorama of the Himalayas, at the very culminating point of their grandeur, is a full compensation for anything that may be otherwise lacking. Sir Frank Younghusband's eloquent descriptions of the snowy range as seen from the north, with the ever-varying atmospheric effects, are of special interest as the first ever given by a European capable of appreciating adequately the glories of the prospect.

The discovery by Mr. Hayden, of the Indian Geological Survey, of a bed of fossil oysters, permitted an accurate determination of the age of the hills in this part of Tibet, showing them to be geologically quite recent, though somewhat older than the main axis of the Himalayan range. The Chumbi Valley, through which the final advance was made, is less wide and open than the valleys in Tibet proper, of which, in fact, it is not considered a part. The passage hence into Tibet, made during the height of winter by the Tang-la Pass, 15,200 feet high, involved much suffering from the effects of the great cold (18° below zero Fahr.) combined with the rarity of the air. The subsequent march over the elevated plateau was made in the teeth of bitter winds and blinding blizzards, which continued through January, February, and March. But on arrival at Gyantse (April 11) the piercing cold was left behind. Willow and poplar trees were bursting into foliage, and the banks of the river were covered with masses of iris-plants, which later on became sheets of purple. On July 14, the day of the start for Lhasa, heavy rain destroyed the delusion that Tibet is a rainless country. Frequent rain was experienced until September, and the size of the rivers showed that this part of Tibet receives—probably up the Brahmaputra Valley—a quite considerable rainfall. Finally, in a lovely valley covered with trees, rich with cultivation, and watered by a river as broad as the Thames at Westminster, the mysterious city which no living European had seen before was at last reached, hidden away by range after range of snowy mountains. It proved anything but a dreamland city, and its streets were horribly muddy, but the grand lama's palace was an imposing, massive structure. Even the leading men were of low mental calibre, having much of the nature of children. The Ti Rimpochi—the leading lama—though benevolent and genial, had few intellectual attainments, and was firmly convinced that the earth was triangular; while the religion of the Tibetans was described as the most degraded form of Buddhism in existence.

THE LONDON CONFERENCE ON SCHOOL HYGIENE.

The conference on school hygiene, organised by the Royal Sanitary Institute, met on February 8, 9, and 10 at the University of London. Sir Arthur Rücker, who was installed as president of the conference, delivered an address in which he insisted that the elements of education should include some knowledge of the dangers by which mankind is surrounded and of the means to keep them at bay, and that those to whom young lives are entrusted should learn the main outlines of hygiene.

The ignorance of household management and of the principles of hygiene among the poor is responsible in no small measure for their high preventable mortality, their inferior physique, their intemperance and their poverty. How possible it is to better the conditions of modern life, and thus to improve the health, happiness, and physical powers of the people, and thereby their mental vigour and industrial efficiency, is generally recognised, and to this end a suitable hygienic education, moral and material, of the future parents seems essential. Not only have 15,000 medical men and the Commissions on Physical Degeneration recommended that such teaching should be made compulsory, but the English Board of Education and the Scotch Education Department have accepted that recommendation. It is important that from the earliest years of school life children should be taught by example as well as precept the elements of healthy living. The knowledge that may be procured subsequent to that age is often gained at the price of a needlessly costly personal experience. The object then, of school hygiene is to secure for the physical life its maximum possibility of sound health, and to develop the mental life side by side with this. The need of bodily health as the foundation of sound mental work is largely recognised at the present day, and we must not rest content until in the homes as well as in the schools there is sound knowledge of what may be done to give the proper environment for healthy life and work.

At the conference considerable prominence was given to the subject of the physical development and physical inspection of the scholar. Fresh air, good light, wholesome food, and abundant sleep are essentials of development. These should form, as it were, the compulsory subjects in childhood. The co-relation between the healthy mind and the healthy body is disputed by no one, and yet it is necessary still to plead against the unimportant position which is given to physical education in the curriculum of a large majority of schools, particularly in those for girls. The responsibility of the education authority may be said to be of a dual nature, viz. the responsibility not to injure the child's health during school life either by bad building or furniture, by the discipline or curriculum of the school, or by preventable risks of infection, and the responsibility to take the consequence of its own defective training of the future parent. The relative merits of systems and methods of physical training were not discussed, but free play was held to be preferable to gymnastics for physical training. The methods in the former are more spontaneous and thorough, and the most enthusiastic disciple of gymnastics does not wish the gymnasium to take the place of our great games. Discipline, prompt and unquestioning obedience to command, is perhaps the greatest gain derived from class drilling. But the lesson in physical exercise is not the only opportunity for paying attention to the needs of the growing child. If the best results are to be produced, the necessary standing and sitting positions of the pupils throughout the rest of the school routine must not be treated with indifference.

The early age at which children commence education and the length of the school day were both objects of adverse comment. It was pointed out that in primary schools children at three years of age pass the same number of hours in school as those of fourteen years of age; and in secondary schools a child of fourteen has allotted to him the same number of hours of work as the youth of nineteen. Longer intervals of rest and recreation and the abolition of home-work for young children were advocated, and it was pointed out that, in the experience of many authorities, the beginning of the day after a night's rest, the commencement of the week after the Saturday and Sunday rest, and the beginning of a term after the rest of the vacation, are the times when the best work is accomplished.

It is at present by no means unusual in many first-grade girls' schools to make the first test which a pupil undergoes a physical one based on a medical inspection. Before a scholarship can be held, physical as well as mental fitness should be required to be shown. It is a waste of public money to allot scholarships to those who are physically unfit to make use of them. But while we may discuss the physical inspection of children as specially referable to the school period of life at which, for convenience, it is conducted, we should keep in mind the bearing of the facts thereby disclosed on the periods of life which precede and follow it. Much educational energy is at present misspent in endeavouring to educate children who are physically unfit, as evidenced in Glasgow by the small proportion of underfed children who reach a reasonable standard of proficiency according to the master's estimate. In this important work of physical inspection the school teacher should be able to co-operate intelligently with the medical man.

Owing to various causes, artificial and economic, thousands of children three years of age are found in English elementary schools. It is a question whether taking the child out of the mother's hands for the greater part of the day, at so tender an age, may not have weakened the maternal instinct. It is certain, on the other hand, that, owing to the high susceptibility to certain infectious diseases amongst such young children, the practice is dangerous; and the conference passed a resolution to the effect that no child should be permitted to begin formal instruction in school classes under the age of six.

The subject of school buildings and equipment is one of great importance. The school premises often need to be improved if they are to illustrate the sanitary precepts which it is necessary to inculcate and if they are to enable the child to pursue its education under the best hygienic environment. The requirements of the Board of Education with reference to the floor space and air space given to each child were subject to some adverse criticism. Surely it may be claimed that as 15 feet is generally recognised as the healthy minimum floor space per child, 10 feet should no longer be officially recognised as sufficient. The school furniture, moreover, generally leaves much to be desired. Observation has shown that the difference in height of the children of the same age may vary from 6 to 11 inches, and this difference in height and growth ought to be provided for in the seats and desks of every class-room if physical deformities are to be prevented. That is to say, the desks and seats should be adjusted to the pupils' bodies, and not the bodies to the desks and seats. Teachers, moreover, must be taught to realise that, though their effective administration may be aided by efficient inspectors, actual daily care in providing fresh air, including cleanliness and teaching the children to use all sanitary appliances with cleanly decency, is a responsibility which cannot be shifted to other people's shoulders. Unfortunately, however, the local authorities themselves need stimulating and educating. Nor is this to be wondered at when one recalls the fact that the English Board of Education, though responsible for the compulsory attendance at school of some 6,000,000 children, is absolutely without expert assistance where problems of health and sanitation are concerned.

The last day of the conference was devoted to discussions upon the training of teachers and scholars in hygiene. Not only must the teacher have a knowledge of hygiene, but he must also be made responsible for the supervision of the hygienic environment of the pupil while at school, and he must ever bear in mind the circumstance that he will probably do most to create a sanitary conscience among the rising generation by example and personal influence. The training in the observation of sanitary precepts is a form of moral training, and if the home influences are antagonistic to those of the school the home influences will often prevail. The dirty and neglected child indicates the necessity of attempting to do something to improve the parent. The teaching of hygiene to the scholars must be suitably graduated to the age and capacities of the scholars; whereas from the very commencement of school life the object lessons of a sanitary environment should always be presented to the child, it is not before he at least reaches the age of seven—and several authorities prefer a later age—that he should commence to receive definite instruction in domestic and personal hygiene.

Subsequent to the age of ten or eleven, the scholar may be taught some of the more elementary scientific principles involved in hygiene precept and practice, but in the whole scheme of teaching hygiene it is only from the broadest point of view the simple and essential laws of health that require to be taught. It is almost sufficient to give to the scholar rules regarding health and reasons for them. If the teacher is to have an intelligent appreciation of the significance of hygienic principles, he must be taught the elements of physiology. The two subjects naturally go hand-in-hand and must be taught together. Their interests mutually reinforce. Physiology gives the basis and hygiene the application.

Reference was made at the conference to the circumstance that it had been repeatedly urged that there is no room for extra subjects such as "hygiene" to be taught at our schools; but surely hygiene, if properly taught, need not contribute to further over-pressure. The subject of hygiene has a great educative value in itself, and there is no subject which can be so easily co-related to many other branches of knowledge. Hygiene could be introduced as the practical outcome of the whole of the science teaching in the school, and, if the subject is properly taught to the teachers, an enthusiastic and intelligent teacher could prepare his or her own scheme of work and obtain the necessary results without the displacement of a single subject at present being taught. The great requirement for success in whatever may be attempted is an enthusiasm which will stimulate both the teacher and scholar to convert knowledge into conviction and conviction into conduct.

In connection with the conference there was a trade exhibition of school building and furnishing appliances, which consisted chiefly of school furniture; and the Board of Education, the Scotch Education Department, the Technical Instruction Department for Ireland, the London County Council, Home Office, &c., contributed loan exhibits.

A conference upon school hygiene, international in character, is to be held in London in 1907.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The subject selected for the Adams Prize in 1906 is "The inequalities in the moon's motion due to the direct action of the planets." The successful candidate will receive about 225*l*.

The syndicate appointed to draw up a scheme of instruction and examination in mining engineering has issued a second and amended report to the Senate. It is proposed that a diploma in mining engineering be granted to students who have passed the previous examination and have kept nine terms, and who have attained an honours standard in geology and chemistry in part i. of the natural sciences tripos and a second class standard in certain of the papers in the special examination in mechanism. The candidates have also to produce a certificate in mechanical drawing. This amended scheme meets the objections which had at one time been raised to the recommendations of the syndicate, and it was warmly welcomed at the discussion in the Senate house a week or two ago.

Mr. William Loring, formerly fellow of King's College, Cambridge, and late director of education under the County Council of the West Riding of Yorkshire, has been appointed warden of the Goldsmiths' College, New Cross.

Science states that the Emperor of Germany has directed the German Ambassador to the United States to lay before President Roosevelt in official form the suggestion for an exchange of professors between German and American universities which he made to the American Ambassador on New Year's Day.

The administration of the Board of Education in respect of secondary schools under the board's regulations for secondary schools, as also of charitable trusts and endowments connected therewith, will be conducted in future in the board's offices at Whitehall, and not at South Kensington. All correspondence on these matters should therefore be addressed to the Secretary, Board of Education, Whitehall, London, S.W. This change does not apply to the board's administration under the regulations for evening schools, technical institutions, and schools of art and art classes, which will remain for the present at South Kensington.

In the *Journal* of the Royal Statistical Society for December 31, Mr. L. L. Price contributes a paper on the accounts of the colleges of Oxford, 1893–1903, with special reference to their agricultural revenues. An interesting feature of the discussions was the reference to the disastrous results arising from the new statutes drawn up by the last commission, consequent on the fact that the work of the commission was done at a time when agriculture was prosperous, and no sooner had the sittings ceased than agricultural depression came on the country, and the resources of the colleges were seriously hampered.

The trustees of the Peabody Education Fund have, we learn from *Science*, voted to dissolve their trust. An appropriation of 200,000*l*. for the George Peabody School for Teachers in Nashville, Tenn., was made by a unanimous vote, the State and city having together voted an equal sum for the school. This appropriation leaves a fund of approximately 240,000*l*., which will be distributed later among other educational institutions. From the same source we learn that the trustees of Syracuse University are about to construct, with the bequest made to the university by the late Mr. John Lyman, which is said to amount to 40,000*l*., a building to be known as the John Lyman Laboratory of Natural History. Mr. Adolph Lewisohn, of New York, has given 1000*l*. for the reconstruction of the chemical laboratories at Dartmouth College.

The following recent appointments are announced:—Dr. Ernst Neumann, associate professor of physics at Marburg; Dr. Emil Wiechert, professor of geophysics at Bonn; Dr. Holleman, of Gröningen, professor of inorganic chemistry at Amsterdam; Dr. Bernhard Dessau, of Bologna, professor of physics at Perugia; Dr. C. Russjan, of Cracow, professor of mechanics at Lemberg; Dr. L. Courvoisier, of Heidelberg, observer at the Berlin Observatory; Dr. Ferdinand Henrich, associate professor of chemistry at Erlangen; Dr. Boehm, associate professor of mathematics at Heidelberg; Dr. Kueser, professor of mathematics at Breslau; Dr. Th. Vahlen, of Königsberg, associate professor of mathematics at Greifswald; Dr. M. Weber, professor of mechanics at the Hanover Technical College; Mr. B. H. Camp and Dr. G. D. Richardson, instructors in mathematics at Wesleyan and Yale Universities respectively.

SOCIETIES AND ACADEMIES.

London.

Royal Society, June 16, 1904.—"On the Influence of the Time Factor on the Correlation between the Barometric Heights at Stations more than 1000 Miles apart." By F. E. **Cave-Browne-Cave**, Girton College, Cambridge. Communicated by Prof. Karl Pearson, F.R.S.

The conclusions drawn from the results given in this paper are as follows:—

(1) The correlation between the barometric readings at two stations upwards of 1000 miles apart depends upon the interval between the readings. In the case of Halifax and Wilmington, the correlation is sensible for at least nine days, and it reaches a maximum for an interval of about sixteen hours in summer and twenty-three in winter. For these stations, and also for St. Helena and Cape Town, the observation at the more easterly station should be taken later for maximum correlation.

(2) There is a considerable correlation between the daily rise at Halifax and Wilmington, and this correlation changes with the interval in a manner somewhat analogous to that in which the correlation between simultaneous heights at two stations approximately on the same meridian depends upon the distance between them.

(3) There are considerable differences between the summer and winter correlations, and these differences are of the same general nature for both pairs of stations considered.

(4) It is possible to predict the barometric height at one station from an earlier height at a second station more than 1000 miles away, with a fair degree of accuracy, the mean observed error for forty dates, taken at random, for Halifax and Wilmington, being $0''{\cdot}15$.

January 19.—"On the Comparative Effects of the Trypanosomata of Gambia Fever and Sleeping Sickness upon Rats." By H. G. **Plimmer**. Communicated by C. J. Martin, F.R.S.

The organisms used in these experiments were given to the author by Col. Bruce, F.R.S., and they were taken from monkeys which had been inoculated in Africa from cases of the respective diseases; so that when the author's experiments were commenced each organism had been through one monkey, and they were therefore similar as regards conditions.

Rats inoculated with the Trypanosomata from Gambia fever lived about two and a half months; the Trypanosomata were present in the blood from about four weeks after inoculation until death. *Post mortem* the organisms were present in the blood and in all the organs; the spleen was very much enlarged, and the liver and kidneys were congested. The lymphatic glands were enlarged.

Rats inoculated with the Trypanosomata from sleeping sickness lived without any symptoms for a period of from six to nine months, when they became paralysed, first in one hind leg and then in the other, and they died in from two to eight weeks after the paraplegia was complete, living altogether up to eleven or twelve months. At no time were any Trypanosomata found in the blood, nor *post mortem* in the viscera or glands. But in the spinal cord they were present in small numbers, and inoculation of the cord into other rats has produced similar symptoms, whilst inoculation of the organs has been negative. In sections of the spinal cord amoeboid and adult forms of the Trypanosoma have been found, and also those lesions which Dr. Mott found in the nervous system of man in cases of sleeping sickness, viz., a considerable cellular exudation around the vessels. This is not found in monkeys, in which the organisms become generalised, and do not get localised in the nervous system as is the case in rats.

These experiments go to show that the organisms associated with the diseases of Gambia fever and sleeping sickness, which are thought by some to be the same disease in different stages, are quite distinct in their effects, and they are also distinct morphologically; that the Trypanosoma of sleeping sickness can be inoculated into rats, which has been denied; and that there is a great similarity in the lesions produced in the nervous systems of man and of rats, and in the localisation of the disease to the nervous system.

From experiments made, a double infection would seem to be quite possible, and to be a likely event in these diseases.

January 26.—"On the Modulus of Torsional Rigidity of Quartz Fibres and its Temperature Coefficient." By Dr. Frank **Horton,** St. John's College, Cambridge, late Mackinnon Student. Communicated by Prof. J. J. Thomson, F.R.S.

In this research the dynamical method of experimenting was employed, and the investigaton was divided into three parts:—

(1) The determination of the absolute value of the torsion modulus.

(2) The variation of the modulus between 15° C. and 100° C.

(3) The variation of the modulus between 20° C. and 1000° C.

The radii of the fibres used were determined by measuring their circumferences, the fibres being rolled between two fine glass capillary tubes and the number of revolutions made in travelling a distance of 5 mm. counted. By this method fibres of diameter 0.001 cm. were measured to 0.01 per cent.

In the second part of the research the jacket enclosing the fibre was heated by using the vapours of various liquids boiling under atmospheric pressure. The modulus of rigidity was found to increase as a linear function of the temperature, but the values of the temperature coefficient of the modulus obtained from different fibres were considerably different. In the experiments between 20° C. and 1000° C. the fibres were suspended inside a platinum tube, which was heated electrically. It was found that the modulus of rigidity increased with the temperature, at first as a linear function of it, but as the temperature rose the rate of increase gradually diminished and a maximum rigidity was attained at about 880° C. After passing this point the rigidity decreased very rapidly with increase of temperature.

"Note on the Cause of the Period of Chemical Induction in the Union of Hydrogen and Chlorine." By D. L. **Chapman** and C. H. **Burgess.** Communicated by Prof. H. B. Dixon.

The induction period in the union of hydrogen and chlorine exposed to light, which has been ascribed by various authors either to a change in the physical condition of the chlorine or of the mixture of hydrogen and chlorine, or to the primary formation of an unstable intermediate compound, has been shown by the authors to be due to impurities. The impurities are those which react with chlorine, such as ammonia and sulphur dioxide. At the ordinary temperature in the dark the reaction between these substances and chlorine is not completed. In the light or by raising the temperature these impurities can be entirely removed by the chlorine. The time required for their removal is the induction period during which the chlorine is rendered incapable of combining with the hydrogen.

It has been hitherto supposed that an induced mixture of hydrogen and chlorine if left to stand for some time in the dark must be again induced before combination will proceed at its normal rate. This is not the case if a quartz actinometer is substituted for a glass one.

"The Theory of Symmetrical Optical Objectives.—Part II." By S. D. **Chalmers.** Communicated by Prof. Larmor, Sec.R.S.

In photographic objectives, consisting of two similar lenses symmetrical to a central stop, the back member is generally corrected for spherical and chromatic aberrations, astigmatism, and curvature of field for distant objects, and thus the whole system is perfectly corrected for unit magnification. The present paper discusses the aberrations for distant objects. In part i. it was proved that, to the first approximation, the above defects are corrected in the whole system when they are corrected in the single member. By geometrical constructions, using the symmetry with respect to the axis and to the stop, these results are extended to practical systems. The paths of parallel rays, incident on the combined system, are obtained from those of two sets of parallel rays incident on the single system; the aberrations of the combined system are expressed in terms of the single system with small errors—negligible in practical systems—due to the image of the stop being imperfect.

"Exterior Ballistics. Error of the Day and other Corrections to Naval Range Tables." By Prof. Geo. **Forbes,** F.R.S.

Gun-sights are always marked for standard conditions of muzzle velocity (m.v.) and air density (a.d.). When either of these change the sights must be corrected. The author finds from theory that if a.d. is increased *m* fold, and the range is diminished *m* fold, then the elevation and time-of-flight must be diminished *m* fold; and, empirically, that up to 10° of elevation (10,000 yards for a 12" gun) elevation varies very closely as $1 \,[\text{m.v.}]^2$, as *in vacuo*. On these laws he calculated from the naval range table of a 12" gun, 850lbs. shot, 2463 m.v., at 2, 4, 6, 8, and 10 thousand yards, the table for a 6" gun, 100lb. shot, 1960ft. secs. The elevations only differed from the Naval 6" table by −1, −4, −2, +2, and +4 min. of arc.

The laws, therefore, may be applied with perfect confidence for the comparatively small variations that occur in any one gun.

Linnean Society, January 19.—Prof. W. A. Herdman, F.R.S., president, in the chair.—The Rev T. R. R. **Stebbing** exhibited and explained specimens of Crustacea, in various ways remarkable for structure, habits, habitat, or colouring.—Botanical collecting: Dr. A. **Henry.** The actual methods were briefly alluded to, stress being laid on truthful labelling of the specimens at the moment of collection, instead of months afterwards, when identical numbers were often given to plants of different *provenance*. Dr. Henry described observations made by him in China. He alluded to mimicry in plants, in the case of two species of Lysimachia (a protomorphic genus in China), one of which mimicked *Paris quadrifolia*, with 4 leaves, while the other recalled another species of Paris with 10–12 leaves. He referred also to the extraordinary richness of species on calcareous soils as compared with other soils, a fact constantly seen in China, and well marked also in France, and asked for some explanation. In China, as elsewhere, pure woods were rare, being only formed by a few conifers, like *Abies Fargesii* at high altitudes in Hupeh, *Cupressus funebris* in the same province at lower levels (the home of the Reeves's pheasant), *Pinus Massoniana* (almost everywhere in the central and southern provinces), other species of Pinus more local; also certain species of oak widely distributed; and *Alnus nepalensis* in Yunnan. The explanation of the occurrence of pure forests was also a subject not completely understood: *e.g.* in this country ash seeded freely, and in some places for a time looked as if it would grow into a pure wood; but apparently pure forests of ash only occurred on extremely rich soil in some districts in Russia. With regard to botanical collecting, three stages had occurred. At an early period plants were collected to be merely named and classified; in fact, they were treated like postage stamps. The second period began with Sir Joseph Hooker, who inaugurated the study of the geographical distribution of plants. The third period, that of the present day, was a step forward, in that attention should be paid to the plants themselves as social organisms, living in harmony and yet in competition together; and Dr. Henry urged that the time had come when the hunt for new species should cease to be the sole aim of the collector, and the study of the known species be taken in hand in their living conditions. He advocated map-making of small areas, census-taking, measurements, records of natural seedlings, soil, shade, &c., and to illustrate this plan showed a series of slides taken in France, the idea of which was to explain how the commoner species of trees behaved at different altitudes and on different soils.—Cranial osteology of the fishes of the families Osteoglossidæ, Pantodontidæ, and Phractolæmidæ: Dr. W. G. **Ridewood.** This paper is a fourth instalment of the results of an extensive investigation upon the skull of the lower teleostean fishes begun in 1896. Descriptions are given of the skulls of Osteoglossum, Heterotis, Arapaima, Pantodon, and Phractolæmus; and in a summary Dr. Ridewood points out that the evidence of the skull goes to show that the three genera Osteoglossum, Heterotis, and Arapaima, first brought together into the family Osteoglossidæ by Dr. Günther, constitute a perfectly natural group; that the Pantodontidæ are more closely related to the Osteoglossidæ than to any other family of fishes, as has been suspected since the first discovery of the genus Pantodon in 1876; and that the Phractolæmidæ do not in their cranial osteology offer any evidence of close alliance with either of these families.

February 2.—Prof. W. A. Herdman, F.R.S., president, in the chair.—Descriptions of some new species and notes on other Chinese plants: W. J. **Tutcher.** The species in question had been found on the island of Hong Kong, with one from Kowloon and one from Wei-hai-wei. Bentham's "Flora Hongkongensis" in 1861 enumerated 1053 species from the island, 159 of which had not at that time been found elsewhere, but at the present time only about 50 of these remain peculiar to the island. The flora as now known amounts to about 1400 species, of which 100 are regarded as endemic, though probably many will be found natives of the mainland Ferns amount to 100; grasses about as many; Leguminosæ nearly as many; between 70 and 80 Cyperaceæ; Compositæ more than 60, and orchids 60. *Quercus Eyrei*, first found by Capt. Champion, was not collected by any recent collector until the author re-found it in quantity; even Hance had declared that Champion must have been mistaken in his locality. The luxuriance usually associated with tropical vegetation is here wanting, due to the poverty of the soil, which is almost exclusively disintegrated granite. The new territory leased to Great Britain in 1898 has an area of about 300 square miles, that is, ten times the area of Hong Kong. Lantao is an island resembling Hong Kong, but its highest peak is 3050 feet, with many well-wooded ravines, and when explored will doubtless prove rich in plants.—Revision of the European marine forms of the Cirolaninæ, a subfamily of Crustacea Isopoda: Dr. H. J. **Hansen.** Three new species are described—*Cirolana gallica, C. Schmidtii*, and *Eurydice affinis*. Comparative tables of the genera and species are supplied, distinguishing eight European species of Cirolana, one of Conilera, and six of Eurydice.

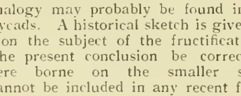
Challenger Society, January 25.—Sir J hn Murray in the chair.—Mr. E. W. L. **Holt** exhibited and made remarks on some rare and interesting deep-water fish and Crustacea from West Ireland.—Dr. R. N. **Wolfenden** exhibited and made remarks upon some Copepoda from the *Gauss* (German Antarctic) expedition; their large size, up to 10mm., was remarkable, as also the fact that, of the 42 species from the *Gauss* and *Belgica*, five were common to the subpolar seas and continuous by way of the mesoplankton.—Sir John **Murray** spoke on the relation of oceanography to other sciences. He pointed out that recent expeditions had made only inconsiderable alterations in the contour lines of the sea-bottom published in the *Challenger* reports, and was of the opinion that no great changes were likely to be made by the soundings of future expeditions. He expressed his belief that the great ocean basins had been practically unaltered through geological time, but that the continents, including a zone of not more than 200 miles seaward of their present outline, had frequently altered their levels, supporting this belief by the fact that all known sedimentary rocks are of "terrigenous" character, to the exclusion of deep-sea materials. The meteorology of mid-ocean, where the diurnal temperature range of the water is about 2° F., was contrasted with the meteorology over land-masses, where absorption and radiation are high, and the diurnal atmospheric range may amount to 80° F. As an example of the far-reaching effects of temperature, Sir John Murray cited the range of annual variation where hot and cold currents are at war, amounting in some cases to 40° F.; in such regions the animal death-rate is very high, and the dead organisms decomposing on the bottom start the formation of glauconite, a well-known constituent of sedimentary rocks. As another result of temperature, it has been estimated that a tropical Copepod lives twenty-four times as fast as an Arctic Copepod in the same period of time; this may explain the predominance of specimens and paucity of species in the Arctic as compared with the Tropical fauna. In connection with chemistry, he pointed out the gradual transference of lime from the poles to the tropics by organic agency; and, in connection with physiology, the possible relation between the serous and similar fluids of existing organisms, and the constitution of the primæval sea in which life first began on our earth.

Faraday Society, January 30.—Prof. A. K. Huntington in the chair.—Mass analysis of Muntz's metal by electrolysis, and some notes on the electrolytic properties of this alloy: J. G. A. **Rhodin.** The first portion of the paper describes an apparatus which was specially designed by the author for the purpose of the accurate and rapid determination of the copper content (which should lie between 60·5 and 61·5 per cent.) of Muntz's metal. The author also discusses the electrochemical properties of Muntz's metal. The metal is largely used as a sheathing to protect ships' bottoms from certain mollusca and algæ, and to be successful it should dissolve in sea-water just to a sufficient extent as to render the surface poisonous, the best conditions being the equal dissolution of the copper and zinc. The author shows how these may be calculated approximately by supposing that the electrolytic dissolution rate is proportional to the heat of formation of the ultimate compounds (zinc and cuprous chlorides), and to the conductivities of the metals which dissolve.—The equilibrium between sodium sulphate and magnesium sulphate: R. B. **Denison.** Experiments conducted from the standpoint of the phase rule are described, the object of which was to determine whether the double salt of sodium and magnesium sulphates, $2MgSO_4.Na_2SO_4$, which has been described as a naturally occurring mineral, is capable of existence in contact with solution, that is, whether it has been formed in nature by the evaporation of saline waters. The corresponding potassium compound is known to occur in Stassfurt as langbeinit, and it was thought that a detailed investigation might result in the isolation of the sodium langbeinit from solution. Dilatometer and tensimeter experiments pointed fairly conclusively to the assumption that the compound sodium-langbeinit cannot exist in contact with solution, at least below 100° C., and hence this substance, if found as a mineral, must be a product of a higher temperature.—Refractory materials for furnace linings: E. K. **Scott.**

Mineralogical Society, January 31.—Prof. H. A. Miers, F.R.S., president, in the chair.—Danalite from Wheal Maudlin, Cornwall; crystallographic characters of barium-radium bromide: Prof. H. A. **Miers.**—Epidote from Inverness-shire: H. H. **Thomas.** The crystallographic and optical characters were described. A chemical analysis made by Dr. Pollard showed that the mineral contained a very low percentage of ferric oxide (6.81). In this respect it was similar to epidotes from Huntington, Mass., and the Zillerthal, and like them showed correspondingly low refractive and double refractive power and large optic axial angle, as compared with epidotes containing higher percentages of iron.—Preliminary note on the regular growth of crystals of one substance upon those of another: T. V. **Barker.** The observations of previous investigators were in general confirmed with regard to the growths of KI, KBr, KCl and $NaNO_3$ upon mica, and of $NaNO_3$ upon calcite. In all cases a clean surface is necessary. Attempts to get a regular deposition of $NaNO_3$ upon other rhombohedral carbonates of the calcite group and upon dolomite were without any positive result, although the rhombohedral angle of some of them is much nearer to that of $NaNO_3$ than is that of calcite. The topic axes, however, are in order of magnitude as follows:—$NaNO_3$, calcite, rhodochrosite, dolomite, chalybite, so that if the regular growth depend on the fitting together of similar structures, the experiments point to the usefulness of the conception of topic axes. The author is continuing his observations.—Apparatus for determining the density of small grains: K. A. K. **Hallowes.** The method is by hydrostatic weighing, and the grain is held under water (or preferably alcohol) in a spring-clamp, made of brass wire and two cover-glasses, which is suspended from the beam of the balance by a fine hair.—*Exhibits*: Specimen of phenacite and one of aurichalcite from Cornish localities: A. **Russell.**—Specimens of sulphide of lead and oxide of zinc artificially produced in furnaces at Laurium: H. F. **Collins.**

Geological Society, February 1.—Dr. J. E. Marr, F.R.S., president, in the chair.—On the sporangium-like organs of *Glossopteris Browniana*, Brongn.: E. A. Newell **Arber.** Some specimens from New South Wales, on which scale-fronds of Glossopteris occur, also exhibit impressions of minute bodies, not unlike the sporangia of certain recent and extinct ferns and cycads. They have never been found, except in the closest association with the scale-leaves of Glossopteris, and this is regarded as an indication that they may be attributed to that genus, a conclusion supported by the evidence of the scale-fronds, which show scars of attachment and fragments of the sac-like bodies still apparently in continuity. It is impossible to be quite certain that these bodies are sporangia, but there is much to be said for this view. The closest analogy may probably be found in the microsporangia of cycads. A historical sketch is given of the present evidence on the subject of the fructification of Glossopteris. If the present conclusion be correct (that the sporangia were borne on the smaller scale-fronds), Glossopteris cannot be included in any recent family of the true ferns.

Chemical Society, February 2.—Prof. W. A. Tilden, F.R.S., president, in the chair.—The following papers were read:—Camphorylcarbimide: M. O. **Forster** and H. E. **Fierz.** The authors described this substance and some of its derivatives and reactions.—Configuration of *iso*nitrosocamphor and its unstable modification: M. O. **Forster.** It is proposed to represent *iso*nitrosocamphor and its unstable isomeride by the configurations



Syn-form and *Anti*-form

respectively. The evidence for this view is principally based upon the behaviour of the two isomerides towards magnesium methyl iodide.—The determination of molecular weight by lowering of vapour pressure: E. P. **Perman.** The author has worked out the details of a simple method by which molecular weights can be determined with moderate accuracy from measurements of the lowering of vapour pressure of the solvent in which the substance under investigation is dissolved.—Note on β-NH-ethenyldiaminonaphthalene: R. **Meldola** and J. H. **Lane.** The ethenyldiaminonaphthalene, obtained by Prager in 1885 by debrominating the bromo-anhydro-base prepared by the reduction of 4-bromo : 2 : nitroaceto-α-naphthalide, is now shown to be identical with the anhydro-base obtained from Markfeldt's ethenyltriaminonaphthalene by the diazo-method.

Mathematical Society, February 9.—Prof. A. R. Forsyth, president, in the chair.—The president referred to the loss sustained by the society by the death of Mr. R. Tucker, who was honorary secretary of the society from 1867 to 1902. A resolution of condolence with Mr. Tucker's surviving relatives was passed.—The following papers were communicated:—General theory of transfinite numbers and order types: Dr. E. W. **Hobson.** The paper deals with the well-known contradiction which arises in the theory of aggregates, and is expressed in the statements:—The aggregate of all ordinal numbers has an ordinal number which must be the greatest of all ordinal numbers, that is, the last of the series; but the series cannot have a last element. The source of the contradiction is traced to the assumption that an ordered aggregate necessarily possesses a definite order-type which can be regarded as an object, viz. the ordinal number coming immediately after all those which are the elements of the aggregate of which it is the order-type. The author proposes to deny this principle, and points out that those parts of the theory of aggregates which are of importance for the general purposes of mathematical analysis would not be affected by this denial.—The Maclaurin sum-formula: Rev. E. W. **Barnes.** The paper contains a new form for the remainder, and a fresh demonstration of the conditions in which certain generalisations of the formula are valid.—The asymptotic expansion of integral functions of finite non-zero order: Rev. E. W. **Barnes.** The object of the paper is to investigate the asymptotic expansions of functions of the class in question without making any appeal to the theory of divergent series. It is shown that the most general type of integral function of finite non-zero order with a single sequence of non-repeated zeroes admits, when the argument is large, an asymptotic expansion valid everywhere save in the neighbourhood of the zeroes of the function, and all the coefficients of this expansion can be built up from the simple Riemann Zeta function. Expansions are also found in the case of integral functions of multiple linear sequence.—On the function $\sum_{n=1}^{\infty} x^n/n^s$: G. H. **Hardy.**—On the reducibility of covariants of binary quantics of infinite order, part ii.: P. W. **Wood.**

EDINBURGH.

Royal Society, January 23.—Dr. Traquair in the chair.—On deep water ship waves: Lord **Kelvin.** The waves were supposed to be produced by a floating or submerged body of proper form moving forward with a given speed in a canal of rectangular section. A solution of the approximate equations was first obtained for a particular form of surface wave associated with a definite distribution of pressure over part of the surface and moving forward with a given speed of propagation. The vanishing of the pressure distribution or "forcive" occurred for a given speed which coincided with the speed of propagation of the free sinusoidal wave. When the forcive did not vanish it acted with or against the displacement according as the speed of propagation was less or greater than this critical velocity. By a suitable synthesis of a series of distributed forcives with their associated surface displacements, the solution was put in a form which lent itself towards the elucidation of several important problems. Thus in certain cases it was possible to imagine a cover fitting part of the water surface and moving forward with the proper speed associating this form of surface with a definite forcive, and in this way a solution was obtained of the train of waves accompanying the passage of a suitably shaped pontoon over the fluid surface. Again, by superposition of two exactly equal forcives half a wave-length apart, the surface outside the region over which the forcive acted was reduced to rest. The disturbed surface within the region of the acting forcive and moving forward with it could then be imagined as fitted with a cover; and thus was solved the problem of finding the form of pontoon which, advancing through the fluid at a given speed, would be unaccompanied by any displacement of fluid surface either before or behind.—A comparison of the lakes of Denmark and Scotland: Dr. **Wesenberg-Lund.** Dr. Lund had visited Scotland on the invitation of Sir John Murray with the view of making this comparative study. The greatest possible contrasts existed between the lakes of Denmark and the typical Highland lakes of Scotland, the Danish lakes being, for example, comparatively small and shallow, with great variations of temperature from season to season, the water being rich in lime, and the littoral region being characterised in most cases by luxurious vegetation forming the home of numerous animals. Scottish lakes like Loch Leven, however, approximated more closely in character to the lakes of Denmark. The paper contained an important discussion of the fauna of the two types of lakes, and of its influence on the lakes themselves and their surroundings. The Danish lakes are gradually being silted up, and will before long disappear, while the lochs of Highland Scotland will remain practically unaltered through long ages.—On a new family and twelve new species of Rotifera of the order Bdelloida: J. **Murray.** The great uniformity of structure hitherto observed throughout the order Bdelloida gives much interest to the discovery in the Scottish lochs of an animal showing great divergence from the general type. The new family, which is called Microdinadæ, is peculiar in the structure of head and jaws. The discs and wreaths are quite absent, so that there is no corona, unless the terminal cilia of the throat are regarded as such. The rostrum and toes are as in the genus Philodina. The jaws of all other Bdelloida are *ramate*; those of Microdina are between *ramate* and *malleo-ramate* or *malleate*. The large teeth are all towards the anterior end of the jaws, and there are usually from one to two loops on the manubrium. A remarkable feature of the animal by which alone it could be distinguished from all other Bdelloida is a large crimson gland attached to the œsophagus.—Variations in the crystallisation of potassium hydrogen succinate due to the presence of other metallic compounds in the solution: A. T. **Cameron.** The crystals were obtained from solutions containing small quantities of ferric and chromic compounds, and may be described as oblique elliptic double cones showing curved surfaces only. The crystals belong to the same system as those of the acid succinate, and are evidently modifications due to the presence in small variable quantities of the other metallic compounds possibly in a state of solid solution.—(1) Continuants whose main diagonal is univarial; (2) the eliminant of a set of general ternary quadrics: Dr. Thomas **Muir.**

MANCHESTER.

Literary and Philosophical Society, January 24.—Rigidity of gelatin: H. **Morris-Airey.** After describing some of the properties of aqueous solutions of gelatin, the results of a series of measurements of the rigidity of these media were given.—The cause of the period of chemical induction: C. H. **Burgess** and D. L. **Chapman** (see p. 380).

PARIS.

Academy of Sciences, February 6.—M. H. Poincaré in the chair.—On the stability of ships: E. **Bertin.**—On the action of hail cannons: J. **Violle.** There are in the Beaujolais twenty-eight societies for breaking up the hail-storms common in that region by means of the hail cannon. A comparison of the damage done during the period 1891–1900 with the losses through hail subsequent to the introduction of the cannon (1900–1904) shows marked evidence in favour of the use of this means of dispersing the hail clouds. It has been frequently noticed that both lightning and thunder are suppressed within the protected zone, although they may be raging just outside this area.—Syntheses in the anthracene series. Symmetrical diamido-tetra-alkyl derivatives of the dihydride of γ-tetraphenyl-anthracene: A. **Haller** and A. **Guyot.** As a result of the condensation of γ-diphenyl-γ-dihydroxy-anthracene dihydride with dimethylaniline two stereoisomeric compounds are produced, which, on account of the wide differences in their properties, are very readily separated. A similar reaction takes place with diethylaniline, but the stereoisomers are more difficult to separate.—The substances producing softness in wine: A. **Muntz.** A discussion of the effect of the gummy matters present in wine on its taste.—On the extension of the Cretaceous seas in Africa: A. **de Lapparent.** Traces left by the seas of the Upper Cretaceous have been recognised for some time in the Sahara and the Soudan, but up to the present there has been no direct proof of a communication between this and the Atlantic. Fossils recently collected by Lieut. Desplagnes and Capt. Théveniaud make the existence of this communication highly probable.—On the three methylcyclohexanones and the corresponding methyl-cyclohexanols: Paul **Sabatier** and A. **Mailhe.** The three cresols are readily reduced to the corresponding cyclohexanols by hydrogen in presence of reduced nickel at 200°–220° C. These were converted by heating with zinc chloride into methylcyclohexenes, and by oxidation into methylcyclohexanones. The latter substances are more conveniently obtained from the alcohol by the reaction discovered by Sabatier and Senderens, passing the vapours of the alcohol over copper heated to 300° C., the yield by this method being nearly theoretical.—On a measurement of the height of the reversing layer obtained with the aid of the large telescope of the Observatory of Mont Blanc: M. **Millochau.** Measurements of two calcium lines under good conditions gave a thickness of $0''.15$.—Observations of the zodiacal light made at the summit of Mont Blanc: A. **Hansky.** A detailed account of observations taken under very favourable conditions on September 21–22.—On solutions of systems of linear differential equations with monodrome coefficients: Ed. **Maillet.**—On Poisson's integral and singular lines of analytical functions: P. **Fatou.**—On the whole of the curves traced on an algebraic surface, and on the Picard integrals of this surface: Francesco **Severi.**—On the deviation of freely falling bodies: M. **de Sparre.** Reply to a paper of M. Maurice Fouché on the same subject.—On a new mechanical clutch: M. **Hérisson.**—An integrating thermometer: Ch. **Féry.**—A synchronising electromagnetic brake: Henri **Abraham.** The axis of the motor carries a toothed wheel of copper, the teeth of which pass between the poles of an electromagnet, actuated by the same current as the motor. If synchronism is established, each tooth passes this space at the instant when the electromagnetic field is nil, and there is no braking action. If the synchronism is imperfect, the brake absorbs the whole of the extra energy of the motor.—Magnetic hysteresis at high frequencies in nickel and nickel steels: Ch. Eug. **Guye** and A. **Schidlof.**—On the direct fixation of ethero-organomagnesium derivatives on the ethylene linkage of unsaturated esters: E. E. **Blaise** and A. **Courtot.** Ethyl methacrylate reacts with magnesium-methyl-iodide giving the tertiary alcohol dimethylpropenylcarbinol, the ketone methyl-ethyl-acetone, and diisopropenyl. The conditions giving a maximum yield of either of these have been worked out.—On the cryoscopy of the sulphates: Albert **Colson.**—A new method of testing for ammonia: application to the examination of water for sanitary purposes: MM. **Trillat** and **Turchet.** In presence of potassium iodide and sodium hypochlorite, ammonium salts develop a black coloration, due to iodide of nitrogen, which can be estimated colorimetrically. The coloration appears to be less liable to be interfered with by certain substances commonly present in natural waters than is the case with Nessler's reagent.—On the evolution of carbon in combustibles: Isidore **Bay** and Just **Alix.**—Some hereditary anomalies provoked by traumatisms: M. **Blaringhem.**—On the use of leucine and tyrosine as sources of nitrogen for plants: L. **Lutz.** These two nitrogenous substances can be assimilated both by phanerogams and fungi. The difference noted in a previous paper between these two classes of plants was due to the use of sand as a medium for the growth of the former.—On the cause of the impoverishment of springs in plains: M. **Houllier.** The author draws the conclusion that the progressive impoverishment of the springs in the basin of the Somme during recent years is the result of the increased use of the land for agricultural purposes, leading to a very considerable increase in the amount of water evaporated by plant transpiration.—The proportions of the gases in arterial blood during the course of anæsthesia due to chloroform, remaining invariable so long as the pulmonary respiration remains very nearly normal: J. **Tissot.**—The mechanism of accommodation: H. **Bertin-Sans** and J. **Gagnière.** The experiments described, which were carried out with rabbits' eyes, support

Tscherning's theory, as opposed to that of Helmholtz.—Observations on the absorption bands of blood and oxyhæmoglobin: MM. **Piettre** and **Vila**.—Myelitis produced by tuberculous toxins: E. **Clément**.—On the constitution of Djebel Hadid: Paul **Lemoine**.—On the Eocene strata in Western Morocco: A. **Brives**.—On the mode of formation of high glacial valleys: Paul **Girardin**.

NEW SOUTH WALES.

Royal Society, November 16, 1904.—Mr. C. O. Burge, president, in the chair.—On the occurrence of isolated crystals of augite in the tufaceous mudstones near the top of the upper marine series at Gerringong: H. G. **Foxall**. The author gives the results of crystallographical and chemical examinations of isolated crystals of augite, together with a note on their occurrence.

December 7, 1904.—Mr. C. O. Burge, president, in the chair.—Mr. C. O. Burge delivered his presidential address on the connection between engineering and science. Among the future triumphs of engineering helped by science were mentioned the application of electricity to main line railways. Then there are promises as regards convevance of power by electricity without wires. Increased economy in the utilisation of heat units in the ordinary steam engine will be a work of the future, thus saving our rapidly diminishing fuel supply. Other subjects mentioned as fit ones for the future were the direct utilisation of the sun's rays for power, and of the rise and fall of the tide for the same purpose; the diminution of skin friction in ships; and of the resistance to air in ships and trains; the dispersion of fog by electricity; the further investigation of fatigue in metals used for construction; and the application of single phase electricity to traction.—The approximate colorimetric estimation of nickel and cobalt in presence of one another: R. W. **Challinor**. Use is made of the complementary colours of Ni and Co solutions. The method is to be applied to the solution of the weighed Ni and Co deposited by electrolysis. The mixed metals are dissolved in HNO_3, the solution evaporated and diluted to a definite volume and a fraction taken. Standard Ni $(NO_3)_2$ or Co $(NO_3)_2$ solution is added until the colour matches a neutral tinted solution of known strength; both solutions are brought finally to the same dilution, the colours being compared by looking vertically down the tubes.—Note on a combined wash-bottle and pipette: J. W. **Hogarth**.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 16.

ROYAL SOCIETY, at 4.30.—Pularised Röntgen Radiation: Dr. C. G. Barkla.—The Effects of Momentary Stresses in Metals. Prof. B. Hopkinson.—The Halogen Hydrides as Conducting Solvents. Parts I.—IV.: B. D. Steele, D. McIntosh, and E. H. Archibald.—Further Observations on Slip-bands. Preliminary Note: W. Rosenhain.
ROYAL INSTITUTION, at 5.—Recent Work of the Geological Survey: Prof. J. J. H. Teall, F.R.S.
SOCIETY OF ARTS, at 4.30.—The Indian Census of 1901: Sir Charles A. Elliott, K.C.S.I.
LINNEAN SOCIETY, at 8.—A Revised Classification of Roses: J. G. Baker, F.R.S.—The Botany of the Anglo-German Uganda Boundary Commission: E. G. Baker, Spencer Moore, and Dr. A. B. Rendle.

FRIDAY, FEBRUARY 17.

ROYAL INSTITUTION, at 9.—High Power Microscopy: John W. Gordon.
GEOLOGICAL SOCIETY, at 8.—Anniversary Meeting.
EPIDEMIOLOGICAL SOCIETY, at 8.30.—The Protozoa in Relation to Disease: Prof. E. J. McWeeney.
INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.—Adjourned Discussion on the American Visit, 1904.—The Strength of Columns: Prof. W. E. Lilly.

MONDAY, FEBRUARY 20.

SOCIETY OF ARTS, at 8.—Internal Combustion Engines: Dugald Clerk.
VICTORIA INSTITUTE, at 4.30.—Biblical Astronomy: Lieut.-Colonel G. MacKinlay.

TUESDAY, FEBRUARY 21.

ROYAL INSTITUTION, at 5.—The Structure and Life of Animals: Prof. L. C. Miall, F.R.S.
ROYAL STATISTICAL SOCIETY, at 5.
INSTITUTION OF CIVIL ENGINEERS, at 8.—*Continuation of Discussion*:—Alfreton Second Tunnel: E. F. C. Trench.—The Reconstruction of Moncreiffe Tunnel: D. McLellan.—*Paper*: Surface-Condensing Plants, and the Value of the Vacuum Produced: R. W. Allen.
ZOOLOGICAL SOCIETY, at 8.30.

WEDNESDAY, FEBRUARY 22.

GEOLOGICAL SOCIETY, at 8.—On the Order of Succession of the Manx Slates in their Northern Half, and its Bearing on the Origin of the Schistose Breccia: Rev. J. F. Blake.—On the Wash-outs in the Middle Coal-measures of South Yorkshire: F. E. Middleton.
SOCIETY OF ARTS, at 8.—Some Misconceptions of Musical Pitch: John E. Borland.

THURSDAY, FEBRUARY 23.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On some New Species of Lagenostoma: a Type of Pteridospermous Seed from the Coal-measures: E. A. Newell Arber.—On a New Rhabdosphere: G. Murray, F.R.S.—On Changes observable in the Liver Cells during Digestion, and their Relation to Hepatic Secretion: Prof. E. Wace Carlier.—The Colour-Physiology of the Higher Crustacea. Part III.: F. Keeble and Dr. F. W. Gamble.—Phosphorescence caused by the Beta and Gamma Rays of Radium. Part II.—G. T. Beilby.
ROYAL INSTITUTION, at 5.—Recent Work of the Geological Survey: Prof. J. J. H. Teall, F.R.S.
INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Continuation of Discussion*:—The Value of Overhead Mains for Electric Distribution in the United Kingdom: G. L. Addenbrooke.

FRIDAY, FEBRUARY 24.

ROYAL INSTITUTION, at 9.—Fungi: Prof. H. Marshall Ward, F.R.S.
PHYSICAL SOCIETY, at 5.—On the Curvature Method of teaching Geometrical Optics: Dr. C. V. Drysdale.—Exhibition of Dr. Meisling's Colour Patch Apparatus: R. J. Sowter.—A Method of illustrating the Laws of the Simple Pendulum, and an Exhibition of String Models of Optical Systems: J. Schofield.
INSTITUTION OF CIVIL ENGINEERS, at 8.—Morecambe Sewerage: Method of Laying a 15-inch Cast-iron Sewer under the London and North-Western Railway: F. D. Flint.—The Reconstruction of Bow Bridge over the River Lea: H. M. Rootham.

SATURDAY, FEBRUARY 25.

ROYAL INSTITUTION, at 3.—Archæology: D. G. Hogarth.

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THURSDAY, FEBRUARY 23, 1905.

RECENT ENGLISH HISTORY.

Social England. Edited by H. D. Traill and J. S. Mann. Vol v., pp. lii+864; vol. vi., pp. lvi+948. (London: Cassell and Co., Ltd., 1904.) Price 14*s*. net each volume.

An Introductory History of England. By C. R. L. Fletcher. Pp. xvii+397. (London: John Murray.) Price 7*s*. 6*d*.

Studies on Anglo-Saxon Institutions. By H. M. Chadwick. Pp. xiii+420. (Cambridge University Press, 1905.) Price 8*s*. net.

IN the fifth and sixth volumes of "Social England," lately re-issued in an illustrated edition (1904), considerable prominence is given to subjects of scientific as well as of historical interest. Thus Mr. T. Whittaker (rather more adequately than in earlier stages) writes on philosophy and natural science in the eighteenth century and the Napoleonic age, and for the same period Mr. D'Arcy Power discusses medicine and public health, Mr. Raymond Beazley exploration and the advance of geographical knowledge, and Mr. G. T. Warner manufacturing progress, machinery, and the transformation of industry (v., 31–47, 56–73, 145–55, 292–307, 321–33, 408–35, 543–6, 560–84, 625–45, 756–60, 805–22).

In the final or nineteenth century volume, geology, chemistry, astronomy, physics, biology, anthropology, engineering, mining and metallurgy, applications of electricity, and the railway system of the United Kingdom are also treated, in addition to our old friends philosophy, medicine, and exploration. The list of scientific writers is much enlarged, and comprises Prof. T. G. Bonney, Mr. Robert Steele, Mr. H. C. Jenkins, Lord Farrer, Miss A. M. Clerke, Mr. W. G. Rhodes, Mr. O. G. Jones, and Dr. J. Scott Keltie (vi., 76–95, 239–90, 413–48, 675–793, 892–927).

Among these contributions we may especially notice, for the sake of illustration, that of Dr. Keltie on British exploration, 1815–85. Here we have a good, clear, business-like summary (very well illustrated, especially by contemporary maps) of a great and significant chapter in the life-history of the English people. But the amount of matter to be treated is so vast, and Dr. Keltie is so conscientious in his determination not to omit a reference, however brief, to every important personage and event within the limits of his subject, that the narrative becomes at times a chronicle of the nature of "materials for history." Thus, in tracing the course of British explorations in Central Asia and the Far East alone, the work of Moorcroft, Wood, Shaw, Forsyth, Hayward, Trotter, Carey, Bell, James, Younghusband, Basil Hall, Collinson, Fortune, Blakiston, Ney Elias, Sladen, Margary, Gill, Baber, Colquhoun, McCarthy, Williamson, Gilmore, Alcock, and Mrs. Bishop is summarised in two pages. It is no doubt difficult to avoid such treatment, and the secretary of our Geographical Society is an excellent chronicler; but it is perhaps open to question whether a more selective and less annalistic method might not have been followed in this as in certain other articles, such as the "Engineering" of Mr. O. G. Jones, where a more philosophic style is adopted with marked success.

The British history of the nineteenth, or even of the eighteenth, century in one volume, even though that volume run to 930 pages, is an undertaking of no small difficulty; as the assistant editor—and true chief pilot—of the venture, Mr. J. S. Mann, himself admits. Intellectual and industrial achievements are now so multifarious that they can hardly be dealt with in the same book as the political and social history. Science has become more than ever cosmopolitan; processes in the great staple trades have undergone developments far too specialised for the ordinary reader; to a vast number of secondary and miscellaneous industries and interests it is impossible to assign any adequate recognition; a bare enumeration, the recognition of an allusion, is all that can be spared for whole chapters of national progress during the last age. To such themes as railways, merchant shipping, the machinery of commerce, the new developments in social organisation, art, and literature, it seems almost useless to devote a few pages; while the subject of colonial history has only to be mentioned for the most casual reader to recognise the increased complication which the nineteenth century has brought to the national story.

Even since 1885, where the editors originally drew their line (evidently with some later regrets that this boundary could not be shifted down to the close of the Victorian reign), the local government of the United Kingdom has been profoundly modified; new methods have been introduced into industry; shipbuilding has taken a fresh start; legal reform has made notable progress; labour questions have been attended by many fresh developments; and an Imperial and Conservative movement (or reaction) of the most far-reaching character has influenced every side of national life and consciousness.

All the more heartily, then, we can congratulate the editors, contributors, and publishers of "Social England" on the measure of success they have realised, on the immense body of valuable information (sometimes a trifle unsifted, sometimes marred by error, but on the whole highly creditable) which is presented in these volumes, on the impartiality and truly scientific spirit which pervade almost the whole of the work, and by no means least, on the suggestive and representative illustrations by which the best of all possible commentaries is afforded to the text.

Mr. Fletcher's "Introductory History of England" down to the accession of the Tudors, where the author fixes, for his purpose, the close of the Middle Ages, is a brave and vigorous attempt to get away from dulness without losing touch of truth, to invest the story of mediæval England with an interest which is lacking in such arid text-books as have become only too plentiful of late. As we might expect from

Mr. Fletcher, the book he has now given us is eminently characteristic, full of his own energetic, practical activity, his love of health, fresh air, and good exercise.

"When I began," he tells us, "I had foolish hopes that it might be a book some boys would take up for amusement, but I soon discovered that twenty-three years of teaching had made it impossible for me to do more than smear the powder with a thin layer of jam. We cannot render our dreams of the past (however convinced we may be of their truth) into an intelligible consecutive story."

Here, it seems to us, there is both truth and untruth. Mr. Fletcher's story is, in the main, highly intelligible and adequately consecutive (though one may make an exception of the Anglo-Saxon period, where the author seems at times almost to sink to Milton's notions of "kites and crows"); but how can any true student regard English history as if it were a nauseous drug, to be made palatable by some device? Should one not rather look at it as a storehouse from which a good judgment is needed to draw forth those treasures best suited to the audience one addresses—to the specialist this, to the general reader that, to the working man one thing, to the merchant, the professional man, or the politician another?

Yet though Mr. Fletcher anxiously disclaims the idea of pouring information into anyone, and still more anxiously repudiates the ambition of helping anybody to pass any examination, he has certainly given us here a sketch of living men by a living man, and everyone who is not a pedant, everyone who desires to remember that history is the life-record of humanity, will be grateful to him for this book. Peculiarly interesting is the picture attempted of an imaginary village in pre-Norman, Norman, and post-Norman times, with its three fields, for wheat, barley, and pasture, its arable strips, its green common or waste, its water-meadows, its pig-grazing woods, its no-man's land, and its bull-croft—as successful an attempt to realise the township-manor as any popular treatise has supplied in English of recent years; while a word must also be said in praise of the capital little chapter of geological history, illustrated by a serviceable map of N.W. Europe in the Old Stone age, with which Mr. Fletcher commences.

Mr. Chadwick's "Studies on Anglo-Saxon Institutions" supplies a useful corrective to the studied vagueness with which Mr. Fletcher treats our English history. Here a careful re-examination of the evidence bearing on some of the most interesting problems of early English history and sociology is attempted with distinct success. The writer's object has especially been to call attention to those branches of the subject which have hitherto suffered from comparative neglect. Thus he has dealt very lightly with Mercian and Northumbrian history because he had nothing of importance to add to previous work; but evidence relating to Kent, Sussex, Essex, and the Hwiccas has been reviewed and re-stated with great care, and with the belief that some fresh results have been attained. The most valuable portion of the volume seems to be that dealing with the old English monetary system (accompanied by a useful excursus on Frankish coinage, pp. 1–75). And next to this the reader may be recommended to the chapters dealing with the history of the older counties (Kent, &c., pp. 269–307) and with the origin of the nobility (pp. 378–411). Great caution marks all Mr. Chadwick's work, and this quality is never more useful than in such a difficult period as the Anglo-Saxon. But his treatment of our early charters is also noticeable for its courage; when, even in obviously spurious documents, names and titles otherwise unknown are met with, the author, with a daring that will perhaps greatly shock some dogmatists, ventures to think that such names and titles are not necessarily products of imagination. To find one who will say this, and who will appeal moreover for a fairer hearing in the examination of tradition, popular as well as ecclesiastical, is certainly refreshing at the present moment.

STEREOCHEMISTRY.

Materialien der Stereochemie. (In Form von Jahresberichten.) Band i., 1894–1898; Band ii., 1899–1902. By C. A. Bischoff. Pp. cxxxvi+1977. (Brunswick: Vieweg and Son, 1904.) Price 90 marks.

IN the course of his reply to a letter from the Chemical Society of London congratulating him on the completion of the twenty-fifth year of his doctorate, Prof. Emil Fischer writes as follows:—

"The time when the fundamental principles of our science were laid down, and when it was possible for the individual investigator to stamp the impress of his own mind upon it, is long since past, and in the gigantic structure, which it now represents, each fellow-worker can only finish some small fragment, or it may be, if he is fortunate, a pretty balcony or a striking turret."

The two ponderous tomes, in which Prof. Bischoff records the advances made in stereochemistry from 1894 to 1902, illustrate in a very striking manner this ever-increasing tendency to specialism in chemical research, which Fischer emphasises in the sentence just quoted.

Although Pasteur, in 1861, by his classical experiments with the isomeric tartaric acids, may be said to have laid the foundation of stereochemistry, the growth of this branch of chemical science was at first slow, since it was not till 1873 that Wislicenus pointed out as a consequence of his work with lactic acid that differences between compounds of identical structure must be ascribed to differences in the spacial arrangement of their atoms within the molecule. The publication in the following year by van't Hoff and Le Bel of their theory of the asymmetric carbon atom gave an immense impulse to experimental work, so that optically active compounds, which in those earlier days were numbered by tens, may now be counted by thousands.

The rapid development of stereochemistry is not, however, restricted to the field of optically active compounds. The researches of Victor Meyer and of Bischoff are fundamental in that branch where the normal and abnormal courses of many reactions are interpreted from a stereochemical standpoint. Then again, the study of geometrical isomerides, such as substances of the ethylene type with the so-called double linkage between carbon atoms, of polymethylene and heterocyclic compounds, of compounds with a double linkage between a carbon atom and a nitrogen atom, and finally of compounds with a double linkage between two nitrogen atoms, has engaged the attention of many prominent contemporary workers.

The well-known "Handbuch der Stereochemie," by Walden and Bischoff, gives a comprehensive survey of stereochemical literature up to the year 1894. Owing to the rapid developments of the last ten years, however, this work has lately lost much of its initial value as a source of reference. This defect is now remedied. In the "Materialien der Stereochemie" we have an addendum to the "Handbuch," the literature of each successive year from 1894 to 1902 being classified in a manner which cannot fail to prove of the utmost service. The subject matter for each year is treated under four sections, namely, general stereochemistry, optical isomerism, geometrical isomerism of optically inactive compounds, and interdependence of spacial relationships and chemical reactions. A brief description of each paper quoted is usually given. The first section on general stereochemistry, in addition to the bibliography of special monographs published during the particular year, embraces references to chemical dynamics, crystallography, spectroscopy, &c., in so far as those subjects have any stereochemical bearing. In the three other sections the papers of more general interest are first quoted; then follow references to the more special papers which are not quoted chronologically, but are conveniently classified according to their subject matter.

The field reviewed in the first subdivision of the fourth section deals with ring systems, and is so vast that, as a rule, only references are given to the innumerable papers quoted. On the other hand, the papers on polymerisation, substitution, addition reactions, hydrolysis, &c., included in the same section are dealt with in more detail.

The general student will find this work unreadable. The author contents himself with the abstract he gives, and hardly ever ventures on any criticism. Little or no attempt is made to differentiate between the important and the unimportant, and in this respect it seems to the present reviewer that more prominence might with advantage have been given to such research as is acknowledged by all to be outstanding. From the point of view of the specialist, however, the work is admirable. Its value lies not so much in the information actually afforded by the abstracts themselves as in the remarkably complete bibliography which it presents. The ardent stereochemist, who in his own particular sphere may be tempted to exclaim, "Zwar weiss ich viel, doch möcht' ich alles wissen," will assuredly find in this work an aid to the realisation of his desire.

A. McK.

A TRAVELLER'S GUIDE TO INDIA.

The Imperial Guide to India, including Kashmir, Burma and Ceylon. Pp. xi+244; with illustrations, maps, and plans. (London: John Murray, 1904.) Price 6s. net.

THE large and constantly increasing number of tourists and sportsmen who visit our Indian Empire during the winter, together with the smaller section who extend their trip so as to include a summer sojourn in Kashmir or some other Himalayan district, must create an extensive demand for a work like the one before us, and the wonder is that an attempt has not been made long ago to supply such a manifest want. In the present volume, which is got up in convenient size and shape for the pocket, and printed in small although clear type, with the chief items in caps. or block type, the anonymous author seems, on the whole, to have discharged a by no means easy task in a thoroughly satisfactory and painstaking manner. Indeed, so far as a somewhat extensive personal experience of the country permits of our forming a judgment, we may say that, as a viaticum and itinerary, which is, of course, its main purpose, the work is well-nigh all that can be desired so far as its somewhat limited space permits. Although necessarily brief, the descriptions of the towns, cities, and stations, and of the railway or other routes by which they are reached, are in the main excellent, and convey a very large amount of useful and necessary information. The various routes are also carefully planned and thought out, and will enable the tourist to find his way about and to visit much of what is most worth seeing with the least amount of discomfort and difficulty. Whether, however, the "selected Hindustani phrases" at the end of the volume will enable the tourist to make himself understood by the natives of even the Hindustani-speaking provinces may be more than doubtful.

But the author has not been content to make his work a mere itinerary. On the contrary, he treats his readers to brief dissertations on the ethnology, natural history, and geology of the Indian Empire, with scrappy pieces of information with regard to the sport to be obtained. With respect to this aspect of the volume, we are compelled to say, in the first place, that the author has not allowed himself sufficient space to make the information he attempts to convey of any real value, and secondly, that it would have been well had he taken expert advice and assistance.

One fault about the introductory chapter is that it is too "parochial." The volume professes to treat of India, Ceylon, Burma, and Kashmir, but this chapter, although the reader is not told so, seems to refer only to India proper. For instance, we are told that shooting licences are not required (p. 10), and yet we find (p. 186) that these are necessary in Kashmir. Again, in the ethnological paragraphs we find no reference under the heading of non-Aryan races to either the Veddas of Ceylon, the Burmese, or the Mongoloid tribes of the north-east frontier, while the classification of the natives of the peninsula merely by religion leaves much to be desired. The general description of Indian scenery—inclusive of natural history and geology—is, moreover, little short of ludicrous. What, for instance, are we to say of a writer who describes the rocks of the Himalaya as Archæan, although he does qualify this by stating later on that a band of Cretaceous (which is incorrect) and Tertiary rocks skirts the foot of the range? The reference to the Mesozoic rocks of the peninsula is also misleading, and we should like to know what "similar scenery in Europe" is recalled by the traps of the Ghats. A few colourêd plates of more or less characteristic Indian mammals and birds relieve the necessarily dry details of the work, but it would have been better if the author had made up his mind what name to employ for the Indian antelope, instead of calling it *Antelope* (in error, by the way, for *Antilope*) *bezoartica* on p. 12 and *A. cervicapra* on the plate. When a future edition of this otherwise excellent little work is called for it may be hoped that the introductory chapter will be re-written with the aid of some one who has at least a smattering of elementary information with regard to the geology and zoological products of the country. R. L.

OUR BOOK SHELF.

Bacteriology and the Public Health. By Dr. George Newman. Third edition. Pp. xx+497. (London: John Murray, 1904.) Price 21s. net.

DR. GEORGE NEWMAN is well known as a public health expert and bacteriologist, and his contributions to the literature of preventive medicine have attracted considerable attention both in this country and abroad. The present volume may be regarded as an elaboration of his previous writings, and is, in most respects, thoroughly up to date.

There are thirteen chapters, dealing with subjects as follows:—the biology of bacteria, bacteria in water, bacteria in the air, bacteria and fermentation, bacteria in the soil, the bacteriology of sewage and the bacterial treatment of sewage, bacteria in milk and milk products, bacteria in other foods, bacteria in disease, tuberculosis as a type of bacterial disease, the etiology of tropical diseases, the question of immunity and antitoxins, and disinfection. There is also an appendix on technique and a welcome index.

The chapters dealing with some of the pressing administrative problems of the day are specially worthy of commendation.

The chapter on bacteria in milk is an admirable dissertation, and the author deserves much credit for his judicious handling of a mass of conflicting opinion and apparently irreconcilable facts. For the benefit of those who regard the bacterial diseases of animals, some of which are preventable, as of little economic importance, the following quotations (p. 324, p. 319, p. 203, p. 204) may be given:—

"In 1903 there were in Great Britain as many as 1463 outbreaks of glanders in which 2490 horses were attacked. This is the highest number of outbreaks since 1892, when they numbered 1657. The prevalence of this disease is localised often to certain counties and districts. In 1903, 855 of the 1463 outbreaks occurred in the county of London."

"In 1903 there were 761 outbreaks of anthrax in Great Britain, in which 1127 animals were attacked. This is the largest return recorded since the passing of the Anthrax Order in 1886."

"It is a well known fact that tuberculosis is a common disease of cattle. Probably not less than 20 to 30 per cent. of milch cows in this country are affected with it."

"In the United Kingdom in 1901 there were 4,102,000 milch cows. If we take 2 per cent. of these as having tuberculous udders, it gives us 80,000. The average annual yield of milk per cow may be taken as, at least, 400 gallons, which means that from these 80,000 tuberculous udders 32,000,000 gallons of milk are obtained."

It is perhaps unnecessary to add that glanders, anthrax, and tuberculosis afflict man as well as the lower animals.

The book, judged as a whole, is a most valuable contribution to the literature of preventive medicine. It will prove most useful to medical officers of health, medical men, bacteriologists, veterinary surgeons, trade experts, and many others. The lay reader will find it replete with information, and written in a lucid and agreeable style.

In a sense, the present volume is a later edition of "Bacteria," which was noticed by the present writer in these columns in 1899; but the new publication is amplified and improved to such an extent as fully to merit this second notice. A. C. HOUSTON.

Die bisherige Tätigkeit der Physikalisch-technischen Reichsanstalt. (Brunswick: Vieweg and Son, 1904.)

Die Tätigkeit der Physikalisch-technischen Reichsanstalt im Jahre 1903. (Berlin: Springer, 1904.)

IN these publications is given an interesting account of the progress of the Reichsanstalt from its foundation in 1887 to the present time. From the first pamphlet by the president, Dr. Kohlrausch, we find that the total number of instruments tested up to the end of 1903 was 290,000, an average of nearly 20,000 a year. If, however, we deduct from this the number of clinical thermometers and of safety fusible plugs for boilers, the aggregate is reduced to 50,000, or an average total of about 2800 a year for all other instruments. Against this figure we may compare the totals taken from the report of the National Physical Laboratory for 1903, from which it appears that the aggregate for the year for instruments and tests of all kinds was 30,817, or, excluding clinical thermometers, 11,424.

An interesting recent development of the Reichsanstalt is the opening at various towns throughout Germany of five branch stations, where electrotechnical instruments can be verified. The report concludes with a long list of the recent original papers published by the members of the staff.

It is not possible to give in the space here available anything like an insight into the manifold contents of the second publication—the report of the Reichsanstalt for the year 1903. The researches mentioned include the expansion of water between 0° C. and 100° C., and of numerous materials from liquid air temperatures upwards, the laws of radiation, light units, and magnetic permeability. Full details are given as to the numerous instruments tested.

J. A. H.

The Principles of Inorganic Chemistry. By Wilhelm Ostwald. Translated by Dr. Alexander Findlay. Second edition. Pp. xxxi+799. (Macmillan and Co., Ltd., 1904.) 18s. net.

THE best proof of the excellence of this work and its appreciation by English-speaking students is that a new edition has been found necessary after such a comparatively short time as two and a half years. The work, unlike many text-books on chemistry, forms interesting reading, and this is greatly caused by the excellence of Dr. Findlay's translation. The present edition is practically a reprint of the first, except in so far as a few pages have been added on radio-active phenomena, in connection with the metals thorium and uranium; a necessarily short description is given of compounds of radium, and a sketch of the transformations undergone by that curious element in arriving at a stable condition. W. R.

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 Contemplated Magnetic Survey of the North Pacific Ocean by the Carnegie Institution.

A project for a magnetic survey of the North Pacific Ocean by the Department of International Research in Terrestrial Magnetism has been favourably acted upon by the executive committee of the Carnegie Institution of Washington, and authorisation has been given to begin the work this year. An initial allotment of 20,000 dollars has been made to cover the expenses for the current year.

As is well known, the state of our knowledge of the distribution of the magnetic forces over the greater portion of the earth—the oceanic areas—owing to the paucity of precise data, is exceedingly unsatisfactory. This fact is especially true for that great body of water the Pacific Ocean, rapidly developing in great commercial importance.

Captain Creak, for many years superintendent of the Compass Department of the British Admiralty, now retired, says:—"The North Pacific Ocean is, with the exception of the voyage of the *Challenger*, nearly a blank as regards magnetic observations, and I therefore think the Magnetic Survey proposed will be of great value."

Hence, except for data from occasional expeditions and such as were acquired in wooden vessels a long time ago, the present magnetic charts used by the navigator over this region depend largely upon the observations on islands and along the coasts. Such land observations, however, are rarely representative of the true values because of prevalent local disturbances. It is, therefore, impossible to make any statement as to the correctness of the present charts. The demands of science, as well as those of commerce and navigation, require a systematic magnetic survey of this region under the most favourable conditions possible, and that the work be done under the auspices of some recognised research institution in order to ensure that the scientific aspects of the work receive their adequate recognition.

The eminent physicist and magnetician Prof. Arthur Schuster states as his opinion:—"I believe that no material progress of terrestrial magnetism is possible until the magnetic constants of the great ocean basins, especially the Pacific, have been determined more accurately than they are at present. There is reason to believe that these constants may be affected by considerable systematic errors. It is possible that these errors have crept in by paying too much attention to measurements made on islands and along the sea coast. What is wanted is more numerous and more accurate observations on the sea itself." Furthermore, the superintendent of the United States Coast and Geodetic Survey, Mr. O. H. Tittmann, says:—"There is no doubt in my mind that a survey for that purpose would result in obtaining data of great and permanent value, and that it should be undertaken."

Additional quotations could be given; the above, however, are representative, and show sufficiently the great importance of the proposed work and the fruitful results that may confidently be expected. It is hoped that upon the completion of the magnetic survey of the North Pacific the means will be forthcoming for extending the survey so as to include other oceanic areas. An effort will furthermore be made to secure the interest and cooperation of all civilised countries, so that we may look forward to the completion of a general magnetic survey of the accessible portions of the globe within about fifteen years. Thanks to the awakening and renewed interest in magnetic work shown on all sides, I fully believe that this hope will be realised.

The matter of prime consideration in magnetic work at sea is the elimination of the effects resulting from the ship's own magnetism as due to her construction and equipment. Such effects are especially troublesome to eliminate when it is proposed to obtain not only the magnetic declination at sea, but also the other magnetic elements (the dip and the intensity of the magnetic force). The plan therefore to be attempted this year, as worked out by Mr. G. W. Littlehales, Hydrographic Engineer of the United States Hydrographic Office, and Consulting Hydrographer of the Department of Terrestrial Magnetism of the Carnegie Institution, is, in brief, as follows:—"To charter a wood-built, non-magnetic, sailing vessel of about six hundred tons displacement, which starting out in summer from San Francisco, shall pursue a clockwise spiral course embracing the entire North Pacific Ocean. The object of planning such a course is to gain continuous advantage throughout the survey of the dynamical agencies of the atmosphere and the ocean, in passing in succession into each of the five degree quadrangles into which the chart[1] is divided, and in which observed values of the three magnetic elements need to be obtained.

"The seasonal shifting of the permanent centres of barometric pressure will cause a variation from month to month of the conditions of wind and current that are represented on this particular chart, but if the departure from San Francisco be taken in the summer, the chain of meteorological events will contribute toward the maximum progress over the course passing thence along the west coast of America to the vicinity of the Galapagos Islands, thence across the Pacific in latitude between two and three degrees north, thence along the eastern side of the Philippine Archipelago and the Empire of Japan, thence eastward in about latitude fifty-two degrees north, thence to the latitude of San Francisco, and thence continuing through the series of areas, bounded by parallels of latitude and meridians of longitude each five degrees apart, lying next on the mid-ocean side of the circuit last made, and proceeding gradually and by successive circuits into the central region of the North Pacific."

The total length of the course marked out is about 70,000 knots; however, each of the first circuits practically closes at San Francisco, so that, if it is found that the method pursued is not the best, the work can readily be terminated or modified. From inquiries made, it would appear that the entire work of observation and reduction can be accomplished in three years. The cost per month of the field work, inclusive of all expenses and services, will be approximately fifteen hundred dollars. Counting eight months of continuous service per annum, the total annual outlay is estimated at about twelve thousand dollars.

This project, as a result of careful consideration and solicitation of expert opinion, is believed to be thoroughly feasible. It permits of useful comprehensive results being immediately obtained, and is one which can be interrupted without any important waste of antecedent expense whenever circumstances may render a discontinuance or a modification of the original plan advisable.

The region it is proposed at present to survey fortunately contains magnetic observatories in requisite number and proper distribution for furnishing the necessary corrections to be applied to the observed magnetic elements in order to reduce them to a common epoch. Thus continuous records of the magnetic variations required for this purpose will be available from the following stations:—Sitka, Mexico, Honolulu, Manila, Shanghai, Tokio. In addition, it is hoped that there may be soon a magnetic observatory in California or vicinity for lending effective cooperation, and that the German Government will continue its magnetic observatory at Apia throughout the period of the survey. Also excellent opportunities for controlling instrumental constants and obtaining required additional data will be afforded by stations on the coasts and on islands.

It should also be pointed out that the plan of the courses

[1] The course to be followed was shown in red ink on a U.S. Hydrographic Office Pilot Chart of the North Pacific.

as mapped permits ready adjustment of the observed quantities for closed areas, in accordance with the potential hypothesis, and it may even permit, to a certain degree, the testing of the accuracy of this assumption, though as regards the latter more can be said at the end of a year's work.

While it is not anticipated that any marked irregularities in the distribution of the earth's magnetism will manifest themselves over the deep waters of the Pacific, it may confidently be expected that in the neighbourhood of the islands and along the coasts distortions and irregularities will be revealed. With the aid of the results of the detailed magnetic survey of the United States and Alaska, opportunity will therefore be afforded of studying the effect of the configuration of land and water upon the distribution of the magnetic forces. The first circuit, passing as it does along the American and Asiatic coasts, will yield especially interesting results in this respect. Thus, for example, along the Aleutian Islands marked local disturbances will be disclosed. Reports are received frequently from mariners in this region regarding the unsatisfactory behaviour of the compass; it is therefore greatly to be desired that a systematic magnetic survey of the waters in this region be made.

L. A. BAUER.

Department of Terrestrial Magnetism, Carnegie Institution, Washington, D.C.

Recently Observed Satellites.

IN reply to Sir Oliver Lodge's letter in NATURE of January 26 (p. 295), it may be said that while it is perfectly possible that the newly discovered satellites are captured comets (see *Harvard Annals*, liii., p. 60), yet the chances against the actual occurrence of the required conditions at exactly the right times, even in one case, are exceedingly large; in two cases they are practically prohibitive.

With regard to a possible meteoric constitution, it is known that the density of the four larger satellites of Jupiter is extremely small—but little above that of water. That their discs are frequently found to be elliptical when seen under favourable conditions has now been noted by more than a dozen different astronomers. The regularly recurring changes in their ellipticity, noted by several observers, taken in connection with the small density of these bodies, can hardly be explained in any other manner than by a meteoric constitution. Such being the case, it is highly probable, as Sir Oliver Lodge suggests, that the newly discovered satellites are similarly constituted.

A reply to his further suggestion that they are now in process of dissolution is impossible in the present state of our knowledge. If formed according to the nebular hypothesis, however, as seems most probable, and if they have accordingly existed through the æons during which their primaries have been contracting to their present dimensions, it seems highly unlikely that they should not yet have reached a permanent condition.

WILLIAM H. PICKERING.

Cambridge, Mass., U.S.A., February 9.

Compulsory Greek at Cambridge.

THE proposals of the Studies and Examinations Syndicate in regard to certain changes in the Previous Examination are to be submitted to the Senate on March 3 and 4. Members of the Senate may record their votes on either of these days between 1 and 3, or between 5 and 7 p.m. The controversy has chiefly turned on the proposal to abolish compulsory Greek, and it is mainly on this question that the issue will be decided.

All the five Graces are important, but Grace II., which raises the main issue, is the most important of all.

The secretaries of the committee in support of the recommendations of the syndicate will be glad to hear from non-resident members of the Senate who have not already intimated their intention of supporting the proposed reform. It is believed that amongst resident members of the Senate a majority will vote in favour of the new scheme, but the decision is largely in the hands of non-resident voters. As it is proposed to issue a final list of supporters shortly before March 3, it will be a convenience if additional names are sent to Mr. A. C. Seward, Emmanuel College, Cambridge, at once.

R. VERE LAURENCE,
H. RACKHAM,
A. C. SEWARD.

Cambridge, February 21.

THE experiences of Mr. Willis and others suggest that mine may be in point. Mr. Willis was behind in classics. He wasted $105\frac{1}{2}$ hours on Greek and passed. His present knowledge of Greek, he adds, is *nil*.

Mathematics were my difficulty. Being destined for Cambridge, I was specially coached in mathematics at school. Arrived here I was again coached, but failed. Coached once more I passed, having wasted, not one, but several hundred hours on that study. Needless to say, my knowledge of mathematics is *nil*.

My case is that of hundreds. Why, then, are not compulsory mathematics to be reformed away? Because they can be used in trades and professions for the making of money. But the things that put one touch of art in the life of a dull boy, that open his eyes for once to another world, where "utility" does not count—they, forsooth, must be dispensed with because in the market they have no value. And, verily, they are without price.

Away from Cambridge, an intelligent lady was lately speaking to me of her nephew at the University of Birmingham. Knowing nothing of our pending "reform," she said: "He is going to be an engineer. But he has got to waste his time passing in French, and German, and English. He will never want them again in his whole course. It is absurd." W. BATESON.

Cambridge, February 17.

Secondary Radiation.

IN a paper recently published (*Transactions* Royal Dublin Society and *Phil. Mag.*, February) I described some work on secondary β radiation given off by substances when exposed to β (and γ) rays from radium. The paper gave the relative intensity of this secondary radiation for only a few elements, but the results from these few indicated that the greater the atomic weight the greater was the secondary radiation.

I have since tested a large number of elements, and found this rule to hold without a single exception. The list of substances tested was a very varied one, including carbon, magnesium, aluminium, chromium, iron, nickel, copper, zinc, arsenic, selenium, molybdenum, silver, tin, antimony, tungsten, platinum, mercury, lead, and bismuth.

The secondary radiation is not proportional to the atomic weight; it increases less rapidly than the atomic weight.

This very general result appears to be of interest as bearing on the subject of radio-activity and atomic structure in general, but cannot be further discussed here.

J. A. MCCLELLAND.

University College, Dublin, February 13.

Tenacity to Life of a Grass-snake.

A GRASS-SNAKE which the writer had in his possession for eighteen months has just died.

A fact which seems worthy of note is the length of time during which this snake fasted. The last time the snake fed was June 11, 1904, the meal consisting of a small frog. From that time until the date of its death, February 2, it took no food, although constantly offered it. The animal thus existed for close on eight months without food. During the whole of this time it appeared in good health, and was, at times, most animated. No approach to hibernation was observed, and only for a little more than a week before its death did the snake seem out of health. The body was not unduly thin. E. V. WINDSOR.

Barnet, February 7.

NOTES ON STONEHENGE.[1]

IV.—THE EARLIEST CIRCLES (*continued*).

THE conclusion at which I have arrived is that the older temple dealt primarily, but not exclusively, with the May year; the newer temple represented a change of cult, and was dedicated primarily to the solstitial year. In both, however, the sunrises and sunsets of the June-December and May-November years could be, and doubtless were, observed. I direct attention to the following considerations in support of this theory.

(1) The blocks of unworked sarsen, perhaps dating from a time when the use of stone tools for working stone in Britain was unknown, are precisely those which give us the alignments, both for the May and June years.

FIG. 10—The vertical rod is placed in the axis, and marks the common direction of the present temple and avenue, which passes about 3 feet to the N.W. of the Friar's Heel.

(2) The blue stones, unworked for the same reason, may have originally composed two circles and a central stone as a start point for these alignments. The central stone, marking the centre of the two concentric circles, would naturally stand half-way between the N.W. and S.E. exterior sarsen stones.

In this first simplest form we should have the equivalent of the ancient temple described by Virgil, with the uncovered altar at the centre after the Etruscan fashion.

> "Ædibus in mediis, nudoque sub ætheris axe,
> Ingens ara fuit."

It is sad to think that at Avebury not so very many years ago there were two such double circles as those I postulate. They have now almost entirely disappeared. The central observing place, a cove, in the northern circle still remains with some of the stones of the outermost circle; all the rest have been taken up, broken, and used for building. Truly the English are a "practical" people.

(3) At the reconstruction, about 1680 B.C., the solstitial cult was made predominant, and for some reason or other it was determined to change the centre of the circles in the new structure, and throw the N.E. alignment nearer the north, still remaining parallel to its old direction.

There may possibly have been two reasons for the reconstruction of the temple about the time I have named. At the date mentioned the place of sunrise from the old centre, which I have indicated, was hidden by the Friar's Heel, unless the observer, the high priest, were raised some few feet above the ground at its present level. It may have happened, then, that the difference of the sunrise place, brought about, as we now know, by the gradual reduction of the obliquity of the ecliptic, had shown itself in a very unmistakable way to the priests; in 2680 B.C. it was certainly well to the north of the Friar's Heel, and occupied an uninterrupted horizon, so that they might well wish to secure a clear horizon for the future; this they found by moving the centre of the circles, and therefore the solstitial line, a few (about 4) feet further to the N.W., still preserving their ancient pointer.

But this is not all. Colonel Johnston, the director of the Ordnance Survey, has obligingly pointed out to me that the present centre of Stonehenge, Sidbury Hill to the N.E., and the earthworks at Grovely Castle and Castle Ditches to the S.W., all lie exactly on the solstitial line in 1680 B.C. The top of Sidbury Hill may, then, have been taken for the new pointer, in which case the earthwork camp some 30 feet high on the top had not been built, for it lies a little to the north-west of the line.

(4) While it was determined to erect a temple on a much larger scale by the addition of a larger exterior circle of sarsens and a naos also of trilithons, it was also determined to utilise the unworked blue stones composing the two circles. But while the new sarsens were shaped where they were found (for the very good reason stated by Prof. Judd), the blue stones were taken up and trimmed *sur place* as the new more northerly line and the new centre, to say nothing of the new naos, necessitated their re-arrangement. In this way the excess of blue stone chippings found by Prof. Gowland is simply and sufficiently explained.

(5) It is quite possible that the rebuilding of the temple in 1680 B.C. was part of a very large general plan which could only have been undertaken by a large, powerful and comparatively civilised tribe or people under strict government, commanding the services of skilled mathematicians, for Colonel Johnstone's revelations do not stop at the continuation of the Stonehenge solstitial line to Sidbury and Grovely Castle.

The absolute straightness of this line might have been secured by fires at night, but there is more in

[1] Continued from p. 368.

it than this. Stonehenge, Old Sarum, and Grovely Castle occupy the points of an equilateral triangle of *exactly* six miles in the side, and the three sides are continuations of the entrances at Stonehenge and Old Sarum and of a ditch running through the centre at Grovely Castle. Further, the centre of the triangle

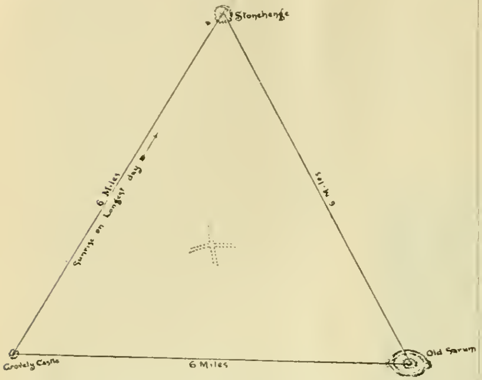

FIG. 11.—The equilateral triangle formed by Stonehenge, Old Sarum, and Grovely Castle.

is on the oldest cross roads in that part of Salisbury Plain.

The figures will show this, and also the curious position of other earthworks, as well as the fact that the line Stonehenge—Old Sarum passes *exactly*

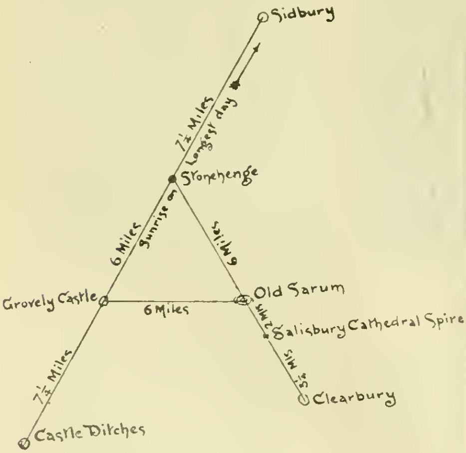

FIG. 12.—Showing the prolongations of the sides of the equilateral triangle.

through Salisbury spire, which again is exactly two miles from Sarum. We ought to restore the old name, Solisbury.

(6) It is probable that the avenue and vallum were added when the line of orientation was moved to the N., placing the new centre to the N.W. of its original position. In this way we can explain how it is that the Friar's Heel lies to the S. of the central line of the avenue, and that the N.W. and S.E. stones are situated at different distances from the vallum.

(7) The number and spacing of the sarsen stones in the new great circle were so chosen that the use of the N.W. and S.E. stones to mark the May new year's day originally could be replaced by observations through one of the trilithons. This was necessary if the May year was to be considered at all, as the use of the N.W. and S.E. stones was blocked by the new outer circle.

Now, on the hypothesis of an earlier temple, it becomes quite clear, from the method of erecting the sarsens revealed by Prof. Gowland's excavations, that the stones comprising the two concentric circles must have been removed, even if there were no other reason.

In the case of the leaning stone, we have evidence that it was erected from the inside of the circle, as the perpendicular wall of chalk is on its S.W. side. If all the other naos sarsens were erected in the same way, there could have been no upright blue stones in the naos. They must have been set in the places they occupy afterwards, because the upright members of the naos trilithons are well over 20 feet long, and this about represents the distance to the central portion of the naos.

The relation between the naos and outer circle trilithons also shows that the naos must have been built first, and further that the outer circle sarsens must have been raised from the inside. Those fallen are about 18 feet long; the average distance between the two systems of naos and outer circle trilithons is about 23 feet. Supposing the outer sarsens are 4 feet in the ground, and that there was a slope for them to slide down some 6 feet long, there would just be room, but none to spare, between the naos and the outer circle. There certainly would not be room enough to pull the stones upright unless the intervals between the naos sarsens were used, and the positions of the stones show that they could not have been conveniently so used, in some cases at all events; we may assume that to pull the stones finally into their perpendicular positions ropes at least as long as those employed by Mr. Carruthers would be needed.

In any case the blue stone circles must have been away, whether removed from their old positions or not, when the naos and sarsen circle were put up.

On this point Prof. Gowland is quite clear.

He writes: "That the stones of the central trilithon were erected from the inside of the circle has been conclusively demonstrated by the excavations, hence the 'blue stones' in front cannot have been erected before them. Moreover, the 'blue stone,' No. 68, the base of which was laid bare in Excavation V., was found to be set in the rubble which had been used to fill up the foundation of No. 56, and further, in a lower layer than its base, there were two small blocks of sarsen with tooled surfaces.

"Whether the outer sarsens were set up from the inside of the circle like the trilithons, or from the outside, is a point which can only be settled by future excavations. If from the inside their erection must have preceded that of the trilithons, and hence of the 'blue stones.'

"On the other hand, should the outer sarsens have been raised from the outside, it would not be possible for the 'blue stones' to have been placed in position before them, as they would then have seriously interfered with if not altogether prevented the erecting operations."

We may take it, I think, that the ring was erected from inwards, sufficient ground only being available outside for "a long pull and a strong pull."

In former notes I have referred to Mr. Cunnington's remarks on the remains of the syenite trilithon, and his suggestion that it formed part of an older temple. He expressed the view that the structure of Stonehenge as we know it with its trilithons was, in fact, suggested by it.

Now if we attempt to find the place it occupied before it fell by seeing where it would be most symmetrically placed in relation to the adjacent stones of the blue stone circles still standing, we are led to an interesting result. Using the old centre as determined from the N.W. and S.E. stones we find that the May sunrise would be seen through the small syenite trilithon. In this way also we can account for the fact that so far as is known this is the only trilithon which existed in the old blue stone circle; it may well have been that the centre and diameter of the new blue stone circle were so regulated as to retain it in position; I have already remarked that this was done in the case of the older unhewn sarsens, as a memorial of the past.

NORMAN LOCKYER.

THE APPROACHING TOTAL SOLAR ECLIPSE OF AUGUST 30.

THERE are many special features about the total solar eclipse of August of the present year. In the first place, perhaps the chief of these is that it will occur about the time when the solar atmosphere is greatly disturbed, or in other words, at a time when the number of sun-spots is about a maximum. Second, the localities from which it may be observed are well distributed over land surfaces, and some are easily accessible from the British Isles. Thirdly, observers will have to wait many years before another favourable eclipse occurs. That in 1907 will be visible in Central Asia, but its occurrence in January will deter many from seeing it. The two eclipses in 1908 will be visible only from the Pacific and South Atlantic. The eclipse of 1909 will occur in June in Greenland, while that in 1910 will be visible only from the Antarctic regions. In 1911 only a short portion of the end of the eclipse track will pass through a part of South Australia. It is therefore the eclipse of 1912, that will take place in April in Spain, which will be the next easily accessible one to observe; but as totality will only last 60 seconds, its duration will be brief compared with that of this year, which will last for more than $3\frac{1}{2}$ minutes.

Further, the fact that the approaching eclipse occurs in a month, such as August, when a great number of people are taking their summer holiday, and therefore can more easily leave these shores, should ensure the presence of many volunteer observers at the more easily reached stations. In the present instance the zone of totality commences in Canada towards the south of Lake Winnipeg, skirts the extreme south of Hudson's Bay, passes a little to the north of Nova Scotia, and then crosses the Atlantic. In Europe it strikes Spain (Fig. 1) on its north-west coast line, and leaves the eastern coast, enveloping the islands of Majorca and Iviza. Reaching Africa in the neighbourhood of eastern Algeria (Fig. 2), it passes through Tunis, Tripoli, Egypt, and the Red Sea, and finally terminates in Arabia.

In Spain an opportunity is afforded of making observations at some stations of high altitude, for the eclipse track includes several lofty mountains. For instance, Penas de Europa, south-west of Santander, and 8000 feet high, is one of numerous possible observing peaks, and advantage should be taken of this or some other elevated region.

It will thus be seen that there is plenty of scope for observers to scatter themselves along the line of totality, and this should be done as much as possible. The low altitude of the sun during totality at Labrador (27°) and Egypt (24°) renders both these regions somewhat unfavourable for the best observations, but there parties should at any rate be present. The former region can undoubtedly be left to Canadian and American observers, for it does not seem necessary that European observers should journey so far when more favourable stations are nearer at hand. The close proximity of Egypt to many European countries renders this part of the zone of totality easily accessible. Here the central line of totality passes just a little north of Assuan, the outer limits enclosing Edfu on the north and Darmut on the south.

The probable weather conditions at the different stations form an important item in eclipse matters, for clouds can easily mar the work of even the best

FIG. 1.—The path of totality across Spain. The duration of totality and the altitude of the sun at that time are given for four different stations along the line.

organised expedition. Omitting Labrador, a station that will not be occupied by observers from this country, the north-western portion of Spain does not seem to be particularly favoured with the required weather conditions. According to Señor F. Iñiguez, the director of the Astronomical and Meteorological Observatory of Madrid, this locality during August is not only cloudy and damp, but storms are of frequent occurrence. Such a report, however, should not prevent one party at least from taking up a position there, but it should suggest to many who had up to the present made up their minds to observe in that locality to seek stations further along the line, and not congregate at a very probably unfavourable station such as this appears to be. At stations towards the east the conditions seem to be more suitable the closer the Mediterranean side is approached, and, according to the authority mentioned above, the probability of fine weather on this coast is very high. Inland stations will probably have the disadvantages of dust and heat combined.

Perhaps one advantage of the north-west over the east coast is that the former will be very much the cooler, but in eclipse matters sky conditions precede temperature considerations.

With regard to such matters as suitable sites for instruments, their safety, guards for camps, building materials, &c., the Spanish Government can be depended upon to render every assistance to those who apply through the proper channels, and the valuable aid they gave to parties during the eclipse of 1900 is still in the memory of many observers.

Those who wish to know something about the routes to Spain, the methods of travel and approximate cost, will find some interesting and useful information in an article recently writen by Mr. G. F. Chambers, and published in the *Journal* of the British Astronomical Asociation (vol. xv., No. 2, p. 93). Another source of information specially useful to those visiting Spain is a publication just received from the Astronomical Observatory of Madrid, entitled "Memoria sobre el Eclipse Total de Sol del dia 30 de Agosto de 1905." This has been prepared by the director, Señor Francisco Iñiguez, and contains details about climate and many useful maps, in addition to data about the eclipse itself.

The weather conditions for the stations situated in Algeria, Tunis, and Tripoli seem to be very favourable, and should be made the most of. For Algeria, and more especially for the neighbourhood of Philippeville, we have some useful facts which have been communicated through M. Mascart by M. A. Angot, of the Bureau Central Météorologique, Paris. Dealing first with cloud and rain, we learn that during the months of July and August Philippeville is the clearest and driest of all the coast stations in Algeria, the mean rainfall for these months amounting to 4 and 10 millimetres respectively out of a total of 807 millimetres for the whole year. The average number of rainy days for each month totals two or three. Storms are rare, but increase towards the interior. If we represent clear sky by 0 and sky covered by 10, then 2 or 3 would represent the condition of cloudiness at Philippeville.

As regards temperature, the diurnal variation has an amplitude of 9° C. or 10° C., the mean temperature being 24° C. (75° F.). By night the temperature would thus be about 18° C. or 19° C. (64° F. or 66° F.), and at two hours after noon the maximum day temperature would reach 29° C. or 30° C. (84° F. or 86° F.). For stations situated some tens of miles inland there is a very rapid increase of day temperature.

The prevailing winds in August vary from N.E. to N.W., *i.e.* are sea winds; they are not strong, and are not much augmented by the sea breeze.

In Egypt the prospect of fine weather in August is also very great, so that observers who go to that region need not be very anxious, at any rate about clouds.

It is impossible at present to give a full or even final statement regarding the distribution of parties along the line of totality, but the following preliminary, but incomplete, list may be of interest, and indicates not only the regions that will be occupied by most of the British expeditions, but the chief types of observations that are proposed during the brief interval of totality. For the greater part of this information I am indebted to Major E. H. Hills, C.M.G., secretary of the Joint Permanent Eclipse Committee of the Royal Society and Royal Astronomical Society:—

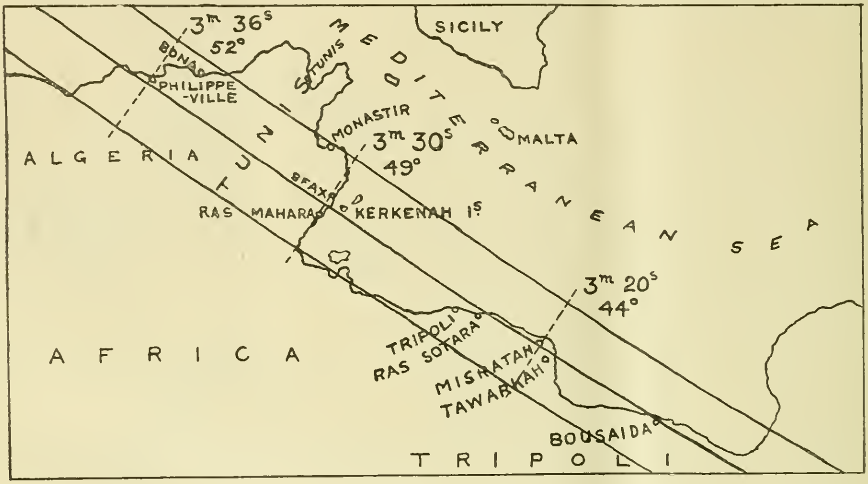

Fig. 2.—The path of the totality track in northern Africa. For three stations the duration of totality and the altitude of the sun during the eclipse are marked on the map.

Labrador.

Lick Observers ... ... — Search for intra-mercurial planets. Large scale corona photographs.

(Canadian parties probably.)

Spain.

Mr. John Evershed. Near Burgos... — Prismatic reflector photography of chromosphere and corona.

Prof. Callendar ... Prof. A. Fowler ... Mr. W. Shackleton.	Near Oropesa.	Experiments on coronal radiation. Photography of the red and green regions of the spectrum of the chromosphere and corona.
Lick Observers		Search for intra-mercurial planet. Large scale corona photographs. Polarisation observations. Spectroscopic photographs of chromosphere and corona.
	Algeria.	
Sir Norman Lockyer Dr. W. J. S. Lockyer Mr. C. P. Butler ...	Near Philippeville	Prismatic camera (three prisms) photographs of chromosphere & corona. Large scale prismatic reflector photographs of chromosphere & corona. Small scale photographs of corona.
Mr. H. F. Newall...	Near Bona ...	Spectroscopic and polariscopic observations.
	Tunis.	
The Astronomer Royal ... ... Mr. F. W. Dyson... Mr. Davidson ...	... Sfax ...	Photographs of the corona on 4-inch and 1¼-inch scales. Spectra of chromosphere & corona with Major Hills's spectroscopes.
	Egypt.	
Prof. Turner ... ... Mr. Bellamy	... ...	Polariscopic observations. Corona photographs with Abney doublet. (Large scale photographs of the corona ?)
Lick Observers		Search for intra-mercurial planets. Large scale corona photographs. Integrating spectroscopic photographs.

One of the novelties that will be attempted during this eclipse will be the photography of the eclipsed sun by means of the three-colour process. The camera that will be employed will probably be one having three lenses, so that the exposures through the three coloured screens can be made simultaneously, the correct ratio of the exposures being obtained by adjusting the apertures of the lenses.

When it is considered that in addition to these parties there will most probably be expeditions from several other countries, such as Spain, Portugal, Holland, France, Germany, Italy, Russia, Egypt, &c., and probably one or two more United States expeditions, there is a great opportunity not only for occupying a large number of different stations along the line, but of gaining a quantity of valuable material to enlarge our knowledge of solar physics.

WILLIAM J. S. LOCKYER.

THE CEYLON PEARL FISHERIES.[1]

LITTLE enough is done by the State in this country in the matter of aiding scientific research, and this is especially true of biological science. To this attitude of indifference, or aloofness, we have grown accustomed; abroad it is a subject for uncomplimentary comment. This attitude cannot be due to the conviction on the part of our ministers that "science is bankrupt," since when some great industry is threatened by injuries which legislation is powerless to check, or some pest is threatening the welfare of the community, the aid of the man of science is at once invoked.

The Pearl Fishery Commission is a striking example of the intervention of the State to aid a crippled industry by calling in the aid of the biologist.

The series of barren years alternating in some mysterious way with years of plenty puzzled those engaged in this fishery for more than two centuries, and, moreover, seriously reduced the profits of the fishing. To fathom this strange uncertainty, and if possible to find means whereby more uniform harvests could be ensured, the Government submitted the matter to a commission of inquiry, which has been held under the auspices of the Ceylon Government. The results of this inquiry have abundantly justified those responsible for its inception, and should do much to establish the advisability of instituting inquiries into other problems to which we could point that can only be dealt with by trained and experienced biologists.

The second part of Prof. Herdman's report to this commission in no wise suffers by comparison with the first volume. It is a very mine of information, yielding rich lodes of fact without the trouble of any preliminary crushing or sifting.

This report opens with a luminous review of the history of the principal fisheries from 1801 to the present time, and should prove of the highest value to those engaged in pearl fishing in future, for the causes of the rise, zenith, and decline of the different fisheries between these dates have been analysed and tabulated.

It is now established beyond doubt that the normal life of the pearl oyster does not average more than five years, and that these, especially to an animal so peacefully disposed as an oyster, are full of catastrophes and rumours of catastrophes!

By way of illustration as to the truth of this, we may well select an instance or so from this report. On the "Kondatchi Paar" in March, 1902, there were about 5,750,000 oysters. By March, 1903, these had been almost entirely wiped out of existence—eaten by starfish! File-fishes and enormous rays also show an insatiable appetite for oysters, and in the course of a few months will devour millions! Not seldom these oysters are smothered or killed by the invasion of hordes of young of their own species. But this is not all. Shifting sands may overwhelm incredible hosts, and millions are swept away by currents.

Man, says Prof. Herdman, "can do comparatively little to mitigate the severity of such influences as tell against the life and prosperity of the Pearl Oyster."

But it is just because he can do so little that there is so great a need of a vigilant and intelligent watch being constantly kept on the different fishing grounds. To a very considerable extent, Prof. Herdman has shown that man can make good these ravages, or snatch the remnant at least of a disappearing host from destruction. His plan is to transplant young oysters from beds known to be dangerous into more sheltered areas. This rescue work is to be further turned to account by using the waifs and strays, which are to be garnered by the inspection vessel, for restocking old beds, where they may grow and thrive—and become infected by the chosen parasite to keep up the growth of pearls of great price!

To ensure this infection is one of the problems which Mr. Hornell, the inspector of fisheries, is to solve.

The life of the pearl oyster is, as we have remarked, about five years, and it is from those of this age that the finest pearls are obtained. Herein lies a danger, since there is always a strong temptation to delay fishing as long as possible to ensure big pearls. Unless, as Prof. Herdman points out, these beds be carefully watched, one of the many catastrophes which attend pearl oysters may carry off this precious crop before

[1] "Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar." By W. A. Herdman, D.Sc., F.R.S., &c. Part ii. Pp. viii+300. (London: The Royal Society, 1904.)

it can be gathered. A case in point is given by Prof. Herdman. The Mutuvaratu Paar, which lies to the south-west of Karativo Island, yielded during 1889, 1890, and 1891 some 117,000,000 oysters, which realised very nearly 1,000,000 rupees—the only fishery since 1814 that has returned so large a sum. The oysters raised during these three years steadily increased in value, those lifted in 1891—the oldest—being by far the most valuable. "But the record," he remarks, "shows the risk there is in trying for the enhanced value by delaying the fishery once the oysters are over 5 years of age. In 1891 this bed must have been 6 years old, and they are described as rapidly dying off, many being dead and putrid."

There are prospects of a good fishing for next year and 1906, but the results of 1907 and the succeeding years depend largely, it is pointed out, on extensive measures of transplantation being undertaken without delay. This Mr. Hornell will doubtless accomplish.

Prof. Herdman's memoir on the anatomy of the pearl oyster adds much to our knowledge of the subject, and contains some valuable observations on the living animal. As an instance of the latter we may cite his remarks on the functions of the foot. These, he points out, "are three-fold: the distal ventral surface subserves locomotion; the median and posterior parts effect attachment by means of the byssal fibres; and lastly, on account of the general mobility of the organ, and probably of its sensory nature, the tip is of great use in clearing the gills and mantle from the intrusive particles that cannot otherwise be got rid of."

FIG. 1.—Pearl-fishing Fleet at work on the Cheval Paar.

It is concerning the latter function that we would direct special attention here. In the living animal Prof. Herdman has observed the foot "pushed between the gill-plate, and over the inner surface of the mantle gently stroking the surface and insinuating itself into the crevices, thus freeing the parts from any foreign bodies . . . that might cause inconvenience."

Mr. Hornell observed one oyster, which had sustained an injury to the mantle, pass the foot-tip gently around the edges of the wound so as to work off the particles of dirt collected there. The tip was even passed *through* the wound to make the cleansing the more thorough.

Concerning the byssus, it is interesting to notice that the operation of dredging for oysters for transplantation in no wise injures the animal when anchored by the threads of which this is composed. Under a great strain these break, and are renewed again within an hour or so, the root of the old byssus being sloughed off.

Some interesting points concerning gill structure are given, especially with regard to the passage from interfilamentar junctions by ciliated discs to junctions by organic union.

With regard to sense organs, the pearl oyster is not very well provided. But a distinct response is shown to the stimulus of light and shadow—"a sensibility which may be termed dermatoptic," and appears to be located in the edges of the mantle and the surface of the foot, where patches of more or less deeply pigmented epithelial cells are met with.

All kinds of creatures seem to find the pearl oyster a particularly "toothsome" morsel, man alone excepted, who prefers to make manure of their bodies for the sake of possible pearls contained therein.

No less than seven different kinds of parasitic worms are now known from the pearl oyster, six of which are new species described in this volume. Of these, only one, a cestode larva (*Tetrarhynchus unionifactor*), appears to be concerned in the formation of cyst pearls. This fact is interesting, inasmuch as the formation of similar pearls in European mussels is due to the cercaria of trematodes.

As to the sequence of hosts called upon to nurse this precious cestode of the pearl oyster to maturity much uncertainty prevails. It was thought that file-fishes and elasmobranchs were the intermediate vertebrate hosts, and this will probably prove to be the case.

Certain novel features seem to be foreshadowed in the life-history of this parasite when the chain of evidence is complete.

To begin with, it would appear that it enters its first host—the pearl oyster—as a free-swimming planaria-like larva, inasmuch as certain larvæ of this type, but containing calcareous corpuscles recalling those of cestodes, were taken in plankton, and these bear, in many features, a close resemblance to the earliest encysted larvæ found in the pearl oyster.

It is assumed that these free-swimming forms are tetrarhynchids, though hitherto it has been believed that tetrarhynchid larvæ make their way into their first hosts while still encased within the egg-shell. The bothriocephalids have free-swimming larvæ, but these are ciliated. That the larvæ in question must be tetrarhynchids seems certain, since older larvæ, showing several stages of development, belonged unquestionably to the genus Tetrarhynchus.

It was believed that these larvæ were next ingested by file-fishes (Balistes), but it now appears that the tetrarhynchid larvæ of Balistes, of which three species are described in this report, are quite distinct forms, distinguished by the presence of a vesicle, which is wanting in the pearl oyster larvæ. Further, the more advanced larvæ of the pearl oyster have arrived at a later stage of development than the larvæ found in Balistes.

The final stage of the pearl oyster cestode was supposed to be undergone within the body of an elasmobranch which fed upon Balistes. But, so far, the only elasmobranch tetrarhynchid which the authors have examined was obtained from the spiral valve of a sting ray (*Taeniura melanospilos*), and this larva was of a species quite distinct from either the Balistes or oyster larvæ. It is to be noted, however, that from this ray two perfect specimens of Balistes were taken.

Thus, though we may yet find that the sequence of hosts is as was indicated in the first volume of this report, we are at present left somewhat in doubt. In due time, doubtless, Messrs. Shipley and Hornell, the authors of this really fascinating section, will solve the riddle.

We have dealt at some length on this matter because, apart from its interest as a sequence of stirring events in the life-history of a very humble organism, it has considerable importance from an economic point of view: since, when the chain of evidence is complete, it may be possible, as was first suggested by Keelart in 1857, to raise the percentage of pearls by infecting oysters in other beds with their parasites.

Prof. Jeffrey Bell contributes some notes on the echinoderms, appended to a description of the species collected, by Prof. Herdman. Although these notes barely fill three pages, Prof. Bell has crowded into this space some trenchant criticisms and some really valuable facts.

The reports on the arthropods are full of interesting matter, and deal with a large number of new species; but we venture to think that a longer summary of the principal results arrived at would have added to the usefulness of these chapters. Dr. Calman's work on the Cumacea will be welcomed, inasmuch as no species of this group have hitherto been described from any part of the Indian Ocean.

The collection of cephalopods has been worked out by Dr. W. E. Hoyle. Though small, it contained one new species of unusual interest. This was a small octopus, which has been named *Polypus arborescens* on account of the presence of curious branched processes scattered all over the body, some of which are surmounted by a tuft of fibrils. After a most careful study Dr. Hoyle is still uncertain as to their purpose. He dwells at considerable length upon their microscopical structure. He is satisfied that they are not parasitic organisms, nor are they, he considers, glandular or phosphorescent organs. The fact that no nerves have been traced to them would seem to show that they are not tactile bodies, yet on the whole he considers that it is this function which they perform. Prof. Herdman, who has studied the living animal in a small tank, describes these mysterious processes as being contractile, and "kept frequently moving—uncoiling to a considerable length and then curling up again suddenly." This seems to suggest that they may be alluring organs comparable to the waving flag of the angler-fish or the long, worm-like tongue of the "mata-mata" tortoise.

The fishes collected during this investigation have been described by Mr. J. Johnstone. Twelve species in all are dealt with.

The most interesting feature of this report is that concerning the supposed naso-pharyngeal passage in Cynoglossus. Kyle, in 1900, described in this genus a curious nasal sac, which, he believed, communicated with the mouth by means of a pore in the floor of the sac, a feature which he regarded as of considerable morphological importance.

Mr. Johnstone examined several species belonging to this genus, and in no case did he find this naso-pharyngeal passage. But what is really interesting is the fact that he found this cavity, on more than one occasion, inhabited by a copepod. Since this creature anchors itself by hooks, the presence of an occasional hole in the floor of this chamber is not to be wondered at!

There is a wealth of plates in this volume, all of which are as good of their kind as one could wish. The same cannot be said of one or two of the text figures, however, which leave much to be desired—notably the figure of the dissection of a pearl oyster on p. 43.

Yet another volume is required to complete this report; this is promised early next year. Judging by the standard set by the two volumes now issued, the complete work will form one of the most valuable commentaries on a great industry yet issued.

W. P. P.

NOTES.

AT the invitation of the British Association, the local committee in Johannesburg has nominated the following as vice-presidents and secretaries respectively of the different sections for the meeting in South Africa, the general arrangements of which were described in NATURE of February 2 (p. 323):—*Mathematics and Physical Science*—vice-president, Dr. Breyer; secretary, Mr. R. T. A. Innes. *Chemistry*—Mr. J. R. Williams, Mr. W. A. Caldecott. *Geology*—Dr. Corstorphine, Dr. Molengraaff. *Zoology*—Dr. Gunning, Dr. Pakes. *Geography*, Mr. E. H. V. Melvill, Mr. F. Flowers. *Economic Science and Statistics*—Mr. S. Evans, Mr. Robert A. Ababrelton. *Engineering*—Mr. S. Jennings, Mr. E. Williams. *Anthropology*—Dr. Schonland, Mr. A. von Dessauer. *Physiology*—Sir Kendal Franks, Dr. A. Mackenzie. *Botany*—Mr. Burtt Davy, Prof. Pearson. *Educational Science*—Mr. E. B. Sargant, Prof. Hele-Shaw.

THE Hunterian oration delivered by Mr. John Tweedy at the Royal College of Surgeons on February 14, and abridged elsewhere in this issue, contains several interesting references to the growth of natural knowledge by the use of the experimental method, with illustrations from John Hunter's work. It has been said that though Hunter had never read Bacon, his method was as strictly Baconian as if he had. Mr. Tweedy pointed out that this view is based upon a complete misinterpretation of the Baconian system. Francis Bacon himself neither knew nor understood the physical sciences, and his spirit was much less modern than that of his illustrious namesake, Roger Bacon, who lived three hundred years before him. John Hunter did not follow the mechanical methods of the Baconian system, but he possessed every moral and intellectual qualification for useful scientific research—a fertile imagination ready to suggest possible relations of facts, openness of mind, and a conscientious scientific spirit that submitted every hypothesis to the test of observation and experiment, taking nothing on trust. Mr. Tweedy occupied the chair at the festival dinner held at the college in the evening of February 14, when there were present, among others:—Prof. C. Allbutt, Sir W. Broadbent, Sir Lauder Brunton, Sir D. Duckworth, Sir Harry Johnston, Sir Norman Lockyer, Sir W. Ramsay, Prof. C. Stewart, Sir W. T. Thiselton-Dyer, Prof. W. A. Tilden, and Sir F. Treves.

THE death on February 9, at the age of forty-four, of Mr. F. O. Pickard-Cambridge makes a break it will be impossible to fill in the ranks of British arachnologists. From boyhood he had devoted himself to the study of English spiders, and was rightly regarded as the leading authority upon this subject. He completed, moreover, in 1904, his monograph of the Central American spiders for

Godman and Salvin's "Biologia," and this work, supplemented by the determination of specimens in the British Museum and of the collections made by himself on the Amazons, gave him a quite special knowledge of the Neotropical species. He unfortunately left unfinished his revision of the generic nomenclature of spiders, and also the county records of Arachnida he was compiling for the "Victoria History." Mr. Cambridge was an admirable draughtsman, as is testified by the plates illustrating the many papers he contributed to scientific societies and periodicals.

MATHEMATICIANS will have heard with regret that Mr. Robert Tucker died on January 29. He received his university education at St. John's College, Cambridge, of which he was a scholar, and was placed among the wranglers in 1855. He became a schoolmaster, and was for many years head mathematical master at University College School. His original contributions to mathematics deal chiefly with configurations of points, lines and circles related in special ways to a fixed triangle, and one system of circles, which he discovered, is called after his name. He was also the editor of Clifford's "Mathematical Papers." In 1867 he became one of the secretaries of the London Mathematical Society, founded in 1865. From that time forward he made the society his peculiar care, and the success which it has attained is almost entirely due to him. He retained the office of secretary for thirty-five years, editing the *Proceedings*, and conducting the correspondence with authors and referees—a delicate duty in respect of which he established an admirable tradition. He also wrote an account of the early history of the society. In all his work he was business-like and thorough, and at the same time modest and unselfish.

THE new wing which is to complete the Armstrong College of Science in Newcastle-on-Tyne will be opened by the King next year.

THE Société nationale d'Agriculture de France has awarded to Prof. Wm. B. Alwood, of Charlottesville, Va., a diploma and silver medal for his recent work in pomology, especially as relates to the fermentation of by-products from apples.

THE anniversary meeting of the Geological Society was held at Burlington House on Friday, February 17. Dr. J. E. Marr, F.R.S., was elected president. After the presentation of the medals and prizes already announced (p. 253) the president delivered his anniversary address, which dealt with the classification of the sedimentary rocks.

ARRANGEMENTS have been made whereby messages may be sent to Cunard mail steamers at any stage in their voyage across the Atlantic. During the first three or four days after the vessels leave Liverpool the messages will be sent from Poldhu, Cornwall, direct to the steamer. During the next three or four days the messages will be forwarded by cable to the North American Continent, and repeated thence to the approaching ship.

WE learn from the *Times* that the Treasury has agreed to place at the disposal of the Board of Trade 500*l*. per annum for four years for the purpose of taking practical steps to encourage and investigate the development of the cotton-growing area of the Empire. This sum will be used (1) for the payment of scientific assistants, who would themselves do part of the proposed work and would also set free members of the existing staff of the Imperial Institute for the purpose; and (2) for defraying the cost of equipment. It has also been notified, in connection with the mineral survey which the Government of Northern Nigeria has in contemplation, that a sum of 300*l*. per annum will be paid to the Imperial Institute in order to defray the expenses of examining specimens of minerals, &c., sent to the scientific and technical department so long as the survey is in progress, probably a period of three years.

ON Saturday next, February 25, Mr. D. G. Hogarth will begin a course of two lectures at the Royal Institution on "Archæology." On Tuesday, February 28, Prof. Karl Pearson will deliver the first of three lectures on "Some Recent Biometric Studies." On Thursday, March 2, Prof. H. H. Turner will commence a course of three lectures on "Recent Astronomical Progress," and on Saturday, March 11, Prof. J. J. Thomson will begin a course of three lectures on "Electrical Properties of Radio-active Substances." The Friday evening discourse on March 3 will be delivered by Chevalier G. Marconi, on "Recent Advances in Wireless Telegraphy," and on March 10 by Prof. J. J. Thomson, on the "Structure of the Atom." Mr. Perceval Landon will give two lectures, on April 4 and 11, on "Tibet," Mr. A. Henry Savage Landor's lectures on "Exploration in the Philippines" having been deferred until after Easter.

THE annual report of the council of the Institution of Mechanical Engineers was read at the annual general meeting of the institution on February 17. The first report, by Prof. David S. Capper, to the steam-engine research committee, has now been completed, and, together with a preliminary report on progressive speed and pressure trials carried out previous to March, 1896, will be presented at the March meeting. Since the presentation, in January, 1904, of the late Sir William Roberts-Austen's last report, the alloys research committee has continued its work at the National Physical Laboratory. Dr. Glazebrook, director of the laboratory, has arranged a series of investigations on specimens of nickel steel presented by Mr. R. A. Hadfield. It is anticipated that a further report will be presented this year by the committee, communicating the results of these researches. Further investigations having great practical importance are now being considered. Prof. F. W. Burstall reports that the two specially constructed large gas-engines and a gas-holder erected in the new power house of the Birmingham University are now available for the gas-engine research committee's experiments. A scheme of experiments, indicating the methods of working, is under consideration, and it is hoped that the next report will be ready for presentation at the opening of next session. A gift of 100*l*. towards the expenses of carrying on the research has been received from Dr. Ludwig Mond, F.R.S. The series of experiments on initial condensation in steam cylinders, which Prof. T. Hudson Beare is carrying out with special apparatus for the purpose, are in active progress, but are still incomplete. The results obtained so far, however, justify the hope that the committee will be able to present, during the year 1905, an interim report dealing with the results obtained in the experiments on non-jacketed cylinders. It is intended to hold the next summer meeting in Belgium, in view of the International Exhibition to be held at Liège this year.

WE have received from Messrs. John Wheldon and Co., of Great Queen Street, a copy of a catalogue of zoological and sporting books and papers arranged geographically. To those who are working on faunas and distribution the list will be distinctly useful.

In vol. v., No. 5, of the *Records* of the Australian Museum, Mr. R. Etheridge describes the remains of a plesiosaurian reptile of the genus Cimoliosaurus from the Upper Cretaceous of White Cliffs, New South Wales, which have been completely opalised. This is the second skeleton of the genus which has been obtained from these deposits in an opalised condition. Precious opal occurred only here and there—more especially in the transverse processes of the neck—in the second specimen, the richness of the colour of which bore no comparison to that in the example first obtained.

Mr. W. E. Clarke, of the Edinburgh Museums, sends us a paper from the *Annals of Scottish Natural History* for January on the vole and the shrew of Orkney. The vole, which it will be remembered was recently discovered and named by Mr. Millais, turns out to be remarkably interesting, for it appears to come nearest to the water-vole, although its dentition is of the type of the common field-vole. The shrew, Mr. Clarke believes, will probably turn out to be the pigmy species. Mr. Clarke has been assisted in his investigation into the structure of the vole by Prof. O. C. Bradley.

Dr. Gilchrist's presidential address to the South African Philosophical Society at the meeting in August last, which is reported in the latest issue of the *Transactions* of that body, deals with certain features of the marine fauna of South Africa. It is shown that as the Cape seas receive currents from different parts of the ocean, so the fauna is of a particularly varied type, containing North Atlantic, Antarctic, and Indian types, and even an element from the Far East.

The subject of the affinity of the endothiodont reptiles is resumed by Dr. R. Broom in part iv. of vol. xv. of the *Transactions* of the South African Philosophical Society. The author emphasises their relationship to the dicynodonts, and shows that, while in the endothiodonts the tendency has been to increase the development of the molars, in the dicynodonts the latter teeth have been completely eliminated. In our own opinion, Dr. Broom's work tends to show that both groups should be included in a single family.

The report of the director of the botanic gardens and domains, Sydney, for 1903 refers to the changes in the gardens consequent upon the extension into the inner domain. Tree-planting in the Centennial Park has been continued, the additions during the year being principally *Acacia binervata*, *Eucalyptus botryoides*, woolly-butt, *Tristania conferta*, brush-box, and species of Casuarina. Many of the various species of Eucalyptus have suffered from the attacks of a coccid identified as *Eriococcus coriaceus*.

The Philippine Islands are yielding a number of interesting plants. A second list by Mr. E. D. Merrill has been issued as a publication, No. 17 of the Bureau of Government Laboratories, Manila. The author distinguishes twelve species of Terminalia in his synopsis of the genus, three being new. Among other new plants are four species of Pandanus, three of Illipe (= Bassia), and a climbing Dischidia belonging to the section Conchopyllum in which the leaves flattened against the supporting tree trunk serve as a shelter for ants.

A progress report on the strength of structural timber by Dr. W. K. Hatt forms *Circular* No. 32 of the forestry series published by the United States Department of Agriculture. Tests were made with long-leaf pine, *Pinus palustris*, loblolly, *Pinus taeda*, and a red fir, known also as Oregon pine, *Pseudotsuga taxifolia*. Long-leaf pine is the standard timber of construction, but is not always obtainable in long pieces, when red fir takes its place; red fir produces long, straight timber, but shows considerable variation in quality; loblolly being principally sap-wood has to be treated with preservatives if it is required for external work. Experiments were also made with sweet gum, *Liquidambar styraciflua*, to ascertain whether the timber could be bent and put to the same uses as hickory, but the results were not favourable.

When we consider the enormous mass of material which has been accumulated regarding the quantity of rain which falls, it is remarkable how little attention appears to have been given to the number and size of the drops. A very simple and ingenious method of studying raindrops is described in a paper in the *Monthly Weather Review* for October, 1904, by Mr. W. A. Bentley. The raindrops are allowed to fall into a layer of dry flour one inch deep, which is exposed to the rain for a few seconds. The flour is allowed to stand for some time, and the pellets of dough, each representing a raindrop, are then picked out and may be preserved. The method was tested by allowing measured

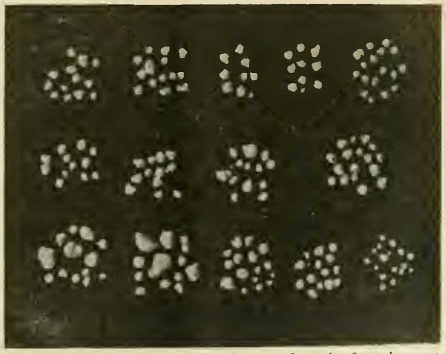

Fig. 1.—Forms of raindrops. Complete set of samples from the great general storm of August 20, 1904. Duration of storm, fifteen hours. One raindrop sample per hour was taken throughout the storm.

drops of water to fall from a height into the flour; it was found that the dough pellet differed but little in size from the drop which produced it. In the paper a series of interesting photographs of such dough-pellets is given, illustrating the variation in the size of the raindrops during the course of showers of different types. The largest drops met with somewhat exceeded a fifth of an inch in diameter; this is in agreement with the observations of Wiesner (quoted by Hann in his "Lehrbuch"), which gave 7 mm. as an upper limit. Mr. Bentley gives tables showing the relative frequency of occurrence of drops of various sizes in rain from various kinds of clouds.

We have received from the secretary of the English Ceramic Society a copy of its *Transactions* for the session 1903–4. The society, which has its headquarters at Tunstall, Staffordshire, is still in its infancy, but it would appear that its existence is likely to exert considerable influence for good on the future development of the English potteries. The *Transactions* contain papers describing attempts to solve special problems in the industry, and the keen discussion which followed their delivery is indicative of the interest with which they were received. There can be little doubt that such a society must tend to the spread of knowledge and the improvement of method in pottery manufacture.

An interesting paper by R. Kremann on the melting point of dissociating substances and the degree of dissociation during melting is contained in the *Sitzungsberichte* (1904, vol. ciii., part vii.) of the Imperial Academy of Sciences of Vienna. From theoretical considerations involving the law of mass action, melting-point curves are deduced for substances, such as the compounds of phenol with aromatic bases and with picric acid, at different degrees of dissociation. By comparing the shape of these curves with those obtained, for instance, on adding aniline to the compound of aniline and phenol, the actual degree of dissociation of these substances during melting may be very approximately ascertained. Incidentally, the important result is established that the addition of one of the products of dissociation of the compound may in many cases cause a rise in the melting point without there being question of the formation of an isomorphous mixture. The results obtained are applied to an investigation of the additive compounds of nitrosodimethylaniline with various aromatic bases.

In an inaugural dissertation for a doctorate at Bonn University, Herr Jacob Steinhausen presents the results he has obtained during a research on "enhanced lines." Adopting the English name originally proposed by Sir Norman Lockyer, the author gives a detailed description of the enhanced lines and their different appearances in various spectra, and then describes the apparatus and methods employed by him in his own research. Using a small grating of 1 metre radius, which produced a dispersion such that 10 Ångström units extended over 0.595 mm. on the plate, he photographed and compared the arc and spark spectra of the elements Al, Sb, Pb, Cd, Mg, Hg, Bi, Sn, Zn, Ba, Ca, Sr, and Tl, using in most cases metallic poles for the spark, and powdered metal, or salt, on carbon poles for the arc. The wave-lengths are only given to the nearest unit, and will, therefore, need re-determining, with a larger dispersion, before they become of any great use for stellar identifications. In discussing the nature of the lines the author adopts an error made by Prof. Kayser ("Handbuch der Spectroscopie"), viz. that in accounting for spectral variations Sir Norman Lockyer has always considered only the temperature of the spark as the cause; yet it is now more than thirty years since the discoverer of enhanced lines explicitly stated that the possible effects of electrical variations must be included in the general term "temperature."

Some ten years ago Prof. H. Moissan, in the course of his work on the production of carbides in the electric furnace, prepared aluminium carbide and showed that in contact with water pure methane was evolved, thus giving a new and direct synthesis of this important hydrocarbon. In the current number of the *Comptes rendus* (February 13) Prof. Moissan and M. Chavanne give an account of their determinations of the physical constants of pure marsh gas prepared in this way. The methane, after being freed from traces of moisture and less volatile impurities by passing through a tube cooled to -85° C., is solidified by cooling with liquid air, and any more volatile gases present pumped away. The gas allowed to boil off from the crystals was proved to be pure by a combustion analysis, and possessed at 0° C. and 760 mm. pressure a density of 0.5547, the theoretical density being 0.555. The melting and boiling points were measured by means of an iron-Constantin thermocouple, previously standardised against a petroleum ether thermometer, the crystals melting sharply at -184° C. and boiling at -164° at atmospheric pressure. The authors add that the methane, purified in this way, always possessed a sweet, faint garlic odour, which cannot be attributed to impurities, and must be regarded as due to the gas itself. The reaction between solid methane and liquid fluorine was studied at the same time; the two substances instantly combined, the reaction being accompanied by a bright flash and a violent explosion, completely pulverising the glass tubes.

A twelfth edition of Mr. W. T. Lynn's booklet on "Remarkable Comets" has been published by Messrs. Sampson Low, Marston and Co., Ltd.

The Cambridge University Press has published the first number of a new scientific periodical entitled the *Journal of Agricultural Science*. The magazine is edited by Messrs. R. H. Biffen, A. D. Hall, T. H. Middleton, and T. B. Wood, in consultation with Messrs. W. Bateson, F.R.S., J. R. Campbell, and W. Sommerville. It is intended to circulate among agricultural teachers and experts, and will be issued, as material accumulates, in parts of about one hundred pages. Each volume will consist of four parts. The first number appeals to workers in many departments of agricultural research, and among the articles it contains may be mentioned those on Mendel's laws of inheritance and wheat breeding, by Mr. R. H. Biffen; the influence of pollination on the development of the hop, by Mr. A. Howard; the importance of the removal of the products of growth in the assimilation of nitrogen by the organisms of the root nodules of leguminous plants, by Mr. J. Golding; the analysis of the soil by means of the plant, by Mr. A. D. Hall; variation in the chemical composition of the swede, by Mr. S. H. Collins; soil analysis as a guide to the manurial treatment of poor pastures, by Messrs. T. B. Wood and R. A. Berry; and the improvement of poor pastures, by Prof. T. H. Middleton. The magazine should prove of interest and help to all teachers of agricultural science as well as to those engaged in research in this field of knowledge.

The third part of Herr C. K. Schneider's "Illustriertes Handbuch der Laubholzkunde" has just been published by the firm of Gustav Fischer, Jena. The first two parts were reviewed in Nature of November 24, 1904 (vol. lxxi., p. 76), and a further notice will appear after the work, consisting of about nine parts, has been completed.

OUR ASTRONOMICAL COLUMN.

Ephemeris for Comet 1904 *e*.—The following is an extract from a continued ephemeris for comet 1904 *e*, as calculated from M. Fayet's elliptical elements by Dr. E. Strömgren, and published in No. 3994 of the *Astronomische Nachrichten*:—

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

1905	α (true) h. m. s.	δ (true) ° ′	log *r*	log Δ	Brightness
Feb. 25	3 10 47	+30 7	0·1669	0·1233	0·46
Mar. 1	3 22 3	+32 0	0·1711	0·1359	0·43
,, 5	3 33 44	+33 47	0·1757	0·1486	0·39
,, 9	3 45 49	+35 25	0·1805	0·1611	0·36
,, 13	3 58 16	+36 56	0·1855	0·1736	0·33

The comet is now becoming very faint, and is travelling in a north-easterly direction through the southern part of the constellation Perseus. On March 11 it will pass near to ξ Persei.

Revised Elements for Borrelly's Comet (1904 *e*).—When publishing the previous set of elements for comet 1904 *e*, M. Fayet explained that, as his computations were based upon the results of only a few observations, they could only be regarded as approximate. Now, however, the observations extend over nearly a month, and M. Fayet has made another research regarding this comet's orbit, obtaining the following set of elements as his result:—

$$T = 1905 \text{ Jan. } 16{\cdot}65370 \text{ (M.T. Paris)}$$

$$\left.\begin{aligned} \Omega &= 76^\circ\ 41'\ 34''{\cdot}49 \\ i &= 30^\circ\ 31'\ 58''{\cdot}75 \\ \omega &= 352^\circ\ 13'\ 58''{\cdot}98 \end{aligned}\right\} 1905{\cdot}0$$

$$\log q = 0{\cdot}145175$$

$$\log e = 9{\cdot}792206$$

$$\mu = 503''{\cdot}932$$

These elements give a close agreement with the places determined by independent observations, and indicate that Borrelly's 1904 comet is, really, of the short-period type, completing its orbital revolution in about seven years, instead of six years as given by the previous elements (*Comptes rendus*, No. 5, 1905).

The Sun's Rotation.—During the years 1899, 1900, and 1901 Prof. N. C. Dunér made a further series of observations of the rotation velocity of the sun at different heliocentric latitudes. Combining the results with those obtained by him during a similar research prosecuted in the years 1887–1889, and now corrected, he found the values given in the following table:—

ϕ	v km.	n	$\xi \cos\phi$ °	ξ °
0·4	+2·08	183	14·770	14·77
15·0	+1·97	180	13·989	14·48
30·1	+1·70	184	12·072	13·95
45·0	+1·27	181	9·018	12·75
60·0	+0·81	183	5·752	11·50
75·0	+0·39	184	2·769	10·70

wherein ϕ = the heliocentric latitude, v = the rotational velocity of the sun's edge, n = the number of observations, and ξ = the daily rotation angle (*Astronomische Nachrichten*, No. 3994).

Secondary Shadow on Saturn's Rings.—During a series of observations of Saturn made at Aosta (Italy) in October, November, and December, 1904, Signors M. Amann and Cl. Rozet observed a secondary shadow, other than that of the planet, projected on to the illuminated surface of the rings. First seen on October 20, this shadow was thinner and much less accentuated than that of the planet, whilst its curvature was in the opposite sense to that of the latter body. From October 20 to November 15, despite the fact that numerous opportunities of observing it occurred, the shadow was not seen, but from the latter date until the end of December it was shown on twenty-six drawings of the system. On seven drawings made between December 22 and 27, the shadow appeared bifurcated where it traversed the inner ring, and on November 28 and 29 a third line of shadow, narrower and feebler than the preceding and much further from the planet, was seen (*Comptes rendus*, No. 5, 1905).

Observations of the Zodiacal Light.—During a sojourn on the summit of Mont Blanc on September 21 and 22, 1904, M. A. Hansky made a number of observations of the Zodiacal Light, and found that its form was that of a spherical triangle having its apex near to the ecliptic. At 3h. 40m. (M.T. Paris) the altitude of the apex was 52°, the length of the triangle, reckoned from the centre of the sun, was 80°, and its breadth was, at the horizon, 25°, and in the plane of the sun's axis 30°. The latitude of the apex was +2°, and three zones were distinguishable in the light. The first of these had the form of a spherical triangle and was very feeble, the second was more parabolic, whilst the form of the third was a parabola.

In his paper, published in the *Comptes rendus* (No. 6, 1905), M. Hansky indicates the points of resemblance between this phenomenon and the corona, and makes a number of speculations as to the true nature of the light. He concludes by saying that he believes it to be an electrical phenomenon of the same type as the corona, and that it is, probably, simply a prolongation of the coronal streamers.

Permanent Numbers for the Minor Planets discovered during 1904.—In No. 3994 of the *Astronomische Nachrichten*, the permanent numbers allotted to the minor planets discovered during 1904 are given. The list contains the numbers 522 to 548, inclusive, thereby showing the number discovered during last year to be twenty-seven. The provisional designation, the name of the discoverer, the date of discovery, and the authority for the orbit are also given for each planet. A number of notes explain the absence, for various reasons, of several bodies, to which provisional designations were allotted, from the final list.

STUDIES IN EUGENICS.

At a meeting of the Sociological Society on February 14 Mr. Francis Galton communicated two papers:—(1) restrictions in marriage, and (2) studies in national eugenics.

In the first paper he remarked that marriage, as one of the social agencies that influenced the racial qualities of future generations, came within the purview of eugenics. It belonged to the practical policy arising out of eugenic science, to promote such choice in marriage as should tend to the reproduction of the higher types of individual. Anthropological investigation had shown marriage to be one of the most modifiable of social institutions. Hence the assumption was warrantable that with the gradual incorporation of eugenic conceptions in the social ideal, there would proceed a concomitant change in the customs and conventions affecting marriage. The paper then proceeded to illustrate by actual examples the modifiability of marriage customs. In one or other of its many forms polygamy was now permitted—by religion, customs and law—to at least one-half of the population of the world, though its practice might be restricted, on account of cost, domestic peace, and the insufficiency of females. In Christian nations the prohibition of polygamy, under severe penalties, by civil and ecclesiastical law had been due, not to any natural instinct against the practice, but to consideration of social well-being. Hence it might be inferred that equally strict limitations of freedom of marriage might, under the pressure of worthy motives, be hereafter enacted for eugenic and other purposes. Endogamy, or the custom of marrying exclusively within one's own tribe or caste, had been sanctioned by religion and enforced by law in all parts of the world, but chiefly in long-settled nations, where there was wealth to bequeath and where neighbouring communities professed different creeds. Endogamous systems of marriage rested on customs determined by a certain religious view of family property and family descent. Eugenics dealt with what was more valuable than money or lands, namely, with natural inheritance of high character, capable brains, fine physique and vigour, in short, with all that was most desirable for a family to possess. It aimed at the evolution and preservation of high races, and it well deserved to be strictly enforced. In every society there existed conventional restrictions of the nature of "taboo," though not necessarily called by that name. If non-eugenic unions were prohibited by such taboos, none would take place. Marriage selection was very largely conditioned by motives based on religious and social convention. Persons who were born under the various marriage systems lived under such rules without any objection. They were unconscious of their restriction.

Under the heading "Studies in National Eugenics," Mr. Galton communicated what he described as "an unauthorised programme" of what he conceived to be the duties of the Francis Galton research fellowship in national eugenics. The topics to be considered he classified under the following headings:—(1) Estimation of the average quality of the offspring of married couples from their personal and ancestral data. This included questions of fertility, and the determination of the probable error of the estimate according to the data employed. (2) Effects of action by the State and by public institutions. (3) Other influences that further or restrain particular classes of marriage. (4) Heredity. The facts, after being collected, should be discussed, for improving our knowledge of the laws both of actuarial and of physiological heredity, the recent methods of advanced statistics being of course used. (5) Bibliographical compilations. (6) Extension of eugenic studies by wider cooperation. (7) Certificates. With regard to the last named, he said that in some future time, dependent on circumstances, he looked forward to a suitable authority issuing eugenic certificates to candidates for them. They would imply more than an average share of the several qualities of at least goodness of constitution, of physique, and of mental capacity.

The discussion on the papers was opened by Dr. Haddon, who said Mr. Galton sought to establish a science of eugenics, he took it, because the postulates of eugenics were an inevitable corollary from the general doctrine of organic evolution—in the building up of which Mr. Galton had played a notable part. The evolution of the species having reached a self-conscious stage in man, it followed of necessity that increasingly rational and coordinated attempts should be made to guide and direct the evolutionary process towards definable and verifiable ideals. It was, as he understood it, the aim of eugenic studies to ascertain the means available for this rational guidance of human evolution, and the defining of the ideals towards which it should be directed. There was ample warrant in anthropological data for the assumption that in the development of marriage customs there was a tendency towards adaptation to higher social purposes.

Dr. F. W. Mott said there were two general ways towards the rational improvement of the stock:—(1) by checking the reproduction of the unfit, and (2) by encouraging the reproduction of the fit. For the former purpose the readiest means would be the segregation of defective children while quite young, and the curtailment of their social privileges as they grew to maturity. As regards means towards the encouragement of fertility in the higher types, he suggested as an initial tentative in practical measures a further development of the present system of marriage registration. Why, for instance, should not medical as well as legal certificates of marriage be procurable at registry offices? The former would be of the nature of a bill of health, certifying that the contracting parties reached a certain standard of hygienic requirement. Such certificates would of course be voluntary, but since they would be valuable not only to their possessors but also to their children, they would tend to come into general usage. In any case he considered it a matter of national importance that Mr. Galton's conception of eugenics should be most seriously considered. The first desideratum was to get it accepted as a legitimate and hopeful study.

Mr. Ernest Crawley said Mr. Galton's paper showed how anthropological studies could be made fruitful in practical politics. Sociology should be founding its science of eugenics upon anthropology, psychology, and physiology. He hoped that while chiefly considering the normal individual it would not forget the special claims of those abnormal persons whom we call geniuses. In a well ordered State they should be considered before the degenerate and the diseased. As regards marriage customs, he took it as an assured generalisation of anthropological science that there are two permanent polar tendencies in human nature, first against unions in the same home, and secondly against too promiscuous marriage. Many customs assumed by early anthropologists as normal types were, he believed, mere sports—such as group-marriage, and marriage of brother and sister. Polygamy he believed to be an example of a certain tendency in man to confuse sexual (*i.e.* organic), with matrimonial (*i.e.* social) concerns. They must beware of this confusion, and therefore be on their guard against its possible effects in studying eugenics. Mr. Galton's suggestion that religion was called upon to play a part in the development of eugenics he considered to be a sound deduction from history and anthropology. In the sanctification of marriage, religion had one of its earliest and greatest functions; and as primitive religion, in this as in other respects, was based upon the best knowledge of primitive times (*i.e.* upon primitive science), so the most developed form of religion should be illuminated by the most advanced form of knowledge (*i.e.* by contemporary science).

Dr. E. Westermarck said he entirely agreed with Mr. Galton's contention that restrictions in marriage as they existed in the simpler social formations, so they might be further modified and developed for eugenic purposes amongst the most highly civilised peoples. The germ of eugenic intentions was well seen amongst savage and barbarian peoples in those customs which imposed a test of fitness on the husband before marriage. In Kaffir tribes, for instance, a man may not marry until he has demonstrated his strength and courage and competence in the chase by killing a rhinoceros. In the Malay Archipelago there are peoples where the marriage test consists in the collection of a number of skulls from hostile tribes. Among the Arabs of Upper Egypt, the young aspirant to marriage must evidence his courage and self-control by suffering—with smiling countenance—a severe ordeal of whipping by the relatives of the bride. He considered that on this question of marriage, whereby the individual was brought into both organic and social relation with the species, moral teachers had before them one of the greatest of tasks, in inculcating a keener sense of foresight in the individual. There was perhaps hardly any other point in which the moral consciousness of civilised men stood in greater need of intellectual training.

As contributions to the discussion, a considerable number of written communications were received, from the following amongst others:—Dr. Havelock Ellis, Mr. A. H. Huth, Dr. Max Nordau, and Profs. Yves Delage, J. G. McKendrick, Posada, Sergi, Steinmetz, Tonnies, and Weismann. The last named raised the question whether, when a hereditary disease like tuberculosis has made its appearance in a family, it is afterwards possible for it to be banished entirely from this or that branch of the family, or whether, on the contrary, the progeny of those members who appear healthy must not sooner or later produce a tuberculous progeny. He himself considered that a tainted stock might produce a branch entirely free from that specific disease.

Mr. Galton, in the course of his reply, said it gave him satisfaction to find that no one amongst his critics had impugned the conclusion which his memoir on "Restrictions in Marriage" was written to justify.

THE ABSORPTION OF LIGHT BY THE ATMOSPHERE.[1]

THE great attention that has been paid during the last few years to the subject of photometry has brought into prominence the problem of the amount of light absorbed by the atmosphere. At the same time, the improvement that has taken place in the instrumental means, which renders possible the detection of minute changes in lustre, has required the use of accurate corrections by which the effect of the earth's atmosphere can be eliminated from the observations. The corrections which have been applied to photometric measures have been based generally on empirical or interpolation methods rather than on a strictly physical basis. There are several reasons which have contributed to this unsatisfactory condition of the problem. The difficulty of computing the length of the path of the ray of light in its passage through our atmosphere, the want of homogeneity in the constitution of the atmosphere itself, our ignorance of the law of the temperature gradient at considerable heights above the surface, and of the distribution of water and dust particles near the surface, have all complicated a subject the theory of which under ideal limiting conditions may not be very difficult. Bouguer left a very satisfactory theory, based, however, on the assumption that the path of the ray was rectilinear. Laplace attacked the subject from the side of the theory of refraction, but practically did not much advance it. From that time onward, the question has rather been left in the hands of observers, who have been content to make their observations homogeneous by the employment of an interpolation formula, based on the results of their actual practice.

Dr. A. Bemporod thinks that the time has come for the discussion of a physical theory of the extinction of light in the atmosphere, and certainly his pamphlet bearing this title is a most welcome contribution to this subject. It may be that in some sense it is a premature effort. That is to say, that the data for a complete solution of the problem do not exist. The series of observations which are now being conducted by means of kites and balloons, and which have for their object the examination of the different

[1] "Zur Theorie der Extinktion des Lichtes in der Erdatmosphäre." By Dr. A. Bemporod. Pp. 78. (Mitteilungen der Grossh. Sternwarte zu Heidelberg.)

strata of the atmosphere at various distances remote from the surface, may be expected to throw some additional light upon the constitution of the gaseous envelope through which the light passes, and, moreover, there is the troublesome and disturbing question of selective absorption, the importance of which the author fully admits, but does not consider numerically in his work, which may play a very important part in the future theory of atmospheric extinction. But any improvement which may hereafter be made will not invalidate the calculations, so far as they refer to the mass of the air through which the light beam penetrates.

Dr. Bemporod divides his work into five sections. In the first he presents the problem in its most general form, and defines the function F(z), the so-called path of the ray in the atmosphere. Chapter ii. exhibits a critical examination of the theories of Bouguer, Lambert, Laplace, and of some others less well known. In the next the author discusses the hypotheses of Ivory and Schmidt on the constitution of the atmosphere. Of the two, Schmidt's hypothesis of a uniform decrease of the temperature with the height above the surface gives the best agreement with the observed temperatures derived by Assmann and Berson from balloon ascents. The latter hypothesis is the one therefore selected for development, but both Ivory and Schmidt give practically the same values for extinction, while Laplace's theory at the zenith distance of 87° appears to be a tenth of a magnitude in error. Chapter iv. explains the formation of the extensive numerical tables that accompany the work, and in the last the author has some remarks on the influence of geographical position on the absorption, as well as of the effects of oscillations in temperature and pressure. The whole forms a valuable addition to a subject of great interest and importance.

JOHN HUNTER AND HIS INFLUENCE ON SCIENTIFIC PROGRESS.[1]

As the history of philosophy, considered from one point of view, is the record of the development and growth of ideas and of the formation of beliefs and doctrines respecting man and the universe accomplished through the thinking of a few great *minds*, so the history of medicine is a record of the observations, thoughts, and achievements of a few great *personalities*—Hippocrates, Celsus, Galen, Paré, Harvey, and John Hunter, to name only the greatest. John Hunter is the theme which has been assigned to me.

Throughout the ages of civilisation the growth of knowledge has been slow and often irregular, but it has been continuous and it has been sure. How slow and yet how sure we may realise by comparing the dialectic notions of Aristotle respecting weight and motion with the direct appeals to the evidences of the senses afforded by the demonstrations of Galilei, whereby it was shown that, so far from there being in nature bodies possessing positive levity, all matter is equally affected by gravity, irrespective of its form, magnitude, or texture. By the simple experiment of dropping objects from the Tower of Pisa, Galilei, who began life as a medical student, laid the foundation of modern physical science, and especially of dynamics. This expedient was one of the first appeals, at least in modern times, to the use of direct experiment in physical science, and the truth thereby established became a determining factor in Newton's great discovery of the law of gravitation. From Aristotle to Galilei an interval of more than eighteen centuries had elapsed. Galilei and Harvey were contemporaries.

John Hunter was born exactly a century after the publication of Harvey's "Exercitatio De Motu Cordis." It is one hundred and eleven years since John Hunter died. Yet how modern Hunter is! Inventions and discoveries now crowd upon us so thick and fast that we are apt to forget how recently modern physical science began, and especially modern medicine. In the order of time medicine, in its rudest and simplest forms, must have been one of the first of the empirical arts, but in the order of ideas it was one of the last to enter into the hierarchy of the sciences. As a system of organised knowledge medicine presupposes and requires not only centuries of clinical observation and a complete logical apparatus, but it also requires an advanced state of all the other natural sciences. It concerns itself with the recondite problems of life in the most complex and the most highly differentiated of its manifestations, whether under the conditions of health or under those of disease. Until physics and chemistry had advanced from the conjectural and the aprioristic to the scientific stage, medicine could only be conjectural and aprioristic too, however useful it may have been as a practical art. The thoughts and labours, the experiments and discoveries of the great pioneers of modern knowledge in the physical sciences were the necessary prelude to a scientific progress in biology, which, in its turn, was a condition precedent to any real advance in the science of medicine, surgery, and pathology. Harvey, in the order of time and of thought, was the necessary antecedent of Hunter.

The starting-point of John Hunter's career as anatomist, biologist, and surgeon was in the year 1748, when he came to London with a receptive and intelligent mind, a quick and observant eye, and a well-trained hand, to collaborate with his brother William in the anatomical school which had been started two or three years before.

Considering the important part that human anatomy now plays in medical education, it is difficult to conceive that there was no systematic teaching of anatomy in England before the middle of the eighteenth century. During the many centuries which elapsed between, say, the time of Hippocrates and the middle of the sixteenth century, the dissection of the human cadaver was almost unknown. Forbidden alike by the laws and customs and religion of the ancient Greeks, and by the creed of Mohammed, the study of human anatomy was placed under a civil and religious ban until the end of the thirteenth century. In ancient Greece the laws relating to immediate burial were very stringent. Even victorious generals had been condemned to death because they neglected to bury the slain. The pathos of Sophocles' tragedy of "Antigone" turns, it will be remembered, upon the sacredness of the dead, and of the necessity, higher than imperial commands, of immediate burial.

When the tradition of Greek medicine passed—in the seventh and eighth centuries—into the hands of the Mohammedans, human anatomy was equally neglected, the practice of dissection being implicitly forbidden by the Qurân. Even after the dissection of the human cadaver received the sanction of the civil authorities in southern Europe, the teaching of anatomy was cursory and occasional, and merely descriptive. Mundino of Bologna, in the fourteenth century, who was the first in modern times to dissect the human cadaver, seems to have dissected only two bodies. So little was known of human anatomy, and so strong was the tyranny of tradition, that when Vesalius, in the middle of the sixteenth century, alleged that the anatomical descriptions of Galen could not be adapted to man, there were not a few who, in their zeal to repel the accusation that Galen had used animals in dissection, did not hesitate to maintain that the human organisation had changed since Galen's time.

In England, notwithstanding Harvey lectures on anatomy in the first quarter of the seventeenth century, there was no organised teaching of anatomy before William Hunter's time. In this matter William Hunter has not received all the credit he deserves. Had his ambition been realised, he would, nearly a century and a half ago, have solved a problem in early medical education in London which is still perplexing the minds of many thoughtful persons. He desired to establish an anatomical school in London upon an extensive scale. With this object in view, he offered to erect a building at the cost of 7000*l.* for the study and teaching of anatomy provided the Government would grant him a piece of ground to build upon. It was also his intention to give to this institution all his preparations and his books. With a lamentable lack of sympathy which British Governments have too often manifested in their dealings with science and education, William Hunter's offer was declined. Smarting under a keen sense of disappointment and full of resentment, he determined to transfer his favours to Glasgow, which now enjoys the possession of his priceless museum and his library. *Beati possidentes.*

[1] Abridged from the Hunterian oration, delivered before the Royal College of Surgeons, February 14, by Mr. John Tweedy, president of the college.

After John Hunter had worked at human anatomy for ten years, he manifested his intellectual growth by directing his thoughts to the higher and more scientific discipline of comparative anatomy and physiology. He realised that human anatomy alone was an insufficient guide to pathology and surgery. He collected all manner of animals at his house and grounds at Earl's Court in order to study their ways and habits, and from every available source he acquired animals, living or dead, for the purposes of observation, experimentation, or dissection. In his use of the lower animals for the elucidation of physiological problems he followed while amplifying the practice of Harvey, who in his turn adduced the authority of Aristotle. There was, however, a striking and characteristic difference between the use which Aristotle made of the dissection of animals with reference to human anatomy and that of Hunter. There is no trustworthy evidence that Aristotle or Hippocrates or even Galen dissected the human body, certainly not in the sense we understand by the term "dissection." They dissected the bodies of animals *instead of* those of man, and transferred their observations of animals to the corporeal organisation of man. Hunter, on the other hand, practised the dissection of lower animals *in addition to* that of man, and transferred his observations to the embryology and morphology of man and to the elucidation of the problems of human and comparative physiology and pathology.

John Hunter was a philosopher in the strict and primary sense of the word. He had a passion for knowledge. "Let no man presume to call himself wise," says Pythagoras; "God alone is wise. Man can never get beyond the passion for wisdom." John Hunter had this passion. He devoted himself to the pursuit of knowledge, searching for it in every department of the organic world, animal and vegetable. In one of his letters to Jenner he says: "I have but one order to send you, which is, to send everything you can get, either animal, vegetable, or mineral, and the compound of the two, either animal or vegetable mineralized." And, again: "Have you any large trees of different kinds that you can make free with? If you have, I will put you upon a set of experiments with regard to the heat of vegetables." With respect to the observations and experiments which he directs Jenner to make, he says, "Be as particular as you possibly can." These sentences express briefly and in epitome, as it were, Hunter's habits of mind and his attitude towards the problems of organic life.

John Hunter may have lacked the power of clear exposition, and he may have disliked routine teaching. He was, however, full and overflowing with ideas, new and original, to which he often found it difficult to give distinct shape and utterance. In contrast with William Hunter's didactic powers, John had the suggestive, the constructive, the creative faculty, the faculty of discovery, of coordinating knowledge, and he had the art of stimulating thought and calling forth effort from others. He taught by example rather than by precept.

Ottley, the first and one of the best of Hunter's biographers, remarks that in pursuing his researches Hunter strove, not like many of his more learned and less philosophical predecessors, to unravel the mysteries of nature by taking up principles *a priori* and seeking for facts to support his theory, but that, on the contrary, he followed in the strictest manner the inductive method laid down by Bacon as the only sure though arduous road to knowledge; and Babington, in his Hunterian oration, remarks of him: "He had never read Bacon, but his mode of studying nature was as strictly Baconian as if he had." Other critics and historians of Hunter's work, and not a few Hunterian orators, have written or spoken in a similar strain. In my judgment this view is entirely erroneous with respect to Hunter's method, and it is a complete misinterpretation of the Baconian system. Bacon's eloquence and influence undoubtedly did much to attract men to the observation and study of natural phenomena. He directed attention to the necessity of studying the powers and forces of the world as a means of subjecting the world to the human mind, and so far his message was appropriate and opportune. The significance of that message is probably greater now than at the time he delivered it. The future belongs to the nation which understands best the forces of nature, and which can most skilfully and economically employ them. But Bacon himself neither knew nor understood the physical sciences. His spirit was essentially mediæval, and much less modern than that of his illustrious namesake Roger Bacon, who lived three hundred years before him. Francis Bacon's aim was purely utilitarian. He had no idea of knowledge for its own sake, and he cherished the hope that by increasing our knowledge of nature the secret of the transmutation of substances would be learnt, and probably the knowledge of the making of gold. He not only had no practical acquaintance with natural science, but he lacked insight into the true methods of its investigation. He understood very imperfectly the value of experiment, and he assigned quite a subordinate position to quantitative determination, the precise quality which is the most striking characteristic of modern science, and which constituted the most original and perhaps most brilliant of the reasonings which Harvey employed in his famous induction. So far from being the founder of the modern scientific method, Bacon's writings were themselves one of the products of the intellectual awakening which began at the end of the sixteenth century. Notwithstanding his affectation of scientific knowledge and scientific methods, Bacon had an unscientific weakness for superstitions. He believed in natural and judicial astrology, though not without some hesitation and discrimination. He believed in the transmutability of elements and of the metals, in charms and signatures as remedies, and so completely did he ignore Harvey's discovery of the circulation of the blood that in one of the latest of his writings he ascribes the pulsation of the heart and arteries to the dilatation and contraction of the spirits. Well might Harvey say, in disparagement of Bacon's scientific writings: "He writes philosophy like a Lord Chancellor."

Bacon's ruling idea was the collection of masses of facts and then the employment of processes of arrangement, and separation, and exclusion, so artificially contrived that a man of common intelligence should be able to announce the truth sought for. This method has been slightingly described as a kind of scientific bookkeeping. "It is difficult," says Stanley Jevons, "to imagine a less likely way of arriving at great discoveries. The greater the array of facts the less is the probability that they will by any routine system of classification disclose the laws of nature." The answer to the claim that Bacon was the philosophic father of modern methods of scientific investigation is that none of the scientific truths established by the great masters of science can be made even to *appear* in correspondence with Bacon's methods. Whether we look to Copernicus, who preceded him, or to Kepler, Galilei, Torricelli, Pascal, Gilbert, and Harvey, or to Newton, Descartes, or Huygens, or to Thomas Young, or to the chemists Black, Priestley, Scheele, and Lavoisier, we find that discovery was achieved by a method quite different from that advocated by Bacon. So dispassionate a critic of philosophy as John Grote remarks: "I have not the smallest belief in Bacon's having reformed the method of discovery, believing rather that if he had *had* any success in that way, in the manner he wished, it would have been most calamitous for science." And even with regard to the claim of Bacon to be the founder of inductive philosophy, Ellis, one of the ablest of his editors, asserts that the nature of the act of induction is as clearly stated by Aristotle as by any later writer, while Aristotle himself ascribes the credit to Socrates. Perhaps the Baconian claim has never been more convincingly refuted than by Augustus De Morgan, at once one of the profoundest and subtlest thinkers of the nineteenth century. "Modern discoveries," he says, "have not been made by large collections of facts, with subsequent discussion, separation, and resulting deduction of a truth thus rendered perceptible. A few facts have suggested an *hypothesis* which means a *supposition* proper to explain them. The necessary results of this supposition are worked out, and then, and not till then, other facts are examined to see if these ulterior results are found in nature. . . . Wrong hypotheses rightly worked from have produced more useful results than unguided observation. But this is not the Baconian plan. . . . What are large collections of facts for? 'To make theories *from*,' says Bacon; 'To try ready-made theories *by*,' says the history of discovery."

Bacon's plan was purely mechanical. He ignored the work of the mind in the constitution of knowledge. He imagined that he had discovered a method by which scientific truth might be determined with absolute certainty, and by a mechanical mode of procedure such that all men were capable of employing it. "Our method of discovering the sciences is," he says, "one which leaves not much to sharpness and strength of wit, but nearly levels all wits and intellects." And this opinion is endorsed by most writers of the empiricist school in complete disregard of the teaching of history. Those who imagine that science requires nothing but the registering and classification of facts forget that the facts observed can only be connected and related by the mind, and that the laws of nature are after all mental products from given data.

Not only did John Hunter not follow the mechanical methods of Francis Bacon, but it is the work of the mind which is the peculiar characteristic of his method and its chief glory. Others could do as well as he the more mechanical part of his task—indeed, much of it was done by others; but the suggesting, controlling, coordinating mind was Hunter's, which, amidst the multiplicity of phenomena and of data apparently conflicting, discovered unity amidst multiformity, which is the special function of science.

John Hunter's constant aim was to arrive at principles, and he was distrustful of so-called facts. "The principles of our art," he said, "are not less necessary to be understood than the principles of other sciences; unless, indeed, the surgeon should wish to resemble the Chinese philosopher whose knowledge consisted only in facts. In that case the science must remain unimproved until new facts arise. In Europe philosophers reason from principles, and thus account for facts before they arise."

Hunter possessed every moral and intellectual qualification necessary for useful scientific research. He had a large knowledge of facts based on an intimate acquaintance with the phenomena of organic nature. He had a fertile imagination ready to suggest possible relations of those facts. He had openness of mind, and a conscientious scientific spirit which submitted every hypothesis to the test of observation and experiment. Scepticism is the first condition of reasoned knowledge. Hunter was not only observant, but he was rationally sceptical and critical, and he himself ascribed his success as a scientific investigator to the sceptical qualities of his mind. He took nothing on trust. He was always careful to distinguish between mere conjecture and reality, and drew a sharp distinction between the actual results of an experiment physically performed and what might have been mentally anticipated. "In pursuing any subject," he says, "most things come to light as it were by accident, that is, many things arise out of investigation that were not at first conceived, and even misfortunes in experiments have brought things to our knowledge that were not, and probably could not have been, previously conceived; on the other hand, I have often devised experiments by the fireside or in my carriage, and have also conceived the result; but when I tried the experiment, the result was different, or I found that the experiment could not be attended with all the circumstances that were suggested." Here, in a sentence, we note the wide difference between the modern and the mediæval spirit in science. The alchemists performed experiments innumerable, but with them theory ranked above experiment, and if experiment gave an unexpected result, this was forced into an artificial conformity with the aprioristic theory. It was therefore, says Lange in his "History of Materialism," "essentially directed to the production of this previously anticipated result rather than to free investigation."

While Hunter was intolerant of a state of doubt in small things as in great, if by any means decision was possible, he ever held his judgment in suspense if certainty was not attainable. Like all strong characters, he cared little for systems or consistencies of opinion. He followed wherever Truth should lead, and by his very nature was always open to new and higher knowledge. To a pupil who asked with surprise whether he had not the year before stated an opinion on some point directly at variance with one he had just put forth, he boldly replied: "Very likely I did; I hope I grow wiser every year." And again: "Never ask me what I have said, or what I have written; but if you will ask me what my present opinions are I will tell you."

In attempting an appreciation of John Hunter's method I have suggested rather than explained the development and growth of the modern knowledge of physics, chemistry, and biology under the influence of the experimental method; but it has not been my purpose or intention to offer any defence of this method. To defend the use of experiment in physics and in chemistry would be manifestly absurd, and I assume that in this place and before this audience it is equally unnecessary to offer an apology for its use in physiology and pathology. I opine, however, that it is within my province as Hunterian orator to anticipate the possible censure of some who would not hesitate in the sacred name of religion to traduce the memory of Hunter because he practised experiments in physiology. John Hunter did employ the method of experiment. He employed it no less with zeal than with intelligence. He employed it not from idle curiosity, not from the promptings of vainglory, or for the purposes of worldly advancement; all that he had he gave to science. He employed it in the service of humanity and in the study of the nature and laws of life; and the knowledge which he thereby acquired he transferred to the domain of medicine and surgery, and applied to the alleviation of sickness and suffering among animals no less than among men.

I pretend not either impiously to affirm or not less impiously to deny all the purposes of infinite wisdom in giving man dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth; but we do know that throughout historic time man has not hesitated to capture, to subjugate, and to slay, beast and bird and fish, for his pleasure, his sustenance, and his service. Was the lordship over the animals given to man only for the satisfying of his physical and sensuous needs? Is not the life more than food? Was it only with reference to man's bodily well-being that the question was asked: Are ye not of much more value than the birds of the heaven? Does the mind need no aliment? And is the veto to be applied only when animals are to be used for the purposes of elucidating the kindly functions of physiology, or of disclosing the baneful secrets of disease?

The vicarious suffering and sacrifice of animals for the service and the salvation of man have obtained throughout the ages, and constituted the basis of the elaborate ceremonial system of the ancient Israelites. In anticipation of the great Passover, Moses directed the Israelites each to kill a lamb according to their families, and to sprinkle its blood upon the lintel and the two side posts. "For the Lord will pass through to smite the Egyptians; and when He seeth the blood upon the lintel, and on the two side posts, the Lord will pass over the door, and will not suffer the destroyer to come into your houses to smite you." The complete purification of *one* leper and his reception back into society involved not only the slaughter of three lambs, but the convalescent had to appear with two living clean birds, one of which was slain, while the other, still living, was baptised in the dead bird's blood, and then allowed to fly away free. The principle of substitution was actualised in the ceremony of the scapegoat. At the annual Feast of Expiation, a young bullock, two kids, and one ram were slain; and two goats were taken upon which lots were cast, one lot for Yahwè, the other for Azazel. The goat on which the lot fell for Yahwè was sacrificed for a sin offering; but the goat upon which the lot fell for Azazel was presented alive, and when the high priest had symbolically placed upon its head the sins and transgressions of all the people, the goat was led into the desert, there to become the victim of hunger and thirst, and the prey of ravenous bird and beast.

Are these hecatombs to be regarded as of Divine origin and sanction, while the inoculation of a cat or dog, or it may be a rat, is to be denounced as a desecration and a violation of the purposes and will of God? Who will say but that in our day, as the Angel of Death passes through the land, seeing upon us the sprinkling of the immunising blood, takes that for a token, and is not suffered to come into our houses to smite us? "Dipt in his fellow's blood the living bird went free"; and so we, dipped in blood, aye, the blood of our fellow-man, as the annals of medical martyrology bear witness, we enjoy a growing freedom from plague and pestilence and noisome disease, and in the fulness of knowledge the measure of our freedom will be full.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The sum of 1600*l.* has been recently contributed to the University Benefaction Fund for the endowment of a lectureship in special pathology. The collection of this fund is largely due to the activity of Prof. G. Sims Woodhead, and the lectureship will be known as the Huddersfield lectureship, in recognition of the town which has largely supplied the capital sum. The general board will proceed shortly to elect the lecturer. Applications should be sent in to the Vice-Chancellor, on or before Tuesday, March 7.

The general board has approved Mr. J. J. H. Teall, of St. John's College, Director of the Geological Survey, for the degree of Sc.D.

The Smith's prizes have been awarded to Mr. H. Bateman for his essay on "The solution of linear differential equations by means of definite integrals," and to Mr. P. E. Marrack for his essay on "Absorption by matter of Röntgen and γ rays." Both the students belong to Trinity College.

Mr. F. J. M. Stratton, of Caius College, has been elected to an Isaac Newton studentship.

LONDON.—At the South-Western Polytechnic Miss Gladys Martyn has been elected to the free studentship in the physical training department. She will devote part of her time to the scientific study of anthropometric measurements and eugenics. Mr. L. D. Coueslant, lecturer in the engineering department of the polytechnic, has been elected to be head of the mechanical and civil engineering department of the Technical Institute of Sunderland. Mr. A. J. Makower has been elected head of the electrical engineering department in succession to Mr. C. F. Smith.

The Fishmongers' Company has granted a sum of 1000*l.* toward the funds necessary for the incorporation of University College in the University of London. By this grant the amount still required to complete the funds necessary for incorporation is reduced to 17,000*l.*, a total of 183,000*l.* having now been raised for the purpose. Dr. A. R. Cushny, of the University of Michigan, U.S.A., has been appointed to the chair of pharmacology and materia medica in the college. Prof. L. F. Vernon-Harcourt has resigned the chair of civil engineering and surveying.

WE learn from *Science* that Mrs. Goldwin Smith has given 4000*l.* to Cornell University; and that by the will of the late Mr. E. A. Goodnough, of Worcester, gifts are made as follows:—5000*l.* to Mount Holyoke College, 3000*l.* to Iowa College, 5000*l.* to the Huguenot Seminary in South Africa, 1000*l.* to Washburn College in Kansas, 2000*l.* to Drury College in Missouri.

THE *Engineering and Mining Journal* of New York publishes the views of Prof. H. M. Howe, the eminent American metallurgist, on the vexed question whether technical schools serve the interests of the community better if they are parts of great universities or if they are isolated institutions. Wisely guided association, while it need not deprive the technical school of character and individuality, should, he thinks, benefit the community through the broadening interaction of the teachers of pure science and the technical teachers, with their closer contact with active life. The grand scale should effect great economy, not so much in saving salaries and in widening the use of the more expensive instruments, as in fitting work to worker, and in supplying more fully the eminent with work on their own plane.

IN a paper on "Architectural Education" read before a meeting of the Royal Institute of British Architects on Monday, Mr. R. Blomfield described the report and syllabus prepared by the Board of Architectural Education appointed by the institute. The following is the syllabus proposed by the board:—(1) Building materials; (2) construction, including (*a*) applied mechanics, strictly in practical relation to construction, and (*b*) the practical methods of the building trades; (3) architectural drawing, including working and freehand drawings, solid geometry, and measured drawings of historical examples of architecture; (4) geometrical projection and rudimentary perspective, this latter to be studied as an aid to the shaping and modelling of buildings, not as a means of elaborating architectural drawings; (5) design and the history of architecture as supplemental to and elucidatory of the study of construction. It is pointed out that these subjects should be taught by class work in the schools and by demonstration in the laboratory or lecture theatre of practical work. The laboratory or workshop for training in practical work is an essential feature of the scheme. The demonstrations given in the laboratory should be in intimate relations with the lectures given in the class-rooms of the schools, and the course must be arranged so that the training in the class-rooms and in the workshops proceed together. In moving a vote of thanks to Mr Blomfield, Sir Arthur Rücker said that, if the great movement which is taking place in technical education is to have a sound foundation, it is absolutely necessary that it should be carried out by those who are themselves the professional members of the great professions and trades which they wish to carry to a point of higher education.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 26.—"On the Drift produced in Ions by Electromagnetic Disturbances, and a Theory of Radio-activity." By George W. **Walker**. Communicated by Prof. A. Gray, F.R.S.

Electromagnetic waves produce certain mechanical forces on an electrically charged particle, and the equations of motion of such a particle can be formed. When the particle is regarded as exceedingly small and endowed with a charge e and inertia m, which includes electrical inertia, the equations take a comparatively simple form. When the small viscous term due to radiation from the particle is neglected the equations can be integrated in certain cases, and it is found that the continued propagation of waves involves an alteration of the position of the particle in space.

The case which suggested the general result was that in which the waves form an infinite simple harmonic train, and the solution showed that while the passage of a complete wave restored the initial velocities of the particle, its position in space was altered.

This alteration of position is not completely accounted for by the change due to the initial velocities had there been no waves. In particular, if the particle is initially at rest, the passage of a complete wave restores the state of rest, but the particle now occupies a new position in space. This curious result has an analogue in the case of a simple pendulum making complete revolutions, where the elapse of a complete period restores the velocity while the angle described has increased by 2π.

The continued propagation of the waves thus involves the result that the particle appears to drift through space in a manner which can be completely determined when the initial circumstances are given and the constants of the train of waves are known.

Similar results are found to hold for any kind of plane disturbances propagated in a straight line. Several cases are worked out where the disturbance is of a simple character. The disturbance is that in which the electric force is X_0, with the appropriate magnetic force X_0/V at right angles to X_0, for a time d/V succeeded by zero force for a time d/V, and this again succeeded by electric force $-X_0$ for a time d/V, and zero force for a time d/V, after which the disturbance recurs. In one case where the particle is initially at rest it appears to drift with the waves, while in another case where the particle has a certain initial velocity at right angles to the direction of propagation it drifts against the waves. If radiation from the particle is neglected, the passage of a complete pulse in which the integrated effect of electric force is zero involves a restoration of the original energy of the particle, and thus the transference of the particle is accomplished without abstraction of energy from the pulse. The expressions for the apparent velocity of drifting in the direction of propagation of the waves are found to depend on the squares of the charge, so that it is probable that an electrically neutral system will also be made to drift.

It is pointed out that if the equations held up to velocities of the charged particle equal to that of radiation, a particle originally moving in the direction of propagation with a velocity slightly less than that of radiation may be picked up by the waves and carried forward with the velocity of radiation.

The conclusion is that the propagation of disturbances of any form in a straight line involves a sorting of free ions and molecules according to their initial circumstances, and streaming of these both with and against the waves must take place.

These results are general, and are limited only by the limits of the electrodynamic equations. They suggest, however, a possible explanation of the action of all kinds of ionising agents.

In particular, it is suggested that if a radio-active substance is an origin from which electromagnetic disturbances are radiated, these disturbances probably ionise the gas in the immediate vicinity and produce streaming of ions and molecules with their associated properties both outwards from and inwards to the substance. This view does not necessarily involve the supposition that there is a continual diminution of the substance.

The results may also throw some light on the question of the energy sent out. For, suppose that there exist a positive and a negative ion which, in the absence of the pulses, would recombine at some point A, thereby radiating a certain amount of energy, then the directive action of the pulses may make them recombine at some other point B. Thus the radiated energy will proceed from the point B instead of from the point A. The transference of a single free ion can be accomplished without the expenditure of energy, and it is possible that the transference of the positive and negative ions may take place without any abstraction of energy from the pulses. Since, however, in general the transference may involve a relative displacement of the two ions, abstraction of energy from the pulses may be involved, so that the question is one about which the greatest caution must be exercised. It cannot be decided without further investigation.

These considerations are in general agreement with the views that have been expressed by Lord Kelvin and Prof. and Madame Curie.

The question whether the apparent velocity of drifting may be of the order indicated by experiment is considered; and it is shown that in order to give velocities comparable with that of radiation, the theory leads us to expect that the frequency of vibration of the waves radiated by the particles should be of the order for visible or ultra-violet light.

The differences between ionising agents would turn to a considerable extent on the character of the disturbances radiated.

Since the propagation of waves through a region of space containing matter involves streaming of the matter, the continued propagation cannot be quite independent of any statical, electric or magnetic field present.

February 2.—"Note on the Determination of the Volume Elasticity of Elastic Solids." By Dr. C. **Chree**, F.R.S.

PARIS.

Academy of Sciences, February 13.—M. Troost in the chair.—On the existence of an ellipsoid of absorption in all translucid crystals, even when without a plane of symmetry or a principal axis: J. **Boussinesq**.—Study of the silicide of carbon from the Cañon Diablo meteorite: Henri **Moissan**. In the residue left after dissolving a block of this meteorite weighing 53 kilograms in hydrochloric acid, a hexagonal crystal of silicon carbide was noticed. It was completely identified by its appearance, density (3·2), and indifference to most chemical reagents. Fused caustic potash gave potassium silicate, and fused lead chromate, carbon dioxide. The origin of this block of iron may be terrestrial or sidereal, but the existence of silicon carbide in the midst of the metal shows that the products prepared with the electric furnace are met with in nature.—On some constants of pure methane, and on the action of solid methane on liquid fluorine: H. **Moissan** and **Chavanne** (see p. 400).—The eruptive basic rocks of French Guinea: A. **Lacroix**. Besides biotite granite, numerous basic eruptive rocks have been found in French Guinea, especially gabbros, peridotites, and diabases, a detailed account of which is given. Attention is directed to the difference in the mode of weathering in tropical and in temperate climates, as exemplified in these samples.—On the use of photography as an aid to topography: A. **Laussedat**. An account of an application of the photographic method to the survey of the region round Mount Argée, in Cappadocia, on a scale of 1/80,000. The use of photography has the advantage of reducing very considerably the time required as compared with the ordinary methods of surveying, and is especially advantageous in mountainous regions.—Observations of the Borrelly comet (1904 *e*) made with the Brunner equatorial at the Observatory of Lyons: J. **Guillaume**. The apparent position of the comet was measured on January 3, together with the positions of two comparison stars. The comet appeared as an object of the tenth magnitude, and possessed a small nucleus.—Observations of the sun made at the Observatory of Lyons with the 16-centimetre Brunner equatorial during the fourth quarter of 1904: J. **Guillaume**. The results are summarised in three tables giving the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Actinometric observations made at the summit of Mont Blanc: A. **Hansky**. The observations were made in the observatory at the summit of Mont Blanc with the instruments of M. Crova. The conditions in 1900 were more favourable than in 1897 and 1898, and the results for this year are given in detail, the most probable result for the constant being between 3·0 and 3·5.—On linear partial differential equations: M. **Hadamard**.—On the deviation of falling bodies: Maurice **Fouché**. A reply to a criticism of M. de Sparre on a former paper by the author.—The thickness of transparent sheets of iron: L. **Houllevigue**. After trying unsuccessfully various methods for estimating the thickness of thin films of iron, a colorimetric estimation with sulphocyanide was found to give trustworthy results. The transparency (T) of these films was determined before dissolving in acid for the colorimetric test, and for films varying in thickness from 0·024 to 0·056 milligram per square centimetre the thickness was found to be a linear function of log T. This curve being established, the thickness of any given film could be quickly determined by the photometer.—The automatic registration of atmospheric ionisation: Charles **Nordmann**. The charge introduced by the ions is removed from the condenser plate by falling drops of water, the constancy of flow being secured by a Marriotte's bottle. The deviations of the electrometer in the arrangement described, a diagram of which is given, are proportional to the number of ions per unit volume of the gas.—On the heat given off by paraffin submitted to the action of a rotating electrostatic field of high frequency: Ch. Eug. **Guye** and P. **Denso**.—On a new reaction of aldehydes and the isomerism of their oxides: A. **Conduché**. The aldehyde is added to a dilute aqueous solution containing equimolecular proportions of hydroxylamine hydrochloride and potassium cyanate. Well crystallised compounds separate out, the melting points of which characterise the aldehyde. The discussion of the composition of these compounds throws light on the constitution of the isomeric aldoximes. No corresponding compounds are obtained when a ketone is substituted for the aldehyde in the reaction.—The action of hydrocyanic acid on epiethyline: M. **Lespieau**. The nitrile $C_2H_5.O.CH_2—CH(OH)—CH_2.CN$ is obtained in this reaction, and the preparation and properties of several substances derived from this are described.—On the non-existence of two stereoisomeric ethyl dioximidobutyrates: L. **Bouveault** and A. **Wahl**. The supposed existence of two stereoisomers indicated by Hantzsch and by Nussberger is shown to be erroneous.—On the transformation of amylocellulose into starch: Eugène **Roux**.—On the electrolysis of organic acids by means of the alternating current: André **Brochet** and Joseph **Petit**. The electrolysis of formic and oxalic acids can be easily effected with the alternating current; the results are the same as with the direct current, but the yields are much higher.—On the phosphorescence of phosphorus: E. **Jungfleisch**. It is shown that an inert gas, saturated with the vapour of phosphorus, contains an extremely small weight of phosphorus, the oxidation of which gives rise to scarcely appreciable light effects. The author regards his experiments as proving that a lower volatile oxide is first produced, and that it is the oxidation of this which gives rise to the luminous phenomena.—On isodimorphism: Frédéric **Wallerant**.—On the extension of the alkaline rocks in the basin of Aouache: H. **Arsandaux**.—Two species of Dalbergia in Madagascar producing a variety of ebony wood: Henri **Jumelle**.—On the biology of the Saprolegnia: Paul **Dop**.—The utilisation of the essential oils in the etiolated plant: Eug. **Charabot** and Alex. **Hébert**. It is shown that in the absence of light the plant is capable of consuming the essential oil which it contains, especially the terpenic compounds.—The relations between *Bougainvillia fruticosa* and *Bougainvillia ramosa*: Paul **Hallez**. The author regards these as one and the same species, the one belonging to calm water, the other to rough water, the slight difference between the two being due to this difference in the surroundings.—Experimental researches on the relations between arterial pressure and the amounts of chloroform absorbed: J. **Tissot**. In the case of subjects under chloroform the examination of the arterial pressure gives indications of approaching trouble earlier than the respiratory modifications, the latter only appearing when the dangerous condition is already set up.—A comparative study of the auto-conducting cage and the condensing couch in the treatment of arterial hypertension by d'Arsonvalisation: A. **Moutier** and A. **Challamel**. The results obtained with the solenoid are better than with the couch, the commonly accepted view that the two are equivalent being erroneous.—The action of radium on the torpedo fish: Maurice **Mendelssohn**.—On the tectonic of the region north of the Montagne Noire: Jules **Bergeron**.—The daily variation of temperature in the upper regions of the atmosphere: L. Teisserenc de **Bort**.

DIARY OF SOCIETIES.

THURSDAY, February 23.

Royal Society, at 4.30.—On some New Species of Lagenostoma: a Type of Pteridospermous Seed from the Coal-measures: E. A. Newell Arber.—On a New Rhabdosphere: G. Murray, F.R.S.—Two Cases of Trichromic Vision: Dr. F. W. Edridge-Green.—On Changes observable in the Liver Cells during Digestion, and their Relation to Hepatic Secretion: Prof. E. Wace Carlier.—The Colour-Physiology of the Higher Crustacea. Part III.: F. Keeble and Dr. F. W. Gamble.—Phosphorescence caused by the Beta and Gamma Rays of Radium. Part II.—G. T. Beilby.

Royal Institution, at 5.—Recent Work of the Geological Survey: Prof. J. J. H. Teall, F.R.S.

Institution of Electrical Engineers, at 8.—*Continuation of Discussion*:—The Value of Overhead Mains for Electric Distribution in the United Kingdom: G. L. Addenbrooke.

FRIDAY, February 24.

Royal Institution, at 9.—Fungi: Prof. H. Marshall Ward, F.R.S.

Physical Society, at 5.—On the Curvature Method of teaching Geometrical Optics: Dr. C. V. Drysdale.—Exhibition of Dr. Meisling's Colour Patch Apparatus: R. J. Sowter.—A Method of illustrating the Laws of the Simple Pendulum, and an Exhibition of String Models of Optical Systems: J. Schofield.

Institution of Civil Engineers, at 8.—Morecambe Sewerage: Method of laying a 15-inch Cast-iron Sewer under the London and North-Western Railway: F. D. Flint.—The Reconstruction of Bow Bridge over the River Lea: H. M. Rootham.

SATURDAY, February 25.

Royal Institution, at 3.—Archæology: D. G. Hogarth.

The Essex Field Club, at 6.30 (at the Essex Museum of Natural History, Stratford).—Straw Plait; a Lost Essex Industry, I.: Chalkley Gould.—Family and Life of Gilberd, of Colchester: Prof. Silvanus P. Thompson, F.R.S.—Revised List of the Hymenomycetal Fungi of Essex: Dr. M. C. Cooke and George Massee.

MONDAY, February 27.

Royal Geographical Society, at 8.30.—The Scientific Results of the National Antarctic Expedition: Capt. R. F. Scott, C.V.O., R.N.

Society of Arts, at 8.—Internal Combustion Engines: Dugald Clerk.

Institute of Actuaries, at 5.—Changes in Pure Premium Policy-Values consequent upon Variations in the Rate of Interest or the Rate of Mortality, or upon the Introduction of the Rate of Discontinuance: G. J. Lidstone.

TUESDAY, February 28.

Royal Institution, at 5.—Some Recent Biometric Studies: Prof. K. Pearson, F.R.S.

Society of Arts, at 4.30.—The Manufactures of Greater Britain. I. Canada: C. F. Just.

Institution of Civil Engineers, at 8.—Surface-Condensing Plants, and the Value of the Vacuum produced: R. W. Allen.

WEDNESDAY, March 1.

Society of Public Analysts, at 8.—The Estimation of Oxygen in Copper: S. Dickson.—(1) Some Conditions affecting the Ether Value of Brandies; (2) The Determination of Higher Alcohols in Spirits. I.: Dr. Philip Schidrowitz and F. Kaye.

Entomological Society, at 8.—New Species of Diurnal Lepidoptera from Northern Rhodesia: Herbert Druce and Hamilton H. Druce.—On Three Remarkable New Genera of Microlepidoptera: Sir George F. Hampson, Bart.

Critical Society of University College (Gower Street, W.C.), at 5.—Evolution and Speculation: Sir Frederick Pollock, Bart. Visitors invited.

THURSDAY, March 2.

Royal Society, at 4.30.—*Probable Papers*: Further Researches on the Temperature Classification of Stars. No. 2: Sir Norman Lockyer, K.C.B., F.R.S.—On the Radio-active Minerals: Hon. R. J. Strutt.—Atmospheric Electricity in High Latitudes: G. C. Simpson.—On the Spectrum of Silicon, with a Note on the Spectrum of Fluorine: J. Lunt.—On the Electric Resistance to the Motion of a Charged Sphere in Free Space or in a Field of Force: G. W. Walker.

Chemical Society, at 8.—The Latent Heat of Evaporation of Benzene and some other Compounds. J. Campbell Brown.—The Relation between Natural and Synthetic Glycerylphosphoric Acids: F. B. Power and F. Tutin.—The Reduction of Isophthalic Acid: W. H. Perkin, jun., and S. S. Pickles.—The Transmutation of Geometrical Isomers: A. W. Stewart.

Royal Institution, at 5.—Recent Astronomical Progress: Prof. H. H. Turner, F.R.S.

Röntgen Society, at 8.15.—A discussion on "The Necessity of Accurate Measurement in X-ray and High Frequency Work," opened by Dr. W. D. Butcher.

Civil and Mechanical Engineers' Society, at 8.—Engineering Expert Evidence: J. F. Reade.

Linnean Society, at 8.—Zoological Nomenclature; International Rules and Others (to be followed by a discussion): Rev. T. R. R. Stebbing, F.R.S.—Biscayan Plankton. Part IV. The Thaliacea: Dr. G. Herbert Fowler.

Institution of Electrical Engineers, at 8.—Type-setting by Telegraph: D. Murray.

FRIDAY, March 3.

Royal Institution, at 9.—Recent Advances in Wireless Telegraphy: Chev. G. Marconi.

SATURDAY, March 4.

Royal Institution, at 3.—Archæology: D. G. Hogarth.

CONTENTS.

THURSDAY, MARCH 2, 1905.

A TEXT-BOOK OF ELECTROMAGNETISM.

Elements of Electromagnetic Theory. By S. J. Barnett, Ph.D. Pp. 480. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 12*s.* 6*d.* net.

MODERN electromagnetic theory is so full of interest, and yet at the same time so full of difficulties, that every fresh attempt to present an elementary account of it in a systematic and connected form is sure to attract the attention of students who are endeavouring to gain a grasp of the fundamental principles of the subject. Such students are always looking out for a "good text-book," hoping that this book, when found, will be better adapted to their needs than those they already possess. Their desire for something better probably arises, in part, from the difficulty of the subject, and the large number of new ideas which it presents to their minds. It is perhaps too much to expect that a student should be able to gain from any single book really vivid physical conceptions of electric and magnetic phenomena and principles, for perhaps, after all, these can only gradually grow in the mind. The author of the treatise under review has, it is clear, made a serious attempt to supply the student's want, so far, at least, as the more formal theory is concerned.

The book is meant to give an introduction to the subject, and thus the author does well to keep the analytical processes within the limits which are suitable for students whose mathematical attainments do not go beyond some knowledge of the differential and integral calculus and of simple differential equations.

In the first part of the book, general electrostatic theory is treated in a fairly complete way, many problems being solved. The chapters on the conduction current, on electrolysis and on thermal and voltaic E.M.F.'s, which then follow, will be found useful. The author next introduces magnetism, the magnetic action of currents, electromagnetic induction and the magnetic effects of moving charges, and concludes with a chapter on the transference of electromagnetic energy and on electromagnetic waves.

Throughout the book the system of rational units originated by Mr. Oliver Heaviside is employed. On this system, if two unit charges are placed at unit distance apart in a vacuum, each exerts a force of $1/4\pi$ dynes upon the other. The adoption of this system banishes the great 4π from many important formulæ; for instance, on the rational system, the magnetomotive force in any circuit is numerically equal to the total current linked with the circuit, and the energy per unit volume in an electrostatic field is $\frac{1}{2}c\mathrm{E}^2$, where E is the electric force and c the specific inductive capacity. But though the 4π is driven from some formulæ it finds a refuge in others, with the result that every one of the rational units corresponding to the practical units, *i.e.* to the Coulomb, Volt, Farad, Ampere, Ohm, Gauss, Maxwell and Henry, differs from the practical unit by some power of 4π. Yet the rational system is doubtless an advantage from the point of view of pure theory, and would probably have been adopted in practice if only there had been someone to suggest it in the early days of the science. The student must remember that he is using the rational system when he compares the formulæ in this treatise with those in most other text-books.

The magnetic properties of currents are deduced from Ampère's result that the mechanical action experienced by a circuit carrying a current I is the same as it would experience if each element of length $d\mathrm{L}$ were acted on by a force $\mathrm{IB}\sin\theta.d\mathrm{L}$, where B is the magnetic induction and θ is the angle between $d\mathrm{L}$ and B; the direction of the force is at right angles to both $d\mathrm{L}$ and B. In this way the idea of the equivalent magnetic shell is avoided, and, in fact, we have found no mention of a magnetic shell in the book. Yet the ideas which group themselves round a magnetic shell and the solid angle subtended by it are of real assistance, and are not easily replaced.

The book, for the most part, goes over well worn ground, and thus the reviewer's attention is naturally directed more to the treatment of the various propositions than to the propositions themselves. The treatment is generally fresh and vigorous, but in a few instances is hardly satisfactory. Taking the electrostatic field due to a point-charge, the author considers the equilibrium of a portion of the field bounded by an elementary circular cone and two concentric spheres, and shows that the tension along the lines of force requires a pressure of equal amount at right angles to them. The result is extended to the general case by the remark that "since the field within the element of volume is uniform when the element is made indefinitely small, and since this is true of any electric field, the result just obtained for a radial field holds universally."

The attempt to establish a general result by the consideration of a single special case is seldom satisfactory. In the present instance the student would not fail to notice that the method which succeeds for the non-uniform field within the conical element will not apply if the tube of force is a circular cylinder so that the field within the element is really uniform.

In chapter xiii. "the coefficient of self induction (L) of a coil or circuit is defined to be the quotient of the coil flux, N, due to the coil's own magnetic field divided by the current I in the coil." This is the way in which the coefficient is usually defined, but it is an exceedingly unsatisfactory way, for unless the conductivity of the wire be infinite, lines of magnetic induction penetrate the wire, and then it becomes difficult to understand what is meant by the "coil flux." It is impossible to escape from the difficulty by supposing the wire to become infinitely thin, for the only result of this is to make L become infinite.

Later in the chapter the coefficient of self induction is defined by means of the expression ($\frac{1}{2}\mathrm{LI}^2$) for the energy of the system. It would be preferable to follow

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Maxwell and to adopt this definition at the outset, for it is from the value of the energy that the coefficient is always calculated.

The methods of vector analysis are so useful in electromagnetic theory and present so little difficulty that the reader naturally expects to find them used in a book which is intended to present a "thoroughly modern introduction" to that theory. The author makes a slight use of this analysis in his later chapters, but in the case of vector products adopts a hybrid notation. In the true vector analysis, as used by Heaviside, if the vector product of the two vectors **A** and **B**, which make an angle θ with each other, be the vector **C**, the result is denoted by

$$\mathbf{C}=\mathrm{V}\mathbf{AB},$$

while the magnitude (C) of the product is given by

$$C=AB \sin \theta.$$

In the author's notation the relation between **C**, **A** and **B** is expressed by

$$C=\mathbf{v}AB \sin \theta,$$

the letter **V** serving to indicate that **C** is at right angles to the plane of **A** and **B**. It is difficult to see that this hybrid notation has any advantage over Heaviside's.

A few misprints have been noticed in a list sent out by the author; only a few others have been detected.

The reader has probably already gathered from this review that the treatise can hardly be described as that "good text-book" for which the student searches. Yet it is undoubtedly a useful book, and with a little modification and revision would be one of the best books of its class. The student who is fortunate enough to have it at hand will often turn to it with profit.

G. F. C. SEARLE.

ASTRONOMICAL LECTURES AT CHICAGO.

Astronomical Discovery. By Herbert Hall Turner, D.Sc., F.R.S., Savilian Professor of Astronomy in the University of Oxford. Pp. xi+225. With plates. (London: Edward Arnold, 1904.) Price 10s. 6d. net.

THE object of this book and the reason for its appearance are explained in a short preface. The purpose is "to illustrate by the study of a few examples, chosen almost at random, the variety in character of astronomical discoveries." The words "almost at random" seem a little out of place, for we learn that the book comprises the matter that was originally delivered in a series of lectures to the University students of Chicago, at the hospitable invitation of President Harper. The expression is probably not to be taken too seriously. It is not likely that a distinguished astronomer, enjoying what may be regarded as a cathedral position, would be careless in the preparation of his material. He would be anxious to give his best, both for the credit of English astronomy and for his own reputation. There is ample internal evidence, not only that the lectures were carefully prepared, but also of judicious selection.

The subjects chosen are about equally distributed between those that are made at the telescope and those that have resulted from the discussion of the observations so made. This will be seen from a list of the several chapters or lectures—(1) Uranus and Eros, (2) discovery of Neptune, (3) Bradley's discoveries of aberration and nutation, (4) accidental discoveries, (5) the sun-spot period, and (6) the variation of latitude. Some subjects which might have been expected to find a place, such as the discoveries resulting from the application of the spectroscope, have been omitted, but the list is sufficiently varied, and we gratefully acknowledge having received a considerable amount of pleasure from reading the well-known and familiar tales, treated, as they are, with the brightness and acuteness characteristic of the author.

The choice of the discovery of Uranus permits a well-deserved tribute to be paid to the memory of the elder Herschel for the keenness, assiduity and patience which mark the work of that astronomer; while the mention of Eros allows something to be said of the problem of the sun's distance and of the history of those times when the discovery of a small planet added something to the reputation of the lucky discoverer. The Savilian professor has some amusing remarks on the subject of naming the host of small planets that diligence has added to our catalogues. He quotes the case of Victoria as giving rise to an outcry by foreign astronomers, who objected to the name of a reigning sovereign being found in the list. But the real struggle of the purists was, we believe, over the christening of Fortuna, which Airy happily settled in favour of the discoverer's choice, by aptly quoting the well known lines of Juvenal:—

"Nullum numen habes si sit prudentia
Sed nos te facimus fortuna deam, cæloque locamus."

The second chapter or lecture is probably the least satisfactory in the book. The tale might have been told without parading the old scandal of sixty years ago to such wearisome length. Controversy seems out of place in lectures of this character. Prof. Turner in reopening the old sore has apparently two objects, the one, the whitewashing of Airy, and the other, the besmirching of Challis' reputation. Very hard things are said of the latter to which we do not wish to give further currency by repeating, but on the subject of Challis' lectures we doubt whether the words given in Airy's "Life" will bear the construction put upon them by Prof. Turner. There is no evidence to show, or at least the author has not produced it, that Airy's opinion was different in 1844 from what it was in 1834, when he wrote to the Rev. T. J. Hussey: "I am sure it could not be done (predict the place of the disturbing planet) till the nature of the irregularity was well determined from several successive revolutions" (of Uranus), p. 43. Airy, it may be suggested, did not believe the problem soluble until he received Le Verrier's memoir in 1846.

The account of Bradley's discoveries is excellent, and the feature in it which will be especially valued is the brief history given of the Rev. James Pound, Bradley's maternal uncle. The reputation of Pound has been overshadowed by that of his more brilliant, but perhaps less versatile, nephew, and it is most desirable to give the uncle his proper position. The whole chapter constitutes a most delightful piece of biography.

The accidental discovery of a "new star" does not differ materially from that of a planet, and the author admits that this fourth chapter might very well have been the first of the series, but we agree with him that it is not a matter upon which to lay any particular stress. The particular discovery is only a peg on which to hang the remarks that the author wishes to make on certain subjects. In this case the discovery of the "new star" in Gemini, at Oxford, by means of photography, serves to introduce an account of the International Chart of the Heavens, and some remarks connected with the behaviour of Nova Persei. This chapter presents a careful examination of the facts and suggestions that have been brought to light by observation. The history of Schwabe and his work on sun-spots do not call for any particular remark. The chapter is not long, and it covers the ground very satisfactorily. In the last lecture, Prof. Turner gives an account of the variation of latitude, wherein he is seen quite at his best. The subject is not so hackneyed as some of the other selections, but to speak to Americans of the work accomplished by Mr. Chandler was, no doubt, inspiring, and the successive steps by which Mr. Chandler established his case are described with clear, logical sequence. Usually the author ends his lecture by pointing out what particular lessons are to be drawn from the discovery under examination, and they generally amount to this, that there is no line of research, however apparently unimportant or monotonous, which can be safely neglected. Some inquiries seem to offer a more immediate prospect of success, such as the establishment of observatories in the Southern Hemisphere, to make accurate observations on the motion of the Pole; but at the same time unexpected discoveries may lie in a direction precisely opposite to that indicated by the most educated opinion at present available. The conclusion may be obvious, but the remark is not unnecessary. To be led too strictly by authority is unwise, to neglect the teachings of experience is a crime.

W. E. P.

ZOOLOGICAL RESULTS.

Zoological Results based on Material from New Britain, New Guinea, Loyalty Islands and Elsewhere, collected during the Years 1895, 1896, *and* 1897, *by Arthur Willey, D.Sc.Lond.* Parts i.–vi. Pp. vi+830; illustrated. (Cambridge: University Press.)

THIS splendid series of "zoological results" should have been recognised at an earlier date in our columns, but the six volumes have appeared through a lustrum of five years, and the fine series of memoirs has mounted up to a total which baffles reviewing. As Balfour student of the University of Cambridge, Arthur Willey went in 1894 to the Pacific in search of the eggs of the pearly nautilus. He found these, but so much more of great interest, *e.g.* as to Peripatus, Amphioxus, Balanoglossus, Ctenoplana, that his tenure of the Balfour scholarship was on two successive occasions judiciously extended for a year beyond the allotted triennium. In his arduous but well rewarded explorations, Dr. Willey was aided by the Government Grant Committee of the Royal Society, who may congratulate themselves on the fact that the money at their disposal was never better spent than on this enterprise. It has seldom been the happy fortune of a single zoologist to bring together in a short span such rich material, including some of the most interesting zoological types.

In part i. Dr. Willey describes the structure and development of *Peripatus novae-britanniae*, n.sp., and in so doing throws some fresh light on the heterogeneity of the class Onychophora, which this "delightful creature" represents. Dr. Paul Mayer describes a new caprellid; Mr. G. A. Boulenger discusses a very rare sea-snake (*Aipysurus annalatus*) from the South Pacific; Mr. R. I. Pocock reports on the centipedes, millipedes, scorpions, Pedipalpi, and spiders; and Dr. Sharp gives an account of the phasmids, with notes on their remarkable eggs.

In part ii. Prof. Hickson reports on Millepora, showing that the single species (*M. alcicornis*) illustrates that great variability in the form of growth which is a characteristic feature of the genus. Prof. Jeffrey Bell discusses the echinoderms (other than holothurians, which are dealt with separately by Mr. F. P. Bedford). Mr. Arthur E. Shipley reports on the sipunculoids, Mr. J. Stanley Gardiner on the solitary corals and on the post-embryonic development of Cycloseris, Mr. Beddard on the earthworms, and Miss Isa L. Hiles on the Gorgonacea, which includes some interesting new species.

In part iii. Dr. Gadow has an interesting essay on orthogenetic variation in the shells of Chelonia, that is to say, cases in which the variations from the normal type seem to lie in the direct line of descent; Dr. Willey describes three new species of Enteropneusta, and develops several theories, *e.g.* that the gill-slits arose originally as perforations in the inter-annular grooves for the aëration of the gonads which occupied the dividing ranges; and Mr. A. E. Shipley reports on the echiurids, making a welcome attempt to revise the group and to determine its geographical range.

In part iv. Mr. Stanley Gardiner describes the structure of a supposed new species of Cœnopsammia from Lifu, and comes *inter alia* to the striking conclusion that the so-called endoderm in Anthozoa, giving rise to the muscular bands and generative organs, and performing also the excretory functions, is homologous with the mesoderm of Triploblastica. In terms of the layer theory, of whatever value it may be, the actinozoon polyp must be regarded as a triploblastic form. Dr. Sharp reports on insects from New Britain, Mr. L. A. Borradaile on Stomatopoda and Macrura from the South Seas, Mr. Walter E. Collinge on the slugs, Mr. E. G. Philipps on the Polyzoa, Miss Laura Roscoe Thornely on the hydroid zoophytes, and Mr. J. J. Lister describes a remarkable type of a new family of sponges (*Astroclera willeyana*), a very interesting novelty. Mr. W. P. Pycraft discusses the pterylography of the Megapodii, Prof. Hickson and Miss Isa L. Hiles the Stolonifera and Alcyonacea, and Dr. Ashworth the Xeniidæ.

In part v. Mr. Arthur E. Shipley gives a description of the Entozoa which Dr. Willey collected during his sojourn in the western Pacific, including *Porocephalus tortus*, Shipley, a member of the interesting family Linguatulidæ. Mr. R. C. Punnett discusses some South Pacific nemertines, Mr. L. A. Borradaile has an interesting note on the young of the robber crab, Miss Edith M. Pratt describes the structure of *Neohelia porcellana*, Mr. Boulenger reports on a new blind snake from Lifu, and the Rev. T. R. R. Stebbing deals with the Crustacea.

Part vi. contains Dr. Willey's contributions to the natural history of the pearly nautilus—a fine piece of work—and his personal narrative, which is not less creditable. In his narrative, amid interesting details of how he went about his collecting business, he discusses, as a zoologist, his new Peripatus, the Ascidian *Styeloides eviscerans*, which readily throws out its entrails in holothurian fashion, the interesting intermediate type Ctenoplana, "which no zoologist could encounter without experiencing a momentary thrill of satisfaction," the lancelets and enteropneusts which he observed, some of the remarkable new forms which he discovered, such as Astroclera, and the egg-laying of nautilus—his main quest. The whole story reflects great credit on the indefatigable explorer himself and on those who have assisted him in working up the descriptions which form this imposing six-volume series of zoological results.

OUR BOOK SHELF.

Flora of the County Dublin. By Nathaniel Colgan. Pp. lxx+324. (Dublin: Hodges, Figgis and Co., Ltd., 1904.)

IN many respects this district is an interesting one, and the floral distribution not quite what might have been expected from a consideration of the adjacent counties. The flora resembles that of southern rather than northern Britain, but the somewhat unexpected result is arrived at that the western Irish flora has a considerably larger proportion of northern plants than has the corresponding eastern flora. The book opens with a summary of previous work in the district from the fifteenth century to the present day. The physical features are then described, and a section headed "Relations of Plants and Soils" lays particular emphasis on the distinction between "calcifuges" and "calcicoles."

Some plants curiously absent from the county are mentioned, one of which, *Nymphaea alba*, L., occurs in Meath, Kildare, and Wicklow. Both *Trifolium repens*, L., and *T. dubium*, Sibth., are stated to do duty as the shamrock or shamrogue. Probably *Oxalis acetosella*, L., has never served as the Irish national badge, this erroneous impression apparently dating from a paper by J. E. Bicheno published in 1830. Mr. Colgan cannot add *Epilobium tetragonum*, L., to the Irish list, although *E. obscurum*, Schreber, is common in the upland districts. A description of that interesting hybrid *Senecio Cineraria*, D.C., × *S. Jacobaea*, L., is given. The belief that one of its forms is identical with the Italian *S. Calvescens* must be abandoned if Sig. Sommier's conclusion that this last plant is *S. Cineraria* × *S. erraticus*, Bertolini, be accepted. It is decidedly suggestive to find that our common *S. Jacobaea* hybridises so much more readily with an alien species than with its fellow Senecios of the British Isles. Another curious fact concerning hybrids deserves mention. The common cross *Primula veris* × *vulgaris*, as found in Kenmure Park and in several other localities, approaches very nearly to the primrose, while the Ballinoscorney plant closely resembles the cowslip. This curious state of affairs demands experimental investigation. Space limitations forbid mention of any more of the numerous points of general botanical interest contained in the volume.

The author is to be congratulated on having produced something far more useful than the mere catalogue of names and places sometimes dignified by the title "County Flora." Particularly pleasing is the attention paid to local names, given in the Irish-Gaelic characters. It is rather surprising that philologists do not devote more study to local and often rapidly disappearing dialects. The botanist working a country district is exceptionally well placed for collecting information on such subjects, and might with advantage make use of his opportunities.

Exercises in Practical Physiological Chemistry. By Sydney W. Cole, M.A. Pp. vii+152. (Cambridge: W. Heffer and Sons; London: Simpkin, Marshall and Co., Ltd., 1904.) Price 5*s*. net.

Practical Exercises in Chemical Physiology and Histology. By H. B. Lacey and C. A. Pannett, B.Sc. Pp. 112. (Cambridge: W. Heffer and Sons; London: Simpkin, Marshall and Co., Ltd., 1904.) Price 2*s*. net.

NOTHING more forcibly illustrates the growing importance attached to the chemical side of physiology than the institution of practical courses dealing with this branch of the subject in centres of physiological teaching. Accompanying this is a multiplication of practical guides. Every teacher has his idiosyncrasies in the exercises he selects for his classes, but one is inclined to doubt whether these are always sufficiently pronounced or important to justify him in issuing a fresh handbook. Competition, however, is not to be despised, and will in the end lead to the survival of the fittest. In the struggle, Mr. Cole's little book, which represents the Cambridge course, will doubtless maintain its own. Though short it is admirably clear, and the practical exercises are judiciously selected. The author is well known for his researches in physiological chemistry, and possesses that preliminary knowledge of pure chemistry which is so necessary nowadays for a successful pursuit of its physiological application.

The book is free from illustrations; the student is required to make his own drawings of crystals, absorption spectra, and so forth in the blanks left for the purpose. This is an admirable idea, and one hopes that the zealous and interested care that Mr. Cole asks from the students in his preface will be responded to in the manner he desires.

The book does not pretend to be complete, but as an elementary introduction to more advanced work it is excellent. I do not propose to direct attention to faults of omission, for these are obviously intentional; the only fault of commission I have discovered is on p. 78, where the statement made implies that potassium ferricyanide contains oxygen.

The second book, that by Messrs. Lacey and

Pannett, demonstrates that practical classes in physiology are not confined to universities and colleges of university standard. The book itself is not a serious contribution to scientific literature, and its authors have neither the requisite training nor knowledge to make it such. It is a mere compilation or *rechauffé* from other well known text-books. One notes that one of the authors blazons upon the title-page that he has obtained a scholarship at the inter. M.B. examination at the University of London, and this is a fair index of what the reader may expect in the interior of the volume. A note-book carefully kept by any moderately good medical student would be equally worthy of publication.

W. D. H.

Laboratory Notes on Practical Metallurgy: being a Graduated Series of Exercises. Arranged by Walter Macfarlane, F.I.C. Pp. x+140. (London: Longmans, Green and Co., 1905.) Price 2s. 6d.

THIS little book is apparently intended as a first course for beginners in practical work in a metallurgical laboratory, and especially for those who are preparing for the examination of the Board of Education in stages 1 and 2 of practical metallurgy. For these classes of students it will be useful and deserves commendation.

It consists of a series of practical exercises, all well within the grasp of the average boy, graduated and arranged with the view of developing the habit of observation, and the instructions given for doing them show a much more intimate acquaintance with the simpler operations of a metallurgical laboratory than is generally found in works of this class. In the first eighteen pages the student is introduced to furnace work by simple experiments on the melting of metals under various conditions, to prepare him for the subsequent more difficult operations.

The preparation of the ordinary common alloys follows, and then a series of well-chosen exercises illustrates the oxidation of metals and the reduction of metallic oxides and sulphides. Later, the more complex subject of the principles on which the processes for the extraction of copper, lead, gold, and silver from their ores depend is dealt with.

The book concludes with a few elementary exercises in assaying gold and silver ores, and the analysis of coal and coke. In the appendix are several tables, the most important being one giving the percentage composition of some of the common alloys.

There are a few slips and blemishes in the text, but they are for the most part trivial, one of the chief being in the table just mentioned, in which the composition of the British gold coinage is given as gold 91.66, silver 8.33; the latter should of course be "copper." The book contains much useful information for junior students, and can be recommended for their use.

Le Liège. Ses produits et ses sous-produits. By M. Martignat. Pp. 158. (Paris: Gauthier-Villars and Masson et Cie.) Price 2.50 francs.

THE latest addition to the "Encyclopédie Scientifique des Aide-Mémoire" is divided into two parts. The first part is concerned with the formation of cork in *Quercus suber*, the distribution of the tree, its treatment, its maladies and enemies, &c., and concludes with an account of prices and other commercial considerations. The second part describes how the natural product is treated in the manufacture of corks of all kinds, and how it is utilised in the production of linoleum and other materials.

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.]*

Charge carried by the α Rays from Radium.

No special difficulty has been experienced in showing that the β particles (electrons), expelled from radium, carry with them a negative charge of electricity. The positive charge left behind on the vessel containing the radio-active material is simply and strikingly illustrated in the arrangement devised by Strutt, which is now popularly known as the "radium clock."

Since the α particles are deflected by a magnet as if they carried a positive charge, it is to be expected that this charge should be easily detected; but all the initial experiments made for this purpose resulted in failure. Since there are four products in radium which give out α particles, and only one which gives out β particles, it is theoretically to be expected that four α particles should be expelled from radium for each β particle.

In the Bakerian lecture (*Phil. Trans.*, series A, vol. cciv., p. 212, 1904) I described some experiments that were made to determine the charge carried by the α particles. About half a milligram of radium bromide was dissolved in water, and spread uniformly over a metal plate and evaporated to dryness. With a plate of 20 sq. cm. in area, the absorption of the α rays in the thin film of radium bromide is negligible. The solution of the radium released the emanation, and, several hours after removal, the activity of the radium fell to about one-quarter of its maximum value, and the β and γ rays from it practically disappeared. The experiments were made with the radium film at this minimum activity, in order to avoid the complication which would ensue if the β particles were present. An insulated plate was placed parallel to the radium plate and about 3mm. away from it. The apparatus was enclosed in an air-tight vessel, which was exhausted to a very low vacuum. The current between the plates was measured by an electrometer. The saturation current between the plates rapidly fell with decrease of pressure, but soon reached a limiting value—about 1/1000 of the initial—which could not be reduced further, however good a vacuum was obtained. No certain evidence that the α particles carried a positive charge could be obtained. It was thought possible that the inability to reduce the current below this value might be due to a strong secondary radiation, consisting of slow-moving electrons, which were liberated by the impact of the α particles on matter. Strutt (*Phil. Mag.*, August, 1904) has also observed a very similar effect, using a plate of radio-tellurium, which is well suited for this purpose, as it gives out only α rays.

J. J. Thomson (*Proc.* Camb. Phil. Soc., November 14, 1904; see NATURE, December 15) has recently shown in a striking manner that a large number of slow-moving electrons are liberated from a plate of radio-tellurium, although this substance is supposed to emit only α particles. These electrons could be readily bent back to the plate from which they came by the action of a magnetic field. No indication, however, that the α particles carried a charge was obtained.

I have recently attacked this problem again, using the methods and apparatus previously described, but, in addition, employing a strong magnetic field to remove the slow-moving electrons present with the α particles. The apparatus was placed between the pole-pieces of an electromagnet, so that the field was parallel to the plane of the plates. In such a case, most of the escaping electrons describe curved paths and return to the plate from which they set out. On application of the magnetic field, a very striking alteration was observed in the magnitude of the current. The positive and negative currents for a given voltage were greatly reduced. The upper plate, into which the α particles were fired, rapidly gained a positive charge. In a good vacuum, this was the case whether the lower plate was charged positively, or negatively, or connected to earth. The magnitude of the charge, deduced from these experiments, was found to be practically independent of the voltage between 0 and 8 volts. When once a magnetic field had been applied, of sufficient strength to stop all the slow-moving electrons, a large increase in its value had no effect on the magnitude of the positive charge. I think these experiments undoubtedly show that the α particles do carry a positive charge, and that the previous failures to detect this charge were due to the masking action of the large number of slow-moving electrons emitted from the plates.

Observations were made under different experimental conditions, and with very concordant results. In one set of experiments a weight of 0·19 mg. of radium bromide was used, spread on a glass plate, which was covered with a thin sheet of aluminium foil; in the other 0.48 mg., spread on an aluminium plate. The saturation current due to the latter plate, measured between parallel plates 3·5 cm. apart by means of a galvanometer, was found to be $7{\cdot}8 \times 10^{-8}$ amperes. It is possible that the failure of Prof. Thomson to detect the positive charge carried by the α rays from radio-tellurium was due to the smallness of the effect to be measured; for with the plate of radio-tellurium in my possession, the current was only about 1/40 of the above value.

Since the film of radium bromide is so thin that all the α particles escape from its surface, it is easy to deduce from the observed charge from a known weight of radium the total number of α particles expelled per second from one gram of radium bromide. Taking into consideration that half of the α particles were projected into the radium plate, and assuming that the α particle carries the same charge as a gaseous ion, it was deduced that one gram of radium bromide emits $3{\cdot}5 \times 10^{10}$ particles per second. Now the activity of radium bromide in radio-active equilibrium is four times this minimum, and contains four products which emit α particles at the same rate. It is thus probable that one gram of radium bromide in radio-active equilibrium emits $1{\cdot}4 \times 10^{11}$ particles per second. I had previously deduced (*loc. cit.*), from indirect data, the value about $1{\cdot}1 \times 10^{11}$, so that the theoretical and experimental numbers are in very good agreement.

I have also made experiments, by a special method, to determine the total number of β particles emitted from one gram of radium bromide in radio-active equilibrium, and have found a value about the same as the number of α particles emitted at its minimum activity. It is thus seen that four α particles are expelled from radium for each β particle. The number of β particles obtained by Wien was much smaller than this, but, in his experiments, a large proportion of the more slowly moving β particles was absorbed in the radium itself and in the envelope enclosing it.

The number of α particles expelled per second from one gram of radium is a most important constant, for on it depends all calculations to determine the volume of the emanation, and of helium, the heat emission of radium, and also the probable life of radium and the other radio-elements.

E. RUTHERFORD.

McGill University, Montreal, February 10.

Compulsory Greek at Cambridge.

THE conclusion to be drawn from Mr. Bateson's letter seems to be that it is useless to compel candidates to get up subjects for which they have no aptitude, or in which they take no interest. The glories of "another world," whether in science or art, are reserved for those that can see them, and a bright boy, not to say a dull one, is unlikely to discover the beauties of compulsory Greek, if he happens to have a distaste for dead languages. But is it not rather a narrow view which recognises only one new world and the entrance to it through compulsory Greek? It is said of a great creative mathematician that surveying his subject from a high pinnacle of abstract thought, he exclaimed, "And we too are poets"; but the most enthusiastic would scarcely expect this feeling to be aroused by compulsory mathematics in a dull boy; it does not seem to have occurred even to an exceptionally bright one.

Sullied, as Mr. Bateson seems to consider mathematics, by a degrading usefulness to "trade and professions," it nevertheless remains of essential importance to nine-tenths of our scientific work, and most of those of us who have but little of it sigh that we have not more. Mr. Bateson himself has not disdained its assistance in his work on breeding and heredity.

The point of previous letters is not that the writers had no aptitude for Greek, but that they found it useless to them in the studies to which they devoted their life. German is indispensable; soon we shall have to read Russian too, and if a man is to keep abreast of his subject he must not only read German, but read it with ease, so great is the bulk of literature to be got through. Arbitrarily to compel a boy to learn Greek, which, if he does not appreciate it, will be perfectly useless to him, when he might be learning German, which, whether he likes it or not, is indispensable for the full pursuit of his scientific studies, seems to be one of the cruellest conceivable tyrannies of pedantic folly. Could there be greater intellectual waste, and could any means be designed more likely to defeat the end for which it is designed? Compulsion and education are terms as opposed philosophically as they are etymologically; let the student be encouraged to work at the subjects he has really at heart and he will proceed from one success to another, and may even find his training in natural science leading him to the higher things in Greek literature.

But since the most natural classification of candidates would seem to be into those having a tendency to exact thought—who will naturally gravitate towards mathematics, and those with a love of art—who will naturally aspire to literature, and those with a little of both—who will be given over to natural science, why not allow a first class in any two of the three to count as a pass? such a measure would prove a great relief both to congenital non-mathematicians and non-linguists.

Finally, why should a want of sympathy with Greek, the noblest language of the noblest literature the world has known, be imputed to those who think that it is too good a thing to be wrested to injurious purposes?

X.

IF Mr. Bateson's case is that of hundreds, I make bold to say the case of the boy who wastes hundreds of hours on Greek grammar is that of thousands.

We do not want to abolish compulsory Greek because it has no value in the market, but because, stopped where the boy who takes it no further than the Little-Go stops it, the study of Greek has no value, ninety-nine times out of a hundred, in the forming of an active, living intelligence.

Mathematics may have contributed nothing to the formation of Mr. Bateson's mind; it is not unlikely, though it is deplorable. But if Mr. Bateson seriously thinks that elementary mathematics contributes no more than elementary Greek to the sound training of an average mind, surely he is curiously destitute in experience of the run of faculties in a young human being. This explanation of Mr. Bateson's astonishing argument suggests itself the more readily, because his idea that Greek is one of the things that put "one touch of art in the life of a dull boy, and open his eyes to another world," appears absolutely grotesque.

The narrow (and conspicuously *unintelligent*) utilitarian idea of education represented by Mr. Bateson's "intelligent lady" must be fought with all our strength, but it cannot be fought successfully with the rusty sword of Mr. Bateson's reactionary classicism. That is a weapon which will break in our hands and leave us defenceless to the spoiler.

A. G. TANSLEY.

New University Club, London, S.W., February 23.

MAY I be permitted to suggest, with all deference, that Mr. Bateson's statement that his knowledge of mathematics is "*nil*" must be taken *cum grano*! He is now, I believe, largely engaged in the business of counting chickens before they are hatched. How could he do this without some mathematics? As a matter of fact, the research in which he is engaged involves mathematical conceptions of no mean order, yet I presume he knows something about his subject.

Mr. Bateson's letter might be a good argument in favour of lowering the mathematical standard in the previous examination. But, as he uses it, it is merely an unusually frank example of the reasoning which is the real support of compulsory Greek, *viz.*, "When I was a little boy the big boys bullied me; now that I am a big boy myself I mean to take it out of the little ones!"

EDWARD T. DIXON.

Racketts, Hythe, Hants, February 24.

A Large Indian Sea-Perch.

THE dimensions and weight of a sea-perch caught in December last by some native fishermen near Diamond Harbour in the River Hooghly seem to me to be worth recording.

Its length is nearly seven and a half feet, its girth just behind the shoulder is a little more than five feet nine inches, and its weight, the day after its capture, was four hundred and sixty pounds.

The fish is so old and worn that its specific identity must remain in doubt, but it agrees fairly well with Day's description, in the "Fauna of British India," of *Epinephelus lanceolatus*, Bloch.

The largest Indian sea-perch of which I can find any record is the one mentioned by Russell (quoted by Day under *Epinephelus pantherinus* and *malabaricus*), which was taken at Vizagapatam in January, 1786, and measured seven feet in length, five feet in girth, and weighed upwards of three hundred pounds.

The scales of the Diamond Harbour monster are so altered by deposit that their accretion lines are very difficult to follow; but in a large scale from the shoulder I can count between 500 and 600 such lines, which are sometimes grouped in series of about eight, but oftener show no grouping at all. A. ALCOCK.

Indian Museum, Calcutta, February 2.

Attractions of Teneriffe.

THOSE members of the British Association who visit South Africa this year will probably desire to spend as much time as they can near their journey's end. But it is just worth mentioning that some of the oceanic islands en route have very special attractions. For instance, I write from Teneriffe, which has igneous rocks, cinder cones, and lava streams for the geologist; and for the botanist all zones of vegetation from the subtropics to the snows. The scientific literature of the island is at present more in German than in English. A single day's excursion, 2000ft. up into the hills by electric tram, is possible whilst the steamer waits to coal. A week would allow of a short tour to Orotava and across the mountains to Guimar, through some of the most interesting parts of the island.

HUGH RICHARDSON.

SAMUEL PEPYS AND THE ROYAL SOCIETY.

MAGDALENE COLLEGE, Cambridge, with which the name of Samuel Pepys is indissolubly associated, held in his memory at the college on Thursday last, his birthday, a reunion which may become an annual event. Some of the institutions with which he was more especially connected were invited to send delegates to this gathering. Thus the Royal Society was represented by one of its secretaries and its foreign secretary. From the immortal Diary it appears that the first proposal that Pepys should join that Society was made to him in the spring of the year 1662 by his friend Dr. Timothy Clerke, who offered to bring him "into the College of Virtuosos and my Lord Brouncker's [P.R.S.] acquaintance, and to show me some anatomy; which makes me very glad, and I shall endeavour it when I come to London." Two years, however, elapsed before his election. From the minute-books of the Society it appears that he was unanimously elected and admitted on the same day (February 15, 1664)—a rapidity of procedure which contrasts with the much more leisurely action of the present day. He records that he "was this day admitted by signing a book and being taken by the hand by the President, my Lord Brunkard, and some words of admittance said to me. But it is a most acceptable thing to hear their discourse and see their experiments. . . . After this being done they to the Crowne Taverne, behind the 'Change', and there my Lord and most of the company to a club-supper."

The meetings of the Royal Society in those days must have been a good deal more lively than they are at present. Robert Hooke, the most fertile and inventive genius of his time, was then "Curator of Experiments," and brought forward at each meeting either some ingenious contrivance of his own or some device provided by one of the members. This constant and exciting variety of practical demonstration would be entirely after Pepys' heart, gratifying his spirit of curiosity and his keen desire to increase his knowledge in every direction. Another feature of the meetings could not but gratify one of his most characteristic proclivities—his sociability and love of congenial company. The evening adjournments to the "club-supper" at the Crowne Taverne behind the 'Change or to the Devil Taverne in Fleet Street would end off his day as he always delighted that it should end. These meetings for supper contained the germ of the Royal Society Club, the oldest extant records of which do not go back further than 1743. This club consists of a limited selection of fellows of the Society who still dine together at some restaurant on the evenings of the Society's meetings.

At the time of Pepys' election the Society met at Gresham College, but a few years afterwards moved to Arundel House. An effort was then being made to raise money for the purpose of building a house in which the "virtuosos" might hold their meetings and place their library and apparatus. Among the other fellows, Pepys was applied to for a subscription. Under date April 2, 1668, he writes, "with Lord Brouncker to the Royall Society, where they were just done; but there I was forced to subscribe to the building of a College and did give 40*l*."—certainly a generous donation at that time. He evidently had some reluctance to join in the scheme, for he thought that this canvassing for money "may spoil the Society for it breeds faction and ill will, and becomes burdensome to some that cannot or would not do it."

The Royal Society held its annual meeting for the election of the council and officers on St. Andrew's Day, November 30—a date which is still kept sacred for the same purpose. But some of the usages that were formerly in vogue have disappeared. Thus Pepys writes on November 30, 1668, "To Arundel House and there I did see them choosing their Council, it being St. Andrew's Day; and I had his cross in my hat, as the rest had, and cost me 2*s*." The diarist himself had already been nearly selected to serve on the council, so well did he stand in the esteem of his fellow members. Only three years and a half after his admission into the Society he records that "I was near being chosen of the Council, but am glad I was not, for I could not have attended, though, above all things, I could wish it; and do take it as a mighty respect to have been named there."

At last, at the end of twenty years from the time of his entry into the Royal Society, his associates showed the estimation in which they held him by electing him President on December 1, 1684. He was the sixth who filled that office in the history of the society. The council minute-book shows that he obtained twenty-nine votes out of thirty-nine, and that he was sworn in upon December 10. The council included at that time Sir Christopher Wren, Dr. Martin Lister, Robert Hooke, E. Halley, John Flamsteed (Astronomer Royal), John Evelyn, and Sir John Hoskyns. The difficulty which Pepys would have had in attending the meetings of council appears to have still continued after his election to the presidency, for he was only occasionally able to be present. Unfortunately, the Diary, which gives such a full and faithful record of his daily life, stops short long before the date of his election to the chair of the Royal Society, so that we are without any memoranda of his own regarding what took place during his tenure of the office. The minute-books of the Society, however, furnish some interesting particulars.

One of the undertakings of the Royal Society during the time that Pepys presided over its business was the publication of the elaborately illustrated work of Francis Willughby, the "Historia Piscium." It was a somewhat costly production, so that several members of the Society agreed to subscribe for one or more plates, which were to be supplied at the cost of one guinea each. Pepys far surpassed all other subscribers in his generosity, seeing that he paid for no fewer than sixty plates. The book is appropriately dedicated to him, and when it was ready for issue the council, to mark its appreciation of his assistance (June 30, 1686), "ordered that a Book of Fishes, of the best paper, curiously bound in Turkey leather, with an inscription of dedication therein, likewise five others bound also, be presented to the President." On the same occasion the following amusing entry was made on the minutes:—"Ordered that the Society to encourage the measuring a Degree of the Earth do give E. Halley 50*l.*, or fifty Books of Fishes (!) when he shall have measured a degree to the satisfaction of Sir Christopher Wren, the President and Sir John Hoskyns." There is no record to show which alternative the future Astronomer Royal accepted.

Undoubtedly the most important event which occurred at the Royal Society during Pepys' term of office was the acceptance and publication of Newton's immortal "Principia." In the MS. journal-book of the Society under date April 28, 1686, it is recorded that Dr. Vincent "presented the Society with a manuscript Treatise intituled *Philosophiae Naturalis Principia mathematica,* and dedicated to the Society by Mr. Isaac Newton wherein he gives a mathematical demonstration of the Copernican hypothesis, as proposed by Kepler, and makes out all the phenomena of the celestial motions by the only supposition of a gravitation towards the centre of the sun, decreasing as the square of the distances therefrom reciprocally. It was ordered that a letter of thanks be wrote to Mr. Newton and that the printing of the book be refer'd to the consideration of the Councell; in the mean time the book to be put into the hands of E. Halley, who is to make a report thereof to the Councell." On May 19 it was "ordered that Mr. Newton's book be printed forthwith in a quarto of a fair letter, and that a letter be written to him to signifie the Societye's resolution, and to desire his opinion as to the print, volume, cutts and so forth." On June 30 the council ordered "that the President be desired to licence Mr. Newton's book, dedicated to the Society." Accordingly the title-page of the famous quarto bears the licence in conspicuous print—"Imprimatur, S. Pepys, Reg. Soc. Praeses, Julii 5, 1686."

Pepys held the office of president for two years, and was succeeded on St. Andrew's Day, 1686, by the Earl of Carbery, by whom he was named one of the vice-presidents. Though not in any sense a man of science, he was distinguished among his contemporaries for his keen interest in scientific progress and his eager desire to acquire as much as he could of "natural knowledge." Though careful of his money, he could be generous where the interests of science appealed to him. The absorbing character of his work at the Admiralty and the enthusiastic devotion with which he applied himself to it no doubt prevented him from taking as active a share in the business of the Royal Society as he would have wished to do. But among the distinguished men who during two centuries and a half have occupied the presidential chair there have been few more entitled to kindly remembrance than Samuel Pepys.

Arch. Geikie.

COMPULSORY GREEK AT CAMBRIDGE.

It is earnestly to be desired that every member of the Senate who is on the side of the Studies and Examinations Syndicate will record his vote in favour of their proposals on either Friday or Saturday, March 3 and 4, between the hours of 1–3 p.m. or 5–7 p.m.

The proposals of the syndicate have been in many places misrepresented. The committee which is opposing them heads its manifestoes "Defence of Classical Studies at Cambridge," but no one has yet attacked these studies. It is true that the proposals allow a modern language instead of either Greek or Latin, but every candidate must take one ancient language, and whichever he elects to offer for the Previous Examination he will have in the future to show a really respectable knowledge of that tongue. At present, as is demonstrated by the students of Newnham and Girton, and many others, and as letters in Nature have shown, a mere smattering of Greek which can be "got up" in a couple of months is all that can be demanded in view of the existing state of education in our public schools.

Those who think no man can be cultivated without Greek (they do not say the same about women) often forget that the Greeks, who are held to have been incomparable educators, dispensed entirely with the study of dead or foreign languages. They did not educate their sons on a basis of ancient languages, they educated them on their own language and their own literature. The Romans, again, got on very well without studying dead languages. It is true that the educated men in ancient Rome studied the Greek authors, but Greek was to them a living language, and the intercourse between the thinkers and the doers of classical times was at least as close as between the French and British of our own day.

The supporters of the present proposals are often charged with encouraging undue specialisation. But what do we mean by specialisation? The term is usually used to denote the study of one subject to the exclusion of others. If this definition be sound it is the advocates of what is called compulsory Greek who are the culprits. A boy begins Latin, say, at eight or nine, and shortly afterwards takes up Greek, and for the next nine or ten years, at many of our public schools, does comparatively little else. He has specialised to such an extent, and his intellect is so cramped and dulled by the process, that he not unfrequently fails to reach the low standard of the Previous Examination when he leaves school. Even if he has a real gift for classics he is often but a narrow specialist. Fifty-five years ago a Mr. John Smith published in his "Sketches of Cantabs" an appreciation of the classical man of the middle of the last century. "He seldom reads an English work, and of the history of his native country is strangely, almost supernaturally, ignorant. Passing occurrences do not affect him. He doesn't care how many men are slaughtered on the banks of the Jhelum. His heart is at Marathon, his sympathies with the great Hannibal at Cannae." We have improved since then, but the type is not extinct.

It is to be regretted that the proposals do little to encourage science. It must distinctly be understood that the alternative to Greek or Latin is not science, but French or German. The papers on experimental mechanics and other parts of elementary physics, and the paper on elementary inorganic chemistry are, with three other papers, alternatives of which two must be taken.

The case for additional recognition of science has been put so well by a distinguished naturalist who was a member of the syndicate, and one of the three who did not sign the report, that we cannot do better than quote his words. "The real substitute for Greek, and the only worthy substitute as it seemed to him, was science. If they are not to meet art let them at least meet truth. Let the boys know the place man had in nature. It seemed to him shocking that they should turn out hundreds of men every year who had not the faintest idea of what was going on in nature, in combustion or chemical decomposition, and who knew nothing of the relation of man to the animal world."

The present issue does not lie between the friends of science and the friends of letters. Nearly one-third of the classical staff at Cambridge are on the side of reform, and amongst them are many of the men who have built up the present classical tripos until it is amongst the biggest of the Cambridge schools. A majority of the university professors and readers *other than those in mathematics and natural science* are on the side of the syndicate. The head masters are half-heartedly with the syndicate, a majority of the Head Masters' Conference and the Head Masters' Association desiring the exemption from Greek of candidates for honours in mathematics and science. A very large majority of the assistant masters in secondary schools are in favour of the change, and it must not be forgotten that the assistant masters have a far more intimate experience of the actual teaching of the boys than have the head masters.

A certain number of the resident members of the Senate have declared their intention of not voting. Some of these are tutors and coaches, who, while agreeing with the general principles of the report, fear that the proposed examination will be so difficult that their pupils will fail to pass. Amongst the residents who intend to vote there is now a majority in favour of the report. If the matter rested upon the Cambridge vote there is little doubt which way it would go. The result, however, rests on the vote of a large electorate of which the resident members form roughly one-tenth. From the fact that the committee for supporting the proposals has issued a very long list of supporters, and from the fact that the committee opposed to the proposals has thought it more politic to publish but a short, select list, there is a strong feeling of confidence that reform may this time win. But the duty of voting cannot be too strongly urged. A single vote may decide the issue.

FOLK-TALES OF PLAINS INDIANS.

A NOTICEABLE addition to the literature of American folk-tales has been made by two recent publications of the anthropological series of the Field Columbian Museum *Publications*. Vol. v. of this valuable series is devoted to the traditions of the Arapaho by Drs. G. A. Dorsey and A. L. Kroeber, collected under the auspices respectively of the Field Columbian Museum and of the American Museum of Natural History. The authors worked independently, and in many instances collected variants of the same tale; but they have published all as they were collected rather than amalgamate the two versions of the one legend. Certain incidents in the tales are translated into Latin, and even some whole tales are similarly translated. A synopsis is given at the end of the volume of each of the hundred and forty-six tales, a feature that will prove of great use to the student. There are one origin-myth and three or four culture-myths; a large number of the stories refer to an individual called Nihançan, whose doings were frequently of a reprehensible nature. No. 1 of vol. vii. of the same series contains a collection of forty folk-tales of the Osage by Dr. Dorsey, who admits that this collection does not adequately represent the traditions of the tribe. The Osage are of Siouan stock, and are now degenerating rapidly, as they are very lazy and much addicted to drink; further, the use of the peyote, or mescal, among them is rapidly increasing, and for these reasons there was great difficulty in engaging the attention of the old men for any length of time. In No. 20, "The Rabbit and the Picture," we have a tar-baby episode. An abstract is given of each tale.

A third collection of folk-tales by Dr. Dorsey is entitled "Traditions of the Arikara"; these were collected under the auspices of the Carnegie Institution at Washington, and the eighty-two tales constitute *Publication* 17 of that institution. The Arikara belong to the Caddoan linguistic stock, and were formerly closely allied with the Skidi band of Pawnee. Like the Skidi, they constructed the earth-lodge, and their social organisation and religious ceremonies in general were also similar. An examination of the tales shows, as might be expected, many points of resemblance with those of the Skidi (*cf.* "Traditions of the Skidi Pawnee," by G. A. Dorsey, *Memoirs* of the Am. Folk-Lore Soc., vol. viii., 1904), but it is apparent that the mythology of the Arikara contains many elements not found among the Skidi; possibly it will be found that there are Mandan affinities, but material for this comparison is not yet available. Two tales narrate the creation of the earth by the Wolf and Lucky-Man, and the creation of people by Spiders through the assistance of the Wolf. The variant tales of the emergence of the Arikara from the earth are undoubtedly original. In several tales a poor boy is a culture hero; in one case he was the son of a woman who climbed to heaven and married a star; his greatest work was freeing the land of four destructive monsters. The Sun-Boy made long life possible after a series of contests with his powerful father. Another boy, Burnt-Hands, saved his tribe from despotism and famine, and furnished by his life a perpetual example to the poor of the Arikara of the value of honest and long-continued effort. Some tales are rite-myths, as they refer to the origin of a ceremony or rite, or to incidents connected with a ceremony. In one tale is found an interesting account of the origin of the well known ring and javelin game of the plains, which is really part of the ceremonial calling of the buffalo (bison); the tale also relates the origin of the buffalo dance. Eleven tales relate to animals; in all of them the coyote plays a prominent part, always as a mean trickster, and committing deeds that generally result disastrously to himself. Several are ordinary traditions, in some of which the supernatural crops up. Abstracts are given of all the tales.

Another memoir on folk-tales, entitled "The Mythology of the Wichita," by Dr. Dorsey, forms *Publication* No. 21 of the Carnegie Institution. The Wichita are a small and dwindling tribe of Caddoan stock who differ somewhat from the surrounding plains tribes; both men and women tattoo, they are very moral and good natured, and their home life is extremely well regulated. The pursuit of the bison was secondary to that of agriculture, and, as among the Pawnee, many of their most important ceremonies were concerned with the cultivation of their fields. All the details of the grass-lodges were symbolic. The social organisation was by villages, at the head of each of which was a chief and a subchief. Election to the chieftainship was never through heredity alone; it was possible for the youngest and meanest-born boy of the village to rise to this position through bravery, generosity, and kindness. In general, the gods of the Wichita are spoken of as "dreams." The sixty tales refer to the first period or Creation, the second period or transformation, and the third period or the present. A few tunes are given by F. R. Burton. Three long Wichita tales by the same indefatigable observer will be found in the *Journal of American Folk-lore* (vol. xv. p. 215, xvi. p. 160, xvii. p. 153). Legends of ancient time were related that the listeners might realise that evil creatures and monsters and evil spirits no longer exist; they were removed from the earth and their destructive powers taken from them by Wonderful Man, who knew that the world was changing, so that human beings might be human beings, and animals exist as animals to serve as food for man. But, above all, the value of many stories for the young lay in the lesson taught by example

FIG. 1.—Hupa woman soaking acorn meal on the river shore. The meal is placed in a crater of sand, water is heated in the basket to the right by dropping hot stones into it, and the hot water is ladled out by means of a basket-cup and poured over the meal until it loses its bitter taste.

that bravery and greatness depended solely upon individual effort, and that there might befall him the same longevity and good fortune as was possessed by the hero of the tale.

In the handsome volume which contains the ninety traditions of the Skidi Pawnee collected by Dr. Dorsey, there are fifteen plates and some interesting ethnological and explanatory notes. The village was the basis of the organisation of the Skidi, no trace of the clan having been found. Each village possessed a sacred bundle, and marriage was endogamous in each village. The religion of the Pawnee reached a higher development than that of any other of the plains tribes, and its ceremonial side was especially developed among the Skidi. Each bundle ceremony and each dance was accompanied, not only by its ritual, but by its tale of origin, and all of these are regarded as personal property. Dr. Dorsey makes some interesting remarks upon the ownership and telling of the tales. Of these some are cosmogonic; a number tell of boy heroes in which the path to renown is due to fixity of purpose and a humble spirit. Numerous tales relate to the tricky coyote; these are told whenever the men assemble during the winter months, but never during the summer, or rather during those months when snakes are visible, for at such times the Coyote-Star directs the Snake-Star to tell the snakes to bite those who talk about the coyote. In one group of tales there is a marriage between humans and animals, or the transformation of a man into an animal.

The first volume of the University of California *Publications*, American archæology and ethnology, contains a study of the Hupa by Mr. P. E. Goddard. The Hupa Indians occupy the beautiful lower valley of the Trinity River; so secluded was it that sixty years ago the news of the coming of the white man had not reached the inhabitants. The people seem to have lived a simple, peaceable life; their social organisation was very simple, but more information is required. A family consisted of a man, his wife or wives, his sons and their wives, the unmarried and half-married daughters and unmarried or widowed brothers and sisters of the man and of his wife. There appears to have been a classificatory system of relationship. The next social unit was the village; a man lived and died where he was born; the women married into other villages. Each village was ruled by the richest man. There seem to have been no formalities in the government of a village or tribe. There was a deep undercurrent of religious feeling, and a great reverence for the spoken word.

The texts are word for word translations and anglicised versions of fourteen myths and tales, and thirty-seven texts relating to the dances and feasts, the majority of which are formulæ. The latter are of especial value, as it is usually so difficult to get the exact words of a magical formula. Thirty excellent heliotype plates embellish the volume.

Mr. Goddard and the university authorities are alike to be congratulated on this excellent piece of work, which augurs well for the success of the new department of the University of California.

A. C. H.

A NATURALIST'S JOURNAL.[1]

THIS daily journal of an observant field-naturalist may be heartily welcomed by every lover of country life and country scenes. It is true the style is somewhat scrappy and *staccato*, but this is to a great extent unavoidable in a work of this nature, and is, after all, no great drawback, although we think it might have been somewhat modified during the revision for press. Mr. Robinson, who is already no stranger to the reading public, has the good fortune to be a resident in Norfolk, the county *par excellence* of redundant bird-life and of enthusiastic bird-lovers; and he is therefore practically assured of a number of sympathetic readers, for every dweller in Norfolk likes to be acquainted with all that is written about his own district.

To the general reader the most attractive feature of the book will almost certainly be the large series of exquisite reproductions from photographs of animal and plant life, taken, we infer, by the author himself. Where all are of such high excellence, it is difficult to make a selection; and the illustration we present to our readers as a sample must not be regarded as either better or worse than its fellows. It has been chosen on account of its depicting an interesting phase of bird-life.

As a rule, the author has nothing specially new to

[1] "The Country Day by Day." By E. K. Robinson. Pp. xix+371 illustrated. (London: W. Heinemann, 1905.) Price 6s.

tell, and his book may be regarded as a guide to what the observant country resident ought to see and notice, rather than as an exponent of fresh facts. In places, indeed, he forsakes his usual style for what we suppose must be called "word-painting," but we can scarcely congratulate him on the result of the change. Neither, we think, is he altogether happy in his theory that bird-song is largely due to rivalry and jealousy; although his eagerness to trace out the reason of every phenomenon in natural life is a trait deserving of the highest commendation.

The reader who follows in Mr. Robinson's footsteps and takes him as guide will not have much to learn about the animals and plants of his native district after a year's diligent apprenticeship.

R. L.

FIG. 1.—Young Peewit hiding. From "The Country Day by Day."

PROF. G. B. HOWES, F.R.S.

GEORGE BOND HOWES, whose state of health for the past two years had been the cause of grave anxiety, passed away on February 4. Born in London on September 7, 1853, his active and useful life was cut short at the age of fifty-one.

Howes was of Huguenot extraction; his father, the late T. J. Howes, married the daughter of the late Captain G. H. Bond—a member of a talented family. While attending a private school he spent his spare time in making microscopical slides, and a prize of one of J. G. Wood's books helped to arouse further his interest in natural history. His parents at first intended that he should prepare for entering the Church, but this plan was given up, and on leaving school he was for a short time in business, which proved very distasteful to him. Having worked out the anatomy of the house-fly, made careful drawings of his preparations, and given a lecture on the subject, his talent was recognised by a friend of the family—a clergyman—who introduced him to Mr. Walter White, then secretary to the Royal Society. Through Mr. White's instrumentality an introduction was obtained to Prof. Huxley, and this resulted in an appointment under the Science and Art Department.

A short time previously, Huxley, assisted by T. J. Parker, had begun to organise his pioneer practical classes in biology at South Kensington, and Howes's first scientific work consisted in making a series of enlarged coloured drawings illustrating the anatomy of various animals, and thus further developing his powers as a draughtsman. These drawings now form the well known series hanging on the walls of the laboratory at the Royal College of Science, copies of which were subsequently made by Howes for use in various universities and colleges in this country and abroad. Although he had no previous scientific training, he rapidly became an expert anatomist, and many of his exquisite dissections are still to be seen on the shelves of the laboratory.

All this time, Howes was taking every advantage of his opportunities for studying under our greatest biological teacher in a school of high tradition, where students are able to devote themselves to one subject at a time, and are fortunate in being unhampered by syllabuses. He was soon appointed assistant demonstrator, and on Parker's election to the chair of biology in the University of Otago, Howes succeeded him as chief demonstrator, so that his originality, zeal, and enthusiasm had full scope for development. The wide knowledge he gradually obtained of his subject, his valuable contributions to zoological literature, and more especially his power and influence as a teacher, soon made it apparent that he was to take an important place in the scientific world. On Huxley's partial retirement in 1885, Howes was appointed assistant professor, and in 1895—when the chair of biology was subdivided—professor of zoology. During his career as demonstrator, he had also for two years held the post of lecturer on comparative anatomy to the St. George's Hospital Medical School.

In 1897, Howes was elected to the fellowship of the Royal Society. He was a vice-president of the Zoological Society, honorary zoological secretary to the Linnean Society, honorary treasurer of the Anatomical Society, ex-president of the Malacological Society, president of Section D of the British Association at the Belfast meeting, corresponding member of the New York Academy of Science, and an honorary member of the New Zealand Institute. He also took an active interest in the work of several local natural history societies, of which he was a member. In 1902 he acted on the committee for the reorganisation of the Zoological Gardens, and in the same year received the degree of D.Sc., *honoris causa*, in the Victoria University, having previously—in 1898—received that of LL.D. at St. Andrews. He had held examinerships in several universities, *e.g.* London, Oxford, Victoria, and New Zealand.

The veneration and affection which Howes felt for his great chief were unbounded, and apparent in all his work, to carry on which on the lines laid down by Huxley was the summit of his ambition.

His publications are too numerous to be mentioned in detail; they consist of some fifty papers and addresses, as well as numerous reviews and articles, all written in a characteristic style; apart from the two editions of his well known "Atlas," and the revised and extended editions of Huxley and Martin's "Elementary Biology" (in collaboration with Prof. D. H. Scott). He also edited the translation by Bernard of Wiedersheim's "Bau des Menschen," and had undertaken to prepare a new edition of Huxley's "Anatomy of Vertebrated Animals," which he had mapped out in his mind, but never actually began. His original work deals mainly with vertebrate comparative anatomy, and all shows the same thoroughness and accurate knowledge.

Considerable and important as his direct contributions to science have been, they only represent a part of his life's work in this direction, for he considered it his duty to devote much time to the business of scientific societies and in helping any serious workers who applied to him; he spared no trouble in assisting others.

Never a robust man, Howes's power of work was extraordinary. He never seemed to be in a hurry, and did not give one the impression that he spent an excessive amount of time in reading the current literature of his subject, although his knowledge and memory in this direction were quite unique. His mind was of a remarkable type, and was, one may say, almost overburdened with details, though he never lost sight of the main issue, and was always clear and stimulating. He absorbed everything which had the remotest bearing on his science, and would talk by the hour on almost every branch of zoology; one had only to ask him some question and he would either have the point at issue at his finger-ends, or would at once give references to the most recent papers on the subject. When giving a lecture or an address, he would put so much into an hour's discourse as to make his hearers marvel at his memory and grasp of the subject. His presidential address to the zoological section of the British Association in 1902 contains no less than 186 references to original authorities, and its preparation must have cost him an enormous amount of labour at a time when he was already over-fatigued.

Howes was a man of high moral standard and ingenuous nature, generous and unselfish in all he did, and his death is mourned by a wide circle of scientific friends, who will long cherish the memory of his friendship and hospitality. He carried out his own belief that "higher ambition than that of adding to the sum of knowledge no man can have; wealth, influence, position, all fade before it; but we must die for it if our work is to live after us."

W. N. P.

NOTES.

THE following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society:—Mr. J. G. Adami, Mr. W. A. Bone, Mr. J. E. Campbell, Mr. W. H. Dines, Capt. A. Mostyn Field, R.N., Mr. M. O. Forster, Mr. E. S. Goodrich, Mr. F. G. Hopkins, Mr. G. W. Lamplugh, Mr. E. W. MacBride, Prof. F. W. Oliver, Lieut.-Col. D. Prain, I.M.S., Mr. G. F. C. Searle, Hon. R. J. Strutt, and Mr. E. T. Whittaker.

THE piercing of the Simplon Tunnel was completed at 7.20 a.m. on February 24. At the time of piercing, the north gallery was inaccessible on account of the accumulation of water. The south gallery is on a lower level than the north, and the final connection was made by the explosion of charges placed in holes driven into the roof of the south gallery, which left a large hole on a level with the floor of the north gallery. No sooner was the piercing effected than the accumulated water flowed rapidly away down the southern side, and was discharged into Italy without doing damage. It is unnecessary again to direct attention to the particulars of this triumph of engineering skill, for a detailed account of the difficulties with which the engineers have had to contend, and the expedients utilised to surmount these obstacles, will be found in an article by Mr. Francis Fox in NATURE for October 27, 1904 (p. 628, vol. lxx.). The work that now remains to be done is to put in place the masonry arching, to cover over the water channel beneath the floor of the tunnel, and to lay the permanent way. It is expected that within three months trains will be running, and the railway will prove a vital link in the line of communication between the Italian cities and mid-Europe.

ON Friday, March 17, Senor Manuel Garcia, the inventor of the laryngoscope, will complete his hundredth year, and the anniversary will be celebrated by a meeting of laryngologists at the rooms of the Royal Medico-Chirurgical Society, Hanover Square. We learn from the *British Medical Journal* that the Spanish Ambassador will attend to congratulate the illustrious centenarian in the name of the Government of his native country, and among the addresses will be one from the Royal Society, before which Senor Garcia read his paper entitled "Physiological Observations on the Human Voice" just fifty years ago. The Berlin, Vienna, French, Dutch, Belgian, and South and West German Laryngological Societies will send special deputations. Most of the addresses will be taken as read, and the proceedings will conclude with the presentation of a portrait of Senor Garcia, painted by Mr. John Sargent, R.A., together with an album containing the names of all the subscribers. In the evening a banquet will take place at the Hotel Cecil, at which it is hoped that Senor Garcia himself will be present.

THE death is announced, on February 6, of Father Timoteo Bertelli. Father Bertelli was born in Bologna in 1826, and was the son of the professor of astronomy at the University of Bologna. At eighteen he joined the Order of the Barnabites, and taught physics in various colleges of the Order. In 1871 he joined the Collège de la Querce in Florence, with which institution he appears to have been associated continuously until the time of his death, except for the three years 1895–7, when he was called to Rome by Leo XIII. to succeed Father Denza at the Vatican Observatory. But his state of health did not permit him permanently to accept this position, and in 1897 he returned to Florence. Father Bertelli first devoted himself to meteorology, and later was attracted by the study of seismic phenomena, inventing the tromometer to assist in his observations. He gave much attention to researches into the history of the sciences and especially to that of the mariner's compass. The results of his life's work are contained in some sixty memoirs, the first of which is dated 1859.

DR. A. S. PACKARD, professor of zoology and geology at Brown University, died on February 14, at the age of sixty-six years. The death occurred, on February 22, of Dr. Ernst F. Dürre, formerly professor of metallurgy at Aix-la-Chapelle, and author of several important treatises on the metallurgy of iron and steel. Dr. Guido Hauck, professor of mathematics at the Berlin Technical College, died on January 14. The deaths are also announced of J. C. V. Hoffmann, founder and editor of the *Zeitschrift fur mathematischen und naturwissenschaftlichen Unterricht*, Dr. T. H. Behrens, professor of microchemistry at Delfdt, Prof. Ludwig von Tetmeyer, principal of the Vienna Technical College, and Prof. Ditscheiner, of Vienna.

We learn from the *Times* that Prof. Adolf Bastian, director of the Berlin Ethnographical Museum, has died at Port of Spain, Trinidad, in his seventy-ninth year, while on a scientific expedition. Prof. Bastian, who was a distinguished traveller for many years, enjoyed a wide reputation as the author of numerous ethnological and anthropological works, of which the best known is "The Peoples of Eastern Asia."

The council of the University of Birmingham recently assigned a plot of land on the new university site at Bournbrook in order to enable Mr. Walter E. Collinge, the lecturer in zoology, to continue his experiments and observations upon the life-histories of the black-currant gall-mite and the plum aphis, with the view of obtaining remedies for exterminating or holding in check these pests to fruit-growers.

The annual dinner of the Institution of Civil Engineers will be held on Wednesday, March 22, at Merchant Taylors' Hall, Threadneedle-street, E.C. Sir Guilford Molesworth, president of the institution, will occupy the chair.

An interesting excursion has been arranged by the American Institute of Mining Engineers. In the first week in July a meeting will be held at Victoria, British Columbia, and this will be followed by a three weeks' trip to the mining districts of Alaska.

A valuable contribution to economic geology is afforded by an article on the Hauraki goldfields of New Zealand published by Mr. W. Lindgren in the *Engineering and Mining Journal* of New York. The occurrence of gold is very similar to that in Transylvania. The gold is met with in quartz veins traversing andesite altered into propylite. The minerals accompanying the gold are dolomite, pyrites, blende, galena, and ruby silver ore. Near the surface the sulphide ores are oxidised; and the greatest yield of gold has been obtained at points where the veins cross.

In the *Transactions* of the Faculty of Actuaries, No. 18 (1905), Dr. James Buchanan discusses the use of various modifications of Simpson's rule in the performance of the integrations involved in the calculation of survivorship benefits.

In the *Physikalische Zeitschrift* for February 1, Profs. Elster and Geitel discuss the radio-activity of certain sediments from the German mineral springs, and Messrs. A. Herrmann and F. Pesendorfer describe experiments indicating traces of radio-activity in the gases from the Sprudel spring at Carlsbad.

An interesting feature of the Johns Hopkins University *Circular* is the series of "Notes in Mathematics," edited by Prof. Frank Morley, appearing in the January number. These notes deal with "A system of parastroids" and "A curve of the fifth class" (Mr. R. P. Stephens), "Applications of quaternions to four dimensions" and "Some invariant relations of linear correspondences" (Mr. H. B. Phillips), "A closed system of conics" (Mr. Charles C. Grove), and "The normal form of a collimation and the reduction of two conics to normal form" (Mr. A. B. Coble).

Prof. Hans Landolt, of Berlin, has received the Prussian Imperial Gold Medal for Science.

The city of Lincoln is now suffering from a serious outbreak of typhoid fever. The epidemic started at the beginning of January, and up to date nearly 800 cases have been notified. The epidemic is plainly a water-borne one, milk and other articles of diet being excluded as channels of diffusion by the extent of the outbreak and its regular distribution over the whole area. The water supply of Lincoln is derived from the River Witham, the water being passed through sand filters before distribution. Attention has been directed from time to time to the unsatisfactory quality of the water, and in 1901 the boring of a deep well into the sandstone was commenced, but after the bore had reached a depth of 880 feet in 1903 the boring tool was lost, and has not been recovered, thus entailing serious delay. The epidemic, it is surmised, has been caused by pollution of the Witham or its tributaries above the intake. It is unfortunate that works were in progress in the autumn to improve the filter beds by deepening the layer of fine sand, but were put a stop to by the early frost, and the same event caused many of the consumers to leave their taps running, and thus to necessitate an increase in the rate of filtration to meet the increased demand.

The Fishmongers' Company has published a preliminary report by Dr. Klein, F.R.S., on experiments undertaken for the company to ascertain the duration of vitality of the typhoid bacillus when introduced into shell-fish. The main conclusions arrived at are:—(1) Oysters readily take up into their interior the *Bacillus typhosus* which has been introduced into their shell or into the surrounding sea-water. (2) Oysters, clean at starting, rapidly clear themselves of the ingested typhoid bacilli if they are kept in clean water which is frequently changed. (3) Oysters, clean at starting, clear themselves of the ingested bacilli to a less extent and slower if they are kept in a "dry" state—*i.e.* out of the sea-water. (4) Oysters, from a polluted locality, clear themselves of the ingested bacilli to a less extent, and at a slower rate, even if kept in clean sea-water, than oysters clean at starting. (5) Oysters from a polluted locality, containing a large number of the *Bacillus coli*, very rapidly clear themselves of this microbe, whether kept in or out of the water. This shows that *Bacillus coli* is foreign to the oyster and is rapidly destroyed by it. When, therefore, it is present in the oyster, it must have been derived from the surroundings. (6) However largely infected with typhoid bacilli, the oysters at no time present to the eye any sign of such infection; they remain in all parts of normal aspect. (7) Cockles and muscles similarly take up the typhoid bacillus, but clear themselves much more slowly, particularly in the case of cockles, than do oysters.

The geographical results of the National Antarctic Expedition, in so far as they relate to the distribution of land, water, and ice within the area allotted to the expedition for exploration, were described by Captain R.F. Scott before the Royal Geographical Society on Monday. He remarked that the main geographical interest of the expedition was the practical observation of a coast-line from Mount Melbourne, in lat. $74\frac{1}{2}°$, to Mount Longstaff, in lat. 83°, and of the conditions which lie to the east and west of this line. The coastal mountains are comparatively low between Mount Melbourne and the Ferrar glacier, and it was the tabular structure of these that first indicated the horizontal stratification of the mainland. But low as the mountains are, in one place only does the internal ice-sheet seem to pour any volume of ice into the sea. It is certain that the ice-cap is of very great extent, and there is evidence that it maintains a great and approximately uniform level over the whole continent. The greater portion of this great ice-sheet is believed to be afloat. The soundings made by the expedition show that some hundreds of fathoms of water still intervene between the bottom of the ice at the barrier edge and the floor of the sea; but the barrier edge sixty years ago was in advance of its present position, in places as much as 20 or 30 miles, and therefore the soundings lie directly beneath Sir James Ross's barrier, and a considerable distance from its edge. The ice-sheet, and the curious and often vast ice-formations met with in the Ross sea, are therefore regarded, not as the result of present-day conditions, but the rapidly wasting remnants of a former age.

Senor A. Arcimis informs us that Mr. Valderrama, director of the Municipal Meteorological Observatory at Santa Cruz (Canaries), observed a fall of dust on January 29 and January 30. During all the former day a very fine dust fell continuously, but not in great amount. On January 30 a rain of a yellow and very fine dust began at 15h. The wind-vane pointed to the S.S.W., and the atmosphere was charged with the very fine dust, the horizon being invisible through a kind of dry fog that introduced itself into the mouth and throat, producing the same effect as when marching on a dusty highway in a hot summer day. All the instruments exposed freely out of doors were covered with the nearly impalpable dust.

At the recent annual meeting of the Glastonbury Antiquarian Society, Prebendary Grant gave an account of the exploration at the ancient British Lake Village at Glastonbury during the summer of 1904. Three new mounds were examined, and the exploration of four others was completed. The "finds" included amber and glass beads, spiral finger-rings of bronze wire, a massive bronze buckle (taken to have been connected with horse-harness), a bronze object which is supposed to have been some part of horse-trapping, a variety of bone objects, wool combs, hammers, portion of horses' bits, and a roedeer antler, pointed and used as a modelling tool for decorating pottery. Several pieces of pottery were dug up. Flint flakes and knives were found, proving that flint implements were made at the village. With respect to wooden articles, two wheel-spokes, finely turned and finished, were found, and a fragment of an axle-box belonging to the same wheel. Iron bars were found also at the Lake Village, and after minute investigation the conclusion has been arrived at that these bars are iron currency bars used by the ancient Britons at the time of Cæsar's invasion.

A large number of new types of Japanese land-shells of the Clausilia group are described by Mr. Pilsbry in the December issue of the *Proceedings* of the Philadelphia Academy.

The shore fishes of the Galapagos and other Pacific islands are described by Messrs. Snodgrass and Heller in part xvii. of the publications of the Hopkins-Stanford Expedition (*Proc.* Ac. Washington, vi., pp. 333–427). Two species are described as new.

The *Emu* for January contains Captain Hutton's presidential address to the Australasian Ornithologists' Union, which deals with the geographical origin and subsequent development of the land birds of New Zealand. An interesting feature of the issue is the reproduction of a photograph of a red gum-tree containing the nests of seven species of birds.

Naturen for January and February contains two illustrated articles on whales and whaling. In the former issue Prof. G. Guldberg describes the method of hunting the Greenland right whale, illustrating his article with reproductions from two old prints. In the February number Mr. E. Koefoed records the capture of a Biscay right whale, or "nordkaper," at Mjofjord, on the west coast of Iceland, and also of a cachalot in northern waters. Two photographs of the former cetacean are reproduced.

Stepney has published a handbook to the vivaria and aquaria in the Borough Museum, the text of which is reproduced, with certain alterations and additions, from the handbook to the Horniman Museum. It is to be hoped that the descriptive portion, when read in the museum, may aid visitors to a right appreciation of the exhibits, but as it stands the guide is admirably calculated to puzzle beginners in systematic zoology. For instance, from the headings on pp. 24 and 25, the reader would be led to infer that while *Argyroneta* is the scientific designation of the water-spider, and *Podura aquatica* that of the water-springtails, *Blattidae* is the name for the cockroach, and from p. 50 that *Lacertilia* is the generic title for the typical lizards. Again, from p. 17 he would be led to suppose that *Gastropoda* is the generic term for snails, and that these rank in classificatory value with the viviparous pond-snail (*Paludina vivipara*). Careful study of the text may in some cases put matters right, but the muddle is as bad as bad can be for beginners.

The address on morphology generally, its modern tendencies and progress, and its relation to other sciences, delivered by Prof. A. Giard before the Congress of Sciences and Art at the St. Louis Exhibition in September last, is published in the *Revue Scientifique* of February 4 and 11. After referring to the revolution in biology effected, first by Lamarck and subsequently by Darwin, the author proceeds to sketch the gradual evolution of modern biological conceptions and theories, dwelling especially on Wolff's hypothesis of epigenesis. Reference is then made to the importance of the study of variation, both among living and extinct types, after which the author passes on to review the influence that palæontology has exerted on biology and the doctrine of evolution. Abiogenesis next claims attention, while the author concludes his discourse by reference to some of the evils attendant on the extreme specialisation of scientific work at the present day. It is time, he urges, that a general organisation to direct scientific work should replace the present state of anarchy, whereby much energy that is now practically wasted would be diverted towards the attainment of a common end and object.

The fifth part of Mr. J. H. Maiden's "Critical Review of the Genus Eucalyptus" includes three species. *Eucalyptus stellulata* receives its name from the disposition of the buds, and is known as black Sally, or muzzlewood; the leaves show longitudinal lateral veins similar to those of the next species, *Eucalyptus coriacea*, which is distinguished by its clean white stem. The third species, *Eucalyptus coccifera*, confined to Tasmania, is sufficiently hardy to have been planted in parts of the United Kingdom.

The alien problem is not unknown to botanists, and the genus Sisymbrium has added two foreign species to the flora of Lancashire. *Sisymbrium pannonicum* is definitely naturalised along the coast from St. Anne's to Crosby, and according to a recent account by Mr. C. Bailey in vol. xlix. part i. of the *Memoirs and Proceedings* of the Manchester Literary and Philosophical Society, *Sisymbrium strictissimum*, a native of continental Europe, has obtained a foothold near Heaton Mersey, where it has been observed for fifteen years.

In a paper only recently published in vol. ii., No. 3, of the *Contributions* from the botanical laboratory of the University of Pennsylvania, but which represents work done two years earlier, Dr. O. P. Phillips maintains that the central body in the cells of the Cyanophyceæ represents a true nucleus, but he failed to obtain complete stages in its mitotic division. Dr. Phillips is of opinion that the movement of the filaments of Oscillaria and Cylindrospermum is due to protoplasmic processes or cilia which, he says, are to be observed around all the cells. The chromatophore, containing cyanophycin granules, was identified as a peripheral zone.

AN interesting address on the present problems of meteorology was given by Mr. A. L. Rotch to the section of cosmical physics of the International Congress of Arts and Sciences at St. Louis, and was printed in *Science* on December 23 last. The author pointed out that although it is nearly fifty years since the first commencement of weather telegraphy, and much has been done to complete and extend the area under observation, the methods employed in the preparation of weather forecasts are still essentially empirical, and practically little or no progress has been made. This is mostly due to the fact that until recently observations have been carried on solely at the bottom of the atmosphere. Even the observations made at mountain stations still pertain to the earth and do not represent the conditions prevailing in free air. The still more recent use of unmanned balloons and kites has led to the acquirement of a knowledge of the vertical gradients of meteorological elements which contradicts previous conceptions, *e.g.* that the temperature diminished with increasing altitude more and more slowly, whereas the results show that it decreases more and more quickly with increasing altitude. The international cloud observations at various altitudes discussed by Dr. Hildebrandsson also show that theories held heretofore are untenable, and that there is no exchange of air between poles and equator. With regard to cosmical relations to meteorology, the author points out that neither the effects of the periods of solar or lunar rotation upon the earth's meteorology can be claimed to have been proved. But coincidences—if nothing more—have been shown by Sir Norman and Dr. Lockyer to exist between sun-spot frequency and atmospheric changes, especially as manifested by barometric pressure, rainfall, and temperature. It does not seem impossible, therefore, that the discussion of meteorological observations from the point of view of their relation to solar phenomena may eventually lead to seasonal predictions of weather possessing at least the success of those now made daily.

THE Survey Department of the Egyptian Public Works Ministry has sent us the meteorological report for the year 1902. This volume indicates that the Director-General of the Survey Department, Captain H. G. Lyons, is making rapid strides, not only in increasing the number of stations which send in records, but in publishing a considerable amount of valuable information which should prove of great value. We are told that arrangements are in progress for commencing a systematic measurement of rainfall in the Delta and western part of the Mediterranean coast; that a monthly *résumé* of the weather has been started; and that forecasts during the early and late months of the year have been issued. All these show the activity that is being displayed in the collection and dissemination of meteorological data. The present report includes magnetic as well as meteorological observations, and also Nile gauge readings. At the end are given numerous curves representing the variations of the meteorological elements as registered at the Abbassia Observatory.

THE *Journal* of the Röntgen Society (vol. i., No. 2) contains a note by Mr. J. H. Gardiner on the new ultraviolet glass manufactured by Messrs. Schott and Genossen, of Jena; it is illustrated by photographs of spectra showing the transparency of the glass in the ultra-violet region.

FLUORESCENT substances are usually regarded as exceptions to Kirchhoff's law of absorption on account of their being able to emit light which in ordinary circumstances they do not absorb, but hitherto no investigation has been made of the absorptive power of such substances during active fluorescence. In the *Physical Review* for December 1904, Messrs. E. L. Nichols and Ernest Merritt show that substances such as fluorescein, when caused to fluoresce strongly in solution, produce a decidedly different absorption from that of the feebly illuminated material, and that the absorption curve obtained in this way is intimately connected with the curve of fluorescence. In the case of five different substances, moreover, there is conclusive evidence of a slight increase in electrical conductivity accompanying the phenomenon, and on this account a dissociation hypothesis is brought forward to explain the nature of fluorescence.

AN address delivered by Prof. Edward B. Rosa at the opening of the John Bell Scott Memorial Laboratory of Physical Science at Wesleyan University, Connecticut, is printed in *Science* for February 3. It deals with the National Bureau of Standards, which commenced work in the United States in 1901, and defines its functions and ideals. It is to be noted that research plays a prominent part in the programme of the bureau. We have already had occasion to refer to Dr. Guthe's critical investigation of the various forms of silver voltameter (NATURE, vol. lxx., p. 583), and to the determinations by Drs. Waidner and Burgess of the temperature of the electric arc (NATURE, vol. lxxi., p. 132). Both these researches were carried out under the auspices of the bureau, and in addition to these, the *Physical Review* for December, 1904, contains a valuable communication by Drs. Waidner and Burgess on "Radiation Pyrometry," in which the degree of accuracy of several radiation pyrometers is discussed. The bureau does not confine itself entirely to physical and mechanical measurements, but contains a department devoted to chemistry, one of the purposes of which is to attempt to secure uniformity in technical analyses. A characteristic of the bureau which deserves particular notice is its aim not only to conduct investigations through its own staff, but also to afford facilities for research to others who may come to work for a limited period as scientific guests. In this way it is hoped that "the output of original research in America will be materially increased."

THE remarkable catalytic power of reduced nickel, discovered some years ago by MM. Paul Sabatier and J. B. Senderens, has been applied by them in many directions, and has been especially fruitful in the addition of hydrogen to cyclic compounds. Applying this reaction in another direction, the authors in the current number (February 20) of the *Comptes rendus* describe the reduction of nitriles to amines. The nitrile, with an excess of hydrogen, is passed over reduced nickel at temperatures between 250° and 300° C. Hydrocyanic acid might be expected to yield methylamine, but, as a matter of fact, the nickel was found to exert a further action, both dimethylamine and trimethylamine being produced, together with ammonia and the primary amine. With acetonitrile all three amines are likewise produced, the diethylamine, which forms about three-fifths of the mixture, predominating. Dipropylamine was similarly the chief product of the reaction with propionitrile; with capronitrile, derived from ordinary amyl alcohol, besides the three amines, two of which were new, an appreciable proportion of the hydrocarbon α-methyl-pentane was obtained. The yields were in all cases good with fatty compounds, but the reaction was less satisfactory when applied to the aromatic series, there being a tendency for the hydrocarbon and ammonia to be the chief products.

Globus for February 23 is a special number containing contributions by friends and admirers of Prof. R. Andree, who reached his seventieth birthday on February 26.

The third part of the *British Journal of Psychology*, published by the Cambridge University Press, has been received. The number contains five papers in addition to a report of the proceedings of the Psychological Society. Mr. Norman Smith discusses Malebranche's theory of the perception of distance and magnitude; Mr. F. N. Hales considers the materials for the psychogenetic theory of comparison; Mr. W. G. Smith makes a comparison of some mental and physical tests in their application to epileptic and to normal subjects; Prof. Mary W. Calkins defines the limits of genetic and of comparative psychology, and Mr. C. Spearman makes an analysis of "localisation," illustrated by a Brown-Séquard case.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in March:—

March 5. 17h. Sun eclipsed; invisible at Greenwich.
7. 13h. Juno in conjunction with Moon. Juno 1° 27′ S.
9. Jupiter in conjunction with Venus. Venus 5° 30′ S.
,, 11h. Jupiter in conjunction with Moon. Jupiter 3° 15′ N.
12. 10h. 11m. to 11h. 6m. Moon occults γ Tauri (mag. 3·9).
17. 12h. 34m. Minimum of Algol (β Persei).
20. 9h. 2m. to 9h. 49m. Moon occults β Virginis (mag. 3·8).
,, 9h. 23m. Minimum of Algol (β Persei).
21. 12h. Venus at maximum brilliancy.
24. 7h. Mars in conjunction with Moon. Mars 3° 40′ S.
,, Vesta in opposition to Sun.

Reported Discovery of a Seventh Satellite to Jupiter.—A telegram received from the Kiel Centralstelle announces the discovery of a seventh satellite in the Jovian system. The description reads:—16 magnitude, position on February 25 62 degrees, distance 21 minutes, daily motion 60 seconds south-easterly.

Planetary Tides in the Solar Atmosphere.—In a communication published in the *Bulletin de la Société astronomique de France* (February, 1905), M. Émile Anceaux discusses the question as to whether the undecennial periodicity of sun-spots may not result from the fluctuations of tides set up in the solar atmosphere by the concerted action of Jupiter, the earth, Venus, and Mercury. He classifies the tides as binary, ternary, and quaternary, according to the number of planets acting in their production by being in, or near, opposition or conjunction. The ternary tide due to the combined action of Jupiter, Venus, and the earth is supposed to be the most important factor in regulating the appearance of spots, and a curve showing the fluctuations in the strength of this tide, as calculated from the knowledge of the planetary positions, agrees fairly well with the sun-spot curve for the years 1891 to 1905.

Finally, the author arrives at a number of conclusions of which the more important are:— (*a*) That sun-spots are the indirect consequences of such tides; (*b*) that the combined action of the three planets especially mentioned governs the fluctuations of the spot period; (*c*) that this ternary tide obeys an eleven-year period; (*d*) that the variation of the sun-spot period is due to the eccentricities of the planets, chiefly Jupiter.

The Bruce Photographic Telescope.—The Bruce photographic telescope, with which a number of beautiful photographs of nebulæ, Milky Way regions, &c., have already been obtained at the Yerkes Observatory, is described in detail in an illustrated article by Prof. Barnard published in No. 1., vol. xxi., of the *Astrophysical Journal*.

The telescope was erected, at the cost of Miss Catharine Bruce, at Yerkes in April, 1904, but has now been dismounted and shipped to Mount Wilson, Pasadena, where it is to be used for photographing those regions of the Milky Way not attainable at the former observatory.

It consists of a 5-inch guiding telescope firmly bolted to two other tubes, which carry photographic doublets of 10-inches and 6¼-inches aperture respectively. The focal length of the 10-inch is only 50 inches, and the polar axis of the instrument has been formed by bending the upper part of the iron pier to the required inclination so that the camera may make a complete revolution about the axis without having to be "reversed." For use in different latitudes an iron wedge-shaped section may be introduced between the upper and lower parts of the pier in order to produce the required change of inclination, whilst a special arrangement, whereby the clock motion may be reversed in two minutes, has been introduced into the driving gear so that the same mounting may be used in the southern hemisphere.

The 10-inch doublet, by Brashear, gives excellent definition over a field 7° wide, and the scale is such that 1 inch = 1°·14, or 1° = 0.88 inch. The ratio aperture/focal length = 1/5.03 is that which Prof. Barnard believes to be the best for the purpose for which this instrument was designed. The 6¼-inch Voigtländer doublet has a focal length of 31 inches, and is used in conjunction with the 10-inch for the purpose of verification. Specimen photographs accompany the description, and these testify eloquently to the satisfactory performance of each of the doublets.

Physical Conditions of the Planets.—In a communication to No. 3992 of the *Astronomische Nachrichten* Prof. T. J. J. See deals exhaustively with the methods that he has employed and the results he has obtained in a research on the internal densities, pressures and moments of inertia of the principal bodies in the planetary system. Some of the results obtained in the preliminary discussion of the available fundamental data are of great interest. For example, he arrives at the conclusion that the most probable values for the rotation period and for the oblateness of Uranus are 10h. 6m. 40.32s. and 1 : 25 respectively, whilst for Neptune the similar values are probably 12h. 50m. 53s. and 1 : 45.

In the case of the earth, Laplace's law of densities appears to be a natural law, for the value obtained for the oblateness of the outer stratum, or surface, of the globe agrees very well with that obtained as a mean of the most trustworthy of the determinations by more direct methods. The probable value obtained for the pressure acting at the earth's centre is 2383·152km. of mercury, a quantity so enormous that Prof. See attempts to render it more comprehensible by suggesting that it is 7838 times as great as a column of mercury equal in height to the Eiffel Tower.

The probable pressure at the sun's centre is nearly 212 billion atmospheres. A column of mercury acting solely under terrestrial gravitational acceleration would have to be high enough to extend beyond the sun in order that it might exert such a pressure.

Similar results for the density and pressure at different levels in the planets and satellites are given in two of the tables accompanying Prof. See's paper, and are also shown diagrammatically, whilst a third table shows the ratios of the actual moments of inertia to those of corresponding homogeneous spheres.

Discussion of Central European Longitudes.—In a series of tables published in Nos. 3993–4 of the *Astronomische Nachrichten*, Prof. Th. Albrecht brings together, weighs and tabulates all the longitude results, affecting central European observatories, hitherto obtained. In the first table the longitude differences between 176 pairs of observing stations, as determined since 1863, are thus dealt with, whilst in the second the longitude differences between Greenwich transit circle and numerous other important circles or observatories are brought together. In the third table the corrections to be applied to the differences given in table i., as determined from the discussion of the whole set, are shown.

THE SCOTTISH NATIONAL ANTARCTIC EXPEDITION.[1]

AFTER getting free from the winter quarters in the South Orkneys on November 23, 1903, the *Scotia* left for the Falkland Islands and Buenos Aires to get into communication with home and obtain a fresh stock of coals and provisions. During the ship's absence a party of six men was left at Scotia Bay under the charge of Mr. R. C. Mossman to carry on the systematic meteorological, magnetic, and biological work.

FIG. 1.—Gough Island, showing hanging valley truncated by shore cliff.

Perhaps the most interesting discovery made by the summer party was the egg of the Cape pigeon (*Daption capensis*). Although known to breed on South Georgia and Kerguelen, its eggs had never hitherto been obtained. As is the case with the majority of petrels, only a single egg is laid—a pure white egg, deposited in a nest which consists of a few angular fragments of stone raked together on a bare ledge of the cliff.

While at Buenos Aires Mr. Bruce arranged for the Argentine Government to take over and continue the meteorological and magnetic observatory at Scotia Bay, South Orkneys. On January 21, 1904, the *Scotia* left Buenos Aires with three Argentine men of science on board in addition to her own staff, and on February 22 they were left on the South Orkneys under the leadership of Mr. Mossman, who had consented to remain for a further period of twelve months.

This season the distribution of the pack ice was very different from that of the previous year. Almost no ice was met with near the Orkneys, and very little until reaching the Antarctic circle in about 32° W. long. In the beginning of March the previous year's southern record, and also that of Ross in 1843, was passed, but in 72° 18′ S. 17° 59′ W. a sudden change of conditions was met with. The water suddenly shallowed from about 2500 fathoms to 1131, and at the same time land was reported ahead. Steaming towards this we found a lofty ice-barrier stretching in a north-easterly and south-westerly direction, effectually barring further progress to the south. Close, heavy pack ice prevented a nearer approach than two miles. This barrier was traced for a distance of 150 miles to the south-west. In 73° 30′ S. 21° 30′ W., a depth of 159 fathoms was met with, the barrier being then two and a half miles off. In 74° 1′ S. 22° 0′ W., the *Scotia* was nipped by the ice in a heavy N.E. gale, and was preparing to spend the winter there; but on March 13 the floe broke up and the ship was released. During the six days' imprisonment collections of the marine fauna were got from a depth of 161 fathoms, and a splendid view was obtained of the inland ice. Although no actual bare rock was seen, there can be no doubt we were really on the edge of the Antarctic continent—off "Coats Land," as it has been named after Mr. James Coats, jun., and Major Andrew Coats, the two chief subscribers to the expedition. In this connection we quote the words of Mr. Bruce:—"I have been asked by several if I am sure that this great ice-

FIG. 2.—Glacier at head of bay, north coast of Laurie Island, South Orkneys.

[1] Abstract of a paper on the "Second Antarctic Voyage of the *Scotia*," by Mr. J. H. Harvey Pirie and Mr. R. N. Rudmose Brown in the *Scottish Geographical Magazine*.

barrier was really part of the Antarctic continent. I have no hesitation in saying 'yes,' and my reasons are these: All our soundings between 60° and 70° S. were 2500 to 2700 fathoms. In 72° S. they shoaled to about 2300, fifty miles from the barrier. Thirty-five miles from the barrier they shoaled to 1400 and 1200 fathoms, and two miles from the barrier to 160 fathoms. This alone should answer the question in the way which I have done. Secondly, from the vertical cliff of ice 100 to 150 feet in height which bordered the ocean, the ice rose high inland in undulating slopes and faded away in height and distance into the sky. It was impossible to estimate the height of this field of ice—the true inland ice of Antarctica—but probably it was many thousands of feet. Thirdly, seals and birds, which up till now had become few in numbers, were seen in myriads—penguins, especially emperors, many petrels, and terns swarming in every direction—the inhabitants of the beaches and rocky cliffs of some actual land not very far distant."

After the escape from the ice the *Scotia* turned north-eastwards to continue the oceanographical survey of the Weddell Sea, and had some very successful deep-sea trawling in high southern latitudes—one haul in 71° 22′ S. 16° 34′ W. (1410 fathoms) yielding more than sixty species of animals. Ross's reported *deep* of 4000 fathoms no bottom was shown conclusively not to exist, the whole Weddell Sea being apparently an almost level plain submerged between 2400 and 2700 fathoms.

FIG. 3.—Weddell Seal—off Coats Land.

Pursuing a track northwards along the meridian of 10° W., although encountering very heavy weather between 45° and 55° S. lat., some very interesting soundings were obtained demonstrating the extension of the mid-Atlantic ridge southwards as far as 52° S. lat. The diatom ooze band extends between 48° and 58° S.; to the south of this is blue-mud, the detritus of the Antarctic ice-sheets, to the north, globigerina ooze.

On April 22 a landing was effected with considerable difficulty on Gough Island, a previously unexplored outlier of the Tristan da Cunha group. This apparently entirely volcanic island is richly clad with vegetation, but the extremely precipitous nature of the ground prevented any extensive survey being made, though two new species of plants were obtained—a Cotula and an Asplenium; and amongst the birds two entirely distinct and new species of finches. Shallow water collections were got off the shore by means of the dredge and trap. Between Gough Island and Cape Town several soundings were taken between the parallels of 39° and 40°.

On February 8 of the present year, the Argentine sloop *Uruguay* returned to Buenos Aires from the South Orkneys, having brought back safely Mr. Mossman and his party, and landed a fresh staff there. The station is being continued for meteorological and magnetic work, and a complete outfit of self-recording magnetic instruments has been installed. This work is in connection with the systematic magnetic survey of Argentina which is at present being undertaken.

THE EARLY HISTORY OF SEED-BEARING PLANTS, AS RECORDED IN THE CARBONIFEROUS FLORA.[1]

A LARGE number of the fern-like fronds of Carboniferous age, including many whole genera, as Neuropteris, Alethopteris, Callipteris, Linopteris, &c., have never been found to offer any satisfactory indications of a fern-like fructification. Some suspicion was thus awakened that such fronds may have belonged to plants other than true ferns.

Positive evidence first came from the anatomical side. The vegetative structure of *Lyginodendron Oldhamium* was completely worked out, chiefly by Williamson, and proved to present a combination of filicinean characters with those of cycadaceous gymnosperms. Similar results were attained in other genera, as Heterangium, Medullosa, Calamopitys and Protopitys, and hence the class Cycadofilices was founded to embrace these apparently intermediate forms. Decisive evidence as to the fructification was first obtained in 1903, when it was shown by Prof. F. W. Oliver, in collaboration with the lecturer, that the seed *Lagenostoma Lomaxi* agreed so closely in certain structural features with the associated *Lyginodendron Oldhamium* as to leave no doubt that the one belonged to the other. Observations on other Lagenostomas support this conclusion and show that the seeds were borne on modified fronds. It thus appears that the family Lyginodendræ consisted of seed-bearing plants, allied to the cycads, but retaining filicinean characters; their foliage was of a sphenopteroid type.

In another extensive family, that of the Neuropterideæ, precisely analogous conclusions have been reached. Here, too, the anatomical evidences indicated a position intermediate between ferns and cycads. In the case of *Neuropteris heterophylla* it has been proved by Mr. Kidston that large seeds, referred by him to the genus Rhabdocarpus of Goeppert and Berger, were borne on the frond. There are reasons for believing that Trigonocarpon was the seed of Alethopteris, and M. Grand-'Eury, on the ground of extensive observations on the distribution of fronds and seeds, is led to conclude that the Neuropterideæ generally were seed-bearing plants, of cycadean affinity.

It has been proposed to group these fern-like seed-plants, which in Carboniferous times probably exceeded the ferns themselves in number, under the name Pteridospermeæ. Their relation to the fern-phylum is evident from many points in their structure, apart from the relatively unimportant external characters.

Other seed-bearing plants of the Carboniferous flora have long been known, notably the Cordaiteæ, great trees with large simple leaves, totally different from the Pteridospermeæ in habit, and with little indication of fern-like structure. The fructifications also are of a more advanced character than those of the pteridosperms. In the structure of the seeds, however, and in some anatomical points, a certain affinity, though a distant one, with that family is suggested. It is probable that the Cordaiteæ ultimately sprang from the same stock as the Pteridospermeæ, though at a very remote period. On the other hand, there is reason to believe that the Coniferæ, appearing at the close of the Palæozoic period, were related to the Cordaiteæ. It is thus indicated as probable that the gymnosperms generally were, in a wide sense, of monophyletic origin, as having been ultimately derived from a common stock allied to the ferns; in a narrower sense they may be termed polyphyletic, as having sprung from this common stock at different points.

Although, as we now know, certain of the Palæozoic lycopods had likewise attained to the production of a seed-like fructification, there is at present no satisfactory evidence for connecting the members of this phylum with any of the groups of seed-bearing plants which have come down to our own day.

[1] Abstract of the Wilde Lecture delivered before the Manchester Literary and Philosophical Society on February 28 by Dr. D. H. Scott, F.R.S.

FORESTRY IN THE UNITED STATES.

WE have lately received five publications from the United States Bureau of Forestry, viz. *Bulletins* Nos. 46, 52 and 53, together with *Circulars* Nos. 30 and 31. *Bulletin* No. 46 is entitled "The Basket Willow," by Mr. William F. Hubbard. The author has evidently made a special

FIG. 1.—Twisted Furrows in Bark of Chestnut from Seed.

study of willow cultivation from every conceivable point of view. At the outset, he gives the general history of willow culture, together with the distribution and characteristics of the willow. This is followed by a most interesting account of willow-growing in the United States from its commencement down to the present time. The present practice is fully described, and much valuable advice is given, showing where improvements can be made on the existing methods of planting and tending the willow holts, choice of species, harvesting, cutting, sorting and packing the rods. The paragraphs which deal with expenditure and returns in American willow culture should go a long way to encourage and increase the development of what is at the present time a somewhat neglected industry in the United States.

The Bureau of Forestry is actively engaged in carrying out field experiments which are yielding, and will yield in the future, information of the utmost importance to willow-growers. The bulletin is not entirely confined to willow-growing in the United States, as the author gives a most interesting account of the development of scientific willow-culture in Europe, which he adds as an object lesson for the guidance of the American cultivator. The manufacture of willow ware in the United States is an important feature of the bulletin, which is replete with suggestions for both grower and basket-maker. A chapter on insects injurious to the basket-willow has been added, by Mr. F. H. Chittenden. A useful appendix at the end of the bulletin gives the production and consumption of willow in the United States.

Forest planting in western Kansas, by Mr. Royal R. Kellogg, constitutes *Bulletin* No. 52. The object of the paper is to show the species of tree best adapted for western Kansas, and the methods of treatment which have proved most successful. It seems, from the nature of the climate, that forestry on large areas is impracticable, but nevertheless, with an intelligent selection of species and a proper method of treatment, it may be possible to raise sufficient timber to exercise a marked effect upon the landscape, and to supply wood for domestic purposes. Among other things, the bulletin shows the enormous importance and influence tree-growth has on agriculture, not only in breaking and tempering the effect of cold, dry winds, but also in increasing the available supply of moisture in the soil. The bulletin is practically a condensed volume on sylviculture. It shows the most suitable species for western Kansas, and the site, soil, method of planting and subsequent treatment, together with the rate of growth and possible returns, are all gone into in a most thorough and workmanlike fashion. Plate iv. in the bulletin shows a row of Russian mulberry, and illustrates how the proper treatment of this species might be turned to the greatest use by the farmer. The above row extends more than 20 rods, and contains 200 trees 3 inches in diameter and 20 feet in height. Its total value, if converted into posts and stakes, would amount to 36.40 dollars, and, as the author remarks, a well-cared-for plantation at this place would evidently be a profitable investment.

Bulletin No. 53, entitled "The Chestnut in Southern Maryland," is by Mr. Raphael Zon. This species is evidently of great commercial importance in Maryland. It is apparently used principally for railway ties and telephone poles. As the result of his investigations, the author has arrived at the conclusion that pure coppice is the sylvicultural system to which the chestnut is best suited. Among other things, the report brings out clearly the difference between trees grown from seed and those from the stool. It is interesting to note that coppiced trees have thicker bark than trees from seed. The author further finds, from careful measurements and observations, that coppiced trees grow faster than seed trees during the first twenty years, and finally yield better and earlier returns than trees from seed. The illustrations reproduced show the interesting fact observed by the author that the furrows in the bark of coppice chestnut are straight, while those in the bark of chestnut from seed show the characteristic spiral twist. The report also contains many tables, showing the rate of growth and dimensions of trees from seed and coppice at various ages.

Circular No. 30, by Mr. Gifford Pinchot, is a description of an exhibit of forest planting in woodlots at the Louisiana Purchase Exposition. The exhibit is intended to illustrate the different methods of planting with different species and mixtures suitable for the different parts of the United

FIG. 2.—Straight Furrows in Bark of Coppice Chestnut.

States. There are in all forty-eight plots, representing different regions to which the various mixtures and density of planting are best adapted. This should form a valuable guide to sylviculturists all over the United States.

Circular No. 31, by the same author, is a description of a forest nursery exhibit at the above exposition. The most suitable form of bed, different methods of sowing, and various kinds of shelter screens are described. The coniferous and deciduous nurseries are for obvious reasons treated separately.

This batch of literature gives some idea of the value of the work which the United States Bureau of Forestry is doing, and, on the whole, its value to the country cannot be over-estimated.

PROGRESSIVE BUDDHISM.[1]

THE handsomely got-up and well-printed review, *Buddhism*, is an interesting sign of the times. The Buddhist community is apparently realising that it is advisable, so far as possible, to bring itself into line with modern developments, and to the monthly periodicals appearing in Ceylon, Japan, and (strange to say) San Francisco, has now added this quarterly journal appearing in Burma.

The present venture is edited by Ananda Maitreya, the name, in religion, of a Scotchman who has entered the Buddhist Order; and he has secured the cooperation for this number not only of Indian, Burmese, and Sinhalese, but also of American and English writers.

In the editor's article on "The New Civilisation," he maintains that the new civilisation which is beginning, in a way that no ancient civilisation did, to permeate mankind should be heartily welcomed by Buddhists as being based on that conception of the inviolable sequence of cause and effect, of the reign of law, which was, indeed, the main tenet in the teaching of the Buddha. And he ventures on a glowing prophesy of what the future of humanity will be when this conception of law, claimed by him as a special mark of Buddhist teaching, shall have worked out its effect in the daily lives of men by an increased deference to knowledge, and to the men of knowledge, by the growth of a spirit of wide toleration and humanity. The courageous optimism of this article is in striking contrast with ideas usually held about Buddhist teaching; but it is interesting to see how thoroughly the party represented by this newest Buddhist journal is in sympathy with the teachings and the spirit of science.

Dr. Paul Carus, of Chicago, follows with an article on "The Philosophy of Buddhism," in which he claims that the latest, as well as the earliest, Buddhism, rests upon the belief in a universal reign of law, and on the idea that nothing is but everything becomes. Mr. Chandra Das has an interesting historical paper on the foundation of Lhassa, and Mr. Tau Seng Ko another on the introduction of Buddhism into Burma, each of them writing with special expert knowledge of his subject. There are shorter articles by other writers, paragraphs of notes and news, and some scholarly reviews. The journal would be useful to those who desire to follow the tendencies in the forward movement among the Buddhist communities; whether it is entitled to speak for all Buddhists is another matter.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—Mr. A. W. Hill, of King's College, has been appointed University lecturer in botany until Michaelmas, 1909.

The degree of Sc.D. *honoris causa* is to be conferred on Prof. E. B. Tylor, of Oxford, at a congregation held to-day. At the same congregation Mr. J. W. Willis, director of the Botanical Gardens, Peradeniya, Ceylon, will proceed by proxy to the same degree.

Mr. C. Shearer, advanced student of Trinity College, has been re-nominated to the university table at the zoological station at Naples.

The Board of Geographical Studies has published the following schedule for the special examination in geography and for part i. of the examination for the diploma in geography:—(1) *Physical Geography*.—Form and motions of the earth. Elementary climatology and oceanography. Typical forms of land configuration, their distribution and modes of formation. (2) *Historical and Political Geography*. The historical development and political partition of the different regions of the world, with a consideration of the influence of their physical features. A more detailed knowledge of the geography of a selected region (for 1905 and 1906, *Europe*). (3) *Economic and Commercial Geography*.—The economic growth of the different regions of the world, and the main lines of commerce and communication by land and sea in past and present times. A more detailed knowledge of a selected region (for 1905 and 1906, *Europe*). (4) *Cartography*.—The construction and use of maps. A general knowledge of the methods of exploratory surveying: plane tabling, latitudes and azimuths by the sun, latitude and azimuth traverses, route traverses and compass sketching. Heights by barometer and boiling-point thermometer. The candidate will be examined orally and practically on maps and on the ordinary surveying instruments. Any candidate who can produce a sketch made by himself of a route traversed by compass, and checked by observations for latitude and azimuth with the necessary computations, will be examined thereon and will receive special credit for good work. (5) *History of Geographical Discovery*.—The outlines of the history of geographical discovery, with special questions on a selected region or period (for 1905 and 1906, *The Fifteenth Century*). (6) *Elements of Ethnology*.—The principal races of mankind, their migrations and present distribution.

London.—At the annual meeting of University College on February 22, the following resolution, moved by Lord Reay, on behalf of the council, was unanimously adopted:—That the Bill now submitted, entitled "A Bill for Transferring University College, London, to the University of London and for other matters connected therewith and for Amending the University of London Act, 1898," be and the same is hereby approved subject to such additions, alterations, and variations as Parliament may think fit to make therein.

Dr. Michele Cantone, of Pavia, is to succeed Prof. E. Villari as professor of physics and director of the physical laboratory at Naples. At Göttingen, Prof. F. Dolezalek has been appointed head of the department of physical and electrical chemistry. Dr. H. Kneser has been appointed professor of mathematics at Breslau. Dr. Ludwig Claisen late professor of chemistry at Kiel, has been appointed honorary professor at Berlin, and Dr. Karl Stöckl professor of mathematics and physics at Passau.

In his last report President Eliot recommends, says *Science*, the collection of 500,000*l*. as an endowment for the college of Harvard University, and it is said that the alumni are making efforts to collect this sum before the next commencement day. The class of 1880 expects to contribute 20,000*l*. on the occasion of its twenty-fifth anniversary. From the same source we learn that Mr. Andrew Carnegie has given to the Rensselaer Polytechnic Institute at Troy 25,000*l*. toward rebuilding the main building which was burned last June. He has also given 20,000*l*. to Tufts College for the erection of a library building.

The committee appointed by the Prince of Wales, as president of King Edward's Hospital Fund, to inquire into the financial relations between the hospitals and medical schools has now issued its report. The committee has formed, it is to be noted with satisfaction, the opinion that a broad line of distinction ought to be drawn between the preliminary and intermediate studies of a medical student on one hand, and the final studies on the other; and that whilst the final studies can be pursued with advantage only within the walls of a hospital, the earlier scientific studies have no real relation with a hospital, and are pursued more properly in an institution of university character. The committee expresses satisfaction that the statutes of the University of London direct the Senate to "use its best endeavours whenever practicable to secure such common courses of instruction for internal medical students in the preliminary and intermediate portion of their studies under appointed or recognised teachers at one or more centres." To do this effectively will mean a great expenditure, and the Senate of the university is appealing for funds to assist it in carrying out the work. The conclusions arrived at by the committee appointed by the Prince of Wales should prove of advantage both to the hospitals and to the

[1] "Buddhism." An Illustrated Quarterly Review. Vol. i., No. 4. Pp. xxii+170. (Rangoon: Hauthbrawaddy Press, 1904.)

university. The hospital should be a school only in the sense of being a school of applied science where general principles of science are applied to a specific technical purpose. But if the medical student is to be no longer provided with instruction in scientific fundamentals at the hospitals, there must be forthcoming—if London is to remain a great medical and surgical centre—funds enough to provide other institutions where this teaching may be given. University College and King's College have long done work of this kind, but the accommodation which they are able to provide is quite inadequate for the instruction of the students of all the hospitals, and other colleges are required where general education of a university standard may be obtained.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 26.—"On the Comparison of the Platinum Scale of Temperature with the Normal Scale at Temperatures between 444° and −190° C., with Notes on Constant Temperatures below the Melting-point of Ice." By Prof. Morris W. **Travers**, F.R.S., and A. G. C. **Gwyer.**

The authors conclude that, as might be expected, it is possible to apply the parabolic formula of Callendar and Griffiths to the re-calculation of the differences between the platinum scale of temperature and the scale of the gas thermometer, though the range through which it is applicable, and value of the constant ∂, precludes the possibility of employing it except for interpolation. A standard scale of temperature, based on Callendar's three fixed points, using standard wire, and taking 1.5 for the value of ∂, would lead to absurd results at low temperatures; and the converse may be said of the authors' own observations. The results referred to in this paper may be summed up as follows:—

Nature of gas thermometer.	Observer.	∂
Constant pressure air (0° to 444°) ...	Callendar and Griffiths	1·50
Constant volume nitrogen (−23° to 445°)	Chappuis and Harker	1·54
Constant volume nitrogen standardised by constant pressure air at 444° (500° to 1000°)	Harker	1·51—1·49
Constant volume hydrogen (−190° to 34)	Travers and Gwyer ...	1·90

February 2.—"On the 'Blaze-currents' of the Gall Bladder of the Frog." By Alice M. **Waller.** Communicated by Dr. Augustus D. Waller, F.R.S. (From the Physiological Research Laboratory of the University of London.)

This investigation was made in continuation of Dr. Waller's work on blaze-currents. A blaze-current, as defined by Dr. Waller in previous communications to the Royal Society and in his lectures on the signs of life, is a current of action, an electric current aroused in living tissues by stimulus; the term "blaze" has reference to the vitality of the tissue, to a chemical exchange going on within it; a muscle at rest is smouldering, a muscle in action is blazing. Dr. Waller's apparatus and method of work were employed; the apparatus consists essentially of a keyboard containing four keys, opening respectively to an induction coil, a compensator, the object to be studied, and a galvanometer or electrometer. Any accidental current in the object is compensated so that the galvanometer key can be opened without altering the zero, then the object is stimulated by a single break induction shock, the galvanometer key is opened, and the after-effect observed.

As seen in previous work by this method, the direction of blaze-current varies in different living objects or tissues, *e.g.* in a plant the blaze-current is either post-anodic or homodrome or it runs from younger to older tissue, in the crystalline lens from anterior to posterior surface, in skin from within outwards. The tissues and organs of the frog were systematically examined, and it was found that the liver gave responses either antidrome or from surface to hilum, and the gall bladder gave surprisingly large electrical variations, as much as 1/10 volt, always antidrome, in a way that one is accustomed to regard as due to polarisation currents in non-living matter. These polarisation currents were proved to be physiological by their abolition on submitting the organ to strong chloroform, boiling or electrocution by tetanisation. The effect is local, it can be destroyed by tetanus at two spots, and was found to persist at other parts of the round bladder.

Employing Waller's A. B. C. method, in which a three-way switch is employed so that the anode and kathode of the exciting current can be separately interrogated, it is found that the blaze at each pole is post-kathodic or antidrome. The blaze lasts about two minutes; it is often diphasic or triphasic; a single break shock with coil at 5000− (Berne scale) gave +0.0125 volt, then −0.0110, then +0.0010.

The bladder was washed out and filled with salt solution, and the same effect obtained; a piece was snipped off and electrodes applied to mucous and serous surfaces, and still antidrome blaze obtained, though there was a tendency to exhibit the usual mucous to serous blaze.

The simplicity of structure of the gall bladder—a sphere having a single row of columnar epithelium on the mucous interior surounded by layers of smooth muscle fibre cells—may account for the large and definite blaze-currents obtained, but why the cells should exhibit negative polarisation, antidrome rather than homodrome or positive polarisation, is not yet apparent.

Entomological Society, February 1.—Mr. F. Merrifield, president, in the chair.—*Exhibitions*:—Specimens of *Oligota granaria* found in a granary at Holborn, the only other localities reported hitherto being Shoe Lane, London, and Scarborough: H. St. J. **Donisthorpe.**—An Erycinid butterfly *Mesosemia eumene* pinned in its natural position of rest to show its resemblance to the head of a small mammal, such as a mouse: W. J. **Kaye.**—A variety of the female of *Lycaena melanops* named by him var. *wheeleri*: Dr. T. A. **Chapman.** As a mere aberration it was interesting, but it was of value as showing that the position in the genus for long accorded to the species, whether by accident or design, close to the Arion-Euphemus group, was correct. The considerable extension of the blue in this specimen showed up certain black spots on the upper surface of both upper and lower wings, strictly similar to these characteristics of the Arion-Euphemus group.—A living ♀ *H. defoliaria*, taken as late as February 1, at rest on north side of oak-tree, and another ♀ taken January 28 in the same wood at Bexley. A ♂ *Notodonta ziczac* × ♀ *N. dromedarius*, with two hybrids, the colour of the hybrids being that of *dromedarius*, while the markings were those of *ziczac*: F. **Enock.**—A living specimen of *Acridium aegyptium*, L., found in a cauliflower in Bloomsbury, and probably imported from Italy: O. E. **Janson.**—Two specimens of *Malachius barnvillei*, Puton, captured by Mr. Thouless at Hunstanton, Norfolk, in June, 1899, a recent addition to the British list: G. C. **Champion.**—♂ and ♀ specimens of *Machimus rusticus*, Mg., a rare Asilid, taken *in cop.* at Freshwater, Isle of Wight, on August 13, 1903: H. W. **Andrews.**—A ♀ example of *Panorpa cognata* taken at Byfleet Canal on August 23, 1904: W. J. **Lucas.** The insect occurs at Folkestone, and is said to be found in the New Forest. It is a little difficult at times to identify the ♀ alone, but Mr. K. J. Morton also had identified the specimen exhibited as *P. cognata*. For comparison he also exhibited ♀♀ of *P. communis* and *P. germanica*.—*Papers*:—A revision of the genus Criocephalus, with notes on the habits of *Asemum striatum* and *Criocephalus ferus*: Dr. D. **Sharp**, F.R.S., and T. G. **Smith.**—Another entomological excursion to Spain (with descriptions of two new species of Hemiptera by Dr. O. M. **Reuter**): Dr. T. A. **Chapman** and G. C. **Champion.**—On the matrivorous habit of the species of Heterogynis, Ramb., and on the pupal suspension of Thais: Dr. T. A. **Chapman.**—Notes on New Zealand Lepidoptera: E. **Meyrick**, F.R.S.

Zoological Society, February 7.—Mr. Howard Saunders, vice-president, in the chair.—A second collection of fishes made by Mr. S. L. Hinde in the Kenya District of East Africa: G. A. **Boulenger**, F.R.S. Examples of five species were contained in the collection, three of which were new to science.—On some points in the anatomy of a theriodont reptile: Dr. R. **Broom.**—Field-notes on the mammals of Southern Cameroons and the Benito: G. L. **Bates.**—A collection of Heterocera from the Fiji Islands: G. T. **Bethune-Baker.** Of the species enumerated eleven were new to science.—A contribution to the knowledge of the arteries of the brain in the class Aves: F. E. **Beddard**, F.R.S.—The function of the antennæ in insects: M. **Yearsley**. After reviewing the literature on the subject the author pointed out that Lowne, in his work on the blowfly, suggested that the antennæ were probably balancing rather than auditory organs. Lord Avebury and Latreille were cited in favour of this view, and the work of Yves Delage on Crustacea and of Clemens upon a moth (*Samia cecropia*) as confirmatory experiments. The author then gave details of experiments upon thirty wasps (*Vespa vulgaris*) in which the antennæ had been removed. The results of this mutilation were:—(1) Loss of power of flight; (2) loss of sense of direction; (3) noticeable slowness in all movements. The conclusion arrived at was that in wasps, the antennæ were equilibrating in function. This supported Lowne's surmise and corroborated the experiments of Clemens on *Samia cecropia*.

Anthropological Institute, February 14.—Prof. W. Gowland, president, in the chair.—Exhibition of native dances and ceremonies from the Torres Straits: Dr. A. C. **Haddon**, F.R.S. The exhibition was illustrated by lantern slides and kinematograph films, and dealt with the "Malu" ceremony, secular dances, and fire-making by a rotary method. Dr. C. S. Myers sang several of the native songs, which are sung at the dances, and accompanied himself on a native drum.—Dog-motive in Bornean design: E. B. **Haddon**. The methods of tattooing are constant among the tribes of Borneo, and most of the patterns are derived from the Kenyah and Kayan tribes. The different patterns are all derived from the dog-motive. The rosette pattern, for instance, which is tattooed on the shoulders of the men, is directly derived from the eye of a dog, although the Iban tribe, who have adopted the pattern, call it by the name of various fruits and flowers. The conventional tattoo pattern found on the firearms of Kenyah and Kayan men in Sarawak, although modified out of all recognition, is also clearly derived from the same source, as it is named *asu*, which means dog; from this same pattern a series can be traced to the Iban pattern, which is said to represent a scorpion, *Kala*, but was clearly originally a dog. Similarly the so-called prawn pattern, *Udang*, was shown to be derived from the dog-motive.

Royal Meteorological Society, February 15.—Mr. R. Bentley, president, in the chair.—Report on the phenological observations for the year 1904: E. **Mawley**. The weather of the phenological year ending with November, 1904, was chiefly remarkable for the persistent rains in January and February, the absence of keen frosts in May, the long continuance of hot and dry weather in July, and the small rainfall during the autumn. Throughout the year wild plants came into flower behind their usual dates, but at no period were the departures from the average exceptional. Such spring migrants as the swallow, cuckoo, and nightingale made their appearance in this country at as nearly as possible their usual time. The yield of wheat per acre was the smallest since 1895, while those of barley, beans, and peas were also deficient. On the other hand, there were good crops of oats, potatoes, and mangles. The best farm crops of the year were, however, those of hay, swedes, and turnips. Both corn and hay were harvested in excellent condition. Apples were everywhere abundant, and all the small fruits yielded well, especially strawberries, but there was only a moderate supply of pears and plums.—Observations of meteorological elements made during a balloon ascent at Berlin on September 1, 1904: Dr. H. **Elias** and J. H. **Field**.—The winds of East London, Cape Colony: J. R. **Sutton**.

Linnean Society, February 16.—Prof. S. H. Vines, F.R.S., vice-president, in the chair.—A revised classification of roses: J. G. **Baker**, F.R.S. The author dealt with the genus by dividing it into three groups. In the first group primary species were enumerated; in the second, sub-species and varieties; in the third, the principal hybrids. The primary species as estimated by the author are sixty-nine in number, and they are classified under eleven groups. The geographical distribution can be very briefly stated as follows:—Five species are found south of the Tropic of Cancer in elevated situations, two in Abyssinia, one in the Neilgherries, and two in Mexico. There are six geographical regions in the North Temperate Zone, each with a considerable proportion of endemic species. (1) Europe, with twenty-nine species; (2) Northern Asia with China and Japan, twenty-six species; (3) Western Asia, with eighteen species; (4) India, with nine species; (5) Western North America with the Rocky Mountains, with ten species; (6) Eastern North America, six species.—The botany of the Anglo-German Uganda Boundary Commission—Polypetalæ, E. G. **Baker**; Gamopetalæ excl. Convolvulaceæ, S. **Moore**; Convolvulaceæ, Apetalæ, and Monocotyledons, Dr. A. B. **Rendle**. The Commission commenced demarcating the boundary in the Uganda Protectorate in December, 1902, H.M. Commissioner on the British side being Lieut.-Col. Delmé-Radcliffe. The collections which are the subject of this paper were made by Dr. A. G. Bagshawe, the medical officer. They contain a considerable number (some fifty) of novelties, as also of known plants not hitherto recorded from the Uganda Protectorate. For the Angolan plant previously known as *Asystasia africana*, C. B. Clarke, which also is in the collection, a new genus, Styasasia, is proposed. A considerable percentage of West African coast-plants is a feature of the Protectorate flora as now made known, and worthy of mention is the presence of a small South African element.

Cambridge.

Philosophical Society, January 30.—Prof. Marshall Ward, F.R.S., president, in the chair.—On the non-electrification of γ rays; Prof. **Thomson**, F.R.S. Experiments were described in which the electrifications imparted to two equal cylinders made of thin brass, one of them hollow and the other filled with lead, were measured. The cylinders were in electrical connection and were symmetrically placed in a large vessel from which the air was exhausted. The cylinders were exposed alternately to the γ rays of radium, and from the measurement of the charges received by them it was concluded that the electrifications observed when γ rays fall on a body are not due to a charge on the γ rays, but to the charge carried by secondary β rays excited by the γ rays when they fall on the body or on the walls of the vessel containing it.—Are metals made radio-active by the influence of radium radiation? Prof. **Thomson**, F.R.S. From experiments made on lead, brass, and tin it was shown that these bodies, after exposure to radium radiation, exhibit no trace of radio-activity four minutes after the radiation has ceased to fall upon them; there was no evidence of induced activity of any kind, but the method used was not adapted for testing the existence of a very short-lived radio-activity; this has been done by Prof. Bumstead by a method described in the next paper.—Are metals made radio-active by the influence of radium radiation? Prof. **Bumstead**. The experiments described formed a continuation of those reported by Prof. Thomson, and were designed to ascertain whether the secondary rays given out by a surface exposed to the β and γ rays of radium persisted for a very short time after the exposure to the exciting rays had ceased. A rotating disc was used and four substances were tested, viz. copper, lead, tin, and blotting-paper which had been soaked in a solution of uranium nitrate and then dried. The interval between exposure to the rays from 30 mg. of pure radium bromide and the subsequent test for residual activity was less than 0·009 second; and no rays capable of penetrating 7 mm. of air and 0.00005 cm. of aluminium were detected. If any were present they must have been considerably less intense than those given out by a layer of potassium uranium sulphate with a surface-density of one milligram per square centimetre.—Note on the positive leak from hot platinum in air: O. W. **Richardson**. Experiments showing that the rate of discharge of positive electricity by a platinum wire, which had been heated in air long enough for the current to become steady, consists of two parts, one proportional to, and the other independent of, the pressure.—Some methods of increasing the spark length of the Wimshurst machine: B. J. **Palmer**.

February 13.—Prof. Marshall Ward, president, in the chair.—Orthogonal and other special systems of invariants, part i.: Major P. A. **MacMahon**, F.R.S. In this paper orthogonal concomitants are discussed by means of a symbolic calculus with imaginary umbræ. For a binary quantic of any given order, the author finds an inferior limit to the maximum degree of an irreducible covariant of given order belonging to it: a superior limit is also found in certain cases. For the first three degrees of the concomitants, for a quantic of any order, the actual number of irreducible concomitants is found; and hence the number of fundamental syzygies is inferred. Tables of ground-forms are given for quantics of order 2, 3, 4, 5, 6 respectively.—Reduction of generating functions by means of complex integration: G. B. **Mathews**, F.R.S. It is shown in this note how a class of generating functions which occur in the theory of invariants, and in that of the partition of numbers, may be reduced by means of Cauchy's calculus of residues.

DUBLIN.

Royal Irish Academy, February 13.—Prof. R. Atkinson, president, in the chair.—Verb functions or explicit operations, with notes on the solution of equations by operative division: Major Ronald **Ross**, C.B., F.R.S. If any expression is being considered as the result of an operation performed on one of its elements, the actual operation can be separately and explicitly represented in the following manner. The place occupied by the subject-element is called the base of the operation and is always denoted by β. Thus, $\beta \cos^{-1}\beta$ is the operation performed on x in order to produce the function $x \cos^{-1}x$. As β has no quantitative value, such an expression as $\beta \cos^{-1}\beta$ denotes, not a quantity, but an *action*, and may be called a *verb function*. Before applying such an expression to a subject it must be placed in special (square) brackets in order to distinguish operation from multiplication. The method may be applied to the solution of a complete equation of the nth degree in $2n$ ways, and applies equally to the solution of linear differential equations.

EDINBURGH.

Royal Society, February 6.—Dr. Traquair in the chair.—On Penella, a Crustacean parasitic on the Finner Whale (*Balaenoptera musculus*): Sir William **Turner**. This copepod was originally recognised by Koven and Danielssen as parasitic on *Balaenoptera rostrata*. The author's specimens were obtained in 1903 from *B. musculus*. The memoir comprised an account of the external characters and internal anatomy of the female, which, being from 10 to 12 inches long, varying in different specimens, is a giant amongst copepods. A comparison of the species with other species of Penella was made, and the great length of the thoracic in comparison with the genito-abdominal segment was referred to. The male of this species has not yet been recognised.—The ontogeny of the neuron in vertebrates; a cytological study of the embryonic nucleus: Dr. John **Cameron**. The results of the investigation tend to show that the so-called neuroblasts of the central nervous system in the early vertebrate embryo are really nuclei, from which the rudiments of the axis cylinder are formed as delicate protrusions. The neuroblast nuclei are found to exhibit remarkable structural changes, as evidence of the formation of these processes. The results attained in this research support the central theory of nerve-genesis as formulated by, among others, His and von Kölliker. They also tend to throw fresh light on the properties and functions of the cell-nucleus.

MANCHESTER.

Literary and Philosophical Society, February 7.—Prof. H. B. Dixon, F.R.S., vice-president, in the chair.—A new direct-vision spectroscope: T. **Thorp**. In Mr. Thorp's instrument the dispersion is effected by means of a transparent grating of about 14,500 lines to the inch, mounted on the long face of a light crown prism having a refracting angle of about 37° to secure direct vision. This prism-grating is mounted in a hinged frame and adjusted so that the grating face is at an angle of 45° with the axis of the instrument when the frame is at the centre of its range of motion. A spring holds the frame tightly against the end of a micrometer screw having a graduated head, this head being in the focus of a lens placed near the ocular of the spectroscope so that it can be read off without taking the instrument away from the eye. The D lines can just be separated in the pocket instrument, and readings can be made by taking the mean of several to about one Ångstrom unit.—Leaden weights found at Melandra Castle, an old Roman edifice near Glossop, among them being the uncia, or ounce, and other weights related thereto: F. A. **Bruton**.—A direct determination of the atomic weight of chlorine by burning a known weight of hydrogen in a known weight of chlorine: Prof. H. B. **Dixon**, F.R.S., and E. C. **Edgar**. The hydrogen was occluded in palladium and so weighed; the chlorine was prepared by the electrolysis of silver chloride, and was weighed in the liquid state. The atomic weight comes out about 35·192, higher than the accepted number by 0.012. This higher value is of interest in view of the recent (unpublished) work of Prof. Theodore Richards, of Harvard, who obtains a value 0.019 higher than the accepted atomic weight.—On the occurrence in Britain of the Pacific eider (*Somateria v-nigrum*, Gray), a species new to the European avifauna: C. **Oldham**.—Some habits of bats, with special reference to the lesser horse-shoe bat (*Rhinolophus hipposiderus*): C. **Oldham**. Proofs were given that the hibernation of these animals is not continuous, but interrupted by transient periods of activity.

PARIS.

Academy of Sciences, February 20.—M. Troost in the chair.—Observation of the partial eclipse of the moon on February 19: G. **Bigourdan**. Owing to the cloudy condition of the sky no observations were possible before 7.50 p.m.—On a new method of synthesis of alkyl derivatives of certain cyclic saturated alcohols: A. **Haller** and F. **March**. The sodium derivatives of propyl, isobutyl, and isoamyl alcohols, heated to 200° to 225° C. in an autoclave with β-methylcyclohexanone, act partly as reducing and partly as alkyl substituting agents. Homologues and isomers of menthol result from the reaction.—On the examples of Palinuridæ and Eryonidæ collected in the eastern Atlantic by the French and Monaco expeditions: E. L. **Bouvier**. The study of the collections brought home by the two expeditions has resulted in the discovery of some new interesting species, among others two types belonging to the genera Puer and Eryonicus, examples of which are extremely rare. These two forms show their distinctive morphological characters very early.—The application to the nitriles of the method of direct hydrogenation by catalysis; the synthesis of primary, secondary, and tertiary amines: Paul **Sabatier** and J. B. **Senderens** (see p. 423).—The large solar spot of February, 1905: Th. **Moureux**. On February 2 this spot, which was clearly visible to the naked eye, had a length of 180,200 kilometres. Its area was 1/20th of the solar disc, and hence it is greater than any sun-spot previously observed.—On Taylor's series on the circle of convergence: Paul **Dienes**.—On differential equations of the second order containing a single parameter: G. **Tzitzeica**.—On the approximate integration of differential equations: Emile **Cotton**.—On the mode of working of the differential gear of automobiles: A. **Petot**.—On the coefficient of magnetisation of bismuth and on some fixed points in the diamagnetic scale: Georges **Meslin**. The coefficient found for mercury was $-0{\cdot}185.10^{-6}$, taking water as $-0.79.10^{-6}$. For crystallised bismuth the value, with the additive correction for the air, was $-1{\cdot}39{\cdot}10^{-6}$, whilst a slightly higher result, $-1.42.10^{-6}$, was obtained for the fused metal.—On the perborates: P. **Melikoff**. A claim for priority as against M. Jaubert.—On lactyllactyllactic acid and the dilactide of the inactive acid: E. **Jungfleisch** and M. **Godchot**.—On the carbimide of natural leucine: MM. **Hugounenq** and **Morel**. The leucine ethyl ester was heated to 130° C. with carbonyl chloride in toluene solution, and the mixture submitted to fractional distillation *in vacuo*. The carbimide sought for was readily separated in this way from the substituted urea formed at the same time.—On the perborates: J. **Bruhat** and H. **Dubois**. A description of the preparation and properties of the perborates of potassium, sodium, and ammonium.—Assimilation outside the organism: Ch. **Bernard**. It has been stated by Friedel and confirmed by Macchiati that the enzyme extracted from leaves by glycerine in the presence of chlorophyll and light was capable of decomposing carbonic acid and setting free oxygen. The author has not been able to obtain any trace of oxygen under these conditions, and on repeating an experiment exactly in accordance with Macchiati's instructions found that the gas evolved consisted of methane and other inflammable gases, arising from the anaërobic decomposition of the plant tissue, this change not taking place in the presence of antiseptics, such as camphor. The author therefore regards the decomposition of carbonic acid outside the plant as unproven.—On the composition of brandy from wine: X. **Rocques**. A table is given showing the results of analysis of twenty-two samples of brandy arising from the distillation of wine, and it is pointed out that a brandy containing a relatively small amount of esters contains an increased amount of higher alcohols.—The prediction of a chemical reaction forming a monovariant system: Camille **Matignon**.—On two plants producing rubber: E. de **Wildeman**. A description of two plants, *Bassea gracillima* and *Periploca nigrescens*, the rubber producing properties of which have not hitherto been recognised.—On a new coffee plant in Central Africa: Aug. **Chevalier**. A detailed account of *Coffea excelsa*, with analyses of the soil in which it flourishes and of the coffee-bean produced from it. The amount of caffeine and the taste and aroma of the coffee are good, and would be worth cultivating in the French Congo.—On the secreting apparatus of Dipterocarpus: P. **Guérin**.—On the effect of low temperatures on the zoospores of the Algæ: E. C. **Teodoresco**. The spores of *Dunaliella salina* were found to retain their activity in a salt solution even after exposure to a temperature of $-30°$ C.—On a new cellular type with metamerised cytoplasm, *Taenicystis mira*: Louis **Léger**.—Geographical variations of the Pleuronectidæ: A. **Cligny**.—The extension of the functional states of the auricle to the ventricle: H. **Kronecker**. The author's experiments lead him to regard this effect as being entirely due to nervous elements.—Variations in morbid processes according to the composition of the organs: MM. **Charrin** and **Le Play**. Hydrolysis of the hepatic glycogen produced by the injection of amylase into the portal vein: M. **Pariset**.—On the stimulation of the nerves by very short electric waves: Louis **Lapicque**.—The experimental reproduction of leprosy in the ape: Charles **Nicolle**.—The geology of the Pyrenees of Haute-Garonne and Ariège: Léon **Bertrand**.—On the Amana meteorites: G. D. **Hinrichs**.—The cave lions: Marcellin **Boule**.

DIARY OF SOCIETIES.

THURSDAY, March 2.

Royal Society, at 4.30.—Further Researches on the Temperature Classification of Stars. No. 2: Sir Norman Lockyer, K.C.B., F.R.S.—On the Radio-active Minerals: Hon. R. J. Strutt.—Atmospheric Electricity in High Latitudes: G. C. Simpson.—On the Spectrum of Silicon, with a Note on the Spectrum of Fluorine: J. Lunt.—On the Electric Resistance to the Motion of a Charged Sphere in Free Space or in a Field of Force: G. W. Walker.

Royal Institution, at 5.—Recent Astronomical Progress: Prof. H. H. Turner, F.R.S.

Chemical Society, at 8.—The Latent Heat of Evaporation of Benzene and some other Compounds: J. Campbell Brown.—The Relation between Natural and Synthetic Glycerylphosphoric Acids: F. B Power and F. Tutin.—The Reduction of Isophthalic Acid: W. H. Perkin. jun., and S. S. Pickles.—The Transmutation of Geometrical Isomers: A. W. Stewart.

Röntgen Society, at 8.15.—A discussion on "The Necessity of Accurate Measurement in X-ray and High Frequency Work," opened by Dr. W. D. Butcher.

Civil and Mechanical Engineers' Society, at 8.—Engineering Expert Evidence: J. F. Reade.

Linnean Society, at 8.—Zoological Nomenclature; International Rules and Others (to be followed by a discussion): Rev. T. R. R. Stebbing, F.R.S.—Biscayan Plankton. Part IV. The Thaliacea: Dr. G. Herbert Fowler.

Institution of Electrical Engineers, at 8.—Type-setting by Telegraph: D. Murray.

FRIDAY, March 3.

Royal Institution, at 9.—Recent Advances in Wireless Telegraphy: Chev. G. Marconi.

Geologists' Association, at 8.—The Diamond Mines of South Africa: Prof. H. A. Miers, F.R.S.

SATURDAY, March 4.

Royal Institution, at 3.—Archæology: D. G. Hogarth.

MONDAY, March 6.

Society of Arts, at 8.—Internal Combustion Engines: Dugald Clerk.

Society of Chemical Industry, at 8.—Mechanics of Fire: Prof. H. E. Armstrong, F.R.S.—On the Estimation of Arsenic in Fuels—A Shortened Method: Dr. G. McGowan and R. B. Floris.

Victoria Institute, at 4.30.—Geological Exterminations: Dr. C. B. Warring.

Faraday Society, at 7.50.—Annual general meeting.—At 8.15.—Recent Developments in Electric Smelting in Connection with Iron and Steel: F. W. Harbord.

TUESDAY, March 7.

Royal Institution, at 5.—Some Recent Biometric Studies: Prof. K. Pearson, F.R.S.

Zoological Society, at 8.30.

Institution of Civil Engineers, at 8.—Surface-Condensing Plants, and the Value of the Vacuum produced: R. W. Allen. (*Continuation of Discussion.*)

WEDNESDAY, March 8.

Geological Society, at 8.—(1) Observations on some of the Loxonematidæ, with Descriptions of two New Species: (2) On some Gasteropoda from the Silurian Rocks of Llangadock: Miss Jane Donald.

Society of Arts, at 8.—Ethics of Japanese Society: Baron Suyematsu.

THURSDAY, March 9.

Royal Society, at 4.30.—*Probable Papers*: The Rate of Transmission of the Guatemala Earthquake of April 19, 1902: R. D. Oldham.—Ionic Sizes in Relation to the Conductivity of Electrolytes: W. R. Bousfield.—Explosions of Mixtures of Coal Gas and Air in a Closed Vessel: L. Bairstow and A. D. Alexander.

Royal Institution, at 5.—Recent Astronomical Progress: Prof. H. H. Turner, F.R.S.

Institution of Electrical Engineers, at 8.—Report on Experiments carried out at the National Physical Laboratory: On the Effect of Heat on the Electrical and Mechanical Properties of Dielectrics, and on the Temperature Distribution in the Interior of Field Coils: Dr. R. T. Glazebrook, F.R.S.—On Temperature Curves and the Rating of Electrical Machinery: R. Goldschmidt.

FRIDAY, March 10.

Royal Institution, at 9.—The Structure of the Atom: Prof. J. J. Thomson, F.R.S.

Royal Astronomical Society, at 5.

Malacological Society, at 8.—On a Dibranchiate Cephalopod from the Eocene of Arabia: G. C. Crick.—Note on the Horizon and Locality of the Type Specimen of *Pleuronautilus pulcher*: G. C. Crick.—New Marine Mollusca from the Collection of the late Admiral Keppel: G. B. Sowerby.—On the Occurrence of Internal Septa in *Glyptostoma newberryanum*: G. K. Gude.—Note on a Dart found in the Body Cavity of *Helix aspersa*: R. G. Barnes.

Institution of Civil Engineers, at 8.—The Purification of Sewage: F. G. Helsby.—The Purification of Sewage by Hydrolysis and Oxidation: F. O. Kirby.

Physical Society, at 8.—On the Stresses in the Earth's Crust before and after the Sinking of a Bore-hole: Dr. C. Chree, F.R.S.—On the Lateral Vibration of Bars of Uniform and Varying Sectional Area: J. Morrow.—On Direct Reading Resistance-Thermometers, with an Appendix on Composite Thermocouples: A. Campbell.

SATURDAY, March 11.

Royal Institution, at 3.—Electrical Properties of Radio-active Substances: Prof. J. J. Thomson, F.R.S.

CONTENTS.

THURSDAY, MARCH 9, 1905.

THE ORIGIN OF MAN.

Morphology and Anthropology. A Handbook for Students. By W. L. H. Duckworth, M.A. Pp. xxvii+546. (Cambridge: University Press, 1904.) Price 15*s.* net.

Studies from the Anthropological Laboratory, the Anatomy School, Cambridge. By W. L. H. Duckworth, M.A. Pp. x+291. (Cambridge: University Press, 1904.) Price 10*s.* net.

THE publication of Mr. Duckworth's text-book for students, bearing on its title page the rather vague terms, "Morphology and Anthropology," marks the culmination of the remarkable movement initiated by the publication of Huxley's "Man's Place in Nature" in 1863, and quickened in 1871 by the appearance of Darwin's "Descent of Man." At the commencement of this movement the subject of man's origin had its abode in the divinity schools; it was taught by theologians; the opening chapters of Genesis constituted the accepted text-book; now, in 1905, the subject is assigned to the anthropological laboratory; the lecturer on physical anthropology is its custodian, and the text-book is the work now under review.

In a clearly written introductory chapter Mr. Duckworth defines the subject-matter of his book as an inquiry into (1) man's zoological position; (2) the nature of his ancestry. That such a work is needed there can be no doubt. Ever since Darwin and Huxley gave this subject a legitimate place in the hands of biologists, experts have been busy as ants, seeking, collecting, and storing facts in the tome upon tome that annually come to crowd our bookshelves. The embryological history of man, anthropoid and ape have become known; important additions have been made to the geological record; our knowledge of the structure of the Primates has increased twenty-fold; all the additional evidence of thirty years thus lay at Mr. Duckworth's disposal awaiting systematisation. He has every qualification for the task; he has devoted many years to examining and extending the evidence on which our conception of man's origin rests. "Studies from the Anthropological Laboratory," the second work included in this review, containing thirty-six papers dealing with various aspects of primatology, guarantee his industry and first-hand knowledge. He has the advantage, too, of having at his disposal the great anthropological collections accumulated by Prof. Macalister, and free access to one of the best libraries of the world.

It is natural to expect that Mr. Duckworth, having so much additional evidence at his command, is able to define man's position in the animal kingdom with a greater degree of precision than was possible at the time when Huxley and Darwin wrote. Huxley, it will be remembered, restored man to the position originally assigned to him by Linnæus, namely, that of a family in the order of Primates, because, on the evidence he was able to adduce, man differed less in point of structure from the family of anthropoids than the anthropoids from the family of the Old World monkeys. Further, Huxley regarded the chimpanzee and gorilla as the animal forms most nearly related to man. In these two respects Darwin agreed with Huxley. In the classification adopted by Mr. Duckworth, man retains the position assigned to him by Huxley. Mr. Duckworth's style in producing evidence and conflicting theories is open, frank, and impartial, but in setting forth his conclusions he is so eminently non-committal that it is difficult to cite a passage which concisely expresses his conception of the exact position which man holds with regard to other families of Primates. On p. 226 the following passage occurs:—

"But no single example among the larger Simiidæ can be pointed out with confidence, as embodying the characters of the human ancestor at the simian stage of evolution more completely than any other, though there is a slight margin of evidence in favour of the Chimpanzee, rather than the Gorilla or the Orang-utan."

Thus it will be seen that the matter of man's zoological position remains where Huxley left it. Huxley had an incomparable faculty of drawing just conclusions from limited data, but few men who are experts on this matter will agree that Mr. Duckworth has utilised the evidence at his disposal to the fullest extent possible.

Nor has the evidence which has accumulated in the last thirty-three years permitted Mr. Duckworth to make a more definite statement as to the ancestral chain or phylogenetic path of man than was made by Darwin in his first edition of the "Descent of Man" in 1871.

"The Simiadæ," wrote Darwin, "then branched into two great stems, the New World and Old World Monkeys; from the latter, at a remote period, Man the Wonder and Glory of the Universe proceeded" (vol. i., p. 213, 1st ed.).

Mr. Duckworth's conclusions in this matter are summed up at p. 542 as follows:—

"But while it is shown that the Hominidæ have in their evolution passed through a stage which is better reproduced by the Simiidæ (anthropoids) than by any other of the Primates, it is practically certain that the modern Simiidæ did not themselves figure in the ancestry of man and that they are themselves specialised in a high degree, more specialised in many ways than the Hominidæ and more specialised than their own ancestors. As Klaatsch puts it, the ancestors of the modern Simiidæ were more anthropoid than the actual Simiidæ, just as the ancestor of the Hominidæ was more pithecoid than modern Man. And the balance of evidence indicates that the line of human ancestry would, were the material still available, be traceable down to the lowest Primates (Lemuroidea) and even to the lowest Mammals. Moreover, it is undeniable that the Hominidæ have retained in hand and foot some features of an early ancestor, from which they have departed less in type than have the (modern) Cercopithecidæ and Simiidæ. But detailed information on these points is still lacking."

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Leaving out of account the oracular statement quoted from Klaatsch, there can be no question that Mr. Duckworth's inference as to man's line of ancestors is much less definite than that of Darwin, and certainly, in the opinion of many well qualified to judge, less in keeping with the evidence at our disposal. What the peculiar primitive characters of the human hand and foot may be the writer cannot guess, but it is certain that there are numerous characters in the human hand and foot which can be accounted for only on the supposition that at one time they were used functionally as are now the hands and feet of anthropoids. Mr. Duckworth states his opinion guardedly, but it is evident from the statement just quoted that he believes the line of ancestors that connect modern man with a primitive lemuroid (Eocene) stock is extinct and unknown, and that this line of ancestry runs an independent and parallel course to the ancestral stock of the anthropoids. Now man shares with the chimpanzee and gorilla some three hundred structural features which are not possessed by any lemuroid form of which we have any knowledge, nor can the common possession of these characters be accounted for except on the supposition that man and these two anthropoids are derived from a common stock. A full investigation of the evidence will show that Darwin was not far from the truth when he supposed that the gorilla, the chimpanzee, and man have their origin from a common stock. Modern man differs from the Miocene anthropoid Dryopithecus in structure no more than does the modern horse from its Miocene ancestor. In Dryopithecus, characters are recognisable which link it with the gibbon on the one hand and the chimpanzee on the other. Palæopithecus, a Pliocene anthropoid, in the characters of its teeth and jaw, which are the only parts yet found, links the chimpanzee to the orang. The modern gibbon differs in an incredibly small degree from its Miocene ancestor, and shares many characters in common with the great anthropoids, man, the Old World monkeys, and New World monkeys, and is by far the most generalised form of higher Primate now extant, in spite of many adaptive features. In short, the evidence points to the common origin of man and the great anthropoids from a gibbon (Hylobatian) stock; this in turn, with monkeys, must be traced to a lemuroid origin.

Mr. Duckworth deals very justly with the evidence yielded by embryological investigation. Thirty years ago, when it was believed that the embryo recapitulated its ancestral stages *in utero*, it was thought that the history of man could be written when his development became known. "Palæontology is good but Embryology is better," wrote Kitchen Parker, but now we know, and Mr. Duckworth states the case fully, that the embryological phases are so obscure that they can only be construed by the help of comparative anatomy and palæontology. It has come to be recognised that every mammal is adapted to two separate lives—an intra-uterine life and an independent life; the features of the one existence mask those of the other. Yet Mr. Duckworth makes the important fact stand out that the intra-uterine life of man is exactly similar, so far as we yet know, to that of the anthropoids, and in that, while it resembles in most points the lower Primates, yet differs from all other mammals.

It must be admitted that Mr. Duckworth's task was not an easy one; yet no essential or important contribution has been passed unnoticed by him. His statements are clear and impartial; he has even a kindly word to say for some notions, such as the temporary fissures of the brain, which most anatomists, in common with himself, now regard as *post-mortem* artefacts. In another edition, which this work is certain to attain, the statements made in the following sentence (p. 201) will require some amendment:—

"Selenka thus regards the syncytium (a peculiar tissue) as derived neither from the chorion-entoderm (Kollmann), nor from the submucous uterine decidual connective tissue cells (Minot, 'Human Embryology,' pp. 13 and 375) nor from the fœtal ectoderm (Robinson, 'Hunterian Lectures,' *Journal of Anatomy and Physiology*, vol. xxxviii. p. 493), but from the epithelial lining of the uterus."

Mr. Duckworth unwittingly does the late Prof. Selenka a double injustice; in the first place he reproduces an acknowledged modification (Fig. 148, p. 203) of a figure by Selenka, in which the syncytium is made to appear as a continuation of the lining epithelium of the uterus, whereas in Selenka's figure it is clearly shown not to be continuous; secondly, Selenka ("Studien ueber Entwickelungsgeschichte," Heft viii., pp. 190, 193) expressly states that he is uncertain of the origin of the syncytium, but that the evidence is rather in favour of its origin from the cells of the uterine glands. Expert opinion regards it as settled that the syncytium does not so arise, but springs from the ectoderm of the embryo, a conclusion which seemed to Selenka not improbable. He does Kollmann also an injustice, for in his text-book (p. 201) that author expressly states that it arises from the lining epithelium of the uterus—the opinion ascribed by Mr. Duckworth to Selenka. Nor will Minot acknowledge the opinion ascribed to him, for on p. 322 of a text-book on human embryology he states that he is convinced that the syncytium is derived from the embryonic (chorionic) ectoderm, the opinion here ascribed to Prof. Robinson. Nor will Prof. Robinson be willing to accept priority for the theory of the ectodermal origin of the syncytium; probably Hubrecht has the greatest claim to be accounted the pioneer in this matter.

It would not be just to close this review without acknowledging the number of original facts and fresh opinions that mark the pages of this work. The opening chapters are perhaps too condensed; the long lists of characters enumerated are rather apt to lead to mental dyspepsia even in the pages of a text-book, and one misses a statement of their functional meaning, which would greatly assist the memory in ranking them together. The chapters on the cerebral organisation are specially well done, and contain the best exposition yet published of our knowledge of that part of the Primate organisation. Special prominence is deservedly given to the brilliant work of Prof. Elliot Smith. There can be no doubt, too, that this work will lead to a renewed vigour in the search for evidence bearing on the origin and relationships of the higher Primates.

A. K.

CHEMISTRY FOR YOUTHS: MRS. MARCET REDEVIVA.

Die Schule der Chemie. By W. Ostwald. Zweiter Teil—Die Chemie der Wichtigsten Elemente und Verbindungen. Pp. viii + 292. (Brunswick: Vieweg and Son.) Price 7·20 marks.

ABOUT a year ago, the first volume of Prof. Ostwald's dialogues on chemistry was noticed in these columns. We have now the second volume, written in as lively a strain as the first, and conveying the author's views, which bid fair to become in the main everybody else's views, as regards the presentation of the elementary facts of chemistry. It would be wrong to say that in this volume, consisting of 292 pages, there is more system; but in it we come to a discussion of chemical facts and theories which are generally treated in school text-books. The pupil is introduced to chlorine, its preparation and properties; its behaviour with water; acids and bases, and elements; combining weights, and multiple proportions; the atomic hypothesis, and the laws of volume combination; electrolysis and salts. Chlorine is again considered as regards its compounds with oxygen, and then follow bromine and iodine; sulphur and its compounds; nitrogen, ammonia, phosphorus, and so on through the commoner elements and their compounds.

Throughout the volume we find neat remarks which sustain interest, at least, when it is glanced through, for I do not think that anyone who is already a chemist will read the volume as carefully as he may have read the first volume. For example, on the first page is an aphorism, too often neglected, but none the less true:—"When much has been learnt, time must be given for digestion." In English "cramming doesn't pay in the long run."

Everyone knows that Prof. Ostwald does not hold by the atomic theory. Yet he does not escape from it. His presentation of it is, however, ingenious, as indeed are all his methods. Discussing the facts of multiple proportion he gives the following illustration:—

"Think of a collection of coins, where German marks, English shillings, French francs, Russian roubles, and other coins are to be found. You can combine these coins in twos and threes; each combination, however, has the value of the sum of the individual value of the coins, and you cannot obtain any other values, combine them as you will. Similarly, no other compounds can be formed but those obtained by bringing the elements together according to their combining weights."

The pupil then draws the required conclusion:—

"That is as if each element consisted only of equal pieces, just as all francs or marks are equal among themselves." "Yes," answers the teacher; "that is the picture which has represented the state of affairs to men's minds for long. It is supposed that each element consists of minute particles, named atoms," and so on. When the boy asks, "Is all this true?" the teacher replies, "No one has seen an atom, nor weighed one. This is therefore a hypothesis, but a very convenient one, because the various applications of the laws of combining proportions can be better realised (merken) when the picture of atoms is simple and clear." "But we can do without it!" says the pupil. "Certainly," says the teacher. "But just as you found it easier to count on your fingers than in your head, so it is easier to think of atoms, than of the abstract and general laws of combination." So we have to teach by means of atoms. Indeed, few of us would go further, especially in these later days, when even atoms are failing us. The hypothesis is, however, ignored a little later, when it is stated that "the rule has been made never to write fractional parts of combining weights." The doctrine of the indivisibility of atoms would appeal more readily to a young mind. Yet in fairness, it must be acknowledged that the writer makes the pupil suggest that each chemical symbol stands for an atom, and acknowledges, in the mouth of the teacher, that "the atomic theory can be easily grasped" ("etwas sehr eingängliches hat").

When electrolysis is discussed, the author's ingenuity in devising analogies is at its best. The pupil has difficulty in picturing a positive and a negative current going in opposite directions through the same wire. He is reminded of waves crossing each other in a pond, and of the upper and under parts of a driving-belt travelling in opposite directions.

Heats of combustion, discussed under the heading "carbon," are measured in kilojoules, instead of calories. This is perhaps logical, but it appears to the reviewer that the older unit might have been retained until a later stage. It is easy to make the reduction when required; and it is easier to realise heat as heat than as work, at first, at least.

While acknowledging that the subject of chemistry is here well treated, and that the author has maintained his lively style and faculty of lucid presentment, it may be questioned whether this method of discussing chemistry should have precedence over the ordinary text-book. A youth who advances so far as to grasp the contents of volume I., will, I think, tire of the plan of question and answer. Yet perhaps there are some who prefer to take their food, as they do medicine, in spoonfuls, and to whom the form of dialogue has its attractions. In old days "Pleasant Pages" was widely read, and no doubt conveyed valuable lessons. And at any rate, teachers of chemistry may learn much from this volume in hints as to how best to present the very numerous facts of the science to their students, whose digestive powers are as a rule limited.

W. R.

FLORAL MORPHOLOGY.

Praktikum für morphologische und systematische Botanik. By Dr. Karl Schumann. Pp. viii+610. (Jena: Gustav Fischer, 1904.) Price 13 marks.

THE morphology of the flower, although an important item in the curriculum of the advanced student of botany, is not infrequently compressed into a period quite insufficient for obtaining a knowledge of more than a few cohorts or families. But the relegation of this branch of botany to an uncertain stage is easily explained, since, as a course for training students, and this is the first object of a scientific curriculum, floral morphology does not offer the same scope as vegetative anatomy or physiology. Nevertheless, the art of discovering all the essential points of a flower is by no means easily acquired, while the ability to distinguish between critical genera and orders requires intuition, based upon experience and practice.

Dr. Schumann has prepared his book, in the first instance, for botanists who are dependent upon their own unaided efforts, thereby providing for that large class of enthusiasts who can only devote their leisure time to botany; but he had also in view the much higher object of leading those who use his book on to the plane, if not to the work, of systematists, and the final chapters deal with determination of species and the essentials of floral monographs.

The book contains two courses, of which the first is the easier, but it includes certain types, such as Phaseolus and Iris, which require some experience to explain thoroughly; the arrangement is according to the order of flowering. There are approximately 130 types of flowers, most of them common varieties, or easily obtainable, and these represent about 80 orders, which are, for the greater part, indigenous to Europe. There is a natural tendency to form a misleading conception of the importance of those orders which preponderate in the flora of one's own country, and for this reason it would have been advantageous to include representatives of more exotic orders, but since the aim of the author has been to present specific instances of floral variation and not systematic types, the choice seems to be very suitable. The keynote to the book lies in the author's inspiring enthusiasm for the study of foliar and floral morphology, and those who use the book will regret that Dr. Schumann did not live to see it completed. To Dr. Max Gürke was entrusted the responsibility of completing the book and of seeing it through the press. The discussion of each type includes general foliar arrangement, branching, inflorescence, floral parts, and methods of pollination, and each chapter has been made self-complete; in addition the author has contrived in a number of cases to derive from the specimen an illustration of some special theoretical point; thus the examination of the pine and fir cones introduces phyllotaxis, the balsam flower leads to the consideration of empirical diagrams, and the origin of double flowers is discussed in the case of the chrysanthemum. In dealing with questions for which different explanations have been offered, Dr. Schumann has carefully avoided dogmatic statements, and, as a rule, gives the arguments, but leaves it to the student to form his own conclusions. There are several allusions to the rules of botanical nomenclature adopted in various countries, and the author inclines towards English practice in the matter; but the instances which he quotes, *e.g. Succisa pratensis* and *Ampelopsis hederacea*, are not the names adopted in the Kew lists for the plants in question. Mention is made of the botanical congress which will be held in Vienna this year, when the subject will be again under discussion.

It has hitherto been a difficulty to obtain a thoroughly trustworthy and full presentation on the subject of floral morphology except in Eichler's "Blutendiagramme"—copies of which are few and expensive—so that teachers and students will do well to note this book, since it contains a number of careful analyses of every-day types with a particularly clear account of inflorescences and bracts, and it may therefore be used for reference to confirm or correct the deductions based upon personal examination. The illustrations were drawn by Dr. Schumann's daughter, and these, like the descriptions, may well be taken as models which the student should emulate.

SCIENTIFIC ASPECTS OF LAWN TENNIS.

Lawn Tennis. By J. Parmly Paret. Edited by Caspar Whitney. American Sportsman's Library. Pp. xiv+419. (London: Macmillan and Co., Ltd., 1904.) Price 8s. 6d. net.

Great Lawn Tennis Players: their Methods illustrated. By George W. Beldam and P. A. Vaile. Pp. xxix+403. (London: Macmillan and Co., Ltd., 1905.) Price 12s. 6d. net.

IN the first of the above books we have an excellently illustrated and interesting volume dealing with the early history, development, and present condition of lawn tennis, the author having produced a treatise which will be heartily welcomed by all lovers of this healthy game.

The author quite rightly deals only with the play of those who have attained a very high order of execution, and are past masters as regards the manipulation of a rapidly moving ball. A plan of campaign, quick decision, and still quicker action on the part of the player are necessary for success, and when these are accompanied by accuracy of execution, steadiness, easiness of style, and good condition, greater achievement is attained. Modern lawn tennis is undoubtedly a combination of skill and science of a high order, and the reader will find described in these pages the different ways in which well-known players employ these fundamental desiderata. By an ingenious application of photography it has been possible to record the start, stroke, and finish of individual strokes on one plate, to illustrate the positions of the body, hand, wrist, and racket during the movement. Many illustrations of this kind are given, serving as valuable guides to correct action. Numerous other snapshots of positions of play taken singly or on three plates with brief intervals form a special feature of this volume.

The physiological side of the game is not lost sight of, and is dealt with by the author in three short chapters, while Part iv. is devoted to "lawn tennis encyclopædia," containing much miscellaneous information useful to players, including a bibliography of the literature on the subject, which, by the way, is very considerable.

The volume concludes with an account of the history and growth of the game of lacrosse, by William Harvey Maddren.

The very complete index adds considerably to the utility of this publication, which should form a welcome addition to any sportsman's library.

In the second of these volumes, which is the combined work of Messrs. G. Beldam and P. A. Vaile, we have another valuable contribution to the literature of lawn tennis. Mr. Beldam presents us with 229 of his action photographs, all of which are here beautifully reproduced. In his book on "Great Golfers" he showed how much could be learnt by closely studying action-photographs, and in the present volume on great lawn tennis players a similar attempt is rewarded with equal success in spite of the greater difficulties involved, since both player and ball are in rapid motion. The photographs here given are not casual snapshots, but taken specially to illustrate the positions occupied by players for particular strokes. Mr. Vaile, writes, so to speak, round these pictures, and in his breezy and straightforward style points out which in his estimation are the good or bad points. This author is of the opinion that the true science of the game is but dimly appreciated in this country, and it is his main endeavour throughout these pages to indicate in which direction progress can be made. The lawn tennis reader will find, therefore, much to think over in these pages, and particular attention is drawn to the first chapter, in which the racket, *per se*, and the methods of holding it are discussed. Mr. E. G. Meers contributes an interesting chapter on "Advanced Tactics of the Single Game," while "The Half-Volley" is treated by Mr. G. A. Caridia.

OUR BOOK SHELF.

New Streets: Laying Out and Making Up. By A. Tayler Allen. Pp. 175. (London: The Sanitary Publishing Company, Ltd.) 3*s*. net.

THIS is not the sort of book that anyone but a proof-reader could read straight through, not even a reviewer or a surveyor or architect, for whom especially it is written. This statement is not made by way of disparagement, quite the reverse, and the author would be the first to agree to it.

In these days, with a multiplicity of petty and of local bye-laws and regulations, all put together primarily and ostensibly to prevent scamping of different kinds, but often, and the more so the more petty the authority, used as weapons to compel public spirited parties to go to unnecessary and extravagant expense so that the members of the petty body or their friends may be the more prosperous, it is above all essential that the surveyor or architect or engineer or even private individual, who has occasion to make a new street or a cottage or a side-walk or a retrospective drain should act warily, and have before him the several acts and bye-laws that regulate or hamper, as the case may be, the particular work he has in hand. The author, judging by this, and by the titles of his previous works, seems to be a good Samaritan and to take pleasure in pointing out the numerous pitfalls that must be avoided by the man who would, if possible, live at peace. The present book is largely filled with a recitation of laws and of district council requirements which no one would wish to read unless under compulsion. The latter part contains examples of work in very full detail and with illustrations.

However, the author has not, as might have been expected, lost all interest in the progress of his subject in wrestling with these dismal details. For instance, on p. 2 he says:—

"The author is one of a few surveyors who believe that all wide carriageways (where traffic is considerable), should have the channel in the centre instead of at the sides, thus obviating the tendency of vehicles to slide down the haunches of the road towards the kerb. The gradient to the centre channel from the kerb need not exceed 1 in 40."

Whatever advantages or the reverse there may be in this plan, spectators on the pavement would no doubt prefer to see this sliding in the direction desired by the author, especially if the vehicles happened to be quick motor-cars going in opposite directions.

The author is to be complimented on performing a tedious and uninteresting task for the general good.

C. V. B.

A Popular Guide to the Heavens. By Sir Robert S. Ball, LL.D., F.R.S. Pp. xii+96; 83 plates (London: George Philip and Son, Ltd., 1905.) Price 15*s*. net.

THIS is a new edition of the "Atlas of Astronomy," by the same author, which appeared in 1892, the revision having extended even to the title of the book. As before, star maps and pictures of the heavenly bodies are the chief feature, but in many cases drawings have been replaced by admirable reproductions of some of the finest celestial photographs at present available. The star charts, comprising twelve maps indicating the aspect of the heavens in the different months, and twenty others showing much greater detail, are excellent in every respect, and will meet the needs of those making a first acquaintance with the stars as well as of those who may wish to observe interesting objects with telescopes of moderate aperture. A valuable feature in connection with the maps is an index to the planets, whereby the positions of these bodies in each month during the next fifty years may be approximately ascertained. A very complete guide to observations of the moon is also provided by the maps and catalogues of lunar formations. So far, the book justifies its title, but the remaining parts give the impression of a scrap-book with pages still remaining to be filled, and pages which would have been filled differently by different owners. The sun, for example, is inadequately represented; the only photograph of a sun-spot which is given conveys no indication of the dimensions of the spot, and there are no illustrations of faculæ or photographs in monochromatic light. A more serious omission, in a book which is styled a "guide," is the absence of all reference to the modes of observing the sun, although careful drawings of the paths of spots at different times of the year are included. Again, there is an elaborate chart of the planet Mars, but nothing to show what the planet looks like in an ordinary telescope.

The text amounts to little more than a description of the plates and is too scrappy to give a connected view of the subject. The book, however, is well produced, and will be valued for its excellent star maps and examples of celestial portraiture.

Denkmäler mittelalterlicher Meteorologie. No. 15 (Schlussheft). Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus herausgegeben von Prof. Dr. G. Hellmann. Pp. lviii + 200. (Berlin: Asher and Co., 1904.)

This is the final volume of a valuable series of publications which we owe to the energy of Prof. Hellmann. In them we have had brought before us the more interesting abstracts and reprints of early works dealing with meteorology and terrestrial magnetism. Prof. Hellmann has thus made available to those interested in these subjects, the records of ancient times, which to many would have remained unread and possibly unknown.

In the present volume, which deals more especially with meteorology, we have presented to us a set of twenty-six separate parts ranging from the seventh to the fourteenth century. Many others have been taken from printed works, but some of them, as we are told in the preface, are here published for the first time.

Further, many of these old texts have here been translated into German so that those who are not familiar with old Saxon, old English, old Norwegian, or Arabic will still be able to gain a good insight into the ideas of the Middle Ages.

In the introduction to this volume Prof. Hellmann gives a brief sketch of the character of meteorology at these periods, and adds a short and interesting summary of biographical facts relating to the writers of the texts to which reference is here made. An appendix contains additions and corrections to the earlier numbers.

For the labour involved in bringing together and preparing this collection of old texts a large debt of gratitude is due to Prof. Hellmann, and it is hoped that from time to time, when further ancient writings are brought to light, he will render them in like manner so conveniently available.

The Birds of Calcutta. By F. Finn. Second edition. Pp. vi + 136. (Calcutta: Thacker, Spink, and Co; London: Thacker and Co., 1904.)

The fact of a work reaching a second edition may generally be taken as an indication that it has received the seal of public approval, and that it accordingly needs no commendation from us. In the present instance, a ready reception would seem to be assured to the new edition, since many additions and improvements have been made. The most important addition is undoubtedly the series of life-like cuts of Indian birds, which adds very largely to the interest of the little volume; but it is also satisfactory to find that the arrangement and nomenclature have been revised so as to bring the work into harmony with the volumes on birds in the "Fauna of British India," to which it may serve in some degree as an introduction. Mr. Finn has a vivacious, if sometimes flippant, style, which removes his works from the "dry-as-dust" category; but in some cases, as in the application of the term "disreputable" to the babbler, we venture to think some of his epithets might be better selected. To a former resident the omission of the adjutant stork from the list of Calcutta birds seems strange, but it appears that for many years these weird birds have ceased to visit the city of palaces. R. L.

Toning Bromide Prints. "Photography" Bookshelf Series, No. 10. By R. E. Blake Smith. Pp. xv + 104. (London: Iliffe and Sons, Ltd., 1904.) Price 1s. net.

Instead of producing a black and white bromide print it is often desirable to change the normal tone to suit the subject photographed. There are many methods by which this change of tints can be obtained, and these pages are devoted to describing the various processes that are available. The material on which this book is based first appeared in a series of articles in *Photography*, but in the present handy form it will be found more convenient for workers. The author gives a good detailed account of each case, and discusses the probable effect of the different processes on the permanence of the finished picture. Workers with bromide papers will find this book of considerable service.

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.*]

Charge on the α Particles of Polonium and Radium.

With reference to the interesting letter on this subject by Prof. Rutherford in last week's Nature, I should like to point out that in my paper "On the positive electrification of α rays and the emission of slowly moving kathode rays by radio-active substances" (*Proc.* Camb. Phil. Soc., xiii., p. 49) I have described experiments which demonstrate the communication of a positive charge of electricity to bodies struck by α rays from polonium or radium. I had considerable difficulty in disentangling this positive charge from the copious streams of slowly moving negatively electrified corpuscles which I found were given out by these substances, and the experiments in which I finally succeeded in doing this were not completed until a few days after the reading of the paper on November 14, and are not referred to in the abstract quoted by Prof. Rutherford. A description of them will be found in the paper which has lately been published. I may take this opportunity of saying that I have recently found that uranium also gives out slowly moving corpuscles, so that this effect seems a general property of radio-active substances. The velocity of these corpuscles is very small compared with that of the β rays, and is more nearly of the order of the velocity of the corpuscles emitted by metals when exposed to light. J. J. Thomson.

Cavendish Laboratory, Cambridge, March 4.

A conversation I had with Prof. Bragg, of the Adelaide University, in passing through Adelaide last summer suggested some thoughts in regard to the nature of the α rays which may be of interest in view of Prof. Rutherford's letter in last week's Nature. Prof. Rutherford announces that he has at last succeeded in detecting the positive charge carried by the α rays of radium by using a magnetic field to deflect and remove the slow-moving electrons present with the α particles. He says, "I think these experiments undoubtedly show that the α particles do carry a positive charge, and that the previous failures to detect this charge were due to the masking action of the large number of slow-moving electrons emitted from the plates." These results, while they afford a welcome confirmation of the conclusions drawn from the evidence of the magnetic and electric deviation suffered by the α rays, do not, to my mind, finally settle the question.

It must be admitted that the α particles in ordinary circumstances do carry a positive charge. Certain evidence, however, seems to point to the conclusion that the α particle at the moment of its expulsion from the parent atom is uncharged, and that it derives its positive charge from secondary causes, independently of, and subsequent to, the expulsion process. To devise a crucial experiment which would decide between the two views would be far from easy, but as I interpret Prof. Rutherford's letter, the results there given do not definitely disprove the view that the α particle is initially uncharged.

I recently directed attention ("Radio-activity," p. 181) to the importance of the fact that in certain well-established cases there appeared to be a simultaneous production of two positive charges in the disintegration of an electrically neutral atom. Thus in the disintegration of the emanation atom a positively charged α particle is expelled, and the residue of the atom—the matter causing the excited activity—is also positively charged, and is concentrated on the negative electrode in an electric field. In a recent paper by Bragg (*Phil. Mag.*, December, 1904, p. 721), the following sentence occurs: "It is easy to see that even if the α particle is uncharged when it leaves the parent body, it must immediately become positive, since in traversing an atom it is just as likely to lose one of its own electrons as to take one away from the atom traversed." As I am unaware that this consequence has received the attention it deserves, perhaps I may be allowed to direct attention to its bearing on the present question. There is a fundamental distinction between the ionisation of the atom of a gas molecule by radiant *electrons* or β particles, and radiant *atoms* or α particles. For in the latter case, if the atom struck suffers ionisation, the radiant atom is just as likely to be ionised in the process also. The ionisation of a neutral atom consists in the detachment from it of an electron which forms the negative ion, the atom thereby becoming positively charged and forming the negative ion. Hence the radiant α particle, if uncharged initially, will become positively charged on collision with the atoms of the gas or other obstacle in its path, and at the same time will lose an electron. The "slow-moving electrons present with the α particles," which Rutherford describes as "emitted from the plates," may therefore in reality be derived from the α particles themselves in the act of becoming positively charged. The fact that they, unless deflected by a magnetic field, exactly neutralise the charge carried by the α particles seems to point in the same direction.

In further support of the view that the positive charges on both the radiant particle and the residue of the atom after disintegration are derived by collision with the gas molecules, Prof. Rutherford's results on the distribution of the excited activity in an electric field at low pressure may be cited (Rutherford, "Radio-activity," p. 282). If the excited-activity-matter particle gains its positive charge in its recoil by collision with the gas molecules, it is to be expected that at low pressures it will not become charged, and will not, therefore, be concentrated on the negative electrode, as is, in fact, the case. FREDERICK SODDY.

The Pressure of Radiation.

THE success of Lebedeff and Nichols and Hull in recognising and measuring the pressure of radiation has aroused much interest in radiation pressure generally, real or apparent. It has some interesting and sometimes somewhat difficult theoretical aspects. In the first place, if the ether is really absolutely at rest (this rigidity is a very difficult idea), the moving force on it has no activity, and its time integral $\nabla\mathbf{DB}$ can only be called momentum out of compliment. The force becomes active in a moving ether, with interesting consequences not now under examination. The present question is rather how to interpret the pressure of radiation on the assumption of a fixed ether, in the measure of its effects on matter which is either fixed or moving through the ether.

The following is striking in what it proves. Let plane radiation fall flush upon a perfect reflector moving in the same direction at speed u, a case considered by Larmor. Let the energy density $p = p_1 + p_2$, the incident being p_1, the reflected p_2. Assume, which seems reasonable at first, that p_3, the pressure in the reflector, is zero, then the moving force $p_1 + p_2 - p_3$ reduces to $p_1 + p_2$. Therefore

$$p_1(v-u) - p_2(v+u) = (p_1+p_2)u, \tag{1}$$

because the left side is the rate of loss of energy from the waves, and the right side the activity of the force on the reflector. So

$$\frac{p_2}{p_1} = \frac{1-2u/v}{1+2u/v} = s^2, \text{ say,} \tag{2}$$

and $s = \mathrm{H}_2/\mathrm{H}_1$ is the ratio of magnetic forces in the electromagnetic case. Now (2) asserts that the reflected wave gets smaller as the mirror goes faster, and vanishes when $u = \frac{1}{2}v$. Or if the mirror be pushed against the radiation, the reflected wave gets stronger, and the resisting force stronger until $u = -\frac{1}{2}v$, when it is infinite. The mirror could not be pushed against the radiation faster than $\frac{1}{2}v$.

An immediate objection is that when u has risen to $\frac{1}{2}v$, if it be maintained at that speed it acts like a perfect absorber to the incident energy. Moreover, since there is the pressure p_1 left, why should it not accelerate the mirror? But, if it does, p_2 becomes negative, and s becomes imaginary. Considered mechanically only, say by $\mathrm{F} = m\dot{u}$, the motion of m is quite determinate when $u = \frac{1}{2}v$, up to v, in fact. But electromagnetically it means that the energy in the reflected wave is negative. Now although there is nothing to object to quantitatively in a continuous transition from a Maxwellian stress consisting of a tension along an axis combined with equal lateral pressure, to its negative, a pressure along the axis with equal lateral tension, still the negativity of the energy in the reflected wave causes difficulty. The stress for both the electric and magnetic energy becomes of the gravitational type. That is, like imaginary electrifications attract, and unlike repel, or matter is imaginary electrification in this comparison. The moving forces and energies are real. But let a real charge and an unreal one co-exist, the energy density becomes imaginary. That is out of all reason in a real universe.

We should, I think, regard (2) as a demonstration that (1) is untrue, in that $(p_1+p_2)u$ is not the activity of the force on the mirror, although p_1+p_2 may be actually the pressure of the radiation. In fact, in the electromagnetic case, the variation of p constitutes a force on the ether itself. We must find the force on the mirror in another way. Let radiation fall flush upon the plane surface of a dielectric, which call glass, moving the same way at constant speed u, and let the circuital equations in the glass be

$$d\mathrm{H}/dx = c\dot{\mathrm{E}} + \partial\mathrm{I}/\partial t, \quad -d\mathrm{E}/dx = \dot{\mathrm{B}} = \mu\dot{\mathrm{H}}; \tag{3}$$

that is, the same as for the ether, with the addition of the electric current of polarisation $\partial\mathrm{I}/\partial t$. The reference space is the fixed ether, and $\partial/\partial t$ is the moving time differentiator. Now if the relation between I and E is such as to permit of an undistorted plane wave, we shall have

$$\underset{\text{(incident)}}{\mathrm{E}_1 = \mu v\mathrm{H}_1}, \quad \underset{\text{(reflected)}}{\mathrm{E}_2 = -\mu v\mathrm{H}_2}, \quad \underset{\text{(transmitted)}}{\mathrm{E}_3 = \mu w\mathrm{H}_3}, \tag{4}$$

if v is the speed in the ether, and w the wave speed referred to the ether in the glass. This w is a function of u. Also, the boundary conditions,

$$\mathrm{E}_1 + \mathrm{E}_2 = \mathrm{E}_3, \quad \mathrm{H}_1 + \mathrm{H}_2 = \mathrm{H}_3, \tag{5}$$

combined with (4), give

$$\mathrm{H}_2/\mathrm{H}_1 = (v-w)/(v+w), \quad \mathrm{H}_3/\mathrm{H}_1 = 2v/(v+w). \tag{6}$$

An incident pulse of unit depth is stretched to depth $(1-u/v)^{-1}$ in the act of reflection; the reflected pulse is of depth $(v+u)(v-u)^{-1}$, and the transmitted pulse of depth $(w-u)(v-u)^{-1}$.

The rate of loss of energy from the waves in the process of reflection is

$$p_1(v-u) - p_2(v+u) - p_3(w-u), \tag{7}$$

where the p's are the energy densities. But, by the above,

$$p_1 v = p_2 v + p_3 w; \tag{8}$$

therefore the rate of loss of energy is

$$(p_3 - p_1 - p_2)u, \tag{9}$$

and the moving force on the mirror is

$$\mathrm{F} = p_3 - p_1 - p_2. \tag{10}$$

This is, in its expression, exactly the *negative* of the previous pressure difference. It is in the direction of the rise of energy density. Its amount is

$$\mathrm{F} = 2\mu\mathrm{H}_1\mathrm{H}_2 = 2p_1(v-w)/(v+w) = \tfrac{1}{2}\mu\mathrm{H}_3^2 - \tfrac{1}{2}c\mathrm{E}_3^2 = \mathrm{U}_0. \tag{11}$$

The first form in terms of $\mathrm{H}_1, \mathrm{H}_2$ is useful. The second is in terms of the wave speeds. The third is in terms of the ethereal energy inside the glass. All these come out of the ratios $\mathrm{H}_2/\mathrm{H}_1$, &c. Now the electric energy equals the magnetic energy in the transmitted wave. Consequently U_0 means the energy of the polarisation I. And the activity is $\mathrm{U}_0 u$, the convective flux of energy.

These properties are true for various relations between I and E. The first approximation is $f = c_1 E$. The second, introduced by Lorentz, is $f = c_1(E - uB)$, that is, the polarisation is proportional to the moving force on a moving ion. Other forms allowing of undistorted pulse propagation may be proposed. All give special relations between w and u. In Lorentz's case,

$$U_0 = \tfrac{1}{2} c_1 E_3^2 (1 - u/w)^2. \quad (12)$$

To pass to perfect reflection, reduce w to u, its least value. U_0 does not vanish, but has the value given by (10), (11) still, with $w = u$. But the transmitted wave is reduced to a surface film, moving with the glass. The moving force on the glass is now

$$F = 2p_1 (w - u)/(v + u), \quad (13)$$

and finally, if $u = 0$, $F = 2p_1$.

Here we come right back to the pressure of radiation. It does measure the force on the glass when at rest, when it reflects perfectly, and it looks as if (13) were merely the form $p_1 + p_2$ a little modified by the motion. But appearances are very deceitful here, for (10) above is the proper formula.

As regards the distribution of F. With an actual transmitted wave consisting of a pulse of uniform intensity all through, F is entirely at the wave front. So, with total reflection, it is just under the surface of the glass. Again, if E_3 varies continuously in the transmitted wave, F is distributed continuously, to the amount $B(\partial f/\partial t)$ per unit volume. What F means in (11) now is the total of this volume force, *i.e.* the integral from the surface up to the wave front, expressed in terms of the momentary surface state.

After a pulse has left the surface there is an equal opposite force at its back, so there is no further loss of energy or moving force on the glass. The obscurities and apparent contradictions arise from the assumption that the ether is quite motionless. If we treat the matter more comprehensively, and seek the forces in a moving ether, with moving polarisable matter in it as well, if this is a complication one way it is a simplification in another, viz. in the ideas concerned. There is harmony produced with the stress theory. To illustrate, $(\partial/\partial t)V\mathbf{DB}$ is the moving force per unit volume when the ether and polarised matter have a common motion, $\mathbf{D}$ and $\mathbf{B}$ being the complete displacement and induction. (The variation of $\mathbf{u}$ is ignored here.) But if we stop the ether, a part of this force becomes inactive. If the matter is unmagnetisable, the only active part is that containing the polarisation current, for that is carried along.

Besides this electromagnetic force, there is also a force due to a pressure of amount U_0. But it does not alter the reckoning of the moving force on the glass, because the pressure acts equally and oppositely at the front and back of a pulse.

Some other illustrations of the curious action between electromagnetic radiation and matter can be given. For example, two oppositely moving plane pulses inside moving glass. Say $E_1 = \mu w_1 H_1$ one way with the glass, and $E_2 = -\mu w_2 H_2$ against the glass. If $H_1 = -H_2$, work is done upon the glass when they cross, ceasing the moment they coincide, so that the energy of the momentary electric field is less than the wave-energy. On separating, the loss is restored. If, on the other hand, $E_1 = -E_2$, work is done by the glass on the waves when uniting, so that the momentary magnetic energy, together with the polarisation energy, is greater than the wave energy. In this second case, too, it is noteworthy that the solitary waves are of unequal energy, whereas they are equal in the first case. But details must be omitted, as this communication is perhaps already too long.

Oliver Heaviside.

February 21.

Secondary Röntgen Radiation.

In a paper read before the Royal Society on February 16, I described experiments demonstrating the partial polarisation of Röntgen radiation proceeding from an X-ray bulb, and at the same time verifying the theory previously given of the emission of secondary X-rays from gases and light solids subject to Röntgen radiation.

Later experiments have shown that beams of X-radiation may be produced exhibiting a greater amount of polarisation than there was evidence of in the original experiments. This discovery has proved useful in the investigation of secondary radiation proceeding from solids.

It has been found that while the intensity of secondary radiation from light substances varies considerably in different directions owing to the partial polarisation of the primary radiation, the amount of this variation diminishes with an increase in the atomic weight of the radiator, and ultimately is inappreciable. The radiations from air, carbon, paper, aluminium, and sulphur vary in intensity in different directions by a considerable amount. From calcium the variation is much less, while from iron, copper, zinc, and lead it is inappreciable. This must be connected with the fact that the radiation from light substances differs in character only very slightly from the primary, while the heavier substances emit radiations differing more from the primary producing them. The radiation from the heavier metals was found not to consist of an easily absorbed radiation superposed on a radiation such as proceeds from light substances, and of intensity given by the law found for that from light substances, but is as a completely transformed radiation. This is strong evidence that the freedom of motion of the electrons which permits what may be called a simple scattering in substances of lower atomic weight is interfered with in the heavier atoms, for we find from them a more absorbable radiation *in place of, not simply superposed on,* a more purely scattered radiation.

With this change in character, the polarisation effect disappears. No special absorption of the radiation proceeding from a substance by plates of the same substance has been observed.

A considerable variation in the penetrating power of the primary radiation incident on heavy substances is accompanied by a smaller change in that of the secondary (measured by change of absorbability).

Radiation from compounds appears to be merely a mixture of the radiations which proceed from the separate elements in the compound, both the absorbability and polarisation effects being what would be given by such mixtures. Atomic weight, not molecular weight or density, thus seems to govern the character of the radiation produced by a given primary.

These results may be accounted for by considering the electrons constituting the atoms as the radiators. In light atoms the electrons are far enough apart, and have sufficient freedom to move almost entirely independently of one another, under the influence of the primary pulses, consequently to emit a secondary radiation similar to the primary, but the intensity of which depends on the direction of propagation with regard to that of electric displacement in the primary beam. In heavier atoms considerable inter-electronic forces are probably brought into play by small displacements, and the resultant acceleration of motion of an electron is then not in the direction of electric displacement of the primary beam, and evidence of polarisation of that beam vanishes. Also there ceases to be a simple connection between the time for which the electron is accelerated and that of passage of the primary pulse.

In atoms of greater weight we would expect appreciable inter-electronic forces to be called into play sooner, and to attain a much greater intensity than in lighter atoms.

The precise connection between the atomic weight of the radiator and the absorbability of the radiation is being investigated.

Charles G. Barkla.

University of Liverpool, March 1.

Dates of Publication of Scientific Books.

I have just bought a copy of "A Treatise on Slate and Slate Quarrying, Scientific, Practical, and Commercial," by D. C. Davies, F.G.S., fourth edition, dated 1899 (Crosby Lockwood and Son).

To my astonishment, I find no statistics of later date in it than 1876, *e.g.* p. 33, statistics of 1872 and 1873, p. 58, list of quarries in 1873, p. 59, production in 1876, p. 64, production last year (1876), p. 170, prices of slates in London last year (1876).

As the Home Office publishes annually a general report and statistics of mines and quarries, and also a list of mines and quarries, there is no excuse for the book being so out of date in its statistics.

B. Hobson.

The Owens College, Manchester, February 21.

SOME SCIENTIFIC CENTRES.

VII.—The Physiological Research Laboratory of the University of London.

THE seat of the University of London was transferred to the Imperial Institute in 1900, and in the same year the University received a new constitution, and commenced its career as a teaching university. In May, 1902, a laboratory devoted to research physiology was housed within the same Imperial building, and the secretariat of the University of London was for the first time brought into contact with one of the sources of knowledge, which it had been newly arranged not only to control but also to foster.

The laboratory occupies the upper floor of the eastern wing of the Imperial Institute, and has already been described in the pages of this Journal (Nature, vol. lxvii., pp. 441, 442). It covers a space of about 3000 square feet.

There are special rooms for experimental psychology, experimental physiology, electrical and chemical work, a lecture theatre fitted up for the delivery of the special courses of lectures in advanced physiology, and a departmental library. The work carried on has been of the double character indicated in the scheme originally adopted by the University Senate. In the first place courses of lectures have been given by a large number of the physiologists who form the professorial staff of the University in this subject. It should not be forgotten that this cooperation has been obtained without an offer of the most trifling award. The professorial staff, by this free gift of its labour, has once more shown its loyalty to interests which are really wider than the interests of any local scheme, but which, nevertheless, are well expressed as the interests of the University of London.

All these lectures, as was originally intended, have been of a peculiarly living type—lectures delivered upon subjects on which each lecturer was actually engaged in research at the time. After submission to referees, they are published for the University by Messrs. Murray; a volume entitled "Signs of Life," by Dr. Waller, and another on the "Biochemistry of Muscle and Nerve," by Prof. Halliburton, have already appeared, and a volume on the Blood, by Dr. Buckmaster, is in the press.

In the second place, room and facilities are afforded to workers in the prosecution of research whether for their doctoral theses or for other purposes. The researches carried on since May, 1902, have resulted in thirty published papers; among them, and specially noteworthy as regards their immediate practical bearing, are the contributions of Captain Leonard Rogers, I.M.S., to our knowledge of the physiological action of the poison of the Hydrophidæ and the physiological action and antidotes of colubrine and viperine snake poisons; of Waller and Plimmer on the physiological action of a ptomaine extracted from commercial beet sugar; and of Waller on the quantitative estimation and graduated administration of chloroform. In physiological psychology, work is continuously carried on by Miss Edgell, who has published a paper on time judgment, and whose work on memory and grasp of the meaning of words is opening out a most important subject.

The output of work from most laboratories bears the stamp of the Director, for in his hands mainly lies the attraction of workers, and their useful employment in the earlier stages of their career. It is his constant patient interest in the problems under investigation in the laboratory which largely determines their direction, and serves to weld them into a solid phalanx of advancing facts. An examination of the list of papers shows the presence of such an influence here, an influence which has already started several workers upon paths of independent inquiry. Acknowledgments of this fact may, for instance, be found in the papers of Drs. Alcock, Collingwood, Legge Symes, Wells, from all of whom valuable contributions have come. Dr. Alcock has carried out several excellent researches upon the electrical response of mammalian medullated and non-medullated nerve. Boldly selecting material offering, as it was thought, almost insuperable difficulties, he has been able to make many observations of value, and in doing so has also extended

Fig. 1.—Dr. Augustus D. Waller, F.R.S., Director of the Laboratory.

the general field of inquiry. Dr. Collingwood has designed an apparatus for the exact dosage of chloroform, and elaborated a method for the estimation of percentage of chloroform vapour in expired air. Mr. Legge Symes has published work on the respiratory quotient, estimation of chlorides in blood, and is carrying on work on the physiological action of chloroform and betaine. Mrs. Waller has continued the work upon the distribution and meaning of "blaze currents."

That the many-sided industries of this laboratory are by no means completely stated in the last paragraph is at once seen from the fact that its walls have also looked out upon the work of several investigators who have obviously been attracted by its conveniences and equipment alone. It is sufficient to mention the names of Drs. Brodie, Buckmaster, Goodall, Locke, Macdonald, Mummery, Seemann. Dr. Pavy is engaged in work on the metabolism of the carbohydrates, and will give a course of three lectures in the summer on the results of his investigations. Dr. George Oliver is now working in the laboratory on the effects of various organic products on the blood-pressure of animals and man, and on the improvement of blood-pressure apparatus for physiological and clinical observation on man. He will shortly also be engaged with Dr. Samuel Rideal in investigating the influence of various gases on the blood-pressure in man. Some of this work has already found expression in this term's course of lectures by Sir Lauder Brunton. Mr. G. P. Mudge is engaged in work which will bear on the theory of transmission of acquired characters. The laboratory is, in fact, not only a consistent school making its influence rapidly felt in work of a particular character, but also a laboratory offering highly appreciated advantages to independent workers.

The laboratory owes no small share of the fact of its existence and present energetic life to the director, Dr. Augustus Waller. His prescience and alertness, and the confidence felt by the authorities and by his colleagues and friends in a scheme which had obviously enchained the full measure of his personal interest, must in this connection remain accountable for many things. The value of his services is best assessed after a consideration of the indefatigable years which he has spent in fruitful furtherance of the science of physiology. His first paper, a contribution to the study of cardiac and vascular innervation, was published from Ludwig's laboratory in 1878. His remaining contributions, many and all well known, have been published as a consequence of work carried out within London itself; and with the scientific life of this city Dr. Waller has been identified since 1879. "The graphic record of the propagation rate of the pulse wave," "The recurrent pulse," "Measurements of the length of systole and diastole with different pulse frequencies," are titles of some of these earlier papers, reminding us of our indebtedness to Dr. Waller for valuable contributions to our knowledge of the circulation. In 1881 he secured the thanks of all workers upon the phenomena of the central nervous system by his contributions to the study of tendon-reflex. In 1881 he devised and first made use of the method, now generally adopted, for the photographic record of electrical currents. His work upon electrotonic currents in the nerves of the human body, carried out with the assistance of Dr. De Watteville, 1882, forms one of the foundation-stones of the art of electro-therapeutics. This and his subsequent record of the electrical changes accompanying the beat of the human heart, 1887, serve to render the first decade of Dr. Waller's experimental work ever memorable in the annals of "Animal Electricity," and were made the basis of two ceremonies of mutual honour. Dr. Waller was invited to Berlin by Du Bois-Reymond to demonstrate the electrical changes due to the heart-beat, and the Academy of Science at Bologna—the birthplace of animal electricity—presented him with the award of the Premio Aldini sul Galvanismo. The Academy of Science of Paris also showed its recognition of the interest of these observations by its award of the Prix Montyon.

In 1885, Dr. Waller laid a basis for the study of "fatigue," by recording his discovery of the site of peripheral fatigue. He again facilitated the study of this phenomenon by the invention and use of the "dynamograph," and contributed important papers upon the "Sense of Effort." In these papers Dr. Waller dealt with matters on the border-line between physiology and psychology, and here also is placed other work of his of admitted importance upon colour contrast, hearing, weight discrimination, the functional attributes of the cerebral cortex. In 1891, Dr. Waller published his "Text-book of Human Physiology." This book marked an era in the methods of physiology classes throughout the country, and served as a standard for the increased extent of scientific training rendered possible by the changes then taking place in physiological staffs and laboratories. In writing this book Dr. Waller rendered an important service not only to physiology but also to medical education.

In 1895 began a series of researches based on the Weber-Fechner law, the electrical response of the retina to the stimulus of light, the mechanical response of muscle to electrical stimulation, the electrical response of medullated nerve to electrical stimulation, leading to the general conclusion that where we can plot physical cause along an abscissa, and physiological effect along ordinates, an S-shaped curve is the result.

The foregoing experiments involved an examination of the electrical response of nerve under the influence of anæsthetics, and led to the systematic employment of nerve to gauge the activity of a large number of reagents, a method having been devised for exciting the nerve at regular intervals and recording its negative variation by photography.

Three mainly important conclusions resulted from this method of work—that CO_2 is evolved in nerve during tetanisation, that the inexhaustibility of nerve and retina is due to an extremely rapid disintegration and reintegration in their tissues, that the effect of anæsthetics on nerve may be taken as a measure of their effect on the human subject, and the method may therefore be employed for studying the limits of safety of chloroform dosage. The important fact was educed that safe anæsthesia requires the continuous administration of a mixture of chloroform and air at an average percentage of 1·5—not below 1 per 100 and not above 2 per 100. Many of the facts of physiological interest made known by these researches are to be found in a course of lectures delivered by Dr. Waller at the Royal Institution, and published in 1897 under the title of "Animal Electricity." Short, and freed from technicalities as it is, this book is unique and permanent, and, as a classic, needs no commendation. The "Characteristic of Nerve," "Veratrine and Protoveratrine," are titles of other papers of physical and physiological interest.

From a study of the electrical response of the eyeball (retina) to the admission and exclusion of light Dr. Waller passed to a consideration of its response to electrical stimulation. This very marked and vigorous response he named the retinal blaze, and this led to a general study of the "blaze-currents" of the eyeball and of other living plant and animal tissues; the importance of this phenomenon as an exact and critical measure of the processes occurring in living tissues can scarcely be overestimated. As a sign of life, its observation (*e.g.* for vitality of seeds) may be of practical advantage.

Within recent years Dr. Waller's energies have also been largely directed towards the problems connected with chloroform anæsthesia, and the apparatus designed and inspired by him promises to lead not only to a further knowledge of the subject, but also to check the lamentable waste of human life so often caused by faulty and inaccurate methods of chloroform administration.

The little that has been said may serve to show that in this Institution and its officers the University has already much upon which it may be congratulated. It is surprising to examine the financial basis upon which this scheme has already been carried to such a pitch of usefulness. When the scheme was first mooted, in March, 1901, no funds were available for its support. The only asset was the promise made by the foremost physiologists in London to deliver courses of lectures, without emolument, upon the branches of physiology with which they were most conversant. The Senate favoured the scheme, and Sir Walter Palmer, by a timely gift of 2000*l.*, rendered available the space which the Senate had assigned for the laboratory. The University supported the scheme with a grant of 500*l.*, and has since provided an annual grant of 400*l.* for five years, conditional upon the acquisition of 600*l.* per annum from other sources. Upon this annual subsidy of 1000*l.*, it is estimated that the present activity of the laboratory can be sustained. So far the support obtained from outside sources, the 3000*l.* required for the five years, 1904–1909, is represented by 2000*l.* subscribed by Mr. G. W. Palmer and Mr. A. Palmer. The sum asked for has therefore not yet been collected; when collected, it should be noted, it will not serve to maintain the laboratory upon a scale commensurate with its activity and promise. Thus the estimated expenditure of 1000*l.* per annum includes no provision for the honoraria of lecturers, or for additional assistants, or for research scholarships. The sum of 50,000*l.*, it is estimated, would suffice for the accomplishment of this greater object.

THE MONTE ROSA AND COL D'OLEN INTERNATIONAL LABORATORIES.

SOME time ago (Nature, April 17, 1902, vol. lxv. p. 568) I directed the attention of the readers of Nature to the international laboratory, the Capanna Regina Margherita, which had been established on the Gnifetti peak of Monte Rosa by Prof. Mosso, of Turin, through the generous aid of the Regina Madre of Italy. Already much valuable work has been done in that laboratory, and if this has been chiefly of a physiological kind, though provision is made in the laboratory for physical and meteorological as well as other investigations, the reason is to be sought partly in the fact that Prof. Mosso is a physiologist, partly in the special interest attaching to the physiological problems presented by living beings at high altitudes.

In August and September, 1903, two physiological expeditions were carried out at the Capanna Regina Margherita, one under the direction of Prof. Zuntz, of Berlin, the other by Prof. Mosso, several observers taking part in each. The records of some of (not of all) the results obtained in these two expeditions are now brought together by Prof. Mosso in a volume [1] of some 300 pages, elegantly bound in such a way as to be easily itself carried to high altitudes, and appropriately dedicated to that Mæcenas of science M. Ernest Solvay, who has so freely given back to science of the good things which science has given to him.

I do not propose, in this notice, to deal in detail with the twenty-one memoirs which make up the volume. One, that by Durig and Zuntz, is given in German; all the others, though written by Italian observers, with that generous abnegation of their own tongue which it is to be hoped will not be considered necessary for them in the coming years, appear in French. I may here perhaps be allowed to express my regret that no memoir by any English observer, either in his own or any other language, is to be found among them. All of them treat, more or less directly, with one or other of the many problems of metabolism which are presented by life at such a high altitude as 4560 metres. At that height the responses which internal chemical, metabolic, processes and the expenditure of energy make to changes in the environment are so different from those which take place at lower levels as to raise great hopes that persistent researches in such Alpine laboratories may carry us far towards solving the intricate problems of the relation of chemical and physical changes of living substance to the energies of life. It may be added that such researches may be expected to explain, and so to afford practical guidance as to, the beneficial sanitary effects of life at high altitudes on many diseases.

Most of the memoirs, as might be expected, record studies on the respiratory exchange and on the condition of the blood at the high altitude as compared with what is found at an ordinary low level; and in some of them the effects of artificially lowering barometric pressure at Turin are compared with the effects of the natural low pressure on Monte Rosa, accompanied as the latter is with other conditions. All these are of great interest to the physiologist, and to him chiefly; but one memoir may perhaps attract the attention of the general reader, and that is the one by Mosso and Galeotti on the physiological effects of alcohol at high altitudes. These observers found that a dose of alcohol, 40 c.c. of absolute alcohol adequately diluted, which at Turin brought about a condition bordering on drunkenness produced, on Monte Rosa, so far as subjective sensations were concerned, hardly any effect at all. I may add that the present volume does not record all the observations made in the expeditions of 1903, a second volume being about to appear shortly. Nor are physiological researches the only ones which have been carried out; important meteorological and physical inquiries have also been conducted.

In spite of every effort to make the accommodation at the Gnifetti laboratory as complete as possible in the circumstances, those circumstances offer many obstacles to continued successful observations. The period during which study is possible is short, and the hardships of living and working at such a high altitude are such as cannot easily be borne by many persons otherwise capable of carrying out fruitful investigations. Hence Prof. Mosso conceived the idea of establishing in connection with the Gnifetti laboratory a supplementary laboratory at a lower but still high level, where work could be carried on in connection with the higher laboratory, but under easier conditions, and for a longer period of the year.

Visitors to the southern slopes of the Monte Rosa group probably know well the little wooden inn at the Col d'Olen at the height of about 3000 metres, reached by a long but easy walk or mule ride from Alagna, and most admirably kept by the well known enterprising hotel proprietors Guglielmina. From it one may, when the air is clear, see afar off the Duomo of Milan, while at one's feet alongside the path to Gressonay lies an Alpine garden which Kew may envy, brilliant in late summer with sheets of gentian and other lovely flowers. Close by the inn, Prof. Mosso has secured a plot of ground on which he is building the new laboratory; this he hopes to have finished next autumn, but it will not be ready for actual use until the summer of 1906.

It is to be a laboratory fully equipped for researches in physiology, meteorology, physics, and botany; but in addition to this it will have sixteen comfortable bedrooms, so that sixteen workers carrying on investigations will have each a bedroom to himself; and if the number of observers should happen at any time to exceed sixteen, accommodation can be obtained at the inn close by. At such altitudes success in investigation is largely dependent on personal comfort, including suitable food; and probably there are not a

[1] Laboratoire Scientifique International du Monte Rosa. Travaux de l'année 1903. Publiés par A. Mosso. (Turin: Loescher, 1904.)

few to whom research at the high Gnifetti laboratory would be impossible, but who could do solid work at a somewhat lower level provided that the life was not too rough, and especially if they had no fear of being hampered by indigestion caused by too rude or monotonous a diet. For these especially is the Col d'Olen Laboratory intended; and unless things have altered sadly in the last few years, such need have no fear for their stomachs. I still have a vivid recollection of a stay at the inn at Col d'Olen during which the efforts of a talented cook produced results which would have satisfied tastes of a far higher epicurean level than my own.

The new laboratory, like the old, is to be carried out as an international institution. It received warm support from the International Physiological Congress at Turin in 1901, and again at Brussels this year. After the plan of the Stazione Zoologica at Naples, its maintenance is to be provided by subsidies which will give the right to occupy working places. Already the Italian Ministry of Instruction has secured accommodation for two investigators, the Italian Alpine Club for one, and the German Government for two. M. Solvay, who has otherwise been a lavish benefactor to the whole enterprise, has taken two places for Belgium, and, through the generosity of Dr. Ludwig Mond, our own Royal Society has the right of nominating two investigators. The undertaking, therefore, is well on the way to success; but much remains yet to be done. Prof. Mosso informs me that though he has obtained 70,000 lire, he still needs some 50,000 lire in order that everything should be on a safe basis, and especially that an annual income should be provided sufficient to ensure at the laboratory adequate service and assistance, which, as might be expected from the circumstances, have to be well paid. The existence of such a laboratory offers unusual opportunities for investigation, not only to those who are interested in the general problems of physiology, of meteorology, and of the physics of the earth, but also to the perhaps larger class who desire a wider and more exact knowledge of the manifold fascinating phenomena of the High Alps. Is it too much to hope that Prof. Mosso will find no great difficulty in obtaining the further funds which he needs?

M. FOSTER.

NEOLITHIC DEPOSITS IN THE NORTH-EAST OF IRELAND.

THE recent changes of level in the north-east of Ireland attracted a considerable amount of public interest during the year 1903, in consequence of the lawsuit, known as the "Gold Ornaments Case" (Attorney-General *v.* the Trustees of the British Museum). A golden boat, collar, and other objects were found in ploughing at Broighter, on the extensive flat that stretches around Limavady Junction in county Londonderry. They were buried eighteen inches deep in stiff clay soil, at a spot which is four feet above ordinary high-water mark. The British Museum authorities rested their claim to the retention of the objects in part on the theory that the ornaments in question constituted a votive offering, which was

FIG. 1.—Wind excavated Pit in Portstewart Sand-dunes, showing "black-layers." From *Proceedings* of the Royal Irish Academy, December, 1904.

deposited in Lough Foyle about the beginning of the Christian era, the spot where the objects were sunk having since become dry land, owing to upheaval of the coast-line. The claim of the British Museum was, however, not sustained.

In connection with this contention, Messrs. George Coffey and R. Lloyd Praeger made special investigations into the evidence of recent geological changes, and these they have brought forward in an essay on "The Larne Raised Beach: a Contribution to the Neolithic History of the North of Ireland" (*Proc.* R. Irish Acad., vol. xxv., December, 1904). To this essay we are indebted for the preceding statement. After dealing generally with the phenomena indicative of changes of level in Glacial and post-Glacial times, the authors treat particularly of the post-Glacial history, which began with a long period of emergence, and a land-level at least 30 feet higher than at present. The evidence obtained near Larne and Belfast tells of subsequent submergence, re-elevation (the amount of which increased northward), and of a final slight movement of submergence in recent times that has left the surface as we now find it. The raised beach of the Curran at Larne was accumulated over estuarine muds during the period of submergence, and it is of peculiar interest owing to the occurrence in it from top to base of worked flints of Neolithic type. A detailed account, with figures of the flints, is given. The evidence is taken to indicate that man was on the ground during the submergence that allowed of the continued laying down of 20 feet of gravels in shallow water or between tides. Moreover, the abundance of flint flakes in the surface-layers renders it probable that Neolithic man persisted after that movement of elevation had set in which made the top of the gravels a land-surface. Attention is directed to further evidence at Whitepark Bay, east of the Giant's Causeway, and again in the neighbourhood of Portstewart, which lies only 13 miles E.N.E. of Broighter. At Whitepark Bay, Neolithic "black layers" or land-surfaces occur at various levels among the sand-dunes, while near Portstewart old surfaces with Neolithic remains are found in deep wind-excavated hollows in the dunes. (see Fig. 1). This evidence proves conclusively that the ground on which the gold ornaments were found has been a land-surface, with an elevation at least as great as at present, since Neolithic times, the whole of the movement of elevation, which formed the post-Glacial raised beach of the north-east of Ireland, having been accomplished during Neolithic times.

NOTES.

THE president of the Royal Society, and Lord Rayleigh, chairman of the general board of the National Physical Laboratory, have issued invitations to a visitation of the laboratory on Friday, March 17, when the various departments will be on view and apparatus will be exhibited.

THE thirteenth "James Forrest" lecture of the Institution of Civil Engineers will be delivered by Colonel R. E. B. Crompton on Monday, April 10, upon the subject of "Unsolved Problems in Electrical Engineering."

PROF. W. J. SOLLAS, F.R.S., has been elected a member of the Athenæum Club under the rule which empowers the annual election by the committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

MR. J. E. S. MOORE has been appointed director of the Cancer Research, which is carried out in connection with the Royal Infirmary.

IT is stated that the Madras Government has sanctioned the establishment of an experimental garden in Malabar for the investigation of pepper vine disease.

THE second annual dinner of old students of the Royal College of Science, Ireland, will be held on St. Patrick's Day, Friday, March 17, at the Holborn Restaurant, London.

PROF. K. MÖBIUS has retired from the directorship of the Berlin Museum of Natural History. The position has been offered to Prof. H. H. Schauinsland, director of the museum at Bremen.

SIR WILLIAM BROADBENT will preside at a medical conference on the teaching of hygiene and temperance, to be held at the Examination Hall, Victoria Embankment, on Friday, March 24.

THE *British Medical Journal* states that Prof. E. A. Minchin, F.R.S., has undertaken to conduct—on the spot—further investigations, under the auspices of the Royal Society's Committee, into the causation of sleeping sickness in the Uganda Protectorate.

THE fifteenth German Geographentag will be held at Danzig on June 13–15. The chief subjects of papers and discussions will be south polar exploration, vulcanology, coast morphology and formation of dunes, and school geography.

AFTER a pause of many years France has again entered the list of gold-producing countries. In December, 1904, the first gold mill in France was started at the La Lucette antimony mine, near Laval. A 10-stamp mill is running steadily, the daily production amounting to about 1 kilogram of gold in the form of a rich concentrate.

WE learn from the *Chemist and Druggist* that two prizes, one of 5000 francs (200*l*.) and the other of 3000 francs (120*l*.), have been offered by Dr. Henri de Rothschild to the Scientific Society of Alimentary Hygiene, Paris, for the best treatises written in French on the rational food for man. The prizes will be awarded in 1906, and the papers must be sent in by December 31, 1905.

THE experiments with wireless telegraphy between Diamond Island and the Andamans are, says the *Pioneer Mail*, giving most satisfactory results. A recent message transmitted from Port Blair reached Calcutta in nineteen minutes, though it had to come over the land-lines after being received at Diamond Island.

THE Paris correspondent of the *Times* reports that a telegram has been received from M. Jean Charcot, the explorer in command of the French Antarctic expedition, dated Puerto Madryn, March 4. It is stated that scientific work was carried on under good conditions while wintering on Wandel Island. Several parts of Graham Land hitherto unknown have been explored, and by following the coast continuously its outline has been determined.

THE *Times* states that the French Ministry of Public Works has commissioned M. Jacquier to project plans for a railway between Chamonix and Aosta. It is considered that the difficulty would not be so great as with the Simplon tunnel; the tunnel would be $4\frac{1}{2}$ miles shorter, and the rock gives no indication of subterranean reservoirs of water. The tunnel would commence at Chamonix, 3415 feet above sea level, and end at Entrèves (4550 feet), a distance of $8\frac{1}{2}$ miles. The Dora Baltea would give ample water power for the boring work, and afterwards for locomotion.

The preliminary programme has been issued for the International Congress of Botany to be held at Vienna in Whitsun week, June 11–18. The formal opening of the congress will take place on Monday, June 12, in the large hall of the University of Vienna. A conference on the nomenclature question will be opened on the same day, and will be continued on other days. The chief subject of papers on June 13 will be the development of the European flora since the Tertiary period. On June 14 a general meeting of the botanical societies assembled for the conference will be held, as well as a conference of agricultural botanists. The subjects of discussion for the scientific meetings on June 14 will be (1) the present condition of the theory of the assimilation of carbonic acid, and (2) regeneration. Among the papers to be read on Friday, June 16, may be mentioned one by Dr. D. H. Scott, F.R.S., on the fern-like seed-plants of the Carboniferous flora. The organising committee has arranged for excursions before, during, and after the congress, and these will afford visitors an opportunity of learning to know botanically interesting regions under the guidance of specialists. In connection with the conference, too, an international botanical exhibition has been arranged, and will take place in the orangery of the Imperial Chateau at Schönbrunn. Full particulars of the conference can be obtained by intending visitors on application to the general secretary, Dr. A. Zahlbruckner, I., Burgring, Vienna.

A short time ago we chronicled the death of Prof. Emilio Villari, of Naples. Some interesting biographical details relating to this well-known physicist have now been published by Prof. A. Ròiti in the *Memorie* of the Italian Spectroscopists' Society (Catania, December, 1904) and the *Atti* of the Lincei Academy, xiv. (i), 1. As in the case of the late Prof. G. F. Fitzgerald, there can be no doubt that Villari's death was largely due to overwork, a result in both instances brought about by the great amount of teaching work which these physicists were required to undertake in their professorial duties, and which, when combined with research work, left them no time for rest. From his birth, in 1836, Villari suffered from epilepsy, and, partly in consequence of this, his early education was obtained at private schools. He graduated in medicine at Pisa. In 1860 he taught in the medical school of Naples; the next year he returned to Pisa as professor of physics and chemistry; in 1864 he studied in the laboratory of Magnus at Berlin. From 1865 to 1871 he occupied chairs at Florence; he was then, by competition, appointed to the chair at Bologna, which he held until 1889, when he went to Naples. His duties at the latter place involved the conducting of three separate University courses of lectures, and it is not surprising that in the session 1902–3 he broke down under the stress of work, and after a long and painful illness died on August 20 of last year. In the forty years from 1865 to 1904, Villari produced a long series of papers, which might advantageously be collected and published in a volume. His most recent work refers to the properties of air and gases which have been rendered radio-active by Röntgen rays, and to which he gave the name "aria ixata," or, literally, "X'd air." He was an honorary member of our Royal Institution and the Physical Society of London, and for some time previous to his death was president of the Lincei Academy.

The usual prize announcements of the Royal Lombardy Institution are given in the *Rendiconti*, xxxviii., 1. The triennial gold medal for industry is awarded to Messrs. Vermot and Rejna for carriage springs and axles. The Cagnola prizes for velocity of kathode rays, steering of balloons and prevention of forgery, as well as several other prizes, remain unawarded, while for cure of pellagra a premium is awarded to Dr. Carlo Ceni, of Reggio (Emilia), and for miasma and contagion the full prize and a gold medal are conferred on Dr. Adelchi Negri, of Pavia. As usual, there is keen competition for the Brambilla industrial prize, and the institution has awarded three first prizes with gold medals and four second prizes with gold medals to Lombardy manufacturers. Under the Fossati foundation an award is made to Dr. Giuseppe Pagano for a thesis on cerebral localisation. The Kramer prize for an essay on electric traction is awarded to Giovanni Giorgi, engineer, of Rome, and three awards under the Ciani prize are given for books on modern Italy.

The following list of prize subjects now issued by the Lombardy Institution for 1905 and following years includes the announcements made last year. Institution prizes, for 1905, on the ophiolitic formations of the Apennines; for 1906, on modern psychiatry. Cagnola prizes, for 1905, on phenomena of catalysis; for 1906, on pathology of suprarenal capsules. Fossati prizes (open to Italian subjects), for 1905, on our present knowledge of neurology; for 1906, on visual centres of higher vertebrates; for 1907, on nuclei of cranial nerves; for 1908, on the central nervous system. Kramer prize, for 1905, on the resistance of cement structures. Secco Comneno prize for a discovery on the virus of rabies. In addition, the triennial medals, Cagnola, Brambilla, Pizzamiglio, Tommasoni, Zanetti, and Ciani prizes are offered under the usual conditions, which have been referred to in previous years in the columns of Nature.

In the West India Committee *Circular*, Mr. Kenrick Gibbons suggests that mosquitoes are largely destroyed in Barbadoes by swarms of small fish, locally known as "millions," which prey on the larvæ.

In the February number of the *Zoologist* Mr. E. Bergroth, of Tammerfors, Finland, gives a list of generic zoological names not included in the supplement to the "Index Zoologicus" compiled by Mr. C. O. Waterhouse and published in 1902. While the number of names in the latter is about 250, no less than about 300 are recorded by Mr. Bergroth, all dating before 1901.

Some months ago Schaudinn published some interesting observations on the development of trypanosome forms from Halteridium, a protozoan blood parasite of birds. Novy and MacNeal now criticise Schaudinn's work, and ascribe his results to a double infection with Trypanosoma and Halteridium, and not to the development of the former from the latter.

We have received the *Transactions* of the Epidemiological Society for the session 1903–4 (vol. xxiii.). It contains a paper by Prof. Simpson on the epidemiology of plague, in which he shows that the domestic animals and birds may contract plague by feeding on plague-infected offal, and important discussions on sleeping sickness, the etiology of scurvy, industrial anthrax, and enteric fever and cholera in Hamburg, together with an obituary notice of the late Sir John Simon.

Some interesting notes on the habits of Natterer's bat (*Myotis nattereri*) are contributed by Mr. T. A. Coward to the *Zoologist* for February. From these it appears that in certain habits this bat is to some extent intermediate between other members of the Vespertilionidæ and the horse-shoe bats (Rhinolophidæ). It has, for instance, the habit of turning in the air, characteristic of the latter. Again, whereas in the horseshoe-bats the short tail is carried bent over the back, while in most British Vespertilionidæ this appendage is usually carried beneath the body, in Natterer's bat, despite the fact of its being used as a pouch to contain the insect-food, it is borne extended in the line of the body.

To the complex subject of nuclear changes is devoted the greater portion of the February issue of the *Quarterly Journal of Microscopical Science*, Messrs. Farmer and Moore discussing the "maiotic" phase (reduction divisions) in animals and plants in the first article, while in the second Prof. Farmer and Miss Shove describe the structure and development of the somatic and heterotype chromosomes of Tradescantia. The term "maiotic" phase is a new one, proposed to cover the whole series of changes formerly known as heterotype and homotype; as being derived from μείωσις (reduction) its orthography should apparently be "miotic." Of the other two articles, one, by Messrs. Moore and Robinson, describes the behaviour of the nucleolus in the spermatogenesis of Periplaneta, while the other, by Mr. G. Wagner, is devoted to certain movements and reactions of Hydra.

From a letter which Mr. P. Olsson-Seffer has written to *Science*, we learn that a Danish botanist, Mr. M. P. Porsild, has sought the help of his Government in founding an Arctic laboratory, which it is proposed to establish near Godhavn (lat. 69° 15′ N.), on Disko Island, North Greenland. Such a laboratory would be the first institution of its kind for investigating Arctic problems, and would form a counterpart in the cold regions to the tropical stations at Buitenzorg and Ceylon. The power of plants to withstand intense cold, and their nutrition under the peculiar conditions of light, will probably be among the earliest researches.

Mr. J. H. Maiden has contributed to the *Proceedings* of the Linnean Society of New South Wales (August, 1904) an account of the plants collected by Mrs. David on Funafuti, one of the Ellice group of coral islands. The list agrees very closely with those of collections made on similar islands, notably Samoa, Fiji and Keeling Islands, and consists of fifty flowering plants representing thirty-three orders. The native names are very similar to the Samoan. Although the plants include various edible products, such as the almonds of *Terminalia Catappa*, the sword-bean, and fruits of Pandanus, the islanders subsist chiefly on taro and bananas.

The second part of Prof. E. C. Jeffery's treatise on the comparative anatomy and phylogeny of the Coniferales claims attention not only for the facts which he has observed in examining various genera of the Abietineæ, but more especially on account of the deductions which, evolved from the consideration of certain formulated canons of comparative anatomy, by their evident consistency go far to establish the validity of these canons. It is possible to trace in the Abietineæ a sequence from forms such as Tsuga and Cedrus, in which resin-canals are absent from the wood of all normal stem parts, through certain species of Abies, in which the resin-canals occur only in the wood of the reproductive axis, to Picea, Larix, and Pinus, where they are formed normally in the wood of the vegetative axis. Among the former, resin-canals are freely produced in the vegetative shoots as a result of injury. From these and other facts Prof. Jeffery concludes that the Abietineæ are a very ancient order, older than the Cupressineæ, and by the possession of a double leaf-trace are allied to the Cordaitales. The treatise forms the first number of vol. vi. of the *Memoirs* of the Boston Society of Natural History.

We have received the report of the Meteorological Commission of Cape Colony for the year 1903. A comparison of the number of ordinary stations shows a fair increase over that for 1902, except in the case of purely rainfall stations, where there is a decrease of 31. This is partly due to the fact that owing to severe drought many farmers have had to trek with the remains of their cattle to adjoining territories, leaving their homesteads entirely unoccupied. The report contains useful monthly and yearly average rainfall data, for districts, over Cape Colony for the ten-year period 1894–1903.

Prof. H. Hergesell, president of the International Aeronautical Committee, has favoured us with a summary of the monthly ascents made during the last six months of the year 1904 for the exploration of the upper air by means of manned and unmanned balloons and kites. The average number of ascents per month was eighteen, and some remarkable altitudes were attained by the unmanned balloons, seven of them exceeding 15,000 metres, and eighteen exceeding 10,000 metres, the extremes being 24,070 metres, at Strassburg, and 19,750 metres, at Pavlovsk, both in the month of September. Special mention may be made of some important kite ascents from the yacht of the Prince of Monaco last autumn, during which a height of 4510 metres was attained to the north-west of the Canary Islands, and 4360 metres south of the Azores. We hope shortly to refer to some valuable results obtained from the discussion of these observations in the region of the trade winds.

We have received a copy of the fifth edition of Jelinek's excellent "Instructions for taking Meteorological Observations," issued under the superintendence of Dr. J. M. Pernter, the present able director of the Austrian Meteorological Service. The first two editions (1869 and 1876) were written by Dr. Jelinek, the third and fourth (1884 and 1893) were revised by Dr. J. Hann, who is justly recognised as the foremost of living meteorologists. Not forgetting the excellent meteorological instructions issued in Russia by the late Dr. H. Wild, in France by M. Angot, and in Germany by Dr. van Bebber, nor the useful handbooks of smaller pretensions by Dr. Scott (late of the Meteorological Office) and Mr. Marriott (Royal Meteorological Society), we can have no hesitation in asserting that the work now under notice is second to none among works of a similar kind. It is thoroughly up-to-date, and contains all that is necessary to be known in connection with the recent considerable advances made by the introduction and more general use of various self-recording instruments, and with the more systematic observations of clouds. It contains good representations of eight of the principal forms of clouds, reproduced from the International Cloud Atlas, and 37 other illustrations, with sound advice in the choice of necessary instruments and the establishment of stations of all classes, whether first-order observatories or stations intended to record merely rainfall and temperature. Any observers in our own country who may be conversant with the German language would, we think, be much interested by a careful perusal of this very instructive work.

The current number of the *Fortnightly Review* contains an article by M. A. Santos-Dumont on "The Future of Air-Ships." The difficulties against which the nagivator of the air has to contend are explained, and the means adopted by various aëronauts to overcome these obstacles are described. The two great obstacles to ballooning, M. Santos-Dumont points out, are contraction and expansion. To counteract contraction ballast must be thrown out, to compensate for expansion, gas must be allowed to escape. The skill of the aëronaut of a spherical balloon consists in maintaining his desired altitude with the greatest economy of gas and ballast. But in any case repeated contractions must mean the loss of the last lot of ballast, and repeated expansions must result in the loss of so much gas that the balloon sinks eventually to earth. The latest plan proposed to overcome this weakness is described at length in the article. Steam circulating in a long aluminium worm will be used to heat the gas of the balloon, and contraction will mean merely the condensation of so much steam into water, while expansion will be brought about by its reconversion into steam. The difficulty consists in preventing any loss of water, and M. Santos-Dumont explains how he proposes to effect this. The successful use, at an early date, of air-ships in Arctic exploration is predicted, and the part that air-ships will take in the warfare of the future is outlined.

We have received from Messrs. A. Gallenkamp and Co. specimens of some new spectrum tubes which we have tested with very satisfactory results. The tubes, three in number, contained argon, helium, and a mixture of argon and helium, and the trial showed that they are a great advance on any other forms that have previously been examined. For spectroscopic work they should be of the greatest service, for the exceeding brilliancy of the gases, when only a small coil, with or without a jar in circuit, is used, will render them particularly useful in research work. The tubes themselves are of rather novel construction, the main point being the insertion of a short capillary tube in a tube of larger dimensions, the latter being connected with two other tubes fixed at right angles, and containing the electrodes. The current passing from one electrode to the other has to pass through the capillary, and the gas in this space is rendered very brilliant. When placed end on to the slit of a spectroscope, the bulb end of the tube containing the capillary being on the slit side, a method first adopted by Monkhoven to obtain the maximum of brilliancy of the illuminated gas on the slit, the result is a brilliant concentration of light which can be examined with large dispersion. The tubes are strong, compact, and well made, and can be strongly recommended both for student and research use.

Prof. A. H. R. Buller, writing from the University of Manitoba, describes some striking electrical effects due to the dryness of the atmosphere at Winnipeg. The air during the winter months contains so little water-vapour that bodies charged with electricity lose their charges relatively slowly. When the thermometer is low, ranging as it often does for a week or more at a time from 0° to −40° F., very little friction, such, for instance, as may be produced by walking along a carpet, causes a person to become charged with sufficient electricity to produce a visible and audible spark on touching an iron bedpost, the radiator, the gas-tap, or any other conductor. It is a favourite amusement of some children to take sparks from each other's noses after running about a carpeted room. In the Manitoba Hotel, now burnt down, there was a ballroom with some iron pillars in it. Prof. Buller was told by a trustworthy eye-witness that after a dance dancers on several occasions have been "severely stung" by accidentally coming into contact with one of the pillars. Many ladies have considerable difficulty in combing their hair; for during the process it becomes so charged with electricity that it stands out in the most astonishing manner. Even the short hair of a man, when being combed, often "crackles," "stands on end," and in the dark produces a display of sparks. It is quite easy to light the gas with a spark from the finger when matches are not handy by merely shuffling a few paces over the carpet and then holding a finger to the burner. On February 6, at 1 p.m., when a thermometer in the shade out of doors registered −5° F. and indoors 62° F., Prof. Buller found that a spark half an inch long could be obtained between his finger and an earth-connected iron pipe after sliding his feet smartly for twenty paces along the maple-wood floor of his laboratory. In the chemical laboratory calcium chloride may be exposed to the air for some weeks without showing the least apparent signs of deliquescence. In order to demonstrate the deliquescence of this substance to the students, the professor of chemistry is obliged to use a damp-chamber.

No. 2 of vol. ii. of *Le Radium* contains an account by M. J. Danne of the deposits of pyromorphite containing radium which have recently been discovered at Issy-l'Evéque (Saone et Loire), and the first part of a study of phosphorescence by M. L. Matout. A description is also given by Dr. Robert Abbe, of St. Luke's Hospital, New York, of several cures of external tumours and cancerous growths which were effected by means of radium.

An investigation of the effect of temperature on the magnetisation of steel, nickel and cobalt by Prof. H. Nagaoka and S. Kusakabe constitutes article 9 of vol. xix. of the *Journal of Science of the University of Tokio*. The most interesting results were obtained with cobalt and with tungsten-steel. The former is characterised by undergoing several remarkable changes of magnetisation as the temperature is raised, whilst with tungsten-steel, between the temperature of disappearance of magnetism on heating and that of its reappearance on cooling, there exist at least five corrugations in the curve of magnetisation in a constant field. When once the magnetisation has disappeared it cannot be recovered until the temperature has been lowered by about 240° C., and the cooling curve again exhibits peculiar sinuosities. In addition to these peculiarities, tungsten-steel shows a very pronounced recalescence at 660° C., this temperature practically coinciding with that at which magnetism reappears in the cooling metal.

In No. 3 of vol. vi. of the *Physikalische Zeitschrift* Messrs. Elster and Geitel describe further investigations of the highly radio-active muds from the thermal springs of Nauheim and Baden. These sediments are completely soluble in hydrochloric acid, and on adding dilute sulphuric acid to the solution, a precipitate of radio-barium sulphate is obtained having an activity many times as great as that of an equal quantity of the original mud. The oxides precipitated by ammonia from the filtrate of the barium sulphate are also radio-active, the character of the emanation indicating the presence of thorium, although this substance could not be separated by chemical methods. Prof. G. Vicentini and M. Levi de Zara, in the *Atti* of the Royal Venetian Institute (vol. lxiv., ii., 95), also deal with the question of radio-active sediments. The radio-activity of the mud and of the incrustation formed by the thermal springs of Battaglia, Abano, Montegrotto and the Lake of Lispida has been measured. The Cittadella spring at Montegrotto is particularly noteworthy on account of the high value of its radio-activity and of the fact that this appears to be due to radium only. The air in the vicinity of the springs was in all cases found to contain notable quantities of a radio-active emanation.

The latest addition to the Philosophische Bibliothek published by the Dürr'schen Buchhandlung, Leipzig, is a translation of Spinoza's "Ethics," with an introduction and notes, by Dr. Otto Baensch. The volume is No. 92 of the series of philosophical manuals in which it is published, and its price is three marks.

WE have received from Mr. A. C. Cossor, of Farringdon-road, E.C., an illustrated catalogue of Röntgen ray tubes, electrical instruments and fittings, and small electric lamps for all purposes. The catalogue should be of interest to physicists, medical men and others interested in high vacuum work.

THE fourth part of the second volume of "The Fauna and Geography of the Maldive and Laccadive Archipelagoes: being the Account of the Work carried on and of the Collections made by an Expedition during the years 1899 and 1900," edited by Mr. J. Stanley Gardiner, has been published by the Cambridge University Press. This part contains reports on the Alcyonaria of the Maldives by Prof. S. J. Hickson, F.R.S.; on marine crustaceans by Major Alcock, F.R.S., and Prof. H. Coutière; on hydroids by Mr. L. A. Borradaile; on Rhynchota by Mr. W. L. Distant; and notes on parasites by Mr. A. E. Shipley, F.R.S.

MESSRS. TEUBNER, of Leipzig, have just issued a fifth edition of Schlömilch's "Uebungsbuch zum Studium der höheren Analysis," part i., of which the first edition appeared in 1868, and a second edition of Dr. A. Föppl's "Einführung in die Maxwell'sche Theorie der Elektrizität," the first edition of which appeared in 1894. Of these, the former, which in England would be called a "treatise on the calculus," has been revised by Prof. E. Naetsch, of Dresden, and several new paragraphs on transformation of coordinates have been added. The work of editing Dr. Föppl's treatise has been undertaken by Dr. M. Abraham, who is preparing a second volume dealing with "theory of electromagnetic radiations."

OUR ASTRONOMICAL COLUMN.

JUPITER'S SEVENTH SATELLITE.—*Circular* 74 from the Kiel Centralstelle confirms the telegram received last week concerning the discovery of a seventh satellite to Jupiter.

It contains a message from Prof. Campbell in which he states that the object was discovered by Prof. Perrine, using the Crossley reflector. The position previously given, viz. position angle = 62°, distance from Jupiter 21′, was that occupied by the satellite on February 25.6 (G.M.T.). The apparent motion was direct, and the orbit is considerably inclined to the ecliptic. This latest satellite has been under observation, with the Crossley reflector, since January 2, but no particulars of the observations, other than those for January 25, are given in the circular.

LONGITUDE OBSERVATIONS OF POINTS ON MARS.—*Bulletin* No. 14 from the Lowell Observatory contains the results of the longitude determinations of nearly sixty features on the surface of Mars made at Flagstaff during 1903. For each point the times of the several observations and the resulting longitudes are given, and these are followed by the mean value for the longitude and its probable error; the mean value for the latitude of each point is also given.

The longitudes were determined by noting the time of transit of each marking across the micrometer thread when the latter was placed parallel to the position angle of the polar axis, as given in Mr. Crommelin's ephemeris, and passing through the polar cap. As the thread obliterated the markings it became easier in practice to record the time at which the marking and the cap were equidistant from the thread.

Mr. Lowell has allotted a number to the result of each determination showing the relative weight to be attached to the value obtained.

OBSERVATIONS OF COMETS.—The comets 1904 *e* (Borrelly), 1904 *d* (Giacobini), and 1904 *a* (Brooks) have been regularly observed, at Lick, by Dr. R. G. Aitken, and the results are published in No. 69 of the Lick Observatory *Bulletins*.

Observations of comet 1904 *e* were made during the end of December and the beginning of January, and two sets of parabolic elements were computed from the results. Subsequent observations did not confirm these, and consequently Dr. Aitken computed elliptic elements from his observations of December 31, 1904, January 17 and 27, 1905. When the observational values were compared with the places calculated from these elements, the agreement was found to be satisfactory, and it seems probable that the comet is moving in an elliptical orbit with a period of about 7.3 years. An ephemeris based upon these elements and extending to March 31 is given, and shows that on March 11 the comet will be only 0.27 as bright as at the time of discovery, when it was variously estimated as being of the tenth or eleventh magnitude.

Comet 1904 *d* was observed on January 28, and the observation showed that the orbit published in *Bulletin* No. 67 needs very little correction. From the comet's appearance on that date it is evident that this object will soon be beyond the reach of all but the most powerful telescopes. An ephemeris extending to April 3 is given.

Observations of comet 1904 *a* were made with the 12-inch refractor by Messrs. Maddrill and Aitken during the period June 21–September 4, 1904, and the results are given in the same circular. A footnote by Dr. Aitken states that the comet was still visible in the 12-inch telescope on January 26, and an observation made on that date showed that Prof. Nijland's ephemeris is very nearly exact.

THE GOVERNMENT OBSERVATORY AT VICTORIA.—We have received the annual reports of the board of visitors and the director of the Victoria (Australia) Observatory for the years ending March 31, 1903, and 1904.

The reports show that the routine work connected with the meridian observations, the time service, the meteorological, magnetic, and seismological observations, and instrument testing was carried out as usual.

On the later date the taking of the catalogue plates for the astrographic chart, to the number of 1149, had been completed, whilst satisfactory progress had also been made with the other sections of the work. The measurement of both the Sydney and the Melbourne plates is being carried out at Melbourne, and on March 31, 1904, 239 Sydney plates containing 137,812 stars, and 522 Melbourne plates containing 151,343 stars, had been completely measured. A new measuring machine designed by Mr. H. C. Russell was finished, and its fitness was being investigated when the report was issued.

The director, Mr. P. Baracchi, states that the work of measuring the magnetograph curves and reducing all the magnetic observations made since 1868 is progressing satisfactorily, and that he hopes the results will be published within the next two or three years.

OBSERVATIONS OF SATURN'S SATELLITES.—The results of a series of observations of the relative positions of the seven inner satellites of Saturn are published in *Bulletin* No. 68 of the Lick Observatory. The observations were made by Prof. Hussey with the 36-inch refractor between August 3 and December 2, 1904, and in each case the position angle and distance of the satellite in regard to one of the other satellites are given.

BRIGHT METEORS.—Mr. R. L. Jones, writing from 3 King's Bench Walk, Temple, E.C., refers to three bright meteors observed on the nights of February 27 and 28. All the three appear to have started from the constellation Monoceros, and to have tracked thence in a north-westerly direction. A brilliant meteor was also seen at 12.10 a.m. on March 1, its brightness far exceeding that of Venus.

THE MAGNETIC SURVEY OF THE UNITED STATES.

THE report for the year ending June 30, 1904, on the magnetic survey of the United States and its outlying territories has lately been issued by the authorities of the Coast and Geodetic Survey, and contains a long list of field observations of the magnetic elements made with the usual completeness, supported by results obtained in five fixed observatories. Two of the latter are at Porto Rico and Honolulu respectively.

The new feature in the present report is that the survey has been extended to the neighbouring seas both on the Atlantic and Pacific sides of North America, and it records the successful observation at sea of thirty-four values of the Dip, and thirty-two of the Intensity, with fifty-two of the Declination.

The observations of the Declination were made with the ship's standard compass in the process of "swinging." Those for Dip and Intensity at the same time with the Lloyd-Creak (shortly L.-C.) dip circle, an instrument originally designed for sea observations of those elements, but which in field work on land has also been found to give results hardly inferior to those of the specially designed land instruments. The degree of accuracy hitherto obtained at sea as compared with land observations with the same instrument is also given.

The accompanying illustration shows the L.-C. circle mounted for observations on land and fitted on top with an arrangement proposed by the U.S. C. Survey for observing the Declination, but which also serves the purpose of placing the circle in the magnetic meridian. At sea the circle is mounted on a gimbal stand with the declination fitting removed, as the angle between the direction of the ship's head and the magnetic meridian is then obtained from the ship's standard compass.

A detailed description of the L.-C. circle is given in the

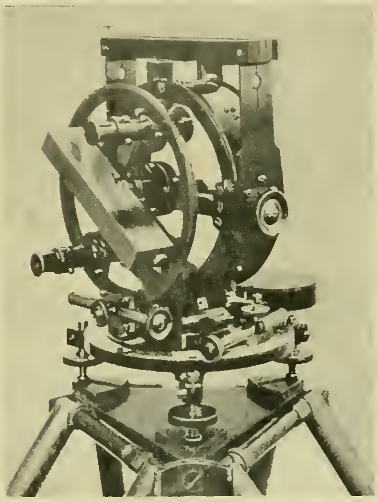


FIG. 1.—Lloyd-Creak Dip Circle, mounted for Observations on Land.

report with the methods adopted for observing therewith at sea in the U.S. surveying vessels, which are, however, not specially adapted to the work. A wood-built vessel, specially designed and devoted to magnetic work as a primary object, is required to obtain the full value from this instrument, and it is therefore pleasant to record that the magnetic survey of the North Pacific Ocean in such a vessel will be commenced this year by the United States.

THE NEST OF THE FIGHTING FISH.

IN most, if not in all, the members of the group of Oriental fishes typified by the so-called climbing perch (*Anabas scandens*), the males take charge of the eggs as they are extracted from the females and place them in a "nest" of mucus-covered bubbles, which they have previously prepared. A well-known representative of the family is the "fighting fish" (*Betta pugnax*), which takes its name from the circumstance that a semi-domesticated breed is kept by the Siamese for the sake of the sport offered by the combats of the males. Of this fish living specimens from Pinang have recently been in the possession of Mr. E. H. Waite, of the Sydney Museum, who has published an illustrated account of their nesting habits in the *Records* of the Australian Museum for December last (vol. v. No. 5). Mr. Waite has obligingly sent us a copy of his original photograph of the nest, which is herewith reproduced.

Mr. Waite states that he received these fish early in April last year, and that the male almost immediately proceeded to blow bubbles, which it produced by rising periodically to the surface and taking in gulps of air. A circular mass of mucus-clad bubbles, about 3 inches in diameter, was soon produced; and in course of time several other layers were formed, which resulted in the final production of a large dome-shaped structure, as shown in the photograph. The structure was completed on the third day, when the female commenced to lay her eggs, which were received between the pectoral and ventral fins as they were extruded, and were then suffered to sink slowly in the water. Here they were collected by the expectant male, decked in his resplendent breeding colours, and placed, after being coated with mucus, below the mass of bubbles, to which they adhered. From three to seven eggs are extracted at a time, and the process is continued until there are from one hundred and fifty to two hundred. When the laying is over, the female is kept away from the nest to prevent her devouring the eggs, which are carefully tended by the male, being constantly moved and from time to time re-coated with slime.

On the third day the eggs hatched, the larvæ remaining beneath the shelter of the bubbles. From time to time some fell off, when they were immediately replaced by the watchful male, but in a day or two the numbers which became de-

FIG. 1.—Nest of the Fighting Fish. About two-thirds natural size. From a photograph by Mr. Waite.

tached were too many for him to secure, although he frequently had seven or eight in his mouth at once. Some were, however, recovered from the bottom of the tank and returned to the shelter of the nest, but many were devoured by the female. Eventually all the larvæ died, and, although the fishes bred on two other occasions, none of the offspring were reared.

SOME RECENT WORK OF THE U.S. GEOLOGICAL SURVEY IN THE WESTERN STATES.[1]

IF it be possible for envy to lurk in the breast of the scientific worker, then surely might we look for it in the geologist of these islands when he regards the lot of his fellow-worker across the Atlantic. In the breadth of field open to research, in the freshness of the land, and in the public support accorded to his labours, the geologist of the present day in the United States may justly claim preeminence. In the four memoirs before us, a mere random selection from the recent publications of the U.S.

[1] "Zinc and Lead Deposits of Northern Arkansas." By G. I. Adams and others. Pp. 118; with 17 plates and 6 figures.
"The Copper Deposits of the Encampment District, Wyoming." By A. C. Spencer. Pp. 107; with 2 plates (maps) and 49 figures.
"Economic Resources of the Northern Black Hills." By J. D. Irving and others. Pp. 222; with 20 plates and 16 figures.
"A Geological Reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho." By W. Lindgren. Pp. 123; with 15 plates and 8 figures.
Being "Professional Papers" Nos. 24, 25, 26 and 27 of the U.S. Geological Survey. (Washington, 1904.)

Geological Survey, all these stimulants are conspicuous. The memoir on the Bitterroot Range alone deals with an area of about 12,000 square miles, respecting which our scientific knowledge has been hitherto of the scantiest; while the other three, though professedly more limited in scope, treat in detail of areas ranging from about 450 to 560 square miles which may be taken as selected illustrations of parts of the vast region west of the Mississippi.

Of course, it is not area only that counts in geology; and in considering the magnificent distances of the Great West, we may take heart in that our own shreds of land have not been carved out of some wide monotonous tract covered by a single formation within which it might be the fate of an ardent geologist of limited means to find himself hopelessly tethered! It is, indeed, fortunate that in the geological map of the world the British Isles lie, as it were, athwart the index.

It is less easy to find consolation when we compare even the most presentable of our British geological publications with these beautifully printed and liberally illustrated memoirs, wherein the native asperities of the technical treatise are so smoothed and adorned that they are hardly perceptible. Take, for example . . . . but comparisons are proverbially odious, and, moreover, the one in mind has been frequently made, with no good result, so let it pass!

It is noteworthy that all four treatises give the results of investigations which, although essentially scientific in scope, have centred around the economic resources of the specified districts. In all cases, also, the prospector and miner, working more or less at haphazard, had made considerable progress in developing the metalliferous deposits before the advent of the geologist, whose function has been to explain the general principles deducible from the discoveries already made, and to indicate the lines along which further exploration may proceed with the best chance of success. This is the proper course, for it is not until the average "practical man" begins to feel the need for professional advice that he is likely to pay much heed to such advice if it be proffered him. All the memoirs, and more especially that on the northern Black Hills, give full descriptions and many illustrations of the principal mine-workings, to which we need not further refer.

First on our list stands the description of the zinc and lead deposits of northern Arkansas, by G. I. Adams, assisted by A. H. Purdue and E. F. Burchard, with a palæontological appendix on the correlation of the formations by E. O. Ulrich. Though occurring mainly at a lower stratigraphical position, these metalliferous deposits appear to be very similar in mode of occurrence and in character of vein-stuff to the lead-ores of the Carboniferous Limestone of the north of England.

The principal locus of the deposits is in "the Yellville formation," a dolomitic limestone of Ordovician age; but they also range upward, less abundantly, into Lower Carboniferous Limestones. The Silurian system appears to be absent from the district described, and the Devonian is represented only by impersistent sandstone and shale, of which the maximum thickness does not exceed 40 feet. The region has been little disturbed; igneous rocks are absent; and the Ordovician rocks still maintain their nearly horizontal position. Nevertheless, there has been in some places much differential movement among the strata, probably as the result of compressive forces, whereby the thinner and more brittle beds have been brecciated and the fragments made to rotate or to shear past each other, producing the structure that in this country has been termed "crush-conglomerate." These breccias have permitted the percolation of the ore-bearing solutions, and are sometimes enriched by metalliferous deposits, though usually only in the vicinity of the nearly vertical fissures which appear to have formed the principal channels of the mineralised waters. It is suggested that the ores represent the concentration of minerals originally disseminated in the country rock, and more especially in the Mississippian (Carboniferous) limestones, this concentration having been effected by waters which, after circulating through the upper belt of weathered rock, have passed downward to the "belt of cementation."

The next memoir carries us some 700 miles north-westward, to the southern border of Wyoming, and to a geological province of utterly different character. "The Copper Deposits of the Encampment District," by A. C. Spencer, describes a hilly region on the Continental Divide, ranging in altitude from about 6650 feet to 11,007 feet, occupied for the most part by a complex mass of pre-Cambrian rocks, broken into and altered by igneous intrusions, with Mesozoic formations lying upon the flanks of the ancient massif as foot hills and dipping away beneath the surrounding prairie. The pre-Cambrian group

Fig. 1.—Trapper Peak, showing gradual slope of Gneiss Zone to the left and Glacial Amphitheatre in Granite at centre.

includes hornblende-schists derived from bedded volcanic rocks, limestones and shales, quartzite and slate, and a thick conglomerate, with intrusions of quartz-diorites, granites, and gabbros in great variety. The structure of the sedimentary rocks of this group is interpreted as a synclinorium, striking east and west, with its component strata dipping invariably to the south. With respect to the conglomerate, it is noted that though locally almost unchanged from its original condition, it is more frequently metamorphosed, and that this metamorphism, both mechanical and chemical, has often been carried so far that the contained boulders and pebbles have been mashed into disc-like plates, and the rocks, by re-crystallisation, converted into a gneiss the origin of which would be entirely indeterminate except through the study of its gradual passage from the unaltered condition. Certain mineral transformations described in the gabbros are assigned to dynamic pressures insufficient to inaugurate actual crushing, and also unaccompanied by a notable degree of hydration. The copper-ores which constitute the chief mineral wealth of the district occur under diverse conditions, which are carefully described and classified. It is believed that a large part, though not all, of the metalliferous deposits had their original source in the gabbros, of which eighteen samples, representing various phases of the rock, were tested in the laboratory of the survey, and in each case yielded traces of copper.

In the richest lodes the ores appear to have been concentrated by ascending solutions.

In the third memoir we are transported some 500 miles north-eastward to consider the economic resources of the northern Black Hills of South Dakota. A brief sketch of the general geology of the district is given in part i. (28 pages) by T. A. Jaggar, jun., and the rest of the volume, forming part ii., by J. D. Irving and S. F. Emmons, deals fully with the economic resources. The dome-like structure of the Black Hills, with their laccolitic intrusions of igneous rock, is already well known. "They rise like an island in the midst of the Great Plains, with culminating peaks of pre-Cambrian granite intrusive in Algonkian schists, and these same schists and granite may be followed outward from the centre of the Hills to an encircling escarpment of Palæozoic rocks dipping away on the northern, southern, and eastern sides, and mantling over the schists to form an extensive forested limestone plateau on the west." The limestones have been crushed in places into "pseudo-conglomerates," and Dr. Jaggar suggests a similar origin for many supposed conglomerates or "intraformational breccias" that have been described in other parts of the continent.

The picture of the region presented in the first few pages of part i. is remarkably clear and impressive. The Cambrian series of shales, quartzite, sandstone, and thin limestones, 200–400 feet thick, which rest in bold unconformity upon the upturned edges of the Algonkian schists, include at their base an irregular conglomerate, evidently an ancient beach-deposit. This basal Cambrian conglomerate contains detrital gold, derived from the erosion of auriferous lodes in the Algonkian rocks, and, according to the present authors, has been further enriched by later infiltration. It thus constitutes in favoured localities a gold-producing ore second only in importance to the lodes in the underlying Algonkians. The last-mentioned lodes are usually fissured belts of rock along which the precious metal, accompanied by other minerals, has been more or less irregularly deposited by permeating solutions. Another important source of gold is described under the heading of "Refractory Siliceous Ores." These ores represent the replacement of portions of the Cambrian dolomitised limestones by silica and other minerals, including gold, that appear to have been carried upward in solution by waters ascending along vertical joints. These waters, when checked by a comparatively impervious bed, tended to spread out laterally along the dolomites, which were partially dissolved and replaced by other substances. This part of the memoir is illustrated with some beautiful plates of microscopic slides. Besides gold, the district has yielded ores of silver-lead, wolframite, and a little copper, with some traces of tin.

FIG. 2.—Upper Valley of Mill Creek, Bitterroot Range, looking East from Main Divide. Notice pronounced U-shape of Valley narrowing toward the lower part. The prevailing rock is granite.

The last memoir of our series, which takes us again 900 miles to the westward, is the description of a geological reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho, by Waldemar Lindgren, and is in some respects the most instructive of the series; but unfortunately we have no space in which to do it justice. It deals with a vast tract of mountainous country, for the most part exceedingly difficult to traverse, and as yet very imperfectly explored. A huge "batholith" of granite or quartz-monzonite 300 miles in length from north to south, and 50 to 100 miles in width, occupies the central part of this region, and has been locally pressed and deformed, especially along its eastern margin, into gneiss. Sedimentary rocks are comparatively restricted in their range, and the age of most of those which are exposed is doubtful, as no well defined fossils have been found; but it is believed that, along with complexes of pre-Cambrian age, the Triassic, Carboniferous, and possibly older Palæozoic systems are represented. In the west the country is overspread by the great Columbia River lavas of Tertiary age. The physiographic features of the region are of extreme interest, and are carefully discussed. It is shown that the Clearwater Mountains had already acquired a sharply accentuated topography before the outpouring of the Columbia River basalts, and that the lower portions of the principal valleys were flooded and dammed by the lava-flows. The most important structural feature of the region, however, is the great fault by which the Bitterroot Mountains have been elevated on the west and the Bitterroot valley carried down on the east. This fault-plane is described as being remarkably flat, though apparently normal. It is supposed to represent a twofold movement, by which the foot-wall has been raised and the hanging wall depressed. It indicates a vertical movement of from 4000 to 6000 feet, and the horizontal component is estimated to be at least two miles. The schistose belt of the granite underlies this plane, and the structure is considered to be an outcome of the disturbance. Movement appears to have continued along the fault up to recent times.

G. W. L.

ANTHROPOLOGICAL NOTES.

AN interesting paper by A. L. Kroeber on the types of Indian culture in California is to be found in vol. ii. of the *Publications* of the University of California—"American Archæology and Ethnology, 1904." Ethnologically, California is characterised by the absence of agriculture and pottery, by the total absence of totemism or gentile organisation, by an unusually simple and loose social organisation in which wealth plays a rather important part, by the very rude development of all arts except basketry, by the lack of realism in art, by a slight development of fetishism and by the conspicuous lack of symbolism and ritualism, by the predominance among ceremonials of mourning and initiation rites, and by a considerable development of true conceptions of creation in mythology. The natives are of an unwarlike nature, and lack intensity and pride. It will therefore be seen that in almost every instance the Californian Indians are among the least characteristic of the Indians of North America, being lacking in the typical qualities of that race, and thus they are the most generalised of the peoples of that continent. In the same volume Dr. Kroeber gives an account of the languages of the coast of California south of San Francisco.

Drs. A. Bloch and P. Vigier have re-examined the hair follicles of negroes (*Bull. et Mém.* Soc. d'Anth., Paris, 1904, p. 124), and have obtained interesting results. The follicle forms at least half a spiral and is not flattened; the distribution of hair on the scalp is uniform, but all the hairs of the same spiral tuft have the intradermic portion of their curves orientated in nearly the same direction, and it is apparently this uniformity of the neighbouring follicles that determines the formation of spiral tufts; a semicircular oblique crest ridge of fibrous tissue constricts the upper portion of the hair bulb, and thus causes the flattening of the hair and its spiral twist.

Mr. E. H. C. Walsh, in an illustrated note on stone implements found in the Darjeeling district (*Journ.* As. Soc. Bengal, lxxiii. p. 21), states that all the implements he found were polished "celts," with the exception of a dumb-bell shaped hammer head. The general belief of the people is that these axe-heads are thunderbolts which have fallen from heaven; they are chiefly found with the medicine men, who use them as charms in their incantations to drive out or cure disease, and also on account of their reputed medicinal properties when mixed with water; on several specimens the scraping or rubbing on stones to obtain medicine is very noticeable. Numerous references to other papers dealing with the subject are given. On p. 27 of the same *Journal* P. O. Bodding describes some shoulder-headed and other forms of stone implements in the Santal Pargans; it is not yet clear who were the makers of these distinctive implements—possibly they were Mon-Kmer and Munda peoples. The *Journal* also contains some interesting folklore.

Some time ago M. Verneau directed attention to some skulls from Palæolithic interments at Mentone with a remarkable negroid aspect, and M. Hervé has noted two somewhat similar Neolithic skulls from Brittany. Prof. Manouvrier points out in the *Bull. et Mém.* Soc. d'Anth., Paris (1904, p. 119), that all these "negroid" characters occur in European or other non-African skulls, but they are very rarely found in conjunction. All the skulls of this type are female; in following out this hint Dr. Manouvrier discusses the "negroid" characters, and comes to the conclusion that in a dolichocephalic population in which the prognathism of the men is so marked, a corresponding degree of prognathism in the women, combined with other characters that are characteristic of female skulls, would give a negroid appearance without any need to conclude that there was a negro element in the population. The same author describes (p. 67) a remarkable trepanned Neolithic skull, and (p. 101) some senile Neolithic skulls.

As the result of a long and careful comparative study of the skeletal variations of the foot in primates and in the races of man, Th. Volkov (*Bull. et Mém.* Soc. d'Anth., Paris, 1903, 1904) arrives at the following conclusions:—The skeleton of the foot of the prosimians bears many traces of the primitive type of foot of the ancient mammals, and presents many intermediate forms between this type and that of the foot of monkeys. The skeleton of the foot of the lower primates appears to be the result of adaptation to arboreal life of ancestors whose foot resembled that of existing rodents. The skeleton of the foot of anthropoids represents the extreme of this adaptation, but at the same time (among the hylobates and partly in the gorilla) the beginning of adaptation to standing and to bipedal progression. The skeleton of the foot in the lower races of man presents as a whole, and for each bone in particular, evident and numerous traces of adaptations characteristic of climbers antecedent to the assumption of the erect attitude and bipedal progression. The ethnical characters range from the oblique and flat foot to the straight and arched foot. Consequently the arch of the foot represents the most essential character from an anthropological point of view. The index of curvature, that is to say, the relation between the height and length of the foot, or especially the tarso-metatarsian length, should be considered as a very important anthropometric datum. The skeleton of the foot of the new-born infant reproduces primitive and transitory forms in the development of the human foot in general, and thus its study possesses a very great anthropological importance.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following is the speech delivered by the Public Orator, Dr. Sandys, on Thursday last, in presenting Dr. E. B. Tylor, F.R.S., professor of anthropology in the University of Oxford, for the degree of Doctor in Science *honoris causa*:—

Adest vir et propter aetatis dignitatem et propter studia in rerum originibus primis exquirendis praeclare posita inter primos merito numerandus, quem iamdudum admirati, nunc demum honore diu debito decoramus. Abhinc annos quinque et quadraginta consuetudines Mexicanas antiquas diligenter exploravit. Deinde de prisco hominum cultu, opere in maximo et doctrinae variae plenissimo, plus quam semel disputavit. Illo vero in opere, animarum praesertim in regno perlustrando aliorum antecursor constitutus, successoribus omnibus facem splendidam praetulit. Denique de anthropologia universa egregie disseruit, hominum ipsorum studium hominibus imprimis proprium esse iure optimo arbitratus. Nemo fortasse magis merito liberalitatem illam Terentianam prae se ferre potest:—

"homo sum, humani nil a me alienum puto."

The proposals forwarded by the Studies Syndicate have been rejected by the Senate by, roughly speaking, three to two. The poll taken was the largest on record, and on the Grace affecting Greek the "non-placets" were 1559 and the "placets" 1052. The result is extremely disappointing to all those who wish to see Cambridge take its rank as a leading university in the Empire. There is, however, a strong consensus of opinion that the matter should not be allowed to rest where it is. Perhaps a consultation between the two opposing bodies might lead to some plan acceptable to the more moderate members of both parties.

The Vice-Chancellor announces that he has appointed Colonel Sir Frank Younghusband, K.C.I.E., to the office of reader on Sir Thomas Rede's foundation for the present year.

Mr. E. H. Hankin, Fellow of St. John's College, and analyst and bacteriologist to the North-West Provinces and Oudh, has been approved by the general board of studies for the degree of Doctor in Science.

MR. H. O. ARNOLD-FORSTER, M.P., Secretary of State for War, has consented to give away the prizes to the students at the Woolwich Polytechnic on April 1.

THE Huxley lecture of the University of Birmingham will be delivered by Prof. E. B. Poulton, F.R.S., in the large lecture theatre of the Midland Institute, on Thursday, March 23.

IN the *Engineering and Mining Journal*, Mr. G. S. Raymer gives an illustrated description of the Simpkins laboratory at Harvard. It is designed for the study of continuous ore-dressing operations on a considerable scale, the plant consisting of a 5-stamp battery and additional apparatus of the most recent type.

THE formal opening of the new building of the École polytechnique of Montreal, in affiliation with Laval University, took place on January 28. This school was founded in 1874 to give French-Canadian youths an opportunity of obtaining a training in practical science. Its sphere has been limited, but with the new building and improved equipment better results are anticipated.

MR. CHARLES H. HACKLEY, of Muskegon, Mich., has made, we learn from *Science*, a bequest of 50,000*l.* to the Hackley Manual Training School of Muskegon, which, added to 72,000*l.* already given by Mr. Hackley, makes the school's total endowment 122,000*l.* Mount Holyoke College will receive, we learn from the same source, 34,400*l.* as the residuary legatee of the late Mr. Edmund K. Turner.

IN an article entitled "The Lesson of Coopers Hill," the *Indian Daily Telegraph* of February 1 institutes a comparison between the methods of government in the cases of Coopers Hill and the City and Guilds of London technical colleges. The success of the latter is traced to adaptation in them of the methods followed in the great German polytechnics which is shown by their senates or college boards responsible for their educational systems. The article proceeds to direct attention to the Thomason Civil Engineering College at Rurki in connection with a proposal at a recent meeting of the Allahabad University to abolish the faculty of engineering, and favours the introduction in the college at Rurki of the method of government which has assured the success of the colleges of the City and Guilds.

THE Berlin correspondent of the *Times* states that in the course of a debate on the estimates for the Ministry of Education in the Prussian Chamber on March 2, an official of that Ministry, Geheimrath Reinhardt, gave some interesting information with regard to the success of the so-called "reform schools," in which the study of the classics is begun at the age of twelve, and Greek not until the age of fourteen. One great advantage of this system is that the decision to assign a pupil to the modern (Realschule) or to the classical school (Gymnasium) can be postponed to a stage when his abilities and tastes can be better estimated. Geheimrath Reinhardt stated that the system of this "reform school" had hitherto been adopted at three classical Gymnasia, and the result was that of 123 pupils in the highest form who presented themselves for the leaving examination only four failed to pass, and of these four three succeeded six months later. Experience had shown that as a result of beginning Latin and Greek at a later age than was customary, the interest of the pupils in their work was rendered keener, and their diligence was certainly in no wise inferior to that of the pupils of the ordinary Gymnasia.

THE fourth annual report of the executive committee of the Carnegie Trust states that sums amounting to 38,114*l.* have been claimed and handed over to the four Scottish universities during the year. The grants for library purposes and for provisional assistance in teaching, amounting in all to 6400*l.*, have been fully paid. The grants for buildings and permanent equipment available for 1904, including a balance of 12,635*l.* unexpended in 1903, amount to 33,035*l.* Of these, the sum of 20,146*l.* has been claimed. Claims for grants towards teaching endowments amount for the year to 11,568*l.* These include contributions to the foundation of two chairs—that of history in the University of Aberdeen, and that of geology in the University of Glasgow. The scheme of endowment of post-graduate study and research has now entered upon its second year. The total expenditure for 1903–4 under the scheme was 3386*l.* The estimated outlay for the current academic year is 5177*l.* Applications for fellowships, scholarships, and grants for 1905–6 must be lodged on or before May 1 with the secretary to the trust, from whom application forms and regulations can be obtained. In the research laboratory of the Royal College of Physicians, the purchase of which was announced in the previous annual report, the superintendent reports that the past year has been one of steady and satisfactory work in all departments. Thirty-five workers have held places in the laboratory, and have been engaged in forty-seven investigations.

THE twenty-seventh annual general meeting of the Institute of Chemistry was held on March 1. In the course of an address Mr. David Howard, the president, referred to the steady growth of the institute, saying that he thought there was still a wide field for those possessing the highest chemical knowledge and skill, and that those who had to call in the aid of such knowledge and skill were becoming more and more alive to the importance of employing only the properly trained and competent. He emphasised the importance of requiring all candidates to produce evidence of a high standard of general education. The professional chemist should be a professional man as well as a chemist, and must, therefore, possess that general culture which is essential if he is to deal with his work in a professional spirit. Referring to the position of the institute in connection with the Sale of Food and Drugs Acts, he mentioned that 94 per cent. of the public analytical appointments were held by fellows of the institute. The president alluded to the action of the Board of Agriculture in encouraging provincial technical and agricultural colleges to undertake professional chemical work gratuitously, or at purely nominal fees. In the endeavour to help dairy farmers, the board has induced the colleges, which are maintained by grants for technical education, for the benefit of a particular class, to compete with professional chemists, particularly those maintained by the agricultural associations, at the expense of the general public. The president held that the colleges need the grants for the promotion of the education of farmers in the science and practice of agriculture, without diverting them to other purposes. It is for them to instruct the farmers in agricultural chemistry.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 2.—"The Theory of Photographic Processes: on the Chemical Dynamics of Development." By S. E. **Sheppard** and C. E. K. **Mees**.

If a photographic plate be exposed to light and developed, the transparency to light of the silver deposited is related to the mass thereof by the equation $D = -\log_{10} T$, where D (termed the density) is proportional to the mass of silver per unit area. This relation has been confirmed with great care for densities varying from 0.5 to 3.5, and for the plates and developer used a density of 1.00 corresponded to 0.01031 gram of silver per 100 sq. cm. This quantity is termed P, the "photometric constant" of the deposit.

A study of the relation of the density to the time of development resulted as follows:—

(*a*) The silver deposited increases rapidly at first, then more slowly, and finally tends to a limit.

(*b*) This limit depends only on the exposure.

(*c*) The velocity depends on the concentration of the reducer.

(*d*) A soluble bromide reduces the velocity, but the "slowing off" with time is not so rapid.

A theoretical investigation of development based on the theory of reaction-velocities in heterogeneous systems led under certain conditions to the equation $dD/dt = \kappa(D_\infty - D)$, w D_∞ is the limiting density, D that at the time t. On integration this leads to the expression

$$1/t \log D_\infty / D_\infty - D = \kappa ;$$

$(D_\infty - D)$ is then the reacting surface.

κ was experimentally shown to be constant.

Further, as κ is theoretically $\Delta/\delta\ a$, where Δ is a diffusion-constant, δ the diffusion path, and a the concentration of the reducer, the velocity should be proportional to this, which was experimentally found.

The addition of alkaline bromides gradually alters the course of the reaction, introducing an induction period, but for the "maximum" velocity $\kappa \times \log Br =$ a constant.

The value of κ depends greatly on the physical condition of the plate, diminishing with keeping, probably from lowered diffusivity.

An important deduction from the development formula is that the ratio of the densities due to two exposures is constant and independent of the time of development, which was confirmed.

For a series of increasing exposures for a certain range Hurter and Driffield showed that $D = \gamma(\log E/i)$, where γ is development-constant.

Hence as γ is proportional to D, and as

$$1/t \log D_\infty / D_\infty - D = \kappa,$$

therefore $1/t \log \gamma_\infty / \gamma_\infty - \gamma = \kappa$, an expression which may be used to compare the velocities of different developers. For ferrous oxalate, citrate and fluoride the following table was obtained:—

Developer	Relative efficiency
Ferrous citrate	1.00
Ferrous fluoride	2.95
Ferrous oxalate	48.7

Further communications are to be made on the influence of temperature, of soluble bromides, on the reversibility of the reaction, on the microscopy of, and on the exposure and development, nature and destruction of the "latent image."

The object of the investigation is to make the study of development quantitative and to bring it in line with general physicochemical theory.

Chemical Society, February 15.—Prof. W. A. Tilden, F.R.S., president, in the chair.—Nitrogen halogen derivatives of the aliphatic diamines: F. D. **Chattaway**. The compounds ethylenetetrachlorodiamine, ethylenetetrabromodiamine, and other similar bodies derived from diamines or their diacyl derivatives were described.—The nitration of substituted azophenols: J. T. **Hewitt** and V. H. **Mitchell**. The authors have systematically studied the action of dilute nitric acid and of a mixture of concentrated nitric and sulphuric acids on the three nitrobenzeneazophenols.—The estimation of saccharin: C. **Proctor**. The process described by E. Emmet Reid for the estimation of saccharin has been tested and found to be convenient and trustworthy. The paper also described a simple volumetric process by means of which the combined percentage of *o*-benzoicsulphinide and *p*-sulphamidobenzoic acid in commercial saccharin can be determined.—The analysis of samples of milk referred to the Government Laboratory in connection with the Sale of Food and Drugs Acts: T. E. **Thorpe**. This paper contained the results of an inquiry into the changes which occur in the "souring" of milk, and especially as to the effects of these on the usual analytical constants of milk.—The condensation of anilinodiacetic esters in presence of sodium ethoxide: A. T. **de Mouilpied**.—The basic properties of oxygen at low temperatures; additive compounds of the halogens with organic substances containing oxygen: D. **McIntosh**. A continuation of previous work on the combination of organic compounds containing oxygen with the halogen hydrides to form definite compounds.—Organic derivatives of silicon: F. S. **Kipping**. The preparation and reactions of a number of these compounds were described. For the purpose of systematic nomenclature these compounds are regarded as derivatives of *silicane*, SiH_4, or of *silicol*, $SiH_3.OH$.—Photographic radiation of some mercury compounds: R. de J. F. **Struthers** and J. E. **Marsh**. The mercury compound $HgC_2N_2,2(NH_2.NH.C_6H_5)$ was found to act on a photographic plate through paper and aluminium foil, and slightly through sheet zinc. Phenylhydrazine and a number of mercury salts were also found to exert a similar action.

Royal Microscopical Society, February 15.—Dr. Dukinfield H. Scott, F.R.S., president, in the chair.—The Finlayson "comparascope": Mr. **Finlayson**. The arrangement exhibited provides a means of examining two slides simultaneously.—An optical bench for microscope illumination, microphotography, micro-projection, lantern projection, &c., and a large photomicrographic and enlarging camera, both bench and camera being on rigid iron tables provided with castors and fixing pedestals: C. **Beck**.—Practical micrometallography: J. E. **Stead**, F.R.S. Mr. Stead described the machinery by means of which metals may be cut and polished rapidly, and explained the various operations of cutting, grinding, and polishing. Many specimens shown by means of the epidiascope exhibited clearly the details of the surface, and especially the coloration. The beautiful colours produced by the heating process, by which some portions became oxidized more quickly than others, were very striking, especially in the case of a specimen of a polished section of a meteorite, which almost equalled in brilliancy and colour that well-known microscopic object the wing of *Morpho menelaus*.

Physical Society, February 24.—Prof. J. H. Poynting, F.R.S., president, in the chair.—On the curvature method of teaching geometrical optics: Dr. C. V. **Drysdale**. The paper has been undertaken with the two-fold object of giving a systematic exposition of the method of teaching elementary optics which the author has found most suitable, and of giving an introduction to a subsequent paper on the treatment of aberrations by curvature methods.—Dr. Meisling's colour-patch apparatus: R. J. **Sowter**. The apparatus is simple in its principle and construction, and is specially adapted for testing colour-blindness.—A method of illustrating the laws of the simple pendulum: J. **Schofield**. A pendulum is fitted at its lower end with a narrow horizontal framework carrying vertical transverse wires. During the oscillations of the pendulum these wires are caused to cut a jet of mercury, and time signals are sent to the recording mechanism of a chronograph. The distances between the wires are known, and together with the time-measures they yield a displacement-time curve of the motion. From this the kinematical curves and equations of the moving system may be deduced by the usual methods. In the actual apparatus a tuning-fork arrangement with an accuracy of about 1/200 of a second is used as the chronograph, and the results obtained from the pendulum are accurate to about three per cent. The principle has also been applied to torsion pendulums.—String models of optical systems: J. **Schofield**. In these models the lenses and prisms are made of celluloid, so that the paths of rays through them can be shown.

PARIS.

Academy of Sciences, February 27.—M. Troost in the chair.—The precautions necessary in the mode of execution of certain researches requiring high precision: M. **Lœwy**. A lengthened study as to the cause of some systematic errors in the circle of a meridian instrument, wrongly attributed to flexure of the circles, showed that these effects were due to bad definition of the images of the lines, and could be remedied by increasing the definition of the reading microscopes and improving the lighting. In the determination of the constant of aberration, and of refraction, by means of a double mirror cut out of one block of glass, a deformation of the image was observed which rendered accurate readings difficult. The form to be given to the two reflecting surfaces to get regular stellar images has been worked out.—On the observation of the partial eclipse of the moon of February 19: M. **Puiseux**. The twelve photographs taken are discussed in detail, and in some respects are not in agreement with descriptions given before 1866. Recent observations render improbable any new changes in the moon's crust.—On an application of the iris diaphragm in astronomy: M. **Salet**. An iris diaphragm, introduced into the plane of the micrometer wires of an eyepiece, has the effect of suppressing diffused light, and thus facilitating observations on faint objects.—Families of Lamy with plane orthogonal trajectories: G. **Carrus**.—On algebraic surfaces: Federigo **Enriques**.—On functions with an infinity of variables: Maurice **Fréchet**.—On some theorems of Riemann: P. **Fatou**.—The theory of the limiting trajectory of an aëroplane: Marcel **Brillouin**.—On the intensity of photographic impressions produced by feeble illuminations: C. **Gutton**. It is shown experimentally that in a photographic negative the contrasts are exaggerated in the faintly illuminated regions and attenuated in the more strongly lighted parts. On a positive, on the contrary, the differences of lighting are faithfully reproduced.—On the kathode rays emitted by the anode: E. **Rogovsky**.—The surface tension of a dielectric in the electric field: Ch. **Fortin**. In an electric field of 20,000 volts per centimetre, normal to the surface, the relative variation of the surface tension of the petroleum, if it exists, is less than 1/450th. If the variation of the surface tension with the strength of the field be regarded as negligible, the arrangement of apparatus described serves as a new method of measuring the specific inductive capacity of the liquid.—On the spectra of the fluorides of the alkaline earths in the electric arc: Ch. **Fabry**.—On the ionisation due to the radium emanation: William **Duane**.—On the purification of gadolina and on the atomic weight of gadolinium: G. **Urbain**. The method of purification adopted was the fractional crystallisation of the double nitrate of gadolinium and nickel from nitric acid of density 1.3. The purity of the product was established by the constancy of the ratio between the crystallised sulphate and the oxide, and the mean atomic weight is given as 157.23 (O = 16). The spark spectrum of this product is being specially studied by Sir William Crookes, and the arc spectrum by Dr. Eberhard, who will publish their results shortly.—On some osmionitrites and on a nitrite of osmium: L. **Wintrebert**.—A special constituent obtained in the tempering of an aluminium bronze: Pierre **Breuil**.—On β-decahydronaphthol and the octahydride of naphthalene: Henri **Leroux**. β-naphthol, reduced by means of the Sabatier and Senderens reaction, gives rise to several substances, from which the decahydride was separated in the pure state. That it is an alcohol was clearly shown by the preparation of the acetate and the phenylurethane, and also by its dehydration to naphthalene octahydride by potassium bisulphate.—On the glycol of anethol: E. **Varenne** and L. **Godefroy**.—The characters of the polygastric muscles: J. **Chaine**.—On the salivary, cephalic and metathoracic glands of some Hemiptera: L. **Bordas**.—The phagocytic resorption of the reproductive elements in the seminal vesicles of *Lumbricus herculeus*: Louis **Brasil**.—On the practical importance of the determination of the arterial pressure to avoid accidents in anæsthesia: L. **Hallion**. Remarks on a recent note of M. Tissot, and directing attention to a paper published by the author and M. Duplay in 1900 on the same subject.—The influence of the radium emanation on the toxic power of snake poison: C. **Phisalix**. Cobra poison, which is distinguished by resistance to destruction by heat, is readily destroyed by the radium radiations. On the other hand, the poisons from the salamander and toad are unaffected by the emanation.—The application of the vowel siren to the study of deafness: M. **Marage**. Each kind of deafness gives a special curve with this instrument, the form of which is characteristic of the seat of the lesion.—The glandular atrophic action of the X-rays: Foveau de **Courmelles**. The ovaries, the breasts, and the lymphatic ganglions can be atrophied under the action of the X-rays.—On the application of thermometry to water supply: E. A. **Martel**.—The coal formation in the Balkans: L. **De Launay**. On the uniformity of composition of the Amana meteorites: G. D. **Hinrichs**.

DIARY OF SOCIETIES.

THURSDAY, MARCH 9.

ROYAL SOCIETY, at 4.30.—The Rate of Transmission of the Guatemala Earthquake of April 19, 1902: R. D. Oldham.—Ionic Sizes in Relation to the Conductivity of Electrolytes: W. R. Bousfield.—Explosions of Mixtures of Coal Gas and Air in a Closed Vessel: L. Bairstow and A. D. Alexander.—On some Continuous Observations on the Rate of Dissipation of Electric Charges in the Open Air: C. Coleridge Farr.

ROYAL INSTITUTION, at 5.—Recent Astronomical Progress: Prof. H. H. Turner, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Report on Experiments carried out at the National Physical Laboratory: On the Effect of Heat on the Electrical and Mechanical Properties of Dielectrics, and on the Temperature Distribution in the Interior of Field Coils: Dr. R. T. Glazebrook, F.R.S.—On Temperature Curves and the Rating of Electrical Machinery: R. Goldschmidt.

MATHEMATICAL SOCIETY, at 5.30.—On the Weddle Quartic Surface: Mr. H. Bateman.—On the Projective Relations between Two Planes: Prof. M. J. M. Hill, Dr. L. N. G. Filon and Mr. H. W. Chapman.—On the Theory of Perpetuants: Mr. P. W. Wood.

FRIDAY, MARCH 10.

ROYAL INSTITUTION, at 9.—The Structure of the Atom: Prof. J. J. Thomson, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Theory of the Motion of the Moon. Part IV.: Prof. E. W. Brown.—The Great Nebula of ψ Eridani: Dr. Max Wolf.—Observations of Uranus and Saturn: C. J. Merfield.—Observations of Uranus at Windsor, New South Wales: John Tebbutt.—The Spectroheliograph of the Solar Physics Observatory: W. J. S. Lockyer.—Nebular Photography; a Suggestion: W. S. Franks.—The Late Leonids of November, 1904: Rev. S. J. Johnson.—Magnetic Disturbances and their Association with Sun-spots; a Reply: E. W. Maunder.—*Promised Papers:* On the Large Sun-spot of 1905, January 29–February 11, and the Contemporaneous Magnetic Disturbances, observed at the Royal Observatory, Greenwich (communicated by the Astronomer-Royal).—Notes on the Siderostat and Cœlostat: H. C. Plummer.

MALACOLOGICAL SOCIETY, at 8.—On a Dibranchiate Cephalopod from the Eocene of Arabia: G. C. Crick.—Note on the Horizon and Locality of the Type Specimen of *Pleuronautilus pulcher*: G. C. Crick.—New Marine Mollusca from the Collection of the late Admiral Keppel: G. B. Sowerby.—On the Occurrence of Internal Septa in *Glyptostoma newberryanum*: G. K. Gude.—Note on a Dart found in the Body Cavity of *Helix aspersa*: R. G. Barnes.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Purification of Sewage: F. G. Helsby.—The Purification of Sewage by Hydrolysis and Oxidation: F. O. Kirby.

PHYSICAL SOCIETY, at 8.—On the Stresses in the Earth's Crust before and after the Sinking of a Bore-hole: Dr. C. Chree, F.R.S.—On the Lateral Vibration of Bars of Uniform and Varying Sectional Area: J. Morrow.—On Direct Reading Resistance-Thermometers, with an Appendix on Composite Thermocouples: A. Campbell.

SATURDAY, MARCH 11.

ROYAL INSTITUTION, at 3.—Electrical Properties of Radio-active Substances: Prof. J. J. Thomson, F.R.S.

MONDAY, MARCH 13.

SOCIETY OF ARTS, at 8.—Telephony: H. L. Webb.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Anglo-German Boundary Expedition in Nigeria: Colonel Louis Jackson, R.E.

TUESDAY, MARCH 14.

ROYAL INSTITUTION, at 5.—Some Recent Biometric Studies: Prof. K. Pearson, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Shipbuilding for the Navy: Lord Brassey, K.C.B.

AËRONAUTICAL SOCIETY, at 8. Some Recent Experiments in Aërodynamics: P. Y. Alexander.—The Shape of Navigable Balloons: Eric Stuart Bruce.—Automatic Stability: E. C. Hawkins.—Note on an Aluminium Kite: Alan H. Burgoyne.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Manners and Customs of the Melanesians: Lantern Illustrations: Rev. W. H. Edgell.

WEDNESDAY, MARCH 15.

CHEMICAL SOCIETY, at 5.30.—The Velocity of Oxime Formation in Certain Ketones: A. W. Stewart.—Catechin and Acacatechin; Supplementary Note: A. G. Perkin.—The Action of Ethyl Dibromopropanetetracarboxylate on the Disodium Compound of Ethyl Propanetetracarboxylate; a Correction: W. H. Perkin, jun.—On Glutaconic Acid and the Conversion of Glutaric Acid into Trimethylenedicarboxylic Acid: G. Tattersall.—The Ultra-violet Absorption Spectra of Certain Enol-keto Tautomerides: E. C. C. Baly and C. H. Desch.—Esterification Constants of Substituted Acrylic Acids: J. J. Sudborough and D. J. Roberts.—α-Chlorocinnamic Acids: J. J. Sudborough and T. C. James.—Di-orthosubstituted Benzoic Acids. Part VI. Conversion of Methyl into Ethyl Esters: J. J. Sudborough and T. H. Davies.—Simple Method for the Estimation of Acetyl Groups: J. J. Sudborough and W. Thomas.—Gynocardin, a New Cyanogenetic Glucoside: F. B. Power and F. H. Lees.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—A Review of Work done by Metallographers: J. E. Stead, F.R.S.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—On the Growth of Instrumental Meteorology: R. Bentley.

MINERALOGICAL SOCIETY, at 8.—On Some New Mineral Localities in Cornwall and Devon: A. E. I. M. Russell.—On a Crystal of Phenakite from East Africa: L. J. Spencer.—(1) Notes on Various Minerals from the Binnenthal, Switzerland.—(2) A New Oxychloride of Copper from Sierra Gorda, Chili: G. T. Prior and G. F. Herbert Smith.

THURSDAY, MARCH 16.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* A Preliminary Note upon the Question of the Nutrition of the Early Embryo: E. Emrys-Roberts.—On Reciprocal Innervation of Antagonistic Muscles. Seventh Note: Prof. C. S. Sherrington, F.R.S.—On the Absence or Marked Diminution of Free Hydrochloric Acid in the Gastric Contents, in Malignant Disease of Organs other than the Stomach: Prof. B. Moore, with W. Alexander, R. E. Kelly, and H. E. Roaf.—On the Heterogenetic Origin of certain Ciliated Infusoria from the Eggs of a Rotifer: Dr. H. C. Bastian, F.R.S.

ROYAL INSTITUTION, at 5.—Recent Astronomical Progress: Prof. H. H. Turner, F.R.S.

SOCIETY OF ARTS, at 4.30.—Manipur and its Tribes: T. C. Hodson.

LINNEAN SOCIETY, at 8.—Contributions to the Flora of Liberia: Dr. Otto Stapf.—*Exhibitions:* Penguins and other Birds from the Falkland Islands, and Scratched Rocks from a Rockhopper's Rookery: R. Vallentin.

CONTENTS.

THURSDAY, MARCH 16, 1905.

MODERN OPTICAL THEORY.

An Introduction to the Theory of Optics. By Prof. A. Schuster, F.R.S. Pp. xv+340. (London: Edward Arnold, 1904.) Price 15*s.* net.

PROF. SCHUSTER has done excellent service to teachers and students alike by publishing this book, which fills a very obvious gap. It is an introduction to the theory, and purposely does not deal with details of methods of measurement or instrumental appliances; these are properly left to courses of laboratory instruction. At the same time the necessity for experiments and observations is everywhere present to the author's mind. The book is not a mere mathematical treatise on simple harmonic motion; indeed, the analysis is generally easy, and purely mathematical difficulties are avoided. Prof. Schuster writes as a physicist. The physical meaning of the steps and processes employed is everywhere insisted on, and the student is made to think throughout.

The standpoint of the author is best explained by two short extracts from his preface. After stating that the elastic solid theory of optics as developed in England by Green and Stokes has proved insufficient, he continues,

"Those who believe in the possibility of a mechanical conception of the universe, and are not willing to abandon the methods which from the time of Galileo and Needham have led uniformly and exclusively to success, must look with the gravest concern on a growing school of scientific thought which rests content with equations correctly representing numerical relationships between different phenomena, even though no precise meaning can be attached to the symbols used."

And again,

"The equations which at present represent the electromagnetic theory of light have rendered excellent service, and we must look upon them as a framework into which a more complete theory must necessarily fit, but they cannot be accepted as constituting in themselves a final theory of light.

"The study of physics must be based on a knowledge of mechanics, and the problem of light will only be solved when we have discovered the mechanical properties of the ether. While we are in ignorance on fundamental matters concerning the origin of electric and magnetic strains and stresses, it is necessary to introduce the theoretical study of light by a careful treatment of wave propagation through media the elastic properties of which are known. A study of the theory of sound and of the old elastic solid theory of light must precede therefore the introduction of the electromagnetic equations."

The book proceeds on these lines; the first part is almost entirely kinematical; the second part deals with theories of light, starting first from an analysis of the equations of motion of an elastic medium; then passing to those of the electromagnetic field, and developing the two theories side by side as far as possible.

To turn now to some details. In the earlier chapters, in accordance with the views expressed in the preface, the author deals with the properties of vibrating mechanical systems, *e.g.*, the air in a closed space, or a stretched string. After some discussion as to periodic motion in general, the equation of motion for an elastic body, propagating plane waves of distortion, is found in an elementary manner, and certain fundamental results are shown to follow from its similarity to the equation for a stretched string. Huyghens' principle of the superposition of small motions is explained, and then the reader, after a chapter on the nature of light, is introduced to the principle of interference.

The problems of diffraction are treated very fully, making use of the method of Fresnel's zones; the method is modified by the author in a manner which permits numerical results of a high order of accuracy to be obtained without the introduction of Fresnel's integrals.

After an interesting chapter on diffraction gratings we come to one on the theory of optical instruments, in which the resolving power of telescopes and spectroscopes is carefully discussed. The theory of the microscope does not find a place in Prof. Schuster's book; perhaps it belongs rather to the domain of geometrical optics.

Fresnel's theory of double refraction is given very fully, and it is based not on any unsound dynamical reasoning, but on the observed experimental fact that the velocities of wave propagation of a plane wave moving through a crystal are given by the axes of the section of a certain ellipsoid by the plane of the wave; this is clearly the right way to deal with this problem. When the laws of the propagation of light in a crystal are once determined the discussion of the rays and brushes due to the interference of polarised light follows easily, and thus we are led to Part II., which, as has been already said, deals with theories of light.

The equations of motion are found both on the elastic solid and electromagnetic theory, and the simpler phenomena are considered from both standpoints.

The weak points of the elastic solid theory, however, soon manifest themselves, and for the rest of the book the equations of the electromagnetic theory are mostly used; in dealing with dispersion Sellmeyers' hypothesis of sympathetic vibrations is applied to the electrons of a molecule, following Drude, and the usual expression connecting the refractive index and the frequency obtained; the same method is applied to explain the rotatory effects of sugar and other active substances, and in a most interesting series of sections the Zeeman and other allied effects are dealt with. In the last chapter we have a discussion on the nature of light as the resultant disturbance arising from the individual vibrations of the molecules of the source. Enough has probably been said to show the nature of the book, but one characteristic should not be omitted. Prof. Schuster has included short historical accounts of the men who have made the science of physical optics. Among them we find the names of Young, Fresnel, Cauchy, Stokes, and Maxwell; the interest of the book is increased by this course, and the subject made more human.

In conclusion, it is perhaps sufficient to say that the treatment is marked throughout by the author's well-known and admirable lucidity of style. Take, for example, the last paragraph in the book discussing the result which follows from the fact that as an extreme case for the green thallium light the periods of 88 per cent. of the vibrating molecules are identical within about one part in two millions.

"If you had a great many clocks, and found that taking their average rate to be correct, not more than one in eight would be wrong by a second in twenty-three days, that would represent the maximum amount of variation which one interpretation of the experiment allows us to admit in the case of molecular vibrations. But would any maker undertake to supply you with a number of clocks satisfying that test? If, further, it is considered that the limits we have chosen for the possible variations of molecular vibrations are far too great, we see that though Sir John Herschel's saying that atoms possess the essential character of manufactured articles is still correct, yet no manufactured article approaches in accuracy of execution the exactitude of atomic construction. We may conclude with Maxwell that 'Each molecule therefore throughout the universe bears impressed on it the stamp of a metric system as distinctly as does the metre of the archives at Paris or the double royal cubit of the Temple at Karnac.'"

TECHNICAL ANALYSIS.

Manual of Chemical Analysis. By E. Prost, D.Sc. Translated by J. C. Smith, B.Sc. Pp. iv+300. (London: Maclaren and Sons, 1904.) Price 12*s*. 6*d*. net.

Techno-Chemical Analysis. By Dr. G. Lunge. Translated by A. I. Cohn. Pp. vi+136. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 4*s*. 6*d*. net.

DR. PROST'S manual contains a number of selected methods dealing more particularly with mineral and metal analysis which have been compiled, so the preface states, for the use of the "industrial chemist," and which the author assures us are the result of his own experience or that of specialists with whom he is in touch.

The analysis of mineral products—silicates, phosphates, clays, cements, iron and iron ores, and the assaying of lead, silver, gold, &c., have been so fully elaborated that no analyst deserving the name would be satisfied without knowing the latest improvements in the methods connected with his own industry. A chemist in an iron works, for example, wants all the information he can obtain from the specialist who has made a minute study of iron and steel analysis, including the character of etched surfaces, and through whose hands a large variety of specimens have passed The same, of course, applies to raw materials and finished products of other manufactures. The works analyst is not a student, and though he may wish to be informed on analysis in general, it is not essential to his business.

Does Dr. Prost's book as a whole fulfil its promise? Whilst there is no doubt that many of the methods answer to the description given in the preface, and will be found serviceable to the works analyst, it must be confessed there are also many others which fall short of it. In too many instances there is a lack of descriptive detail, an absence of reference to recent improvements, and the omission of recognised and standard methods. The common fault of this class of book is to be too discursive; to cover too much ground. The small treatise on one subject by an expert like Blair or Ledebur on iron and steel analysis, Brown on gold and silver assaying, Lunge on the alkali manufacture, is the sort of thing one would like to see multiplied.

The writer has no wish to deal unfairly with the manual under review. It is not uniform in character, and if the above criticism applies to certain sections, it is also abundantly evident that other portions have been carefully and conscientiously put together by one who possesses a thorough knowledge of his subject. Moreover, the introduction of mechanical tests, which are too frequently overlooked, is a feature deserving mention. The translator's attention should be directed to the mis-spelling of Stanfurt for Stassfurth, p. 41, Vollard for Volhard, p. 106, and Spiegal for Spiegel, p. 206. The illustrations suffer very much from the rough surface of the paper.

The name of Dr. G. Lunge on the title page of any book, and especially one connected with technical analysis, would command a careful perusal and a thoughtful judgment. It must be confessed that in the present case the author has not done himself justice. Anyone who purchased the volume in the hope of obtaining practical information on techno-chemical analysis (the translator's rendering of chemisch-technische Untersuchungsmethoden) would, to say the least, be disappointed.

When it is stated that in 128 small octavo pages, in addition to "general operations," and gas, water, and fuel analysis, the analysis of about eighty technical inorganic and organic products is described, further comment seems superfluous. The subject of glycerine, which comes under the section of *soap*, may be taken as a specimen of the method of analytical treatment.

"Glycerine is found in large quantity only in toilet soaps. The method of determining it is given here, because it must be examined by itself as an individual commercial article, and the glycerine yield of raw fats in the manufacture of stearin must also be determined. The determination is effected either by oxidation with potassium-permanganate solution in alkaline solution, precipitating the oxalic acid formed as a lime salt, and titrating the latter, or by oxidation with normal potassium-dichromate solution, with the addition of an excess of ferrous sulphate solution of known effective value, and then titrating the dichromate solution."

This occupies half a page, sugar is elaborately treated in four pages, tanning in two and a half, dyeing in as many as seven, mineral oils, vegetable oils, and fats in seven, and so on. The most useful page in the volume is the bibliography of important works of reference at the beginning, though it is scarcely worth the price of the book. J. B. C.

THE ZOOLOGICAL RECORD.

The Zoological Record, Volume the Fortieth; Relating Chiefly to the Year 1903. Edited by D. Sharp. (London: The Zoological Society, 1904.) Price 30s.

YEAR by year this invaluable publication appears with commendable regularity, and year by year its bulk steadily increases, the bulk of the present issue being nearly double that of its predecessor of forty years ago. Hitherto the subscribers have yearly obtained more for their money, but there are limits beyond which even the generosity of a great scientific society cannot go, and it has consequently been decided, although with reluctance, that in future the price of the annual volume must be increased. The bulk of the present volume has been somewhat diminished by printing it on thinner paper than its predecessors; and, although this innovation may have been unavoidable in order to bring the weight within the limits laid down by the Post Office for transmission abroad, it cannot be said to be altogether an improvement, as in places the type shows through in a decidedly obtrusive manner.

Whether such a radical alteration was really inevitable may perhaps be doubtful, for it is quite evident that a large amount of space might be saved if a uniform plan were adopted throughout the work. For instance, in the section on mammals 385 titles are recorded and their subjects epitomised in a space of forty-two pages, whereas in the section on echinoderms no less than 105 pages are taken up in dealing with 339 papers.

If such prolixity is necessary in the one case, it is equally essential in the other; and, conversely, if the brief mode of treatment will suffice in one instance, it should be adopted in the other. Much space might also be gained, without any loss, in the sections on reptiles and fishes, as well as in certain others.

This lack of uniformity in treatment is, in our opinion, the one point in which this "Record" compares unfavourably with the one issued by the committee of the "International Scientific Record"; and it is high time that it was amended. Surely the editor is strong enough to keep his contributors in hand, and to make them do the work his way and not their own. As an instance of this slackness of the guiding hand we may refer to the fact that in one of the sections the recorder has been allowed to adopt the spelling Meiocene and Pleiocene, which is both wrong (on the supposition that we form our scientific names through the Latin) and pedantic. If any alteration in orthography of this nature were permitted, it should be the substitution of Plistocene for Pleistocene; but if such a change were made it should run through the entire volume.

The comparatively early date at which many of the sections are now sent to press renders it impossible to include so many of the papers for the year to which they specially refer as was formerly the case, but this is a matter of no great moment, so long as such papers make their appearance in the volume for the following year.

Mistakes and omissions there must of course be; but these seem to be few and far between. We notice, however, in the mammal part that Condylarthra has been put in place of Amblypoda, while in the concluding paragraph of the first page of his introduction to the insects the editor is guilty of a blunder which should cause him to be lenient to the shortcomings of his contributors. Whether he can escape blame for errors like the omission of a reference number in the penultimate line of p. 21 of the mammal part may, however, be open to question.

Taken all in all, the volume is a marvellous production, both as regards accuracy, fulness, and the comparatively early date of its appearance; and the editor and his staff are entitled to the best thanks of the zoological world. When we have said that the "Zoological Record" still stands without a rival, we have said sufficient.

R. L.

OUR BOOK SHELF.

A Synonymic Catalogue of Orthoptera. By W. F. Kirby. Vol. i. Orthoptera Euplexoptera, Cursoria, et Gressoria. (Forficulidæ, Hemimeridæ, Blattidæ, Mantidæ, Phasmidæ.) Pp. x + 501. (London: the Trustees of the British Museum, 1904.)

THE value of such a general synonymic catalogue as this work is obvious, but the increased interest which has been taken in Orthoptera in recent years, and the rapidly accumulating mass of literature, has made a complete and systematic catalogue of this order an urgent necessity. The work is upon the same model as the author's previous catalogue of dragon-flies. The species are numbered, though no particular order appears to have been followed; the distribution is given in the margin, and synonymy is attached, although a complete list of references is not given in every case. One of the most prominent features of the list is the conscientious manner in which the author refuses to admit as synonymous such names as to the absolute identity of which he is not personally convinced, resulting in an apparent multiplication of species. Thus, on pp. 30 and 31, we find *Spongiphora parallela*, *S. lherminieri*, *S. dysoni*, and *S. croceipennis* all entered as separate species, though nowadays there are few who doubt their identity, and fewer still who can discriminate between them. Again, on p. 2, *Diplatys gerstaeckeri* and *D. longisetosa* are regarded as separate, although it is impossible to distinguish them. To such an extent does the author carry this principle, that he admits names published with figures only, such as *Pygidicrana huegeli*, Sharp, and even *Ancistrogaster petropolis*, Wood, based upon a reference and an illustration in a popular work. But yet he relegates *Psalis indica*, Hagenb., var. *minor*, Borm., as a synonym of *P. guttata*, Borm., although the describer insisted upon the extreme variability of the older known species. But questions of nomenclature and classification are of necessity controversial; many may disagree with the author's arrangement of the genus Labidura, in which a number of insufficiently described so-called species are regarded as valid, only on account of the difficulty of proving their identity with the excessively variable and universally distributed *Labidura riparia*, Pallas.

Otherwise, changes of well-known names are few. We are glad to see *Blatta* retained, at the expense of *Stylopyga* for *orientalis* and not for *germanica*.

Hololampra, Saussure, 1864, replaces the more familiar Aphlebia, Brunner, 1865.

But this catalogue should be received less with criticism than with gratitude to the painstaking author, and we hope the second volume will appear at an early date; it will doubtless include such omissions as have been unavoidable in the first volume, owing to the time necessary for publication.

M. B.

Percentage Tables for Elementary Analysis. By Leo F. Guttmann, Ph.D. Pp. 43. (London: Whittaker and Co., 1904.) Price 3*s.* net.

THIS book is only intended to facilitate the calculation of the results of an ordinary organic analysis, and its title, therefore, is somewhat misleading. It is stated that "the tables have been carefully calculated and checked, they are therefore absolutely accurate." After this statement, nothing is left to us but to see if they are likely to be useful. After careful consideration of this question we are compelled to give an unfavourable reply. If we have the analytical result that 0·1173 gr. of a substance gave 0·2869 gr. carbon dioxide, we can, in the ordinary course of things, by looking out the logarithm of 0·2869, adding the easily remembered logs. of 12/44 and of 100, and subtracting the log. of 0·1173, get the log. of the percentage. But according to the tables before us, we look out a number corresponding to 0·117 and 0.28. We then look again for a number corresponding to 0.118 and 0·28. We subtract the two numbers, multiply by 0.3 by means of another table, and subtract this result from the first number looked out. We next find a number corresponding to 0·117 and 0·69, divide by 100 and add this result, and thus, after four references to tables, two arithmetical operations in the head, one subtraction and one addition on paper, we get our percentage. Appeal to a chemist constantly engaged in organic analysis has only confirmed the view that these tables are unlikely to save time or to promote exactitude in the calculation of organic analyses.

A. S.

How to Photograph with Roll and Cut Films. "The Amateur Photographer" Library, No. 30. By John A. Hodges. Pp. xviii+120. (London: Hazell, Watson, and Viney, Ltd., 1904.) Price 1*s.* net.

THE ever increasing number of photographers and more especially amateurs, who work with either roll or cut films, will find in these pages all the necessary information for the production of pictures. The author does not pretend to have written a treatise on the whole art and science of photography, but he has given a straightforward account of the various operations that have to be completed to ensure good results. The treatment is well suited for amateurs, and the numerous well reproduced illustrations serve admirably to render many points clear.

The Telescope. By Thomas Nolan. (New York: D. Van Nostrand Company, 1904.) Price 50 cents.

THE first edition of this small treatise on the elementary principles of optics as applied to telescopes appeared in 1881. In the present issue the author has left this matter practically as it first appeared, with only one or two minor corrections, but has added a chapter describing in a brief manner the advances that have since been made. At the end is also given a bibliography relating to the telescope, which will be of service to those who wish to study more in detail different branches of the subject to which slight references only have been given. The book is published in the Van Nostrand Science Series, and should prove a useful addition.

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 Infection of Laboratories by Radium.

IN a recent attempt in the physics building of McGill University to make electroscopes with a very small natural leak, repeated failures were encountered. The rate of discharge of several instruments, carefully made, was found to be about sixty to one hundred times as large as that obtained by Mr. H. L. Cooke two years earlier in the same building. At first it was supposed that the insulation of the sulphur bead was defective. But the natural leak was large and unaffected when the upper support of the sulphur bead was raised to a higher potential than the gold leaf system, so that the insulation was not at fault. Nor was the rate of discharge altered when the electroscope was entirely surrounded by lead one inch thick. Removal to another building produced no effect on the leak of the electroscope. It appeared probable that the trouble was due to the radio-activity of the materials from which the electroscope was made. A rude instrument, made in a private house with a tobacco tin, the amber mouthpiece of a pipe, and a cork, was found to give better results than the most carefully constructed instrument in the physics building. Some electroscopes were next made in the chemistry building, using materials which had never been into the physics building. Instruments with a very slow rate of discharge were now easily manufactured. These were used to test materials from various parts of the physics building, and it was found that all were infected with excited activity. Sheets of mica, lead foil, iron, zinc and tin were all active, even when taken from drawers or cupboards.

Of the substances tested, the only one which showed no activity was some thin Dutch metal leaf kept between tissue paper in a closed drawer. About 90 per cent. of the excited activity could be removed from the metal sheets by strong hydrochloric acid, but the activity was transferred to the solution. It was also possible to volatilise a portion of the deposit by raising the metal sheet to a red-heat in a Bunsen flame. Both α and β rays were detected, but it was difficult to measure their exact proportion. The natural leak of an electroscope was increased to a measurable extent when a mica window was replaced by one cut from a sheet of mica kept in the physics building.

The difficulty of conducting radio-active experiments in rooms where strong preparations of radium were present was early observed by Madame Curie, and later by Elster and Geitel, but the present experiments seem to show that the effect may be widely spread. The emanation from radium used in the large physics building has passed by convection and diffusion into various rooms. In a few days each fresh supply of emanation is transformed into the rapidly changing substances radium A, B, and C. The further changes of the products of radium have been investigated by Prof. Rutherford, and described by him in his Bakerian lecture (*Phil. Trans.*, vol. cciv., pp. 169–219), and in a recent letter to NATURE (February 12). In the former he has pointed out that bodies exposed to the air in the open will be covered with an invisible film of radio-active matter of very slow rate of change, and that the strong radio-activity observed in a room in which radium preparations have once been used is probably due to the deposit on the walls of the room of this slowly decaying matter from the emanation. In his letter to NATURE, he has shown that radium C gives rise to radium D, and that the further change to E is rayless in character and attains half value in forty years. The further change to F emits β rays, and reaches half value in six days, whilst the change from F to the final product is accompanied with α rays, reaching half value in 150 days.

The α and β rays emitted by the coating on the materials in the physics building are doubtless due to the changes above mentioned. If the supply of emanation were arrested at the present date, the activity already deposited would rise to a maximum in two or three years, and then gradually decay, following an exponential law, and reaching half value in forty years. But should the supply of emanation in the future equal that in the past, the activity would continue to increase in magnitude for the next hundred years or so, until the supply and decay of radium D attained a steady value. By that time radio-active experiments of a delicate nature would become difficult or impossible, as the excited activity would rapidly discharge a gold-leaf electroscope.

As the excited activity can be largely removed by acid, the infection will at present cause no serious difficulty in the majority of experiments on radio-activity, particularly as the leak arising from it remains almost constant for weeks or months. But when an electroscope with a very small natural leak is required, it will be necessary to employ fresh materials which have not been exposed to emanation.

It appears desirable, in the case of laboratories not yet infected, to keep radium in sealed vessels, and to blow the emanation into the open air, and not into the rooms of the laboratories.

A. S. Eve.

McGill University, Montreal, February 25.

International Atomic Weights.

The committees engaged in revising the tables of atomic weights have now sent in their reports for 1905. The one which appeared in the *Berichte* is, of course, printed in German, and that which has just been circulated by the Chemical Society is in English.

Unfortunately, there is a want of uniformity in the naming of the elements. Thus, in the English table we find Glucinum, Gl, and Columbium, Cb, whereas in the German table these elements are called Berylium, Be, and Niobium, Nb, respectively. Historically, no doubt, the names adopted in the English table are more accurate. But in all text-books the names and symbols employed in the German tables are used, and have been for many years.

It is difficult to see where the advantage in making the change comes in, but, on the other hand, the disadvantages of having two forms of nomenclature are obvious.

F. Mollwo Perkin.

London, March 8.

The Planet Fortuna.

Perhaps Airy quoted his Juvenal correctly, which "W. E. P." (p. 410) has failed to do. The poet was so well satisfied with the lines that he gives them twice, in his tenth and fourteenth satires. And they run thus:—

> Nullum numen habes, si sit prudentia; nos te
> Nos facimus, Fortuna, deam cæloque locamus.

W. T.

The lines are variously quoted, and I cannot say what version Airy favoured. I believe he spoke from memory.

W. E. P.

COSTA RICA.[1]

Up to 1540, Spain had reserved for the crown that part of the territory of Veragua lying west of the portion which had been granted to the heirs of Columbus; but, in that year, it was erected into a province and called Costa Rica. It lies between Nicaragua and the newly hatched, but featherless, republic of Panamá, and is the smallest State of the New World except Salvador. But it is one of the most interesting, for, with Panamá, it forms the connecting link between North and South America, not only physically but ethnologically. If more were known of its ancient inhabitants, their type, character, modes of life, habits and customs, inter-tribal relations and forms of worship, and of the ruins of ancient towns and burial places which are silently dotted over the country, one might go far towards a solution of many vexed problems as to the relation betwen early Mexican culture and that of the Andean peoples—Chibchas of ancient Cundinamarca, the Quitos and Cañaris of Ecuador, the Quichuas and Aymarás of the Inga empire. Much of the data necessary to the formation of a just conclusion are buried on the slopes of the volcanoes of Turrialba, Irazú, Barba and Poás, and, in that richest of fields for archæological research, the district lying between Lake Nicaragua and the Gulf of Nicoya on the Pacific coast of Costa Rica, while the lowlands lying between Nicaragua and the Atrato River of Colombia probably hide, under their densely matted and almost impenetrable vegetation, whatever evidences may exist of their occupation by man, not only in the far-remote past, but even at the date of the Spanish conquest.

Hence we may welcome a scientific examination of any section of the region outlined above, but especially when the results are so carefully and clearly set forth as they are in the work under review—a large quarto volume richly illustrated. Its publication, as well as the explorations of which it treats, have been made at the expense of Mr. Åke Sjogren, who has presented to the Royal Ethnological Museum of Stockholm the valuable archæological collection with which Mr. Hartman returned home. This gentleman, whose studies had well equipped him for his task, proceeded to Costa Rica in 1897, where he remained more than a year in the territory once occupied by the Guëtare race. He commenced his researches in May (the beginning of the rainy season) near the *hacienda* of Mercedes, which is situated on the Guapiles branch of the Costa Rica Railway, about fifty miles from Port Limon.

"On the Atlantic side, the moisture-laden atmosphere and tropical heat have clothed the mountain chains and the low swamp lands with eternal verdure, with forests which are almost impenetrable, woven together as they are by lianas passing from tree to tree. Neither aboriginal nor Spanish culture ever made great inroads on the primeval forests of the Atlantic coast."

Near Mercedes is a mound about 100 feet in diameter at the base, 65 feet at the top, and 20 feet high. It is in a partially walled enclosure, and probably served as a platform on which to erect statues facing the rising sun. The mound may have been covered with a wooden structure with a thatched roof. Among the many human figures found there, all mutilated, were two of life size, one of which is notable as having ear plugs. The chest and back are crossed by two thick ropes, which pass over the shoulders and reach to the hips. The right wrist supports a human head. The other large statue has its hands resting on the hips. The heads of both figures are covered with conical hats. Rudely sculptured representations of alligators, pumas, and other animals were found, but in fragments. All of these, including the statues, were cut from hard, basaltic lava.

Mr. Hartman also examined the extensive burial places of the ancient inhabitants of this district, and opened a great number of cists. These varied in dimensions, but it is apparent that they were rarely intended for the interment of more than one person. They had side and end walls of cobble stones, but the bottom and top were of slabs of limestone. The horizontal section of the cists was very irregular. Only in one did he find traces of bone, but the "dark soil near the bottom seemed to prove that the body or bodies had been placed there."

Many vessels of burnt clay, sometimes roughly

[1] "Archæological Researches in Costa Rica." By C. V. Hartman. The Royal Ethnological Museum in Stockholm. Pp. 195; map+87 plates. (Stockholm: C. E. Fritzes, 1901.)

decorated, were lying in the cists, but a great part of them, covered with soot, appear to have served as cooking utensils. Several contained charred maize and fragments of corn cobs. In one was found some Millefiori beads, the manufacture of which was an important industry in Venice during the latter part of the fifteenth century, and the author says that, "Later on, I discovered a number of this kind in a grave at Osori in the highlands."

Thus it appears that these Indian towns were still in existence at the time of the Spanish invasion.

Mr. Hartman also opened a *cache*, similar to a cist, but there was no proof that it had ever been used as a grave; in fact, it was too small. It contained sixteen clay vessels, some of them ornamented, and much broken pottery. There were several globular bowls and vases. "The practice of secreting household articles as well as food in pits or in caves has from early days been observed among widely disseminated tribes of North America."

The work-yard of the ancient stone-cutters was happily discovered, and many unfinished idols were lying about.

In June, 1895, I roughly examined the mounds and some of the graves near the *hacienda* of Mercedes, and especially remember the two great statues described by Mr. Hartman. People resident in the vicinity, who know much of the region, said that the whole Santa Clara district, occupying the slopes of Turrialba, Irazú and Barba, and the heavily forested lowlands to the north and east, are dotted with ancient burial grounds.

Fig. 1. Shallow, tripod bowl found in Field II., Chircot Height, 12·8 cm.; Diameter, 22 cm. From "Archæological Researches in Costa Rica."

From the coast lands, Mr. Hartman ascended to the highland plains near Cartago, one and a half miles west of which town is the water divide, 5100 feet elevation, between the Atlantic and Pacific Oceans. Cartago is about 4800 feet above sea-level, and lies upon the southern slope of the volcano of Irazú, the only one of Costa Rica which has ejected compact lavas. In its eruptions of 1841 and 1851 it almost completely destroyed Cartago, which was the former capital of Costa Rica. In its vicinity Mr. Hartman uncovered numerous cists similar to those of Mercedes, but they contained a greater variety of potsherds and ornamental pottery. He made especially rich collections at a spot called Chircot, where he observed that a favourite figure of the ancient artists was a flute-playing god. In the stone-bordered necropolis at this place he found 205 cists, many of them in three layers. In about thirty there were skeletons, or fragments of skeletons, which averaged five feet in length. The skulls were dolichocephalic, but most of the remains were too decayed for removal. Summarising his year's work, he says of the culture of the Guëtares "that it proves to be that of a stone-age people of high standing, possessed of ornaments of gold and copper, but with no tools or weapons of metal at all. We have no data whatever to enable us to determine how far back into the past this culture reaches, but the presence of beads of glass in the graves goes to show that it continued to exist after the arrival of the Spaniards. No traces of a more primitive culture were met with."

Similar cists are to be found on the slopes of Popocatapetl in Mexico, Zaculen in Guatemala, Chiriqui in Panama, and at Arayo in the Cauca valley of Colombia. In outline and elegance, the clay vessels of the Guëtares are inferior to those found in Chiriqui, but the objects in stone from the two sources closely resemble each other.

It is to be regretted that Mr. Hartman has not given us his views as to the ethnological relations of the Guëtares to the other aboriginal tribes of Central America. No doubt, in his travels subsequent to the researches so elaborately detailed in his valuable volume, he must have formed opinions of much importance to the student of aboriginal America. Costa Rica was a debatable ground between the Mexican race and the warlike Carib of the northern shore of South America. It may, perhaps, be conceded that an offshoot of the highland people of Mexico pressed south and east from Chiapas into and through the long strip of the Pacific coast occupied by the Chorotegas or Mangues, followed the Pacific slope of the Cordillera and the narrow belt of land between Lake Nicaragua and the ocean, penetrated into north-western Costa Rica, settled and helped the Mangues to develop a considerable civilisation in the Guanacaste and Nicoya districts, and in part subdued all the mountainous area lying north and west of the river Reventazon. The culture which was characteristic of the region indicated was infinitely superior to anything attained by the Guëtares, for the Mangue-Náhua people carried some of the arts, such as pottery, sculpture, weaving, and tilling the ground, to greater perfection than any of the tribes occupying the territory between theirs and that of the Chibchas of the plateau of Bogotá. In their graves are found examples of the ceramic art and gold ornaments showing taste in design superior to any that the present civilised Indian of Costa Rica can equal. Their graves produce beautiful specimens of obsidian, greenstone, and finely wrought nephrite

Fig. 2.—Seat of Stone. Found in the forest in the neighbourhood of the large mound, Mercedes. From "Archæological Researches in Costa Rica."

tools and jade ornaments, knives, hatchets, arrowheads, armlets, rings, and a multitude of stone seats and idols.

Let us hope that Mr. Hartman may follow up his good and useful work by an exploration of the northwestern slope of the country which has been the scene of his labours. GEORGE EARL CHURCH.

PROGRESS IN AËRIAL NAVIGATION.

THE problem of aërial navigation has been attacked by direct methods for so many centuries that the results of the recent aëronautical competition at St. Louis can scarcely be regarded as a matter of surprise. It is doubtful whether the offering of large prizes for the achievement of a result which has been attempted for years without success is the best means of promoting progress. As will have been learnt from the daily Press the great prize of 20,000*l.* was not even competed for, and a much more useful purpose would have been served by a systematic and organised attempt to encourage, by means of prizes, investigations calculated to throw an indirect light on the general question of aërial navigation, such, for example, as improvements in the efficiency of propellers, diminution of the angle of gliding of gravity-propelled machines, reduction of air-resistance of motor-propelled balloons, solution of the difficulties connected with longitudinal stability, especially in gliding machines travelling at low speeds, and what is still more important, the discovery of new results in any direction whatever calculated to open up fresh methods of approaching the whole question.

If we chronicle merely the attempts that have successfully been made in striking out on new lines, leaving out of account improvements subsequently made on the same lines, and also omitting early attempts such as those of Dante of Perugia and Le Bris, a history of aërial navigation will be summed up in the following short list :—(1) Montgolfier's discovery of the balloon; (2) application of mechanical power to the propulsion of balloons by Renard and Krebs; (3) introduction of gliding experiments under gravity by Lilienthal; (4) the introduction of explosion engines and other light motors theoretically capable of maintaining a flying machine in the air. Each of these innovations has brought the goal more distinctly in view, and yet experiments so far have left a wide gap between the results of actual performance and what is necessary to render aërial navigation practically useful. The special difficulty connected with aërial navigation is that it is not easy to see how to approach the problem except by direct methods of attack, while the great majority of scientific discoveries have been made indirectly as the result of observations originally undertaken for some entirely different object that has been known from the very outset to be possible of attainment.

By analogy with fishes and birds, respectively, the two forms of machine experimented on, involving as they do the use of gas bags and aëroplanes or aërocurves, might not inappropriately be described as the aërial swimming machine and the flying machine proper. It is somewhat remarkable in the face of natural evidence that the swimming machine has up to the present proved by far the most tractable of the two, and has undoubtedly led to the best results. It is the safest to experiment with. That accidents have frequently occurred is perfectly true, but they have all been attributable to causes not beyond the ken of an ordinary practical but intelligent mechanic.

Of aërial swimmers constructed within the last few years the most notable ones are undoubtedly the Santos Dumont series, the ill-fated De Bradski airship, the Lebaudy, Barton, Spencer, Baldwin, Benbow, Beedle, and Deutsch forms. A few details of these, collected for comparison, may be of interest.

M. Santos Dumont's No. 7 is 160 feet long and 23 feet in diameter, and is provided with a four-cylinder motor capable of developing 60 horse-power and making 1200 revolutions per minute. Its predecessor, No. 6, was 108 feet long and 20 feet in diameter, with a motor of 16-20 horse-power. This was the machine which won the Deutsch prize, and its speed relative to the air was probably about 19 miles an hour. No. 7 was originally intended to compete at St. Louis, but M. Santos Dumont did not enter.

The De Bradski airship is now a thing of the past. It was 111 feet long and weighed about 1923lb., and a special feature was that the machine was not *quite* light enough to raise itself, the ascent being effected by a screw revolving in a horizontal plane. The experiment ended in October, 1902, with a fatal accident, the airship becoming unmanageable, and the car breaking away owing to the weakness of its supporting wires.

The experiments of MM. Lebaudy have been remarkably successful in spite of an accident which destroyed their first machine in November, 1903. This did not deter these indefatigable aëronauts from constructing, partly out of the wreckage of the old one, a new machine of the following dimensions :— Length 58 metres, greatest diameter 9·8 metres, volume of gas 2600 cubic metres, or about 94,000 cubic feet; motor, a four-cylinder Daimler of 40 horse-power running at 250 to 1200 revolutions per minute; propellers, two screws 2·44 metres in diameter running at 800 to 1000 revolutions per minute. Of the thirty voyages made with this "aërial cruiser" in 1904, the following appear to have been the most successful :— August 16, a distance of 16 miles in 41 minutes; November 22, a run of 1 hour 33 minutes. An accident occurred on August 28 owing to the "swimmer" breaking loose, but it floated away to a distance and finally got caught in a wood 70 kilometres distant, whence it was brought back with slight damage. The present model is remarkably like a fish in shape, and the resemblance is further accentuated by the tail-like double horizontal rudder in the stern. The balloon has a flat base with a long vertical keel, and all these arrangements are well calculated to make it travel steadily.

Beyond the mere rumour of an accident last spring the Barton airship seems to have lapsed into oblivion of late, but it must not be forgotten that a year is small interval of time in the construction of aëronautical machines. The dimensions given are as follows :—Length of balloon 170 feet, diameter 40 feet, total estimated weight 15,700lb.; number of propellers, six, each consisting of six blades arranged tandem fashion, placed in pairs, one on each side of each motor; motors, three in number, developing 50 horse-power each, and running at 1600 revolutions. A peculiarity of Dr. Barton's design is the series of aëroplanes, thirty in number, employed to raise the machine. The shape of the balloon and the structure of the underlying framework and car suggest the possibility of considerable head resistance.

Of the performances of Messrs. Spencer's airship satisfactory records were given in the Press at the time. The dimensions are :—Length 93 feet, diameter 24 feet; propeller, a single screw 12 feet in diameter, placed in front; engine of 24 horse-power running at 1050 revolutions.

Mr. Baldwin's and Mr. Benbow's airships, exhibited at St. Louis, appear not to have made any noteworthy performances, the former having failed to stem a wind of six to eight miles an hour, and the latter having made progress at the rate of three miles an hour. We have before us a brief description of the machine with which Mr. Beedle made a successful preliminary trial in November, 1903, and further trials were promised for last spring. Mr. Beedle proposed to dispense with rudders and steer by means of a screw fan in front which could be turned in any desired direction, an arrangement calculated to leave much to be desired in the matter of steadiness. The particulars are:—Length 90 feet, diameter 24 feet, horse-power 12. Of the Deutsch "swimmer" only a model was exhibited at St. Louis.

A comparison of the figures of several of these airships gives the impression that the Lebaudy balloon is far ahead of most of its rivals in its well designed proportions. The only questionable feature is the presence of horizontal rudders at the back of the car, in a place where they might prevent the stream lines of air from closing round the balloon, and thus increase the resistance. About this point MM. Lebaudy are best able to judge.

The limits of speed of the aërial swimmer attainable by existing methods are now pretty well known, and fall far short of the amount necessary to travel in the teeth of a high wind. Still, the navigable balloon offers the most promising field of experiment for those who are not prepared to devote themselves to a long course of purely mathematical and experimental researches, or to run blindfold into the dangers which such a course of study would enable them to predict.

For the successful realisation of mechanical flight proper, what is most wanted is a complete and exhaustive investigation, both by mathematical and experimental methods, of the longitudinal stability of various forms of machine gliding at various angles either under gravity alone or when mechanically propelled.

The small fluctuations of a gliding machine about steady motion are determined by exponential functions of the time the coefficients of which are the roots of an equation of the fourth degree. If these roots determine oscillatory motions there will be, not one, but two different oscillations of the machine in a vertical plane. Either of these oscillations may increase or decrease with the time, and unless they both tend to decrease the pitching will become dangerous and the machine will overturn. Photographs of the paths of gliders taken by Mr. Williams some time ago with magnesium light distinctly showed the two oscillations, and in several cases the final overturning in a manner perfectly consistent with theory.

Now it is possible to determine experimentally for any given machine the coefficients of stability when gliding at every different angle. To do this it would be necessary to measure, by means of dynamometers, the force and couple components acting on either a full-sized machine or a model when moved through the air in different directions in its plane of symmetry. It is necessary also to take account of the small changes in these forces and couples when the machine has a small rotational motion, such as occurs when it is turning upwards or downwards in the course of its oscillations. These small changes may, and in all probability do, play an important part in affecting the stability. A whirling table gives exactly the kind of small rotation required in addition to the necessary translatory motion. By reversing the model experimented on, the direction of this rotation may be reversed, and the differences of the two sets of dynamometer readings will give three of the coefficients of stability.

If observations of this kind were made it would be possible to work out on paper the oscillations, and to ascertain the lowest velocity at which a machine would glide safely.

But experimenters have hitherto confined their attention to measurements of the air resistance, and very few have up to the present given much attention even to the variations in the position of the centre of pressure except for a few cases such as a square lamina. The object in most cases has been merely to find out the speed at which a flying machine would travel under favourable conditions, and not its powers of extricating itself from the most unfavourable positions which it might assume on a gusty day. "Stability of motion" is a phenomenon which rarely enters into practical problems. In the flying machine it is of paramount importance.

A similar mathematical investigation has been made by Signor G. A. Crocco in Italy, in connection with stability of airships, but the author obtains an equation of the third instead of the fourth degree. He, however, takes no account of the fluctuations in the horizontal motion, which are certainly of importance in the case of gliders.

Meanwhile the artificial balancing of gliders under gravity has been the subject of a considerable number of experiments in America, and more recently in France, and the initial success of Mr. Orville Wright in rising from the ground on a motor-driven machine in the face of a wind, and landing safely constitutes the first achievement of an actual flight. It is a matter of congratulation that Mr. Wright was not so emboldened by his success that he became reckless, and pushed the experiments on to a premature end.

The large curved surfaces of the disastrous Lilienthal and Pilcher experiments have now given place to a pair of narrow superposed rectangles, first introduced by Chanute and Herring. The tail has since, in the hands of Messrs. Wilbur and Orville Wright, been replaced by a front rudder, and the adoption of a horizontal position "à plat ventre" shows that the maintenance of balance has been reduced to a matter of steering.

These types of gliders have been taken up in France by Captain Ferber, of the Artillery, and subsequently by Mr. Ernest Archdeacon, both of whom have become enthusiastic "aviators," and have in their turn brought gliding experiments into considerable popularity in that country. As Captain Ferber remarks, a sloping hillside with a wind blowing straight up it are necessary, and a convenient experimenting ground has been found at Meudon. With the object of experimenting on larger motor-driven models Captain Ferber constructed an aërodrome consisting of a column eighteen metres high, supporting a rotating beam thirty metres across. This apparatus would be very useful for determining the stability coefficients of an actual machine firmly attached to its beam, but it must not be forgotten that any kind of suspension may seriously modify the longitudinal oscillations. So, too, may the rotation about the vertical axis; it is much easier to make a glider describe a corkscrew path than glide in a straight line. A kite illustrates the same properties. Its oscillations also depend on a biquadratic equation, but the supporting string modifies their character, and Mr. Cody claims that a man has been lifted 1600 feet by kites, though how the *photograph* of "the Cody man-lifting kite 800 feet high" was taken, which appears in the *Aëronautical Journal*, is not explained. The use of kites for saving life at sea might well receive more attention than has been bestowed on this question up to the present. The clumsy plan of sending up rockets in the teeth of a gale such as would just blow a kite line from ship to shore needs reconsideration.

Little has been published about Prof. Langley's experiments beyond a reference to the accident which gave Prof. Manley a premature bath in the Potomac.

The idea of combining a glider and boat was tried initially with success and ultimately with failure by Herr Kress on a reservoir a few miles out of Vienna, near the main railway line from Germany. Major Baden-Powell has adopted the same plan at the Crystal Palace. The machine descends a kind of chute from a height of about thirty feet, and is shot off into the air about six feet above the water. With this small height it is not unlikely that successful glides might be made even if the steady motion were longitudinally unstable, for by careful projection several wave-lengths might safely be described in the air before the pitching became dangerous.

It is probable that a motor driven machine travelling at high speed would be much more stable than a gravity machine, but to understand the management of the machine is a necessary condition of success, and the more this can be made the subject of mathematical study the easier will the task be for an aëronaut who is perfectly familiar with the equations of motion. In regard to the effect of speed on stability, the pretty butterfly-like "helicoptera" driven by elastic must not be quoted as instances. They raise themselves nearly vertically; we are concerned with machines moving nearly horizontally.

From all that has been said above it will be seen that there is plenty of work to be done in connection with aërial navigation. At the present time, careful quantitative measurements of the coefficients of stability of actual machines by attaching them to whirling tables are even more needed than further balancing experiments in mid-air.

G. H. BRYAN.

PHAISTOS AND HAGIA TRIADA, CRETE.

IN the south of Central Crete, a day's journey from Candia on a good horse, lies the scene of discoveries no less important than those of Dr. A. J. Evans at Knossos. They consist of the ruins of two palaces, one large and one small, but both built on the same general plan and with the same materials (stone and concrete) as that which has made Dr. Evans famous. There can be no doubt that all three belong to one age and one social system; that they were under one Government is clear from the fact that none of the three were fortresses. Crete was, in fact, as Thucydides told us long ago, a sea-power which had no fear of assault by land. With the architectural or historical interest of these remains we need not concern ourselves at present, nor with the general character of the articles found in them. In all three we meet with vessels of use and ornament, painted frescoes, inscribed blocks or tablets, seals, human and animal figures, and articles of domestic or religious character. But in or near Hagia Triada there came to light a number of objects of special interest which distinguish that palace, smallest of the three, above the others.

First there is a sarcophagus of stone, painted upon all four sides. Each of the two ends bears a chariot in which are two female figures; a pair of horses draws one, a pair of griffins the other. The two sides bear a representation of sacrifice to the dead. Men leading animals—bull, goat, or sheep—women with baskets of fruit, others with bowls apparently full of wine or some other liquid, which is being poured into a large jar; a flutist and a harper, playing upon a lyre of seven strings (which are therefore older than Terpander by a thousand years); men carrying animals in their arms; and lastly the dead man himself, standing beside a tree before his own tomb and receiving the pious offerings. A most noteworthy fact in this representation is that the men wear women's skirts.

Next come three vases of steatite, each bearing a scene carved in relief. The workmanship of these carvings is astonishing for its finish, and the designs are full of life, reminding us not distantly of good Attic work. On one vase a couple of youths stand face to face, one leaning upon a spear or staff, the other bearing over his shoulders a staff and a whisk of some sort. Both are naked, save for the familiar loincloth of the Mycenæans (which the Greeks never wore, except in the very earliest times at the Olympian games), and high boots of the same kind which are still worn in Crete and always have been. The second vase represents several pairs of men, some wrestling and some boxing, and a bull-hunt or bull-baiting. The boxers have their hands bound about with straps of leather, or something like a fingerless glove. Some of these men wear helmets, which in part at least seem to be made of metal; and helmets hitherto have been undreamt of at this period.

But the last vase is the most striking of all. It bears a procession of men marching two and two, led by a personage clad in a stiff bell-shaped tunic covered with scales. He is bareheaded and carries a long staff or sceptre resting upon his shoulder. The men behind him wear flat caps something like to a turban, and loincloths, and each carries over his left shoulder a long pole branching out into three long flexible wands at the end. In the middle of the procession are four men singing, one bearing the *sistrum* of Isis; these have no wands. Some see in this a triumphal procession of soldiers after war. The lack of arms or shields makes this unlikely; the three-pronged objects can hardly be weapons, for they seem to be flexible, but what they are it is impossible to say. Those are more likely to be right who believe it to be a harvest festival of some kind, and the three-pronged implement an implement used in some harvesting process. If we may assume that these objects have no use at all, but are ornamental (which is not likely), the whole might be a religious procession without regard either to war or husbandry.

NOTES.

THE Bakerian lecture of the Royal Society will be delivered by Dr. Horace T. Brown, F.R.S., on March 23, upon the subject of "The Reception and Utilisation of Energy by the Green Leaf."

IT is proposed to erect in Jena a memorial to Prof. Ernst Abbe, so that all who see it may be reminded of his great services to optical science and industry, and his sterling qualities as a man. Abbe's work and influence are appreciated wherever physical science and sociology are studied, and there should be no difficulty in obtaining sufficient funds to raise a noble monument to his memory. The committee organised for this purpose includes the names of Dr. Czapski, Dr. Eggeling, Dr. G. Fischer, Prof. Rosenthal, and Prof. Winkelmann. Subscriptions for the memorial should be sent to the treasurer, Dr. Gustav Fischer, Jena.

Science states that the Prussian Academy of Science has awarded its Helmholtz medal to Prof. Ramón y Cajal, professor of neurology at Madrid.

It is announced that Prof. Albert B. Prescott, professor of organic and applied chemistry, dean of the school of pharmacy and director of the chemical laboratory of the University of Michigan, died on February 26 in his seventy-third year.

We learn from the *Times* that negotiations are in active progress for the amalgamation of the Society of Arts and the London Institution. A scheme has been prepared by a joint committee, and it only remains to be submitted to the general body of the members, whose assent in all likelihood will be given.

A committee of the French Physical Society has arranged to have a medal struck in commemoration of M. Alfred Cornu.

The Royal Society of Naples (mathematical and physical section) has awarded its prize of 40*l.* to Prof. E. Pascal, the subject being the theory of the invariants of the ternary quartic with special reference to the conditions for splitting into inferior forms. A prize of 20*l.* is now offered for the best essay in Italian, Latin or French on "The theory of electrons and the dispersion of light." The last day for sending in is June 30, 1906, and the essays are to be submitted under a pseudonym.

Since our note on the late Prof. Emilio Villari appeared in last week's Nature, we have received a copy of the *Rendiconto* of the physical and mathematical section of the Neapolitan Royal Society (x., 8–11) containing another notice of Prof. Villari by Prof. L. Pinto. It differs from the previous notices in containing a general summary of the scope of Villari's works, classified under the various headings of acoustics, molecular mechanics, heat, light, electricity, and Röntgen rays, and it will be found a very useful notice for purposes of reference, especially for physicists, whose time is limited, interested in Villari's researches.

The *Lancet* states that the King has acceded to a suggestion that the skeleton of Ambush II., the famous steeplechaser from the Royal Stables which died some weeks ago, should find a place in the Museum of Veterinary Anatomy at the University of Liverpool. The skeleton will be mounted and placed in a prominent position at the University museum, and a plate will be affixed giving a short history of the well-known horse.

It is announced in the *Electrician* that Lord Kelvin will be the recipient of the first John Fritz gold medal awarded by the joint committee of the four national American engineering societies, under the deed of gift, to the man most representative of, and eminent in, scientific advance in the engineering field. This medal was founded three years ago on the occasion of the eightieth birthday of John Fritz, the famous inventor and engineer in the iron and steel industry, who is still enjoying excellent health.

On Tuesday next, March 21, Prof. W. E. Dalby will deliver the first of a course of two lectures at the Royal Institution on "Vibration Problems in Engineering," and on Thursday, March 23, Mr. Thomas G. Jackson will begin a course of two lectures on "The Reasonableness of Architecture." The Friday evening discourse on March 24 will be delivered by Sir Oliver Lodge, his subject being "A Pertinacious Current," and on March 31 by Prof. J. Wright on "The Scientific Study of Dialects." Prof. Meldola will give the first of his two lectures on "Synthetic Chemistry" (experimental) on Thursday, April 6.

The Liverpool correspondent of the *Lancet* states that Mr. J. E. S. Moore, who has become director of cancer research in succession to Prof. A. S. F. Grünbaum, has also been appointed a member of the staff of the Royal Infirmary, Liverpool, in accordance with the terms of the donation that the research work in cancer should be carried on at that infirmary. From the same source we learn that, in response to an appeal made for funds to initiate a permanent memorial to the late Sir W. M. Banks, the sum of 5523*l.* has been subscribed. Of this amount, the sum of 1500*l.* is to be devoted to founding a lectureship, to be attached to the University of Liverpool, and to be called the "Mitchell Banks lectureship." The University authorities will be enabled to invite yearly a distinguished surgeon, pathologist, or anatomist to treat of the latest investigations and discoveries in medical science.

At the Optical Convention to be held in May next at the Northampton Institute, Clerkenwell, to which attention has already been directed in these columns, the following amongst other papers will be read. Dr. R. T. Glazebrook, F.R.S., will deliver the presidential address. Mr. H. Dennis Taylor will read a paper on some properties of lens systems; Mr. Walter Rosenhain will deal with two subjects—the mechanical design of instruments, and some problems relating to optical glass; Dr. C. V. Drysdale will discuss binoculars, and, in collaboration with Mr. S. D. Chalmers, will introduce a discussion on aberration; Mr. J. Gordon will take up the question of diffraction in optical instruments; Mr. J. Blakesley, some optical measurements; Mr. J. H. Sutcliffe, ophthalmometers; Dr. R. M. Walmsley, education in optics; Prof. Forbes, spectroscopic vision; Prof. Poynting, F.R.S., a parallel plate micrometer; and Dr. W. Watson, F.R.S., fused quartz for optical purposes. Full particulars of the convention can be obtained from the secretary, Mr. C. L. Redding, at the Northampton Institute, Clerkenwell, E.C.

The March number of the *American Journal of Science* contains a short account of the work of Prof. A. S. Packard, who died in Providence, R.I., on February 14, at the age of nearly sixty-six years. Prof. Packard was graduated from the Maine Medical School and the Lawrence Scientific School in 1864. At Cambridge, Mass., he was one of that remarkable group of students—Hyatt, Morse, Packard, Putnam, Scudder, Shaler and Verrill—associated with the elder Agassiz in the early 'sixties. He served for a time in 1864–5 as assistant surgeon in the U.S. Army, but never became a regular practitioner of medicine, his life being devoted to his chosen work in zoology and geology. He was specially distinguished as an entomologist, and he was an enthusiastic field naturalist, collector, and explorer, and a voluminous author who wrote on a remarkably wide range of subjects. He will probably be longest remembered for his original work on insects and his several text-books on entomology and zoology. Early in his career he accepted the theory of evolution and later became an ardent neo-Lamarckian. One of his last works was "Lamarck, the Founder of Evolution, his Life and Work." He was one of the founders of the *American Naturalist*, for twenty years its chief editor, and a constant contributor to its pages. Prof. Packard was a member of the National Academy of Sciences and of many other scientific societies.

The ceremony of transferring the museum of the Hastings and St. Leonards Museum Association to the Corporation of Hastings took place on March 1. The museum is a representative one, and is divided into several sections. The anthropological section includes a cosmopolitan ethnological collection, geographically arranged. In it are some good local bronze and bone objects, a series of

Neolithic stone implements from many parts of the world, an ethnological collection from New Guinea and the South Sea Islands, the relics recovered from the Hastings kitchen middens—numbering many thousands of specimens—and many worked flints of the Palæolithic period. The geological section is remarkable for its collection of animal remains of the Pleistocene period from the Lewis Abbott collection, and a collection of Wealden fossils from the neighbourhood. The biological section has a representative collection of the local fauna. After the museum had been accepted by the Mayor on behalf of the Corporation of Hastings, Sir Arthur Rücker, F.R.S., delivered a short address, in which he emphasised the value of museums in the study of natural science, and commended the active part municipal authorities are now taking in educational work. Dr. J. J. H. Teall, F.R.S., expressed the opinion that local museums should illustrate local natural history, and outlined a plan which would secure this end. Sir Harry Johnston, G.C.M.G., K.C.B., also spoke on the value of museums.

A BOTTLE thrown overboard in latitude 29° 30′ N., longitude 68° 10′ W., by Colonel Swalm, U.S. Consul at Southampton, in May, 1903, has just been found on the Donegal coast, Ireland, near Arranmore. The bottle had apparently been carried by the Gulf Stream along the North American coast, then across the Atlantic to the Irish coast. To travel this distance it had taken 662 days at an approximate speed of five miles a day.

ACCORDING to a Reuter despatch from St. Petersburg, dated March 9, the North Pole Commission has officially declared that the expedition under Baron Toll to the new Siberian Islands, in the Arctic Ocean, has ended with the death of all the members of the party. The party sent in search of the expedition found in Benett Island a letter written by Baron Toll saying that the members of the expedition had continued on their journey though having only eighteen or twenty days' provisions left. It is therefore believed that Baron Toll and his companions perished of hunger.

THE *Weekly Weather Report* of March 11 issued by the Meteorological Office showed that the rainfall from the beginning of the year was still deficient in all districts except the north of Scotland and the north of Ireland; the deficiency amounted to 2 inches and upwards in several parts of England and in the south of Ireland. During the recent severe gales, however, falls of about an inch in twenty-four hours have been recorded in several localities. In the neighbourhood of London the rainfall during the part of the present month already elapsed has exceeded the mean for March, which is 1·5 inch.

AN exhibition of meteorological instruments with photographs and records of meteorological phenomena, under the auspices of the Royal Meteorological Society, was opened on Tuesday at the Institution of Civil Engineers, Great George Street, Westminster, and the exhibition will remain open until 5 p.m. to-morrow, Friday. The instruments exhibited represent all branches of meteorology, and show clearly the great advance which the science has made in recent years. Continuous records can now be secured in nearly all branches, and in many of these ample choice is provided. There are several forms of self-recording rain-gauges, notably the Beckley and the Richard patterns, while Halliwell's improved float pattern pluviograph is of more recent invention, and of exceptional scientific value. The thermometer exhibits are fairly numerous, and of various designs, from Callendar's electrically recording thermometer to instruments of an ordinary character. There are to be seen the thermometers in use in Sir J. C. Ross's Antarctic Expedition, 1839–43, and in the Arctic expeditions 1850–59, as well as thermometers used by the National Antarctic Expedition 1901–4. These instruments show the greater degree of accuracy obtainable in manufacture now than was the case, say, half a century ago. Barometers and barographs exhibit considerable advance. An instrument of considerable value is Dines's self-recording mercurial barometer; and a microbarograph, for the study of minor variations of atmospheric pressure, under the joint names of Mr. W. H. Dines and Dr. W. N. Shaw, is likely to prove of much value. A typical climatological station is shown, its enclosure containing all the necessary instruments in position for observation. A prominent position is given to aëronautics, and there are specimen kites with meteorograph in position. There are anemometers of very varied description, many of these being self-recording. Sunshine recorders, past and present, are to be seen, from the wooden bowl, by Campbell, used as early as 1853, to the almost perfect instrument known as the Campbell-Stokes. Among the many drawings and photographs may be mentioned the water-colour drawings made during the recent National Antarctic Expedition, exhibiting sky and cloud effects. The Royal Meteorological Society is to be congratulated on the thoroughly interesting character of the exhibition.

PROF. H. HERGESELL has communicated to the *Comptes rendus* of the Paris Academy of Sciences, January 30, some of the preliminary results of the kite ascents made on the yacht of the Prince of Monaco in the Mediterranean and North Atlantic Ocean in the summer of 1904. Altogether, twenty-five ascents were made, eight in the Mediterranean, one in the Baltic, and sixteen in the Atlantic. The principal object of the latter was the exploration of the meteorological conditions in the region of the trade winds. The results show that in the lowest strata of the air there is a considerable decrease of temperature with increase of altitude; the adiabatic gradient (1° C. per 100 metres) is always attained, and even exceeded in the lowest stratum. The depth of this adiabatic stratum varies from 100 to 600 metres; the relative humidity at the sea-level is 70 or 80 per cent., and rises gradually to 95 or 100 per cent. At the upper limit of this stratum a sudden change occurs: the temperature rises quickly by several degrees, and the humidity suddenly diminishes to below 50 per cent. The temperature continues to rise, through a stratum sometimes extending to a depth of 1000 metres, and the humidity decreases to 10 or 20 per cent.; at a height of 1000 metres, temperatures of 30° C. are experienced, while at the sea-level only 22° or 23° are recorded. Above this stratum the adiabatic gradient again holds, but the humidity is low, compared with that of the first adiabatic stratum. In the lower stratum the N.E. trade is experienced, the velocity being about sixteen miles an hour; with increasing elevation the wind gradually shifted through N. to N.W., and in two instances it shifted through E. to S.E. and S. A south-westerly current, which would correspond to the theory of anti-trades, was never exhibited by the kites, although they several times exceeded the height of the Peak of Teneriffe. The velocity of the N.W. or S.E. winds experienced in the highest strata did not exceed seven or nine miles an hour, and was generally still less in the intermediate strata.

THE latest issues of the *Proceedings* of the U.S. National Museum include a description, by Dr. Stejneger, of a gecko and three frogs from the Philippines, and an article by Mr.

Gill on the gurnard commonly known as *Prionotus stearnsi*, which is made the type of a new genus.

The structure of the squamoso-parietal crest in the skulls of the horned dinosaurs of the Cretaceous of Alberta is deemed by Mr. L. M. Lambe of sufficient interest to merit a paper by itself, and he has accordingly described this part of the skeleton in a recent issue of the *Transactions* of the Royal Society of Canada (vol. x., sect. iv.).

Our weekly budget includes copies of Nos. 3 and 4 of the *Sitzungsberichte* of the Vienna Academy for the current year. Among the notes is one by Prof. Molisch on phosphorescence in eggs and potatoes after cooking, and a second by Dr. F. Werner on the Orthoptera of the Egyptian Sudan.

In the January number of the *American Naturalist*, Mr. J. Stafford discusses the larva and spat of the Canadian oyster, the latter of which is extremely minute and very difficult to discover. Unlike the later stages, the very young spat presents a dark metallic lustre. When once recognised, the young spat is, however, by no means difficult to discover, and the sailors soon became adepts in the search. Although found on many kinds of shells, and sometimes on stones, the spat displays a preference for the young of *Crepidula fornicata* and colonies of *Ralfsia verrucosa*.

To the *Biologisches Centralblatt* of February 15, Mr. J. P. Lotsy contributes an article on "X-generation and 2X-generation," in which he proposes a theory to explain certain features connected with cell-development and heredity. In the second article in the same issue Mr. E. Wasmann seeks to explain the origin and development of slavery among ants, showing the manner in which a colony of *Formica truncicola* may have been gradually modified from a type in which a certain number of stranger ants were received as guests, to one in which a host of captives are maintained.

The *Otago Daily Times* of January 6 contains an article on the marine fish-hatchery at Portobello and the progress recently made there. The institution was nominally opened a year ago last January, but it was by no means in good working order, having to contend with such difficulties as leaky tanks. Work during the past year has been to a great extent confined to observing the behaviour of a few kinds of food-fishes in captivity. Many of these died off quickly when introduced into the tanks, some, apparently, on account of having been injured in their capture, and others owing to a difference in the temperature of the water. Blue cod, however, thrive well, although the endeavours to rear the fry were unsuccessful. The introduction of the European lobster is contemplated.

Mr. L. Frederico, director of the class of science in the Belgian Royal Academy, sends us a copy of an essay (from the *Bulletin* of the Academy for December last) on the Glacial fauna and flora of the plateau of Baraque-Michel, the culminating point of the Ardennes. The boreal conditions of climate have, it appears, preserved on this exposed plateau a small colony of animals and plants of an essentially arctic type, the nearest relatives of which are to be met with only in the extreme north, and on certain much higher mountains in central Europe. This assemblage seems to be at the critical stage as regards temperature, a very slight elevation of which would lead to its disappearance. We thus have a definite refutation of the prevailing idea that the temperature of this part of Europe has been higher at some date since the Glacial epoch than it is at the present day.

The February number of the Johns Hopkins Hospital *Bulletin* (vol. xvi., No. 167) is mainly devoted to anatomy. The teaching of anatomy is discussed by Mr. Mall, who also writes on the working of the Anatomy Act (U.S.A.) and preservation of material, and the anatomical department of the University of California is described by Dr. Flint. Three papers dealing with points in the development of the kidney, a review of Flechsig's researches on the brain, and an article on body-snatching in England complete the contents of an excellent number.

On the subject of the mandrake or mandragora, Mr. C. B. Randolph has collated, in the *Proceedings* of the American Academy of Arts and Sciences (vol. xl., No. 12), a number of references from the classics, from which he concludes that, on account of its narcotic qualities, it was employed as an anæsthetic about the first century of the Christian era.

Experiments by Mr. E. S. Salmon showing that "biologic forms" of *Erysiphe graminis* can be identified according to their power of infecting different species of cereals have been previously referred to. Pursuing his investigations on the subject, Mr. Salmon states, in the *Annals of Botany* (January, 1905), that portions of a host plant which is normally immune, become susceptible to infection by the fungal conidia if they are injured or subjected to heat or the action of anæsthetics, but the conidia produced as a result of such infection cannot attack a healthy plant of the same species. The practical application of this fact is far reaching, as a wheat-rust can in this way spread to barley leaves which have been injured by animals or storms.

With the object of arousing interest in the subject of the giant trees of Victoria—all species of Eucalyptus—Mr. N. J. Caire has collected data as to size, height, and localities of specimens known to him in a paper published in the *Victorian Naturalist* (January, 1905). Big Ben, a specimen of *Eucalyptus amygdalinus*, possessing a trunk of 57 feet girth, was destroyed by a bush fire in 1902, and Billy Barlow, a blackbutt of the same circumference, was sacrificed for the Paris Exhibition; both these veterans were probably more than a thousand years old. Most of these trees of enormous girth present signs of senile decay, as shown by broken tops or later by hollow stems.

The results of recent experiments have proved conclusively, says the *Pioneer Mail*, that silk of excellent quality can be raised in Ceylon, and samples of cocoons raised at Peradeniya from European seed have been classed by a European expert as second only to the best Italian silk. Hitherto all experiments have been on a small scale, limited partly by the comparative scarcity of mulberry trees. The time seems now to have arrived when more extensive operations might be undertaken with advantage; and, with this object, it is proposed that an experimental silkworm rearing establishment be created. A scheme is under consideration by the Ceylon Board of Agriculture.

Some interesting observations of the spark discharge from a Holtz machine are described in a paper by Dr. L. Amaduzzi in the *Atti* of the Italian Electrotechnical Association for 1904. Marked variations in the character of the discharge were observed with varying atmospheric conditions.

The peculiar photographic activity of hydrogen peroxide has recently been considered by Graetz to be due to a special radiation, in virtue of the fact that its influence is capable of penetrating solid bodies, particularly thin sheets of metals. It is, however, shown by J. Precht and C. Otsuki, in the *Verhandlungen* of the German Physical Society (vol. vii. p. 53), that hydrogen peroxide itself is capable of penetrating thin films of gelatin, celluloid, india-rubber and black paper, the peroxide being subsequently capable of detection by titanic acid. Metals in the form of the thinnest sheet are, nevertheless, impervious to hydrogen peroxide, if small holes be not present; the same is true of thin films of paraffin, glass, and ebonite.

Two papers dealing with the accurate measurement of coefficients of expansion are contained in the January number of the *Physical Review*. Mr. H. McAllister Randall describes the determination of the coefficient of expansion of quartz between the temperatures of 36° and 500° C. by means of Pulfrich's optical method, and shows that up to about 250° C. the expansion of quartz follows a straight-line law; between 250° and 470° C. it is necessary to include a term involving the square of the temperature, whilst at 500° C. a sudden large increase in the expansibility becomes visible. At this temperature it is probable, as suggested by Le Chatelier, that quartz undergoes a change into a second modification having very different physical properties from those of the ordinary form. The second paper, by Mr. H. D. Ayres, deals with the measurement by Pulfrich's method of the coefficients of linear expansion of the metals aluminium and silver at temperatures between 100° and −184° C.

THE firm of Leybolt Nachfolger in Cologne has recently issued a very complete and interesting catalogue of physical apparatus and fittings sold by them. The book starts with a history of the instrument trade in Cologne during the last century. In its second section we find an account of the construction and fittings of various chemical and physical institutions. It is noteworthy, perhaps, that while the students' laboratory, with its work tables and appliances for experiments, figures prominently in the chemical institutions, the arrangements for practical work by the students in the physical laboratories are distinctly less complete. After this follows the catalogue proper, filling some 800 large pages, profusely illustrated and admirably arranged. The book will be most useful to the teacher, and is a striking illustration of German enterprise and go. At the same time it is observable throughout that the apparatus is intended chiefly for demonstrations and the lecture-room. The list of electrical measuring instruments, for example, is comparatively meagre, while there are not many examples of the simpler forms of apparatus supplied to an English school laboratory for use by the students. It is probably the case that such apparatus is less used in Germany than here, but though this is absent the book is full of apparatus of the greatest value and utility.

A SECOND edition of Prof. Luigi de Marchi's "Meteorologia generale" has been published by the house of Hoepli, of Milan. The book has been revised and enlarged.

A SECOND edition of the "Rural Calendar," fully revised and enlarged, has been prepared by Dr. A. J. Ewart and published by Messrs. Davis and Moughton, Ltd., Birmingham. The book is a helpful index to observations of animate nature throughout the year, and a guide to gardening and farming operations. It includes an artificial key to the commoner wild British herbs, giving description, common name, scientific name, and natural order. By using this key as plants become available, a good knowledge of common flowers may be obtained. The price of the book is one shilling net.

OUR ASTRONOMICAL COLUMN.

STRUCTURE OF THE CORONA.—In an interesting paper published in No. 3 (1905) of the *Revue générale des Sciences*, Dr. Ch. Nordmann discusses the structural details of the solar corona and their causes. In the first place, he shows that the incurvation of the coronal rays cannot be due solely to the action of gravitation, for the angles which they make with the normals to the limb at the points of their projection are far too small for this theory.

He then shows that the "minimum" corona, which obtains at the time when the solar surface is least disturbed simply assumes the form natural for it to assume under the action of centrifugal force, if it be granted that the particles forming the coronal streams are exactly balanced in the solar atmosphere—that is to say, if their weight is counterbalanced by the force of the light-repulsion. At times of "maximum," when the solar surface in the sun-spot (*i.e.* equatorial) region is most disturbed, the local disturbances, and their consequent convection currents, modify the action of the normal centrifugal forces, and thus produce the *abnormal* coronas observed at eclipses occurring during periods of maximum solar activity, which, although of the same general form, vary greatly in their detailed features.

RADIANT POINT OF THE BIELID METEORS.—From a number of observations of the Bielids made on November 21, 1904, Herr K. Bohlin, of Stockholm, has calculated the radiant point of the shower.

The resulting position is only about 3° from γ Andromedæ, and has the following coordinates:—

1904 November 21·33 (Mid-European time).

$$\left.\begin{aligned}\alpha &= 26^\circ\ \ 2' \\ \delta &= +43^\circ\ 10'\end{aligned}\right\}1900.$$

(*Astronomische Nachrichten*, No. 3997.)

BRIGHTNESS OF ENCKE'S COMET.—The results of a number of magnitude observations of Encke's comet, made by Herr J. Holetschek, at Vienna, during the present apparition, are published in No. 3997 of the *Astronomische Nachrichten*. The observations covered the period November 25–December 27, and, in the table wherein the results are shown, the vertical diameter, the magnitudes of the nucleus, and the magnitudes of the whole comet are given. From the last-named values we learn that on November 25 the magnitude of the comet was 9·0, on December 10, 6, and on December 23, 5·3. The value obtained on December 27 was mag. = 5·0, but this is queried.

JANUARY FIREBALLS.—A note from Mr. Denning to the *Observatory* (No. 355) shows that the appearance of fireballs during the predicted dates in January was well sustained. On January 14 a bright object was seen by several observers, and on combining the records a radiant point situated in Monoceros at 119°+3° was obtained. The height of this fireball ranged from 60 miles over Brecon to 29 miles over Aberystwith. Two fireballs were seen on January 27 and one on January 29, thus corroborating the January 28 epoch. One of those on the former date was very bright, and was apparently stationary at 118°−18°.

In February, bright fireballs were seen on February 11, 13 and 18, the time of the apparition on the last-named date being 7h. 15m. a.m., *i.e.* in daylight.

ROTATION OF JUPITER'S SATELLITES I. AND II.—During the period January 13–20, Dr. P. Guthnick, of Bothkamp Observatory, made a series of magnitude observations of Jupiter's first and second satellites, the period of observation covering about four revolutions of the former and two revolutions of the latter round the planet.

The measurements were made with a Zollner photometer attached to the 11-inch refractor. Plotting the values obtained on curves having the "anomaly" of each satellite as abscissa and the corresponding apparent magnitude as ordinate, it was seen that the period of the light-variations coincided with that of the revolution about Jupiter, and as a consequence it seems probable that the periods of revolution and rotation are coincident in each case (*Astronomische Nachrichten*, No. 4000).

ORBITS OF MINOR PLANETS.—In No. 4000 of the *Astronomische Nachrichten*, Prof. J. Bauschinger publishes the elements of the orbits of those minor planets discovered during 1904 of which the paths have been computed at the Berlin Astronomischen Recheninstitut. The list contains the orbits of 28 minor planets, 24 (523–549) of which are referred to the epoch 1904.0, and 4 (550–553) to 1905.0, and is followed by a series of remarks which name the observations on which the computations were based, and the corrections to some of the orbits as obtained from subsequent observations. A note concerning (526) NQ says that that object is probably identical with 1901 HA.

An additional list of five asteroids discovered during November and December, 1904, and to which the permanent numbers 549–553 are now allotted, brings the total number discovered during last year up to thirty-two.

EFFECT OF AUTUMNAL RAINFALL UPON WHEAT CROPS.[1]

BY autumn, in this note, is to be understood the period from the thirty-sixth to the forty-eighth week, both inclusive, of the year, as represented in the *Weekly Weather Report* of the Meteorological Office; it covers the months of September, October, and November, approximately. The rainfall to be referred to is the average amount in inches, for the general consonance, with exceptions, more or less striking, in a few of the years. In other words, the yield of wheat in any year seems to depend mainly on the absence of rainfall in the previous autumn, and but little on any other factor.

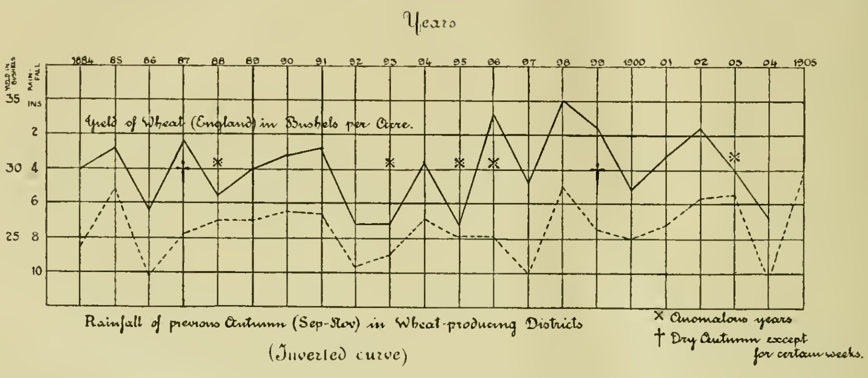
The obvious algebraical expression for such a condition as the curves represent is a linear equation, and the equation which represents the relation between yield of wheat for England and the previous autumn rainfall is:—

Yield = 39.5 bushels per acre − 5/4 (previous autumn rainfall in inches).

If we call the yield obtained from the rainfall by this equation the "computed yield," a comparison with the actual yield for the twenty-one years shows that the computed yield agrees with the actual yield within half a bushel in seven years out of the twenty-one. In fourteen years the agreement is within 2 bushels; in the remaining seven years the difference between computed and actual yield exceeds 2 bushels. The extreme variation of yield in the twenty-one years is 9 bushels, from 26 bushels per acre in 1892 and two other years to 35 bushels per acre in 1898.

Of the seven years for which the formula gives yields differing from the actual by upwards of 2 bushels, 1896 is the most conspicuous; its actual yield exceeds the computed yield by 4.5 bushels.

These seven years all show anomalous seasons. Taken



"Principal Wheat Producing Districts," for the period mentioned, in successive years. The amounts are taken from the summaries of the *Weekly Weather Report*.

The yield of wheat is that given for successive years in the annual summaries of the Board of Agriculture and Fisheries as the average yield in bushels per acre for England, since 1884, or more strictly since 1885, as that is the first year for which the figures for England are given separately. In 1884 the figure for Great Britain, which generally differs but little from that for England, is used.

These are the only figures in the official publications which are immediately available for the purposes of comparison. The totals of rainfall for the thirteen weeks have been compiled from the weekly amounts, otherwise the figures are taken as they stand in published returns. The areas referred to are not exactly coterminous, but they are more nearly so than if the rainfall values had been taken for the whole of England, or the wheat yield for Great Britain.

When the autumn rainfall and the yields of wheat for successive years from 1884 to 1904, as thus defined, are plotted, the rainfall curve being inverted, *i.e.* rainfall being measured downward on the paper while yield is measured upward, there is a very striking similarity between the curves, so much so as to suggest that if the scales were suitably chosen the two curves would superpose and show

[1] "On a Relation between Autumnal Rainfall and the Yield of Wheat of the following Year.—Preliminary Note." By Dr. W. N. Shaw, F.R.S., Secretary of the Meteorological Council. Read before the Royal Society on February 2.

seriatim, they are 1887, 1888, 1893, 1895, 1896, 1899, and 1903.

In 1888 and 1903 the crops were washed away by 10 inches of rain in the summer; 1893 is the year of phenomenal drought, and the crop was below the computed figure by 2.5 bushels. The years 1892 and 1899 are interesting, because though the amounts of rain were up to the average, the former had eight dry weeks and the latter ten dry weeks out of the thirteen included in the conventional autumn. They were thus dry autumns, the average amount of rainfall being made up by a few exceptionally wet weeks. The yields correspond with dry autumn values. They are above the average and above the computed figures by some 2 or 3 bushels per acre.

There remain 1895 and 1896. 1895 was the year of remarkably cold weather, and in that year the yield fell short, but in the following year the deficiency was made up by a yield as much above the computed value as the previous one fell short. It would appear that in this instance the productive power not utilised in the year of the great cold was not lost, but stored. On the other hand, it must be remarked that 1896 had the advantage of a specially dry winter.

It appears from these considerations that the dryness of autumn is the dominant element in the determination of the yield of wheat of the following year. The averages of yield and of rainfall are taken over very large areas, and it may be taken for granted that the investigation of the question for more restricted areas would introduce some modification in the numerical coefficients, if not in the form of the relation.

The data for making such an investigation are not yet in an available form. A comparison has been made between autumnal rainfall for "England, East," and the average yield for the counties of Cambridge, Essex, Norfolk, and Suffolk, which shows a similar relation but a magnified effect of autumnal rainfall upon the crop, and also two exceptional years which have not yet been investigated.

GEOLOGICAL NOTES.

FROM the Geological Survey we have received a memoir on the water supply of Lincolnshire from underground sources, with records of sinkings and borings, edited by Mr. H. B. Woodward, with contributions by Mr. W. Whitaker, Dr. H. F. Parsons, Dr. H. R. Mill, and Mr. H. Preston. In the introduction a description is given of the various geological formations with especial reference to the water-bearing strata. The bulk of the work is taken up with records of borings, among which we note particulars of a new boring in progress at Boultham for the supply of Lincoln; many records from the prolific locality of Bourn, where from one bore-hole five million gallons of water a day have been obtained; and other records from Scunthorpe, Skegness, Woodhall Spa, &c. Many analyses of water are given, and Dr. Mill contributes a useful section on rainfall, with a colour-printed map.

The Geological Survey has issued a memoir on the geology of West-Central Skye, with Soay, in explanation of sheet 70 of the geological map of Scotland. The memoir is written by Mr. C. T. Clough and Mr. Alfred Harker. The area is mainly occupied by the Tertiary igneous rocks of the Cuillin Hills, but it includes also some Torridonian rocks, and small tracts of Trias, Lower Lias, and Cretaceous. The occurrence of Cretaceous strata, probably cf Upper Greensand age, is of especial interest. The Glacial and post-Glacial accumulations, the physical features and scenery are duly described. The memoir, in short, is in a handy form (pp. 59, and price 1s.), well suited as a guide on the ground, and as an introduction, as regards the volcanic rocks, to the larger work by Mr. Harker (lately noticed in NATURE) on the Tertiary igneous rocks of Skye.

Another memoir issued by the Geological Survey is on the geology of the country around Bridgend, being part vi. of the "Geology of the South Wales Coal-field," by Mr. A. Strahan and Mr. T. C. Cantrill, with parts by Mr. H. B. Woodward and Mr. R. H. Tiddeman. The district here described includes the Vale of Glamorgan, for the most part an area of Lias with irregular scatterings of Drift; an agricultural district, famed also for its Blue Lias lime, so well known in old times at Aberthaw, and now largely manufactured at Bridgend. The basement portions of the Lias at Sutton and Southerndown, conglomeratic in character, are duly described, as well as the littoral portions of the Keuper and Rhætic Beds. A small tract of the main coalfield enters the area, bounded by Millstone Grit and Lower Carboniferous Rocks, and the Old Red Sandstone appears in inliers. The bulk of the work is taken up with a description of the Keuper, Rhætic Beds and Lias, which furnish many points of interest.

The fifteenth report by Prof. W. W. Watts on photographs of geological interest in the United Kingdom (Brit. Assoc., Cambridge, 1904) is of a most satisfactory character. A clear profit of 130*l*. has been made. This shows that the work of collecting and storing typical photographs of geological features and phenomena, and of supplying copies to teachers and others in various parts of the world, has proved a great success, and a distinct service to geological and perhaps also to geographical science. This success is due to the indefatigable energy of Prof. Watts.

In his address to the Liverpool Geological Society, Mr. T. H. Cope took as his subject types of rock-flow in the Ceiriog valley and their analogies with river structure (*Proc.* Liverpool Geol. Soc., vol. ix., part iv.). The author points out the evidence of flow structures and other terrestrial movements in igneous and metamorphic rocks, and compares them with the known movements of water.

We have received No. 37 of vol. v. of "Spelunca" (*Bulletin* and *Mémoires* de la Société de Spéléologie). This contains a number of articles on caves and on underground waters, on prehistoric remains from caves, on the present subterranean flora, on contamination of waters, and on the use of fluorescence in detecting the flow of underground streams. A report on the sources of the water of Arcier, with special reference to the water-supply for the town of Besançon, is contributed by Prof. E. Fournier to the same periodical (No. 38), and he concludes that the supply from Arcier must at all costs be abandoned. The subject has excited much controversy owing to the fact that the probable sources of contamination through porous and fissured limestones are at a distance from the outlet of the stream at Arcier.

In the ninth report of the periodic variations of glaciers by Dr. H. F. Reid and M. E. Muret (*Arch. des Sc. phys. et nat. Genève*, xviii., 1904), the general record is one of decrease.

The records of the Geological Survey of India (vol. xxxi. part iii.) contain an article by Mr. R. D. Oldham on the glaciation and history of the Sind Valley, Kashmir, a subject illustrated by six excellent photographic views, which exhibit features produced respectively by glaciers and by rivers, and afford support to the view of the author of a diversion of the drainage since the glaciers attained their greatest dimensions.

A report on the Jammu coal-fields has been written by Mr. R. R. Simpson, mining specialist to the Geological Survey of India (*Mem.* Geol. Surv. India, vol. xxxii. part iv.). The coal-fields lie in a mountainous country, varying from three thousand to nine thousand feet above sea-level, and the strike of the coal-bearing rocks does not conform to any of the main natural features. The prospects of working the coal with profit are not considered good, in present circumstances, as the expenses would be great on account of the inclined and broken character of the rocks, the possibility of landslips, and of trouble from water. Otherwise a fairly good steam-coal may be obtained.

A geological map of Cyprus, by Mr. C. V. Bellamy, has been issued by Mr. Stanford (price 6s.). It is accompanied by a key or short explanation, in which the author describes the physical features and the various geological formations which range from Cretaceous to Pliocene and Pleistocene. Between the Oligocene and Pliocene there is a break, marked by the occurrence of basic igneous rocks, which have baked and altered the Oligocene (Idalian) limestones. These igneous rocks, which comprise serpentine, variolite, gabbro, &c., form a broad belt of mountainous ground in the south-central portion of the island. The map, which is produced on a scale of 5½ English miles to one inch, is printed in colours, and clearly shows the extent of the main geological divisions. It will be a useful guide to those interested in the geology, whether from a scientific or practical point of view. The economic products include building stones, marble, pottery clay, gypsum, &c.

Our knowledge of the geology of South Africa proceeds apace. We have received vol. vii., part iii., of the *Transactions* of the Geological Society of South Africa, which contains among other articles an essay by Dr. F. H. Hatch and Dr. G. S. Corstorphine on the petrography of the Witwatersrand conglomerates, with special reference to the origin of the gold. The original explanation was that the Rand conglomerates were ancient placer deposits, in which the gold was as much a product of denudation as the pebbles which accompany it. The authors show that the theory of the subsequent infiltration of the gold is most in accordance with the facts. The gold is practically confined to the matrix of the conglomerate, and occurs there in crystalline particles in association with other minerals of secondary origin.

Mr. E. Jorissen, in the same *Transactions*, deals with some intrusive granites in the Transvaal, the Orange River Colony and in Swaziland. These old granites, mostly grey in colour, penetrate the crystalline schists which are regarded as of Archæan age, but they do not intrude into the Witwatersrand series. Mr. J. P. Johnson contributes further notes on some pigmy stone implements from Elandsfontein No. 1. They are regarded as scrapers belonging to the Neolithic stage of culture.

In his address to the South African Association for the Advancement of Science (Johannesburg meeting, 1904), Dr. Corstorphine took for his subject the history of stratigraphical investigation in South Africa, and in a table he gives the groupings successively introduced by A. G. Bain, A. Wyley and others up to those of G. A. F. Molengraaff and F. H. Hatch.

We have received from the Minister of Mines, Victoria, a diagram, compiled and drawn up by the director of the Geological Survey, Mr. E. J. Dunn, showing the yield of gold and other statistics from 1851 to 1903. The gross value of the gold is stated to be 266,945,344*l*. The greatest yield was in 1856.

We have received the annual progress report of the Geological Survey of Western Australia for 1903, by Mr. A. Gibb Maitland, Government Geologist. This includes observations on the Pibara and Murchison gold-fields, on the Arrino copper deposits, the Irwin River coal-field, &c., miscellaneous notes on minerals, including gypsum and diatomite, and notes on water supply. The report is accompanied by several maps.

The progress of vertebrate palæontology in Canada forms the subject of an essay by Mr. Lawrence M. Lambe (*Trans. Roy. Soc. Canada*, series 2, vol. x.). As he remarks, our knowledge of this life-history began when Sir William Logan, in 1841, discovered amphibian footprints in the Lower Coal-measures at Horton bluff in Nova Scotia. Since then remains of vertebrates have been found in rocks from the Silurian to the Pleistocene, and a full list is given, together with a bibliography of the subject.

In the *American Journal of Science* (December, 1904) two new species of reptiles from the Titanothere Beds (Oligocene) of Dakota, are described by Mr. F. B. Loomis. These are *Crocodilus prenasalis* and *Chrysemys inornata*. Some derived Cretaceous fossils are recorded also from the same strata, which form a part of the White River formation, and the author is led to regard the beds as of fluviatile origin.

The *American Journal of Science* for January contains an article on the submarine great canyon of the Hudson River, by Dr. J. W. Spencer. The early work of the Coast Survey brought to light a depression extending from near New York to the border of the continental shelf, and J. D. Dana was the first to recognise this feature as the submerged channel of the Hudson River, formed when the continent stood at a greater altitude above the sea than it does now. Later on, Prof. A. Linden Kohl discovered that the channel became suddenly transformed into a canyon near the continental border, reaching to a depth of 2400 feet below the surface of the submerged plain, which was then about 400 feet beneath sea-level. Following on to these observations, Dr. Spencer has pointed out that the channel was traceable to much greater depths—the canyon section having sunk from 6000 to 7000 feet, and the valley beyond to 9000 feet. He maintains that the period of great elevation coincided with the early Pleistocene. Since then there has been a subsidence to somewhat below the present level, followed by a re-elevation of 250 feet, as seen in the shallow channels of the shelf.

The *American Journal of Science* for February contains an important essay on the isomorphism and thermal properties of the feldspars, by Mr. Arthur L. Day and Mr. E. T. Allen. To the same journal Dr. Albrecht Penck contributes an interesting article on climatic features in the land surface, and indicates how the features of past as well as present climates may be discerned. Instances are seen in areas that were formerly covered by ice and are now exposed to river action. They are seen in desert regions, as in those of the Great Salt Lake and of the Sahara, where ancient shore lines and old river valleys have been traced. In some mountain areas evidence of river action, preceding glacial action, has been noticed. Dr. Penck points out that a study of the oscillations in the situation of the climatic belts of the earth is fraught with interest, and that observations on the erosional forms of rocks and on the corresponding deposits derived from them assist in the interpretation of climatic conditions.

In the *Bulletin* from the Laboratories of Natural History of the State University of Iowa (vol. v., No. 4) there is a series of papers on the loess by Prof. B. Shimek. The loess of Natchez and of the lower Mississippi valley is of special interest, inasmuch as in that region loess was first recognised in America by Lyell in 1846. The researches of the author afford arguments against both the aqueous and glacial theories of its origin. The characteristic fossils are terrestrial upland species of land snails. Even the extremely delicate shells of snails' eggs are preserved in the loess. Natchez lies far south of the limits of glaciation, and the molluscan fauna does not support the notion of a glacial climate. The æolian theory offers the best explanation. The discovery of human remains in a deposit regarded as loess near Lansing, in Kansas, is discussed, and Prof. Shimek concludes that the deposit is not loess, but a talus. Considering, again, the relations of loess to the Iowan drift, the author points out that there were several periods of loess formation, inter-Glacial and post-Glacial. Far beyond the border of the newer drift sheets, however, the sharp lines of distinction between the successive accumulations disappear, and there the deposits of loess probably represent the combined accumulation of several inter-Glacial and later drift periods. The essays are illustrated by pictorial views and figures of the mollusca. In another article Mr. F. J. Seaver describes and illustrates the Discomycetes of eastern Iowa.

The "Materials and Manufacture of Portland Cement," by Mr. E. C. Eckel, with an essay on the cement resources of Alabama, by Mr. E. A. Smith, form the contents of *Bulletin* No. 8, Geological Survey of Alabama. In that State there is found an extensive series of limestones capable of furnishing material for the manufacture of Portland cement, while clays and shales necessary to complete the mixture are abundant.

In an article on the genesis of the magnetite deposits in Sussex Co., New Jersey (*Mining Magazine*, December, 1904), Mr. Arthur C. Spencer concludes that they are connected in origin with intrusive dioritic pegmatites. To the same magazine Mr. W. H. Heydrick contributes a paper on the physical and commercial conditions of the Kansas oil-fields. The area extends over more than ten thousand square miles. In 1889 the yield was 500 barrels of oil, while in ten months during 1904 the yield was more than four million barrels.

A reconnaissance in Trans-Pecos Texas, by Mr. G. B. Richardson (Univ. of Texas, Mineral Survey, *Bulletin* No. 9), was undertaken mainly to determine the conditions of occurrence of underground water. The author was enabled, however, to make general observations on the successive formations from the pre-Cambrian to the Cretaceous and Quaternary, and on the occurrence of coal, salt, petroleum, and sulphur. The presence of underground water was found to be widespread, but in a number of places the wells contain much gypsum and other salts. The report is accompanied by a geological map and pictorial views.

Some account of the exploration of the Potter Creek Cave in California, is given by Mr. W. J. Sinclair (Univ. of California Publications, *Amer. Archaeol. and Ethnol.*, vol. ii., No. 1). The cave is about one mile south-east of the United States fishery station at Baird, on the McCloud River, and it lies in a belt of carboniferous limestone at an elevation of 1500 feet above sea-level, and about 800 feet above the river-level at the mouth of Potter Creek. Remains of various vertebrate animals were obtained from fan-like deposits of earth and stalagmite-cemented breccia, which formed the floor in a large chamber, above which there were vertical chimney-like openings. With the exception of the stalagmitic growths and fallen blocks, the entire cave deposit was brought in through the vertical chutes. Apart from fragments, more than 4600 determinable specimens were collected of dissociated limb bones, jaws, and teeth. Complete skeletons were not common. Associated parts of the skeletons of squirrels and wood-rats, of a snake (Crotalus), and a bat were found; also several complete limbs of *Arctotherium simum*, remains of Megalonyx, Mastodon, *Elephas primigenius*, and a new genus named Euceratherium, a member of the cavicorn division of Artiodactyla, which combines characters of several groups. Of the fifty-two species listed, twenty-one belong to extinct forms. No human remains were found, but some very doubtful "implement-like bone fragments" are described and figured. The cave-fauna is older than the Glacial period in California, and it is remarked that the 1500 foot contour marks approximately the present elevation of an earlier valley stage beneath which the existing cañons are trenched.

FORTHCOMING BOOKS OF SCIENCE.

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In Messrs. A. and C. Black's list we notice:—"The Metaphysics of Nature," by Carveth Read, and a "Treatise on Zoology," edited by Dr. E. Ray Lankester, F.R.S., part v., "Mollusca."

The announcements of the Cambridge University Press include:—"The Lands of the Eastern Caliphate," by G. Le Strange; "Trees, vol. iii., Inflorescences and Flowers," by Prof. H. Marshall Ward, F.R.S.; "The Origin and Influence of the Thorough-bred Horse," by Prof. W. Ridgeway; "The Plague," by Dr. W. J. Simpson; and "Immunity in Infectious Diseases," by Prof. E. Metchnikoff, authorised English translation by F. G. Binnie, illustrated.

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UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—An Arnold Gerstenberg studentship will be offered for competition in the Michaelmas term of 1906. The studentship will be awarded by means of essays. Every candidate must send on or before October 1, 1906, an essay on one of the subjects printed below addressed to Dr. James Ward, Trinity College. The studentship, which will be of the annual value of nearly 90*l.*, will be tenable for two years, upon the condition that at the end of the first year the student's progress in philosophical study is deemed satisfactory by the board of managers. The subjects for essays are :—(1) a philosophical discussion of the doctrine of energy and particularly of the new theory of energetics; (2) a critical examination of Descartes' philosophy of nature; (3) the relation of mathematics and the theory of probability to physics; (4) the theory of psychophysical parallelism; (5) the scope and methods of comparative psychology; (6) the philosophical import of post-Darwinian theories of natural selection.

The principal and the professors at McGill University, Montreal, have nominated Mr. L. V. King, a student in the faculty of arts, to the Canadian scholarship lately established at Christ's College.

An exhibition of 50*l.* a year tenable for two years is offered by the governing body of Emmanuel College to an advanced student commencing residence at the college in October, 1905. Applications should be sent to the master of Emmanuel (from whom further particulars may be obtained) not later than October 1.

The local examinations and lectures syndicate is about to elect an assistant secretary for the department of the local lectures. The appointment will be in the first instance for one year. The stipend will be 150*l.* in an ordinary year, and 200*l.* in those years in which summer meetings are held. Graduates of the university who desire to offer themselves as candidates are requested to send their names before May 8 to the Rev. D. H. S. Cranage.

The London School of Tropical Medicine has been admitted as a school of the University of London in the faculty of medicine in tropical medicine only.

The committee of the Liverpool School of Tropical Medicine has appointed Mr. R. T. Newstead lecturer in economic entomology and parasitology.

The fourth annual students' soirée of the Sir John Cass Technical Institute will be held in the institute, Jewry Street, Aldgate, E.C., on Saturday, March 18. Exhibits and demonstrations referring to the work of the various departments form part of the programme.

It is reported, says *Science*, that Mr. Andrew Carnegie has offered to give 100,000*l.* to the University of Virginia on the condition that the authorities of the institution raise a similar amount from other sources, and that the late James C. Carter, the eminent New York lawyer, has bequeathed 40,000*l.* to Harvard University. *Science* also states that at the first of the winter convocations of the George Washington University a gift of property, estimated to be worth 20,000*l.*, was announced for the establishment of a chair and course of graduate study on the history of civilisation. Various sums of money raised by the trustees and alumni association, aggregating 55,000*l.*, were also announced.

A Commission was appointed a few years ago to inquire into the condition of manual and practical instruction in Irish primary schools, and, as the result of the recommendations made by this Commission, instruction in elementary experimental science was introduced into the primary schools of Ireland. The results of this teaching have, in the opinion of competent authorities, been in every way satisfactory. Not only has the educational value of experimental science again been demonstrated, but its beneficial effects on the progress of Ireland's industries and agriculture have been made clear. Notwithstanding the success which naturally has followed the introduction of practical instruction in scientific principles into Irish elementary schools, the Treasury has refused to renew the small grant required to meet the necessary expenditure, and the work of organising science instruction in the schools—after four years—is being stopped. It is difficult indeed to understand so retrograde a policy. The incompleteness of all schemes of education which ignore the claims of practical instruction in the fundamental facts of science has been demonstrated repeatedly; the connection between American and German industrial success and the scientific systems of education established in these countries has become familiar to all interested in their country's welfare, so that no excuse—not even the urgent need of economy in national expenditure—can justify this action of the Treasury. It is to be hoped earnestly that steps may yet be taken to avert what would be nothing short of a calamity to Ireland, and that the work, which has begun so auspiciously under the present organisers of science instruction, instead of being stopped may be broadened and extended.

It is stated in the *Times* that the committee, presided over by Mr. Haldane, M.P., appointed to consider the allocation of the increased grant-in-aid of education of a university standard in arts and science has now finished its inquiry. Excluding 9000*l.* to be allotted later in the financial year, the committee proposes that the sum of 45,000*l.* (making a total grant of 54,000*l.*) be allotted as follows:—Manchester, 6000*l.*; University College, London, 5000*l.*; Liverpool, 5000*l.*; Birmingham, 4500*l.*; Leeds, 4000*l.*; King's College, London, 3900*l.*; Newcastle-on-Tyne, 3000*l.*; Nottingham, 2900*l.*; Sheffield, 2300*l.*; Bedford College, London, 2000*l.*; Bristol, 2000*l.*; Reading, 1700*l.*; Southampton, 1700*l.*; Dundee, 1000*l.* The committee expresses the view that the time has come for making a new departure in the principle on which State assistance is to be given to the highest education. It is recommended that a moderate sum should be set aside for distribution by way of payment to post-graduate students from the university colleges who devote themselves for one, two, or three years to special problems; and that to ensure the money being applied most efficiently to the stimulation of individual study, as distinguished from the general purposes of the college to the development of which other sums out of the grant are directed, the distribution should assume the form of a grant made directly to the student on the advice of some impartial authority. It is also suggested that the grant-in-aid should in future be made to a committee, instead of to the colleges direct, and that this committee should make an annual report to the Treasury, to be laid before Parliament. In conclusion the committee urges the necessity of leaving to the advisory committee discretion to deal with particular circumstances as they arise.

SOCIETIES AND ACADEMIES.

London.

Royal Society, February 9.—"On the Stellar Line near λ 4686." By Sir Norman **Lockyer**, K.C.B., F.R.S., and F. E. **Baxandall**, A.R.C.Sc.

In this paper the authors direct attention to a well-marked line of unknown origin which appears in one of the Kensington photographs of the helium spectrum near λ 4686.

It is shown that a conspicuous line near the same wave-length occurs in the spectra of the chromosphere, nebulæ, bright-line stars, certain Orion stars, and in ζ Puppis, the star the spectrum of which was found by Prof. Pickering to contain a new series of lines which he considered to belong to hydrogen.

The mean wave-length of the stellar line, as derived from the available published records, is shown to agree very closely with the wave-length of the line in the laboratory spectrum, and the authors conclude that the identity of the two lines is probably a real one.

Rydberg has shown that the line near λ 4686 is the first line in the principal series of hydrogen, and the authors of the present paper consider that the "strange" line in the helium spectrum is probably none other than the same line. They can, however, assign no reason for its appearance in only one of the numerous photographs of the helium spectrum taken at Kensington.

"Note on the Spectrum of μ Centauri." By Sir Norman **Lockyer,** K.C.B., F.R.S., and F. E. **Baxandall,** A.R.C.Sc.

In this note the authors give an analysis of some of the bright lines in the spectrum of μ Centauri. This star not being available at Kensington, an excellent reproduction by Prof. Pickering was used as a basis for the analysis.

The chief bright lines belong to hydrogen, as Pickering and other observers have pointed out. The minor bright lines, however, have hitherto had no origin suggested for them. In this note it is shown that the most marked of the minor bright lines agree very closely in position with the strongest enhanced lines of iron, and the authors conclude that the stellar and terrestrial lines are probably identical in origin. It is pointed out that the same lines are conspicuous in the spectra of Novæ in their earlier stages.

"The Arc Spectrum of Scandium and its Relation to Celestial Spectra." By Sir Norman **Lockyer,** K.C.B., F.R.S., and F. E. **Baxandall,** A.R.C.Sc.

In this paper a record is given of the lines in the arc spectrum of the rare element scandium between λ 3900 and λ 5720. The photograph used for reduction was taken with a large Rowland concave grating, having a ruled surface of $5\frac{3}{4}\times 2$ inches ($14\frac{1}{2}\times 5$ cm.) and a radius of 21 feet 6 inches. The scale of the photograph is such that the distance between K and D is $30\frac{1}{4}$ inches, or 77 cm. This is equivalent to 2·6 tenth-metres per millimetre.

An analysis of the lines is given with regard to their appearance in the Fraunhoferic spectrum. It is shown that nearly all the stronger lines occur as solar lines, but the great majority of the lines weaker than intensity 6 (maximum intensity 10) are missing from the solar spectrum.

Short analyses are also given of the relation of the scandium arc lines to the lines in the spectra of the chromosphere, sun-spots, and stars. The strongest scandium lines are shown to be specially prominent in the chromospheric spectrum, the same lines being conspicuous in stellar spectra of the Polarian type (*e.g.* γ Cygni). In the higher stellar type Cygnian (α Cygni), the strongest scandium lines are present, but only weak. At the still higher stages of stellar spectra the scandium lines are lacking.

With regard to sun-spot spectra, the only solar-scandium line (λ 5672·047) given by Rowland in the region F to D, is found to be nearly always well affected, and it often occurs amongst the twelve most widened lines recorded at Kensington in spot spectra.

"On Europium and its Ultra-violet Spectrum": Sir William **Crookes,** F.R.S.

Exner and Haschek have measured the wave-lengths of the europium lines[1] from material supplied by Demarçay. A comparison of their lines with the present author's shows that the material was by no means pure. Urbain's europia is not quite so free from impurities as his gadolinia. The author has been able to detect in his photographs the following lines:—Gadolinium is represented by very faint lines at 3450·55, 3481·99, 3585·10, 3646·36, 3654·79, 3656·32, 3664·76, 3697·90, 3699·89, 3743·62, 3768·52, 3796·58, 3805·70, 3850·83, 3851·16, 4050·08, 4225·33. Yttrium is represented by the line at 3774·51, lanthanum by the line at 3988·66, and calcium by the two lines at 3933·825 and 3968·625.

February 9 and February 23.—"Phosphorescence caused by the Beta and Gamma Rays of Radium." By G. T. **Beilby.** Communicated by Prof. Larmor, Sec. R.S. Part i. read February 9, part ii. read February 23.

The conclusions arrived at in these papers may be summarised as follows:—

(1) Certain types of phosphorescence are due to the molecular movement or displacement which is produced by heat, by mechanical stresses, or by radiant energy.

(2) Certain other types are distinguished by their appearance in three stages, called here primary, secondary, and revived phosphorescence. These can be explained as due to atomic changes in which chemical affinity is the controlling factor.

(3) The phenomena of this type appear to support the view that a species of electrolysis occurs in solids exposed to the β or kathode rays; that the products of electrolysis are insulated from each other, as in a viscous electrolyte; and that it is the breaking down of this insulation with the re-combination of the ions which causes revived phosphorescence.

When the canary-yellow crystals of barium platinocyanide are exposed to the β and γ rays for some hours, they turn red, and their phosphorescence in the rays falls to 8 per cent. of its original value. Neither the colour nor the phosphorescence is restored by exposure to sunlight or to diffused daylight. The only way completely to restore these qualities is to dissolve the salt in water and re-crystallise it. In this way the reddened salt is completely re-converted into the yellow form, and there are no signs that the reddening has been associated with any permanent chemical change. The possible physical changes were, therefore, investigated. When the crystalline structure of the yellow salt is impaired, either by mechanical flowing or by dehydration by heat, there is a very conspicuous colour change, the canary-yellow giving place to an intense brick-red colour, while the phosphorescence in the radium rays falls to 2 per cent. of its original value. By solution and crystallisation these amorphous forms are restored to the yellow crystalline state with its full phosphorescent value. The effects produced by the β rays are, therefore, closely analogous to those produced by the change from the crystalline to the amorphous state. In the light of the author's earlier observations on the phase changes $A \rightleftarrows C$ in metals and salts, it was to be expected that the change $C \rightarrow A$, produced by mechanical flow, would be reversed by raising the temperature of the substance to the stability point of the A phase. Making due allowance for the difficulty caused by the presence of water of crystallisation and its partial loss on heating the salt, it was found that the change $A \rightarrow C$ could be brought about in the mechanically-flowed salt at a temperature of about 90°, the colour being thereby changed from red to yellow, and the phosphorescence raised from 2 per cent. to 33 per cent. of its original value. It was found that the crystals reddened by the rays could also be partially restored to their former condition of colour and phosphorescence by quickly heating them in a sealed capillary tube to about 120°. By this treatment the phosphorescence was raised from 8 per cent. to 33 per cent. of its original value in the yellow crystals. The analogy between the phase changes caused by mechanical flow and the change which results from exposure to the β rays is thus complete, and it is concluded that the over-stimulation to which the vibrating molecules of the platinocyanide crystals are subjected under the action of the β rays during the preliminary stage of bright phosphorescence results in a state analogous to that of elastic fatigue in vibrating metal wires or glass fibres. Up to a certain point, this fatigue may be recovered from, that is to say, if the relative displacement of the molecules from their proper crystalline relations has not passed beyond a certain stage; but beyond this stage there is no power of self-recovery, and heat is necessary to endow the molecules with freedom of movement sufficient to enable them to return to their crystalline positions. The final stage of permanent fatigue or over-strain in the salt corresponds with the amorphous condition which results from mechanically-produced flow. The comparative instability of the crystalline structure in this salt has thus been the means of directing attention to the part which may be played by physical structure in phosphorescence. But the persistence of phosphorescence, even in the amorphous state, gives an equally clear indication that a more general explanation of these phenomena is still needed.

This further explanation was reached by a study of the action of the β and γ rays on quartz, glass, calcspar, and the haloid salts of potassium. In these substances, in addition to a primary phosphorescence, the rays produce certain well-marked coloration effects; quartz is turned brown, calcspar faint yellow, glass purple or brown, potassium chloride reddish-violet, and bromide and iodide blue to green. Further, whether the coloration lasts for months or only for a few moments, it is found that phosphor-

[1] "Wellenlängen-Tabellen für Spektralanalytische Untersuchungen," F. Deuticke. (Leipzig and Vienna, 1902.)

escence is revived when the substance is heated, while the colour fades or disappears. In quartz, glass, and calcspar it is easy to locate the seat of phosphorescence within the layers which have been penetrated and coloured by the rays. This penetration may take place to the depth of several millimetres, and in materials like quartz, glass, or calcspar it is certain that whatever changes occur in these layers must be chemically self-contained and quite removed from atmospheric influences. The view, therefore, that coloration is due to the reduction of one of the elements of the substance, *e.g.* potassium in glass, affords only a partial explanation of the phenomena. It is necessary to suppose that the separation and retention of the metal ions must equally involve the separation and retention of the ions of the acid radicle with which the metal had been combined. Further, in order that the different ions may be kept apart, the unaltered molecules must act as barriers or insulators to prevent their re-combination. But the molecules are not always immovable barriers, for, as the temperature is raised, their mobility is increased, and their insulating power is correspondingly diminished. Experiments were made on the storage of latent phosphorescing power at all temperatures between -100° and $+300^\circ$. While for each substance there is a range of temperature over which its storage capacity is at a maximum, yet the range over which storage can take place is sometimes very wide. In calcspar, storage occurs over the whole range investigated, while in crystallised platinocyanide of barium it was only observed between -100° and -50°.

February 16.—"Polarised Röntgen Radiation." By Dr. Charles G. **Barkla**. Communicated by Prof. J. J. Thomson, F.R.S.

Experiments on secondary radiation from gases and light solids subject to X-rays led to the theory that during the passage of Röntgen radiation through such substances each electron has its motion accelerated by the intense electric fields in the primary pulses, and consequently is the origin of a secondary radiation which is most intense in the direction perpendicular to that of acceleration of the electron, and vanishes in the direction of that acceleration. The direction of electric intensity at a point in a secondary pulse is perpendicular to the line joining that point and the origin of the pulse, and is in the plane passing through the direction of acceleration of the electron.

A secondary beam the direction of propagation of which is perpendicular to that of the primary will, according to this theory, be plane polarised, the direction of electric intensity being parallel to the pulse front in the primary beam. If the primary beam be plane polarised, the secondary radiation from the electrons has a maximum intensity in a direction perpendicular to that of electric displacement in the primary beam, and zero intensity in the direction of electric displacement.

In these experiments the secondary radiation from light substances was too feeble to allow accurate measurement of the intensity of the tertiary radiation.

A consideration of the method of production of primary Röntgen rays in an X-ray tube, however, leads one to expect partial polarisation of the primary beam proceeding from the antikathode in a direction perpendicular to that of propagation of the impinging kathode rays, for there is probably at the antikathode a greater acceleration along the line of propagation of the kathode rays than in a direction at right angles; consequently, in a beam of X-rays proceeding in a direction perpendicular to that of the kathode stream, there should be greater electric intensity parallel to the stream than in a direction at right angles.

Using such a beam as the primary radiation, and a light substance, as air, paper, or aluminium, as the radiator, the intensity of a secondary beam as indicated by an electroscope was found to reach a maximum when the direction of the kathode stream was perpendicular to that of propagation of the secondary beam, and a minimum when these two were parallel.

A number of experiments made this evidence of partial polarisation of the primary radiation conclusive.

When heavier metals, such as copper, tin, and lead, which emit a secondary radiation differing considerably in character from the primary producing it, were used as the radiators, no variation in intensity of secondary radiation was observed as the bulb was rotated, though experiments were made with primary radiations varying considerably in penetrating power.

Geological Society, February 17.—Dr. J. E. Marr, F.R.S., president, in the chair.—Annual general meeting.—In his anniversary address, the president directed attention to the classification of the sedimentary rocks, pointing out that the arrangement of the events which, taken together, constitute earth-history, according to their proper sequence in time must ever remain the territory of the geologist in which he will pursue his labours by exclusively-geological methods. He pointed out that, since the time of William Smith, and mainly by the adoption of his principles, the classification of the strata had progressed towards perfection by the method of successive approximations. He directed attention to the many similarities between the records of the geological column and the records preserved in the "meteorograms" of meteorologists. In each case the records were impressed as zigzag and broken lines, though an additional difficulty occurred in the case of the geological records owing to their frequently-blurred nature. Further, the meteorologist had his chronometer, whereas the geologist must construct his time-scale from the records on what might, for purposes of comparison, be referred to as the "geograms," or strips of the geological sediments. In some cases the lines of the geograms closely coincided with time-lines, in other cases they departed therefrom more or less widely, and it was one of the tasks of the geologists, from study of the geograms, to attempt to draw in the time-lines. It was to be remembered, however, that however closely the time-lines and lines of the records coincided, they were not the same lines. The principal variations in the records of the geograms are due to alternate formation and cessation of deposit; to the differences in character of the deposits owing to various local conditions; to accumulation of contemporaneous volcanic material; to variations in the nature of the earth-movements; to changes in the nature of the included organisms; and lastly to climatic changes, and proceeded to consider the significance of these records as bearing upon the classification of the sediments. The president advocated the adoption of a triple classification, such as had been already tacitly adopted in the case of some of the sediments, as, for instance, those of Jurassic age, where divisions were made according to (1) lithological change, (2) organic change, and (3) time; and pointed out how such a classification could be adopted without any violent changes in an existing nomenclature or in the rules of priority. He illustrated the suggested changes by a more detailed discussion of the classification of the Ordovician strata, and pointed out that we had names which might be used with chronological significance in the case of the divisions of the rocks of most of the great systems; and maintained that, as our knowledge increased, we could refer beds of new areas to their places among the different series, marking periods of time with a confidence similar to that with which we have long assigned strata of remote regions to one or other of the great systems.

February 22.—Dr. J. E. Marr, F.R.S., president, in the chair.—Exhibition of a series of Danish rocks illustrating (1) the share that Echinoderms may take in rock-building; (2) the transition from the Secondary to the Tertiary Era in the Baltic basin near Denmark; (3) the special conditions at the close of the Glacial Period, in the limited area where alone these rocks are now found as erratic blocks: Dr. F. A. **Bather**.—On the order of succession of the Manx slates in their northern half, and its bearing on the origin of the schistose breccia associated therewith: Rev. J. F. **Blake**.—On the wash-outs in the Middle Coal-measures of south Yorkshire: F. E. **Middleton**. The opinion of the author is that the wash-outs occupy the sites of winding streams, meandering through the alluvial tracts in which the coal-seams were being formed.

Zoological Society, February 21.—Mr. Howard Saunders, vice-president, in the chair.—A contribution to our knowledge of the varieties of *Lacerta muralis* in western Europe and North Africa: G. A. **Boulenger**.—The Nigerian giraffe (*Giraffa camelopardalis peralta*) and the Kilimanjaro Giraffe (*G. camelopardalis tippelskirchi*): R. **Lydekker**.—Dolphins from Travancore: R. **Lydekker**. In this paper the author made special reference to two specimens of the genus

Tursiops, drawings and particulars of which had been supplied to him from the Trevandrum Museum.—A second collection of mammals made by Mr. C. H. B. Grant for Mr. C. D. Rudd's exploration of South Africa: Oldfield **Thomas** and Harold **Schwann.** The collection, which has been presented to the National Museum by Mr. Rudd, was made in the Wakkerstroom district of the South-eastern Transvaal, and includes examples of twenty-six species. Several local subspecies were described, besides a new shrew from Zululand.—The greater kudu of Somaliland: R. I. **Pocock.** The author pointed out that the northern form of *Strepsiceros strepsiceros* differed from the southern in having only about five white stripes instead of nine or ten on each side of the body. The northern form should thus rank as a distinct subspecies, for which the name *chora* was available. The difference in coloration seemed to be correlated with a difference of habitat, the northern form frequenting more mountainous and less thickly-wooded country than the southern, which was frequently found in the thick jungle along river-banks as well as in the hills.

Anthropological Institute, February 28.—Prof. W. Gowland, president, in the chair.—Group marriage, with especial reference to Australia: N. W. **Thomas.** In the course of his remarks the author pointed out that the theories of Lewis Morgan were without sufficient basis. In the place of Lewis Morgan's fifteen stages, later theorists had postulated first a period of promiscuity, and following on that group marriage, so-called, which in Australia is only now being transformed into individual marriage. But here too no sufficient account had been given of the causes which led to the abolition of promiscuity. The grounds on which it was assumed that promiscuity and group marriage were stages in human development were first philological and secondly sociological. The philological grounds were shown in the paper to be wholly insufficient, and the facts of present-day Australian life to be susceptible of other explanations.

Chemical Society, March 2.—Prof. W. A. Tilden, F.R.S., president, in the chair.—The following papers were read:—The relation between natural and synthetical glycerylphosphoric acids: F. B. **Power** and F. **Tutin.** The authors have shown that the discrepancies of statement respecting the properties of the glycerylphosphates are due to contamination with salts of the di-ester. They have prepared and analysed a number of these salts in pure condition. Proof is also adduced that the conclusions of Willstätter and Lüdecke that the differences between the salts of natural (derived from lecithin) and artificial glycerylphosphoric acids are not those existing between mere optical isomerides are not justified.—The transmutation of geometrical isomerides: A. W. **Stewart.** The author assumes as a phase of the reaction the formation and disruption of a tetramethylene compound, which in the case of fumaric and maleic acids would be tetramethylene-1:2:3:4-tetracarboxylic acid, and this by disruption in two different directions would give rise to either fumaric or maleic derivatives. Illustrations of the applicability of this explanation to other cases are also given.—Linin: J. S. **Hills** and W. P. **Wynne.** Linin, $C_{23}H_{24}O_9$, a crystalline substance obtained by hydrolysis of a glucoside present in *Linum catharticum*, melts at 203°, contains four methoxyl groups, and is physiologically inactive.—The constitution of phenylmethylacridol: J. J. **Dobbie.** Hantzsch's view that the substance formed when phenylacridine methiodide is treated with an alkali is a carbinol is confirmed by the fact that the absorption spectra are different from those of the parent methiodide, and similar to those of dihydrophenylacridine.—The ultra-violet absorption spectra of certain diazo-compounds in relation to their constitution: J. J. **Dobbie** and C. K. **Tinkler.**—The latent heat of evaporation of benzene and some other compounds: J. C. **Brown.**—The reduction of *iso*phthalic acid: W. H. **Perkin,** jun., and S. S. **Pickles.** When *iso*phthalic acid is reduced with sodium amalgam at 45° it yields two tetrahydro-acids, Δ^2 and *cis*-Δ^5, and from these two others may be obtained, so that the four possible tetrahydro*iso*phthalic acids have now been prepared. The properties and reactions of these are described.—The influence of temperature on the interaction between acetylthiocyanate and certain bases. Thiocarbamides, including carboxy-aromatic groups: the late R. E. **Doran** (compiled by A. E. Dixon).—The influence of solvents on the rotation of optically active compounds. Part viii. Ethyl tartrate in chloroform: T. S. **Patterson.**—A further note on the addition of sodium hydrogen sulphite to ketonic compounds: A. W. **Stewart.**—Action of hydrogen peroxide on carbohydrates in presence of ferrous sulphate: R. S. **Morrell** and A. E. **Bellars.** In this work attempts have been made to trace the disappearance of different sugars by optical measurements during oxidation, and from the initial and final reducing powers of the solutions. The simpler acids, formic and oxalic, resulting from the oxidation, were detected, but the more important keto-acids could not be isolated, though evidence of their presence was obtained.—Studies in chlorination. The chlorination of the isomeric chloronitrobenzenes: J. B. **Cohen** and H. G. **Bennett.** It is shown that when the first two hydrogen atoms of benzene or toluene have been substituted either by two chlorine atoms or by one chlorine atom and one nitro-group the positions occupied by subsequent chlorine atoms or nitro-groups are the same.

Linnean Society, March 2.—Prof. W. A. Herdman, F.R.S., president, in the chair.—The Ashe-Finlayson "Comparascope": D. **Finlayson.** The instrument displays two objects in the same magnified field, this being attained by a secondary stage and objective at right-angles to the primary instrument, the rays being transmitted up the body of the microscope through a right-angled prism, and clearness of the two images preserved by means of a diaphragm placed longitudinally in the microscope-tube.—Zoological nomenclature: international rules and others: Rev. T. R. R. **Stebbing.** The author's paper, introductory to a discussion, insisted on the paramount importance of obtaining agreement among zoologists on this subject. Incidentally, Mr. Stebbing ventured to ask whether there were not many rules of nomenclature on which it would be satisfactory and advisable for zoologists not only to agree among themselves, but also to come to terms with their botanical colleagues. In this regard he offered some remarks in favour of adopting the year 1751 and the "Philosophia Botanica" as starting-point and basis for what might be called the Linnean era. A section of the paper was devoted to the "Nomenclator Entomologicus" of F. Weber, published in 1795, with the object of showing that the generic names in that catalogue are without value in questions of priority. While consigning various smaller details to an appendix, the body of the paper concluded with a proposal to get rid of tautonymy (as in *Trutta trutta, Apus* (*Apus*) *apus,* or other comical arrangements) by a plan distinguishing what was legal in the past from what is to be legal in the future.—Biscayan plankton collected by H.M.S. *Research* in 1901, part ii., Thaliacea: Dr. G. Herbert **Fowler.**

Mathematical Society, March 9.—Prof. Forsyth, president, and temporarily Dr. Hobson, in the chair.—The following papers were communicated:—On the projection of two triangles on to the same triangle: Prof. M. J. M. **Hill,** Dr. L. N. G. **Filon,** and Mr. H. W. **Chapman.** A construction is given for projecting two given triangles on to the same third triangle when the plane of the latter is given, and this construction makes it possible to determine the projective relation between two planes when four points in the one and the four corresponding points in the other are given. The lines joining corresponding vertices of the two given triangles are generators of one system of a regulus, and the possible points of projection when both are projected on to the same triangle lie on a generator of the other system. As this line describes the regulus, the locus of the point in the plane of the second triangle which corresponds to a given point in the plane of the first triangle is a cubic curve with a double point. A construction for the points of the cubic is obtained.—The Weddle quartic surface: H. **Bateman.** The surface is the locus of pairs of points which are conjugate with regard to all quadrics passing through six given points. Any chord of the twisted cubic which passes through the six given points is cut harmonically by the surface. This result leads to a parametric representation of the points of the surface. The reciprocal of the surface belongs to a family of surfaces, described by Darboux, which possess conjugate systems of plane curves.—On the complete reduction of any transitive permutation group, and on the arithmetical nature of the coefficients in its irreducible components: Prof. W. **Burnside**. The first part of the paper contains a determination of the number of times that any given irreducible component occurs, when any representation of a group of finite order as a transitive permutation group is completely reduced. The second part of the paper is occupied with the actual reduction of the permutation group. The reduction takes two forms according as the domain of rationality is defined by the characteristics, or by the roots of unity of which the characteristics are functions.—On the theory of the logarithmic potential: Prof. T. J. I'A. **Bromwich**. The paper is occupied with the conditions for the existence of the second differential coefficients of the potential within an area carrying surface-density, and of the first differential coefficients of the potential on a curve carrying line-density. At a corner of the area in the first case, or of the curve in the second, the differential coefficients in question do not exist unless the axes of coordinates have certain special directions.—Alternative expressions for perpetuant types: P. W. **Wood**.—An informal communication on the theory of geodesics was made by Prof. **Forsyth**.

Cambridge.

Philosophical Society, February 27.—Mr. F. H. Neville in the chair.—Soluble forms of metallic dihydroxytartrates: H. J. H. **Fenton**, F.R.S. Sodium dihydroxytartrate is remarkable for its very sparing solubility in water, and it has previously been shown by the author that this property may be made use of for the qualitative and quantitative estimation of sodium. When equivalent quantities of dihydroxytartaric acid and sodium ethylate are mixed in alcoholic solution a semi-transparent gelatinous precipitate is obtained which is altogether unlike the salt above mentioned and is extremely easily soluble in water. Its aqueous solution after standing for a few minutes deposits a white, crystalline precipitate of the sodium salt in its ordinary hydrated form. The calcium salt shows a similar behaviour, and it would appear that the ordinary metallic dihydroxytartrates must be regarded as derivatives of a hydrated form of the acid $C_4H_6O_8$.—Studies on unsaturated ketonic compounds: S. **Ruhemann**. The author has continued his researches on the combination of mercaptans with unsaturated ketones (see *Trans.* Chem Soc., 1905, lxxxvii., 17). In the light of previous researches, an explanation is given of the catalytic action of organic bases in the formation of additive products of mercaptans with unsaturated ketonic compounds.—Some compounds of guanidine with sugars: R. S. **Morrell** and A. E. **Bellars**. The addition of guanidine to a solution of any sugar in absolute alcohol causes a precipitate of an addition product of the sugar and the base. The compounds are only slightly hydrolysed in aqueous solution, but they are easily decomposed by acids. Their optical properties are peculiar; in some cases the rotation angle is opposite in sign to that of the parent sugar, in others there is a marked multi-rotation.—The influence of strong electromagnetic fields on the spark spectra of some metals: J. E. **Purvis**. The electromagnet is an exceptionally strong one. The pole pieces are conical, and the strength of the field between the two poles with a current of 25 amperes is 40,000 C.G.S. units. It was placed in such a position that a line joining the poles was perpendicular to a line drawn from the slit to the grating. The metals of which an account is given are gold, bismuth, antimony, lead, and tin. The results so far show that amongst the various lines a considerable number aré divided into triplets; whilst, of those which do not show any division, some seem to be widened when the spark is in the field. By analysing the divided lines by means of a calcite crystal, the components do not seem to be polarised in the same way; *i.e.* the outside components of one triplet are vibrating perpendicular to the lines of force, whilst those of another are parallel to the lines of force, and the same applies to the inner component. Some lines appear as doublets; but in many cases most probably the doublets are reversals, and these phenomena are particularly marked amongst the lines of antimony and bismuth. It will be necessary to study these with the magnet placed "end on." Two lines may be very close together, one stronger than the other, and the stronger line will be divided into three, whilst the weaker one is slightly widened only. The work is still in progress, and with other metals.

Paris.

Academy of Sciences, March 6.—M. Troost in the chair.—The president read a telegram from Dr. Jean Charcot concerning the work of the Antarctic Expedition.—On the orthogonal trajectories of a family of surfaces: Gaston **Darboux**.—A rational formula for the coefficient of absorption of light by a translucent body: J. **Boussinesq**.—The study of 1-methyl-4-benzylcyclohexanol and 1-methyl-4-dibenzylcyclohexanol: A. **Haller** and F. **March**. Methylcyclohexanone reacts with sodium derivatives of alcohols in a manner resembling camphor, the sodium derivative of benzyl alcohol giving a mixture of methyl-benzyl- and methyl-dibenzyl-hexanol, separable by fractional distillation in a vacuum.—*Eumedon convictor*, a crustacean accompanying a sea-urchin: E. L. **Bouvier** and G. **Seurat**. The Eumedon occupies a pouch near the anal region of the sea-urchin, and is well protected by the long spines of the latter. The crustacean is not parasitic on its host, the relations between the two closely resembling those holding between *Pionodesmotes phormosoae* and the sea-urchin *Phormosoma uranus*.—On the constitution of sun-spots: Th. **Moreux**. A discussion of the penumbra of the large sun-spot of January, 1904, of which a drawing is given. The second penumbra, attributed by some observers to irregularities in the nucleus of the spot, is clearly shown, and the author regards this as an additional proof of the theory advanced by him in June, 1900.—On sliding friction: L. **Lecornu**. The author considers that the law of Coulomb cannot be regarded as rigorously true, but is rather an empirical rule only roughly approximate.—The oscillations of railway carriages on their springs: Georges **Marié**. The author has deduced a relation between the periodic variations in level of the permanent way, the friction of the spring, and the deflection of the spring, and has applied this experimentally to various classes of rolling stock. As a rule, the condition of convergence was realised, but there were a few faulty vehicles in which this was not the case.—On the determination by the chronometer of differences of latitude at Madagascar and Réunion: M. **Driencourt**. The data given have a probable accuracy of 0·1 sec. This precision is rarely attained in such measurements, and details of the working methods are given.—On the determination of gaseous densities and the accuracy possible in such measurements: A. **Leduc**. For the more permanent gases the author regards the possible accuracy in the density as about 1 in 10,000; for the more easily condensable gases the probable accuracy is lower. The results recently published by MM. Moissan and Chavanne, Moissan and Binet du Jassoneix, Guye and Pintza, and Jacquerod and Pintza are criticised.—The action of radium bromide on the electrical resistance of metals: Bronislas **Sabat**. Bromide of radium, placed near wires of bismuth, iron, steel, copper, platinum, brass and German silver, increases their electrical resistance. This effect cannot be wholly attributed to the rise of temperature caused by the radium salt.—Contribution to the study of ionisation in flames: Pierre **Massoulier**. Previous experimenters have employed electrodes placed one above the other in the flame, and the dissymmetry thus necessarily introduced partially masks the results. The author employs vertical electrodes placed symmetrically in the flame, and the reversal of the field is then without effect on the course of the phenomena. Curves are given showing the relation between the distances from the electrodes and the fall of potential.—The variations of the equivalent spark of an X-ray tube: S. **Turchini**.—On the time that appears before precipitation appears in solutions of hyposulphites: Gaston **Gaillard**.—On the electrolytic solution of platinum in sulphuric acid: André **Brochet** and Joseph **Petit**. Platinum is dissolved in sulphuric acid under the action of a variable current, and the action of the alternating current is not specially due to the change in the sense of the current. In the presence of an oxidising agent the solution of the platinum is impeded.—A comparison of the physical properties of pure nickel and cobalt: H. **Copaux**. Nickel and cobalt have been obtained practically free from other metals, and containing only one or two thousandths of non-metallic impurities. They are magnetic, very crystalline metals, not malleable in the cold. They differ in appearance, cobalt being bright, resembling silver, whilst nickel is dull. Determinations of the density, hardness, melting point, electrical resistance, and breaking load are given.—The action of potassium permanganate on salts of hydroxylamine: L. J. **Simon.** A study of the oxidation of the nitrate, phosphate, and arsenate of hydroxylamine.—On quadrivalent oxygen: E. E. **Blaise.** The author has succeeded in obtaining a zinc compound,

$$(C_2H_5)_2.O.(I).Zn.(I).O.(C_2H_5)_2,$$

crystallising in fine prisms, and corresponding in composition to the magnesium compound previously described. The bearing of this compound on the theory of quadrivalent oxygen is discussed.—On the decomposition of orthonitrobenzyl alcohol under the influence of aqueous and alcoholic soda: P. **Carré.**—On the comparative assimilability of ammonia salts, amines, amides, and nitriles: L. **Lutz.** Experiments with Aspergillus and Penicillium show that of all nitrogenous compounds amides are the most easily assimilated; ammonia salts come next, then amines and nitriles.—The distribution of estragol and terpene compounds between the various parts of an annual plant: Eug. **Charabot** and G. **Laloue.**—On the so-called physicochemical analysis of arable earth: H. **Lagatu.** A description of a graphical mode of representing the analysis into three proximate constituents of an arable earth.—On some facts relating to the development of the kidney in Elasmobranchs: I. **Borcea.** A detailed study, illustrated with four diagrams, of the development of the renal system of *Acanthias vulgaris.*—On a form of scales peculiar to the Pandalidæ: H. **Coutière.**—On some anomalous forms of amitosis in the epithelium of mammals: M. **Pacaut.**—On some diseases of the tobacco plant: Georges **Delacroix.**—An experimental study of the conditions which determine the penetration of the vapours of chloroform into the blood during chloroformic anæsthesia, and on the influence of the variations of the pulmonary ventilation on this penetration: J. **Tissot.** It is shown that, contrary to the view generally accepted, during anæsthesia with mixtures containing between 7 and 12 per cent. of chloroform there is no possibility of establishing an equilibrium between the blood and the mixture, since this equilibrium would correspond to a fatal dose of chloroform. The variable equilibrium which is actually produced depends largely on the pulmonary ventilation.—On the secreting power of the kidney: Henri **Lamy** and André **Mayer.**—The spectroscopic study of oxyhæmoglobin: M. **Piettre** and A. **Vila.**—The action of ammoniacal salts on the nitrification of sodium nitrite by the nitric ferment: E. **Boullanger** and L. **Massol.**—On the distemper of dogs: H. **Carré.**—On a geological section of the High Atlas in the region of Glaoui, Morocco: Paul **Lemoine.**—Examination of the fossils brought from the Yunnan by the Lantenois expedition: H. **Mansuy.** The study of these fossils confirms the analogies previously recognised between the primary and secondary fauna of the Indo-Chinese region and the synchronic fauna of India and Central Asia.—The Bishop's circle of Mt. Pelée, Martinique: F. A. **Forel.**

DIARY OF SOCIETIES.

THURSDAY, MARCH 16.

ROYAL SOCIETY, at 4.30.—A New Radio-active Element, which evolves Thorium Emanation. Preliminary Communication: Dr. O. Hahn.—A Determination of the Amounts of Neon and Helium in Atmospheric Air: Sir William Ramsay, K.C.B., F.R.S.—A Preliminary Note upon the Question of the Nutrition of the Early Embryo: E. Emrys-Roberts.—On the Absence or Marked Diminution of Free Hydrochloric Acid in the Gastric Contents, in Malignant Disease of Organs other than the Stomach: Prof. B. Moore (with W. Alexander, R. E. Kelly, and H. E. Roaf).—On the Occurrence of certain Ciliated Infusoria within the Eggs of a Rotifer, considered from the Point of View of Heterogenesis: Dr. H. C. Bastian, F.R.S.—On the Dimorphism of the English Species of Nummulites, and the Size of the Megalosphere in Relation to that of the Microspheric and Megalospheric Tests in this Genus: J. J. Lister, F.R.S.—Observations on the Brains of Man and Animals with Trypanosome Infection. Preliminary Note: Dr. F. W. Mott, F.R.S.

ROYAL INSTITUTION, at 5.—Recent Astronomical Progress: Prof. H. H. Turner, F.R.S.

SOCIETY OF ARTS, at 4.30.—Manipur and its Tribes: T. C. Hodson.

LINNEAN SOCIETY, at 8.—Contributions to the Flora of Liberia: Dr. Otto Stapf.—*Exhibitions:* Penguins and other Birds from the Falkland Islands, and Scratched Rocks from a Rockhopper's Rookery: R. Vallentin.

FRIDAY, MARCH 17.

EPIDEMIOLOGICAL SOCIETY, at 8.30.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—First Report to the Steam-Engine Research Committee: Prof. David S. Capper.

SATURDAY, MARCH 18.

ROYAL INSTITUTION, at 3.—Electrical Properties of Radio-active Substances: Prof. J. J. Thomson, F.R.S.

MONDAY, MARCH 20.

SOCIETY OF ARTS, at 8.—Telephony: H. L. Webb.

VICTORIA INSTITUTE, at 4.30.—The Nebular and Planetesimal Theories of the Earth's Origin: Warren Upham.

TUESDAY, MARCH 21.

ROYAL INSTITUTION, at 5.—Engineering Problems: Prof. W. E. Dalby.

ROYAL STATISTICAL SOCIETY, at 5.

ZOOLOGICAL SOCIETY, at 8.30.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion:* Shipbuilding for the Navy: Lord Brassey, K.C.B.—*Paper:* Coolgardie Water-Supply: C. S. R. Palmer.

WEDNESDAY, MARCH 22.

GEOLOGICAL SOCIETY, at 8.—An Experiment in Mountain-Building Part II.: Lord Avebury, P.C., F.R.S.—The Rhætic Rocks of Monmouthshire: L. Richardson.

SOCIETY OF DYERS AND COLOURISTS, at 7.30.—The Dyeing and Finishing of Leather for Bookbinding; with remarks on Preparatory Manufacturing Processes: F. W. Colin Robinson.—A Dyeing Drum Door, removable and replaceable without stopping the Drum: H. W. Ley.

THURSDAY, MARCH 23.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: The Reception and Utilisation of Energy by the Green Leaf: Dr. Horace T. Brown, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Report of Experiments carried out at the National Physical Laboratory: On the Effect of Heat on the Electrical and Mechanical Properties of Dielectrics, and on the Temperature Distribution in the Interior of Field Coils: E. H. Rayner.—*Discussion:* On Temperature Curves and the Rating of Electrical Machinery: R. Goldschmidt.

ROYAL INSTITUTION, at 5.—The Reasonableness of Architecture: Thomas G. Jackson.

FRIDAY, MARCH 24.

ROYAL INSTITUTION, at 9.—A Pertinacious Current: Sir Oliver Lodge, F.R.S.

PHYSICAL SOCIETY, at 5.—Note on the Voltage Ratios of an Inverted Rotary Converter: W. C. Clinton.—On the Flux of Light from the Electric Arc with varying Power Supply: G. B. Dyke.—The Application of the Cymometer and the Determination of the Coefficient of Coupling of Oscillation Transformers: Prof. J. A. Fleming, F.R.S.—Exhibition of Cymometers and other Instruments.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Wanki to Victoria Falls Section; Victoria Falls Railway: C. T. Gardner.—Design of a Double-Line Plate-Girder Railway-Bridge: H. S. Coppock.

SATURDAY, MARCH 25.

ROYAL INSTITUTION, at 3.—Electrical Properties of Radio-active Substances: Prof. J. J. Thomson, F.R.S.

CONTENTS.

THURSDAY, MARCH 23, 1905.

THE KALAHARI DESERT.

Die Kalahari. Versuch einer physisch-geographischen Darstellung der Sandfelder des südafrikanischen Beckens. By Dr. Siegfried Passarge. Pp. xvi+822; illustrated; and with a "Kartenband" containing 11 maps and 10 sheets of sections, sketches, &c. (Berlin: Dietrich Reimer [Ernst Vohsen], 1904.) Herausgegeben mit Unterstützung der königlich-preussischen Akademie der Wissenschaften. Price 80 marks (unbound).

NOW if we could imagine that Mr. Shandy the elder were alive, this is a book that, like many another of its class, would have delighted him. Hereby he could have proved triumphantly to Yorick the potency of that great scheme of education—that "north-west passage to the intellectual world"—which he propounded so enthusiastically upon a memorable occasion. His scheme, it will be remembered, was that upon every substantive in the dictionary the Auxiliaries (so gravely misunderstood by the Corporal and Uncle Toby) should be brought to bear exhaustively:—"Every word, Yorick, by this means, you see, is converted into a thesis or an hypothesis:—every thesis and hypothesis have an offspring of propositions;—and each proposition has its own consequences and conclusions; every one of which leads the mind on again, into fresh tracts of enquiries and doubtings.—'The force of this engine,' added my father, 'is incredible. . . .'"

Even up to the numberless "tracts of enquiries and doubtings," it is in this spirit that Dr. Passarge has attacked "Die Kalahari"; and the book before us, with its mass of spacious solidly printed pages, is the result. It is a work which compels our admiration, not only for the thorough and painstaking manner in which its author has carried out his personal investigations, often in circumstances of great difficulty; but also for the acumen with which he has grasped the bearing of his observations upon problems of world-wide range; and for the astounding industry with which he has pushed his researches into all the ramifications of his subject. In giving us, for the first time, an adequate knowledge of a large part of that hitherto little known region of South Africa, the Kalahari Desert, he has also contributed most significantly to our earth-knowledge in general. Hence his book, besides forming the basis for all future work in the Kalahari, must have a weighty influence in many questions pertaining to the geological history of the continent of Africa and to the changes of climate that are recorded in the rocks of many other parts of the globe.

We feel that it is a forlorn hope to attempt within the limits of our space to present in true proportion even an outline of the contents of this great mass of information with its leaven of speculative deduction. But let us to the attack!

Dr. Passarge was attached, as mining expert, to an expedition of the British West Charterland, Ltd., organised to explore the Kalahari, under the leadership of Sir Frederick Lugard, during the years 1896–9. Of the main expedition and its personnel we hear very little throughout the book. It had left Palapye some time before Dr. Passarge reached that place, at the beginning of October, 1896. He followed with a small party, and a few days after starting he was stricken with fever. A woful month ensued, during which, with a dying prospector as his companion in misfortune, he lay in or under the wagon as it trekked slowly north-westward across the eastern part of the desert.

Not until the middle of November did he regain his feet; but his recovery thereafter was rapid, and his field-work in various parts of the Middle Kalahari was carried on subsequently without serious interruption until its termination in October, 1898. During the two years thus spent, his traverses extended east and west over a breadth of about 700 km., and north and south for about 500 km., the site of the desiccated Lake Ngami lying roughly central to these journeys. His official investigations were directed chiefly to the islands of ancient rocks with which the region is sparingly studded, mainly in the form of subdued hill-chains but occasionally in comparatively low-lying tracts that have remained uncovered by the superficial formations of the desert. To reach these islands it was necessary to cross the level sandy veldt for longer or shorter distances—traverses that were often very difficult and full of hardship—and Dr. Passarge had thus the opportunity to carry out that careful study of desert conditions in the Kalahari which forms what we must regard as the main subject of his book. The ancient rocks were found to consist of two great series of unfossiliferous greywackes, schists, and limestones, often much altered by dynamic and thermal agencies, and probably in the main pre-Cambrian, though possibly ranging down into Cambrian times. Among these ancient sediments there are many intrusions of acid and basic igneous rocks. The thin superficial deposits, though incomparably more recent, are believed by Dr. Passarge to include beds that may date back to Eocene times. By their composition and structural alteration through weathering, these desert-formations are held to indicate the successive conditions that have ruled in the region since Mesozoic times; and it is in his discussion of these deposits that the author gives the fullest play to his powers.

To take the contents of the book in their given order:—After a modest preface, the author deals, in chapter i., with the explorations of his predecessors in the Kalahari. The list of references added at the end of the chapter constitute his bibliography of the subject—a convenient arrangement that is followed throughout the book. In the second chapter Dr. Passarge gives a consecutive account and itinerary of his travels and experiences. This account is to a large extent repeated and amplified in the topographical descriptions of later chapters. The third chapter is occupied with a short description and categorical formulation of the topographical and hydrographical conditions of South Africa generally, through all its divisions and subdivisions. In chapter iv. the author deals in the same manner with South African geology, with the literature of which he appears to be well acquainted. Respecting this literature, he remarks (p. 39):—

"So ist denn die Geschichte der geologischen Forschung in Südafrika eine wahre Komödie der Irrungen. So viel Forscher, so viel Ansichten! Ja, ein und derselbe Forscher . . . haben ihre Auffassung wiederholt gewechselt. . . ."

He debates anew the many doubtful points in the correlation of the rocks, and expresses his views thereon. This chapter with its bibliographical appendix might be used as a general introduction to the study of South African geology. It is illustrated by a geological map of Africa south of 10° S. lat. (Blatt ii. in the "Kartenband"), which, though rough in execution and crude in colouring, serves to give at a glance the main lines on which the rocks of this part of the continent are arranged. The climate of South Africa and of the Kalahari afford material for chapter v., which includes a summary of the author's personal observations on the weather, and concludes with some very acceptable notes on the rapidly progressive desiccation of the country, based on a comparison of the experiences of the earlier and later explorers.

Then follows a solid block of chapters—vi. to xxiv., pp. 105-530—devoted, except for an interlude in chapters xvi. and xvii., to the detailed account of the author's investigations in the several districts visited—the Kwebe and neighbouring hill ranges; the region bordering on Ngami and the Botletle River; the Haina Veldt; the Chanse Veldt and the adjacent German frontier; the western part of the Okavango basin with its rapidly perishing river-system, of which the description is of extreme interest; the Kaukau Veldt; the Kung Veldt; and the Mahura Veldt. With many an "Überblick" and "Rückblick," "Übersicht" and "Folgerung," the author pursues his way through masses of detailed observations, all carefully classified, subdivided, and marked with sign-posts in the form of head-lines; and many a pertinent interrogative sentence, spaced out in the text, is conscientiously answered or as conscientiously evaded by further questions. It is in these chapters that the operation of the Auxiliaries is most forcefully felt. To the general reader the greater part of these details must be arid, as befits the description of a desert, yet not without refreshing oases here and there. Nor can it be denied that in a region undergoing such rapid changes in respect to rainfall and drainage-systems, the full particulars as to the exact condition of all the water-pans at the time that they were examined are certain to prove of value in the future for purposes of comparison; while to the geological traveller who may hereafter visit the Middle Kalahari the whole of these chapters are likely to prove of service. Indeed, when we remember how much more might have been written from the impressions of a trained observer at work in a new country during two whole years, we feel, on the whole, inclined to be grateful to Dr. Passarge for his moderation.

The two chapters already mentioned as forming an interlude to the topographical details are comparatively amusing. The first (xvi.) describes the geological effect of the burrowing animals of the desert, both mammals and insects, upon the superficial formations, with numerical calculations as to its efficacy in producing large results. The second gives a summarised description of the structure of the deposits found on the sites of the desiccated lakelets or "Kalkpfannen" of a certain district, with a particular inquiry into the origin of the water-holes ("Pfannenkrater") that in many cases still persist within them. After stating the problem in his favourite manner, under various headings in interrogative form, the author proceeds to show that all the peculiar features of the water-holes may be assigned to the agency of the wild animals that have used them as drinking places and bath-tubs. He enumerates these animals; shows from the records of the first white travellers how multitudinous they once were; gathers data from the Berlin Zoological Gardens as to the drinking capacity of most of the larger herbivores; supplements this with observations on the drinking of his draught animals when trekking in the desert; calculates the amount of dissolved and suspended matter in the water of the "pans," and how much would be carried away in the interiors of the beasts that drank it; and also how much they removed on their exteriors after their occasional mud-baths. Then, the cubic space of the water-hole being known, and the number of its former visitants estimated, a simple calculation brings out the number of years in which, by this agency, the hole could have been produced.

Is there not the germ of a glorious question for some future examination paper in the following sentences?—

"Nehmen wir die Oberfläche eines Nashorns auf 6 qm an und die Kruste nach jedem Schlammbad auf 1 mm, so trägt jedes Tier 6 l Schlamm fort. Wenn also 10 dieser Tiere während der Trockenzeit (180 Tage) täglich baden, tragen sie im Jahr 10.8 cbm Schlamm fort, im Laufe von weniger als 2000 Jahren also den Inhalt einer Pfanne von 20,000 cbm. Das würden 10 Nashörner allein fertig bringen!" (p. 321).

Let us acknowledge, however, that from this singular line of research a very important deduction is drawn, and is in keeping with all the other evidence:—

"Denn diese Zahl besagt, dass vor dieser Zeit—sagen wir rund 6000–7000 Jahren—das Chansefeld ein wesentlich anderes Klima gehabt haben muss" (p. 322).

After giving, in chapter xxx., a summary of our scanty knowledge of the vast area of the Kalahari beyond the regions which he visited, the author proceeds to epitomise his own observations and to deal with the broader aspects of his subject. The orographic and hydrographic conditions of the Kalahari as a whole are briefly stated in chapter xxxi., with a summary of the evidence for the rapidly progressive desiccation of the land in a definite direction. Then follow chapters on the basement-rocks (das Grundgestein) of the region; on the development and antiquity of the South African land-mass; and on the superficial formations (die Deckschichten). In chapter xxxv., entitled "Die Mesozoische Wüsten-periode," the author discusses the different stages of alteration shown both by the older rocks and by the superficial formations, through "einkieselung" or cementation by infiltrated silica, and "verkieselung" or replacement of carbonates by silica; and he gives his reasons for recognising successive periods of alteration and deposition consequent upon changes in the physical conditions of the land. He goes far afield in his argument, touching upon the various effects of rock-weathering under almost every climate of the globe, but with especial reference to desert-conditions. He brings this information to bear upon the South African geology generally, where he recognises evidence for desert-conditions of great antiquity and long duration, but with occasional intermission. Whether these speculations are well founded it will remain for the keen investigators now working in South Africa to decide.

In the same strain of more or less hypothetical deduction following upon an epitomised re-statement of the main facts, are the next two chapters—xxvi. "Die Periode der Brackwasserkalke und der Laterite," and xxvii. "Die Pluvialzeit und ihr Abklingen bis zur Gegenwart"—in which the probable condition of the interior of South Africa is traced through Tertiary and post-Tertiary times. It seems somewhat hazardous to correlate the isolated and widely scattered patches of thin sandstone and limestone by their lithological characters alone, and to assign them to successive periods. One line of argument by which the author reaches his conclusions with respect to the age of the desert-beds of the Kalahari is by comparing them with the more readily determinable Tertiary succession of Egypt. On questionable grounds he suggests that his "Pfannensandstein" may be assigned to the Eocene, his "Kalaharikalk" to a somewhat moist episode in Miocene and Lower Pliocene times; after which he recognises a period of dry conditions in the Middle Pliocene, and then a Pluvial period of late Pliocene and early post-Pliocene times. This Pluvial period may be accepted with some confidence as being in close relation to the occurrence of the Glacial period in northern Europe. Evidence from many other parts of the world tends to show that the progressive desiccation that has gone on since that period has not by any means been confined to the African continent.

Among the interesting side-issues raised or recapitulated in these later chapters of the book are questions as to the antiquity of the Kalahari fauna; the geological effect of wind-action; the obliteration of dry river-beds; "zoogene erosion"; the change of climate in North Africa during historic times; and others that we have no space even to catalogue.

The next—and last—chapter gives a review of the plant-life of the Kalahari, with especial reference to the evidence which it bears as to the changing conditions of the land. Then follow various appendices, occupying one hundred pages. These contain a few astronomical observations; a petrographical description of 447 rock-specimens and slides by Prof. Kalkowsky; twelve chemical analyses of rocks; an account of the land and freshwater shells from the newer superficial deposits by Prof. E. v. Martens; a full account of the diatoms by H. Reichelt; and a list of plants. The last twenty-seven pages of the book are occupied by the classified indices.

There is no attempt at artistic embellishment in the text-illustrations; and the same may be said of the numerous sheets of maps, plans, and sections contained in the "Kartenband," some of which, indeed, appear scarcely to justify their reproduction, while in many the scale seems to be unnecessarily large.

And now that we have growled our way through the book, and have earned the concluding pipe of peace, let us add that when a capable and earnest worker is willing, in publishing his results, to undergo the severe labour that a production of this kind must have entailed, our sense of gratitude toward him should be paramount, and should stifle all minor complaints and especially the impatient grumbling that arises in the main from our own unrealised indolence.

G. W. L.

ANIMAL PHOTOGRAPHY.

Photography for the Sportsman Naturalist. By L. W. Brownell. American Sportsman's Library. Pp. xviii+311; illustrated. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1904.) Price 8s. 6d. net.

On several previous occasions we have had the pleasure of noticing some of the admirable volumes belonging to that series of the "Sportsman's Library" which deals exclusively with the various animals constituting the sportsman's quarry. In the volume now before us we have, on the other hand, one of a second series devoted to different aspects of sports and matters connected therewith. In regarding practical photography as an essential element in the education and outfit of every modern sportsman who desires to be something more than a mere slayer of game, the editor has undoubtedly been well advised; and he also has been exceptionally fortunate in securing the services of an expert with the experience and reputation of Mr. Brownell to make known to the beginner the mysteries of the camera and the technique of outdoor animal photography. If the reader is careful to bear in mind that when the author refers to "our animals" he means the members of the North American and not of the British fauna, the book will, we venture to think, prove as acceptable to sportsmen and field-naturalists on this side of the Atlantic as to the countrymen of the author; and if this turn out to be the case, a wide circulation would seem to be assured.

In his introduction Mr. Brownell gives a concise and yet comprehensive sketch of the history of photography, dwelling especially on the enormous strides it has made during the last half-dozen years. The loss of time that he himself experienced in having to learn everything for himself when first taking up animal photography is alluded to as a kind of justification (if one be needed) for the appearance of his volume, while the value of accurate photographs of animals as a means of instruction in natural history is noticed in the concluding paragraphs of the introduction.

Possibly, and if so pardonably, the author is inclined to over-rate the importance of photographic illustrations in zoological work. In many respects, such as representing birds in their natural surroundings, its importance cannot, indeed, be over-estimated. But when the author goes on to deride the work of the pencil of the artist as a means of illustrating books on natural history, and to declare that the wood-cut and the "process-block" are things of the past in this connection, we take leave to differ from such a sweeping assertion. Nor are we alone in so doing, for Mr. W. T. Hornaday, in his recently issued "American Natural History," takes occasion to point out that photography has its limitations in the portrayal of animals, and that some illustrations demand the artist's pencil in order to become satisfactory zoological portraits. It is quite true, as Mr. Brownell urges, that the sketch, as compared with the photograph, may be crude and unfaithful to nature, yet it will nevertheless often accentuate or display essential features which are scarcely perceptible or absolutely hidden in the sun-portrait.

With this reservation, we are absolutely at one with the author in regard to the extreme importance and value of photography in natural history work, and, like him, we look forward to the time when real colour-photography will have been discovered and made available for everyday use. After describing in full detail the general technique of the photographic art and the kinds of camera and other apparatus best suited to the outdoor photographer of animal life, the author proceeds to discuss the mode of procedure in the case of different subjects, devoting one chapter to the larger mammals, another to the small mammals, a third to birds, and so on. So far as we can judge, all his advice is to the point, and the illustrations given as samples are in most cases admirable animal portraits. Not that attention is confined to animated nature, for we have a chapter on plant-photography, and another on the use of the camera in depicting sporting scenes and incidents, each as charmingly illustrated as their predecessors. Above all, the book is by no means dry reading, the technical details being enlivened with numerous and appropriate anecdotes. Mr. Brownell has, in fact, succeeded in producing a treatise on practical field-photography which it will be very hard to beat.

R. L.

A POPULAR STAR ATLAS.

Popular Star Maps. A Rapid and Easy Method of Finding the Principal Stars. By Comte de Miremont, F.R.A.S. (London: George Philip and Son, Ltd., 1904.) Price 10s. 6d. net.

IT is by no means an easy task to construct a series of charts of the principal stars in the sky that will at once be of service to those wishing to make themselves familiar with the chief constellations or star groupings. Many, if not the majority, of star atlases printed for beginners are so belaboured with lines indicating right ascensions and declinations, names of constellations, Greek letters or numbers against each star, different notations for variable stars, &c., that when the beginner turns his eyes from the starry heavens towards a chart in order to find out the particular grouping in question he is unable to recognise it among the innumerable markings. For this reason many who have made valiant attempts to learn the stars have given up trying, and it is the atlases that are to blame and not the seekers after knowledge.

The ideal set of charts for a beginner should in the first place represent the appearance of the starry heavens as near as possible, and consist of maps showing small white discs or stars on a dark background, the discs or stars varying in size according to the magnitude of the star; secondly, a fairly large region should be included in each map; thirdly, only stars to the third or fourth magnitude should be inserted; and lastly, each map should have an accompanying duplicate chart or key-map on the same scale, but with dark discs or stars on a white background, on which as much information as may be useful should be given.

In this way the beginner can at once find his particular stars on the first map, and learn their names, &c., on the accompanying key-map. This seems to be the logical method of aiding those who are not accustomed to deal with star charts, and it is a pleasure to find that such a series of maps is now available for those who wish to take advantage of them.

The charts is question, ten in numb-r, and each accompanied by a key-map, have been prepared by Comte de Miremont, one who is thoroughly acquainted with the stars from the navigating point of view, and is familiar with the desire of sailors and others for a simple star atlas. Stars to the fourth magnitude only are inserted, and these are represented, on charts 10 inches square, as white stars on a dark blue background; in the accompanying but separate key-maps, of the same size, the stars are black on a white background. Great care has been taken to ensure accuracy in the star positions.

The method of projection, namely, the gnomonic, is also one which lends itself well to this type of atlas, for the whole of the celestial sphere can be projected on six plates, each plate thus representing one side of a cube enveloping the sphere. The upper and lower sides of the cube enclose the north and south polar regions respectively, and the other four sides the equatorial regions. To render more clearly the relations to each other of star groups near the edges of each of these equatorial sides in contact, four additional overlapping maps are added. Thus there are ten charts in all, and there is this advantage, that each one with its corresponding key-map can be taken out of the portfolio and used in the observatory, in the field, or on board ship by itself. On each chart and its key is a scale of right ascensions with the seasons of the year when each of the constellations is visible in these longitudes; the declinations are omitted from the maps, but this information, and the right ascensions of every star marked, are given in the table showing the mean places (and annual change) for January, 1904. Other lists include the names of the constellations and the principal stars in each, and a complete alphabetical list of stars in the maps.

With regard to the general get-up of the maps, letterpress, and portfolio which encloses them, more could not be desired, and great credit is due to both compiler and publisher for producing such a serviceable and handsome set of star charts for the use of beginners, and at such a low price. W. J. S. L.

A CONTRIBUTION TO MUSEUM HISTORY.

The History of the Collections contained in the Natural History Departments of the British Museum. Vol. i. Pp. xvii+442. (London: Printed by Order of the Trustees of the British Museum, 1904.)

EVERY museum of the first rank has two histories, one of which is usually written but rarely published—the history of the gradual accumulation of the museum material, by purchase, exchange, or donation, and another, which can hardly ever be written—the history of the internal metabolism, the arrangement and re-arrangement, the differentiation and integration, the "Kampf der Theile im Organismus." It may not be difficult to indicate how various museums have adapted themselves to the advance of science and to their growing constituency under the influence of effective directors, how nature has crept in between the teeth of the abstractive scientific fork, how evolutionary series have replaced static taxonomic displays, how problems of practical human interest have been recognised, how a mere chamber of horrors has become an introduction to a rational study of pathological variation, and so on; but who can ever tell the detailed physiological story of the metamorphoses? For the great museum is an organism of many parts, each with its *spiritus rector,* each developing independently, and yet in cooperation with the rest. It may not be difficult to show how a museum has changed or is changing as the various objectives—for instruction, for investigation, for inspiration—have become more clear to the organisers; when, for instance, the simple step is taken of discriminating between what can be usefully exhibited and what should be as usefully concealed; but who can ever tell how much even this simple step costs? Is the priceless connecting link to be shown with blinds up or with blinds down, or not at all? But we must not intrude further into the real history of a great museum; it is an intricate story of thrust and parry between keepers and their environment, both animate and inanimate. The history before us is a history, not of the British Museum (Natural History Departments) as a growing organism; it is the history of the collections—a story of accretion.

The first volume of the history of the collections preserved in the four natural history departments of the British Museum deals with the botanical, geological, and mineralogical material, and also with the libraries. It has been produced at the suggestion of the director, Prof. E. Ray Lankester, by the officers in charge of the collections. Mr. B. B. Woodward has written the history of the libraries; Mr. George Murray, assisted by Mr. Britten, that of the department of botany; Dr. Arthur Smith Woodward, with valuable help from the late keeper, Dr. Henry Woodward, and from Dr. Bather, assistant keeper, that of the department of geology; and Mr. Fletcher that of the department of minerals. The second volume will deal with the department of zoology.

It need hardly be said that the various histories of the collections are scholarly productions; they tell of the foundation-stones and of the additions made from year to year, and they give an annotated alphabetical list of the numerous benefactors and vendors. The result is not adapted for fireside perusal, but it is very impressive, giving us a correct idea of the variety, extent, and importance of the immense series of collected specimens which are carefully guarded and ordered, "not only" (according to the terms of Sir Hans Sloane's will) "for the inspection and entertainment of the learned and curious, but for the general use and benefit of the public to all posterity." And it is also interesting to turn over the leaves and observe how many famous names occur on the honourable lists. Many of the short biographical notes in the geological and mineralogical sections supply valuable historical material. A useful addendum, we think, would have been a series of references to the catalogues and memoirs in which the collected material has been described.

The book will be of great value to investigators who wish to trace collections and specimens, or who wish to know beforehand what to expect in the British Museum; and everyone will agree that it furnishes abundant documentary proof of the carefulness and business-like methods of the great museum, which is one of the national assets that we have most reason to be proud of.

SCIENCE AND METAPHYSICS.

Scientific Fact and Metaphysical Reality. By Robert Brandon Arnold. Pp. xxiii+360. (London: Macmillan and Co., Ltd., 1904.) Price 10s. net.

IF this book does not conform to the adage "*Nonum prematur in annum*"—for Mr. Arnold's undergraduate career is no distant memory—that is no ground for complaint. The work is not only one of great promise, but a notable performance. In originality of conception, vigour and clearness of statement, width of outlook and fairness to all the aspects of experience, it would be with difficulty surpassed. At the same time it is quite unpretentious; there is no parade of learning; there is not a single foot-note. The one digression of any length—or modern militarism—is as interesting as it is pardonable.

The following are some of the main characteristics of the author's point of view:—(1) While defending metaphysics from the charge of being "built upon air or quicksands," he readily admits that it has not always taken full advantage of the science which it knows, and that greater accuracy of scientific detail ought to be displayed if it is to appeal to the "plain man" with some knowledge of physics, chemistry, and biology. In the same spirit the chapters on God and the Absolute and Human Immortality attempt to do something like justice to the religious aspirations of the "plain man," which are so severely neglected in such a work as "Appearance and Reality." (2) Mr. Arnold prefers *activity* to *existence* as a basis for investigation. The lower animals, in his view, display only "teleological activities"; the entity "mind" (self-conscious and introspective) belongs only to men. And perhaps not even to all men: "a human being might theoretically pass through life and never be actual mind; possibly with some savages this is almost the truth." (3) Again, Mr. Arnold is fond of the contrast between the individuation (real and objective in every sense) by means of the atom or the electron—"the true physical entities"—and the individuation by means of colour, sound, and the like which depends on our "particular sensuous evolution." The latter form of individuation, which finds expression particularly in the "material totalised image," seems therefore to show that in mind (including "teleological activity") there is something new in principle. "But by asking whether it is a new entity we merely confuse matters. For we should thus assume that the physical world is once and for all limited to atomic activities, whereas all observations tend to show that the various entities are continually changing and re-organising themselves, and developing new relations and qualities." In one sense Mr. Arnold claims that his view of mind in the non-introspective animal is as materialistic as it could be, since mind under such conditions "is matter totalised in a special manner in relation to an external crisis." But he hastens to add that "premental matter was not merely the matter of physics and chemistry." And mind in man he certainly regards as something very different.

It is impossible to do justice to this suggestive work in a short notice, and we are well aware that the above is only a hasty and somewhat arbitrary selection of a few of the topics treated. The views of matter and ether, in particular, might well have a notice of their own; so might the chapter on psychophysical interaction, which is almost a model of philosophical discussion. In this last the theory is stated that the initial impulse required to liberate the energy of the muscular system comes ultimately from "external sources," *e.g.* when the sight of some object moves us to pursue it, from the ethereal vibrations which we apprehend as light. But for the author's defence (in many ways successful) against the obvious objections to this view, we must refer to the book itself.

OUR BOOK SHELF.

Index of Spectra. (Appendix O.) By W. Marshall Watts, D.Sc. (Lond). Pp. 40. (Manchester: Abel Heywood and Son, 1904.) Price 3*s*.

THIS is the latest addition to the very useful series of appendices which Dr. Marshall Watts has given to his well-known "Index of Spectra." In it he has brought together the arc spectrum of molybdenum by Hasselberg, the spark spectra of calcium, scandium, indium, beryllium, lithium, thallium, antimony, and arsenic, by Exner and Haschek; of calcium, lithium, thallium, and antimony, by Eder and Valenta; of radium, by Runge and Precht; and the oxy-hydrogen flame spectra of lithium, potassium, rubidium, and cæsium, by Ramage. Hasselberg's comprehensive record of the arc lines of molybdenum takes up about half the pages of the appendix. In the cases of metals investigated both by Exner and Haschek, and Eder and Valenta, the records are compared in parallel columns. The oscillation frequencies corresponding to the wave-lengths of all the lines given have been reduced by the compiler.

La Matière, l'Éther et les Forces physiques. By Lucien Mottez. Pp. 236. (Paris: Gauthier Villars, 1904.) Price 4 francs.

THE time is fast coming when the qualification which will play the most important part in determining a man's reputation as a physicist will be that he shall abstain from writing books on the philosophy of ether, matter, and the universe. The present book discourses pleasantly about gravitation, heat, electricity and magnetism, polarisation of light, chemical action, and such like matters. It is hardly the kind of book to which a beginner would turn to get his first lessons on physics, as the style is too discursive, and it contains little but what an average physicist either knows or has probably thought of already; and yet we can only say about books of this kind, "still they come." Who reads them?

The Uses and Wonders of Plant-hairs. By Kate E. Styan. Pp. iv+65; with plates. (London: Bemrose and Sons, Ltd.) Price 1*s*.

THE nature and purpose of plant-hairs will have occurred to many teachers as a favourable subject for a course of nature-study. The presence or absence of hairs in allied plants, even in the same plant when growing under different conditions, their position and form, their mechanism and use, afford plenty of opportunity for consideration and deduction. The book offers a fair *résumé* of facts, but it is not obvious that the writer is recording personal observations, and the appendix of illustrations loses some of its value as no allusion is made to it in the text.

LETTER 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 Planet Fortuna.

ALTHOUGH NATURE is scarcely the proper place for a disquisition on a Latin quotation, perhaps you will admit of a further correction of "W. T.'s" correction (p. 461) of the lines quoted by "W. E. P." Numen is, I believe, never used except in the sense of *good* luck, being derived from nuo, and signifying the nodding approval of the gods; hence "Nullum numen habes, si sit prudentia," would mean just the opposite to the obvious sense of the passage. The best editions give, in both the satires where the line occurs, "Nullum numen abest," and this makes sense. Except for this word, "W. T.'s" version is correct.

SPENCER PICKERING.

STATE AID FOR HIGHER EDUCATION.

THE announcement that the committee, presided over by Mr. Haldane, M.P., appointed to consider the allocation of the Treasury grant to the university colleges has finished its inquiry, was made in our issue of last week. In the note dealing with the subject on that occasion the part of the grant to be received by each college was specified, and the fact remains to be recorded that 9000*l.* has been allotted to the purchase of books, apparatus, specimens, instruments, &c., to form equipment for teaching of a university character. As will be known already to most readers of NATURE, the Treasury this year has doubled its contribution to the university colleges, and in this way has acknowledged the national services which these institutions are rendering. The total Treasury grant to the fourteen university colleges is now 54,000*l.*

That the grant has been increased in this substantial manner is certainly a matter for congratulation, and men of science will view with satisfaction the evidence this additional State aid for higher education affords that the Government is beginning to realise the important part played by higher education in securing national efficiency—especially by higher education in science, using that term in its most catholic sense. But, even at the risk of appearing to be ungracious, it must be pointed out at once that the amount is even now ludicrously small and altogether inadequate when regarded as the contribution of the State to the pressing work of placing our system of higher education upon a satisfactory basis. As has been consistently and persistently urged in these columns, there is an enormous amount of leeway to be made up before the facilities for education of university standard in Great Britain can be compared with those in several European countries and with those in the United States, compared, that is, with any chance of a satisfactory result. The reason is a simple one. Great Britain alone among the first-class nations of the world has not learnt that the reign of muscle is over, that success, whether in commerce or war, will be always with the most highly trained and scientifically educated people. Other nations have taken this truth to heart, and believe enthusiastically that what is worth having is worth paying for, and paying for well. Surely, in view of the object-lesson that events in Manchuria afford, it will not be long before our own country will be prepared to make great sacrifices to secure as efficient a system of higher education as that of any other nation on the face of the earth.

The total grant to the fourteen university colleges is, as has been said, 54,000*l.*, and this is a large sum compared with what the colleges have received in previous years. But the State endowment of the University of Berlin in 1891–2 amounted to very nearly 169,000*l.*; that is to say, one university in Germany receives from the State in a year more than three times as much as our fourteen university colleges receive together from the Treasury. A single fact of this kind is enough to convince the student of educational problems that while Germany takes higher scientific education seriously, and reaps the advantages of her sacrifices, Great Britain has still to understand that commercial success and educational efficiency stand in the relation of effect and cause. If at the present day there still exist sceptics as to our educational inefficiency and our national parsimony towards universities and colleges, the presidential address of Sir Norman Lockyer to the British Association at Southport in 1903 may be commended to them. Though men of science who have at heart the true welfare of their country are at present rather like "voices crying in the wilderness," it is clearly their duty to continue to urge the paramount importance of higher scientific education and of scientific research, and to petition the Government to act more generously on their behalf.

But it is not enough to provide large and adequate State grants for education in order to secure efficiency in the face of modern needs. It is just as important so to choose the subjects of study and to arrange the curricula of schools and colleges that our boys and young men may begin life as well and as suitably trained as the youths of other countries. The kind of education suited to the conditions of the days of the Renaissance is not in harmony with the needs of the twentieth century. The work of men of science in the last century has revolutionised life, and our system of education must be adapted to existing circumstances. The custodians of English education are still too much actuated by mediæval ideals. The entrance of the student of science to the older universities is still obstructed by an obsolete and ludicrous test in Greek. There is a tendency even yet among those in charge of our Department of Education to discourage and hamper the instruction in science in our elementary and secondary schools. The Prime Minister is reported once to have said that the only knowledge our boys have of natural phenomena is that obtained on the cricket and football fields, and on the river. The man of science has still much to teach his fellow citizens. The work to which Huxley gave so much of his energy is not yet done, and it is the duty of his successors to continue his efforts, and to take every opportunity of advocating the application of the principles of science to educational administration.

It must be recognised that there are many ways of obtaining culture. The idea of the Middle Ages that culture was obtainable only by studying Latin and Greek, though true enough then, is to-day hopelessly narrow and indicative rather of the state of mind of the Philistine. The scholar steeped in classical lore, yet ignorant of nature's laws and of modern literature, is but an uneducated pedant. The scientific specialist with a complete knowledge of some restricted subdivision of science, yet knowing nothing of the ideas of ancient and modern poets and philosophers, is but a narrow technical registrar. Culture is something broader and higher than anything with which the pedant or cataloguer is acquainted. The man of science desirous of producing cultured men and women will strive so to arrange school and college time-tables that they contain in due measure subjects designed to cultivate and develop all the faculties of the healthy human mind; and in this work the heritage which has been left us by the nineteenth century will not be ignored. The teachings of science, the love of truth wherever it may lead, will be inculcated consistently, so that a race may be produced able to deal with modern problems in a modern way.

Though the Government moves but slowly, and perceives so incompletely the unsatisfactoriness of our supply of higher education, there is cause for satisfaction in another direction. There are growing evidences that the broad-minded policy of wealthy men in the United States, which leads them to give of their millions to colleges and universities, is being emulated in a measure by our merchant princes. We have on several occasions lately been able to record noble instances of private munificence on behalf of higher education, and it may be that before long the Government will recognise its imperative duty.

CAVE HUNTING.[1]

SINCE the memorable researches of Dr. Buckland in the early part of last century, the exploration of British caves has had a great fascination for many investigators. This is no matter for surprise, for there are many points of interest which await elucidation regarding prehistoric man and the animals by which he was surrounded in very early times, and there is a great probability that some of these problems will be solved by cavern researches. When we remember, also, how much has already been revealed by cave hunting, we are led to hope for more in the future, and consequently investigations in this direction raise our expectations.

The current number of the *Quarterly Journal* of the Geological Society contains an interesting account of a cave discovered about two years ago near Brassington, Derbyshire. Shortly after its discovery the cave was visited by a number of "ardent collectors," and many bones and teeth were carried away; but very soon permission was given by Major Nicholson, the owner, for the deposits to be carefully investigated on behalf of the Derbyshire Archæological and Natural History Society, the work falling almost wholly on the authors of this paper.

The cave is in a quarry situated on the south-eastern edge of the Mountain Limestone plateau, and its floor is about 1090 feet above Ordnance Datum, the top of the quarry being some 30 feet higher. The highest part of the plateau in the neighbourhood is formed by the Harbro Rocks, which at some little distance, and with a depression between, rise to a height of 1244 feet, that is, about 120 feet higher than the entrance to the swallow hole which opened into the top of the cavern.

The cavern itself was a master joint in the limestone, enlarged by the action of water, and when found (it is now entirely destroyed) extended about 120 feet from the S.S.E. to the N.N.W., and in this direction it deepened considerably. Much care seems to have been taken to keep separate the bones from each layer, and fifteen spots are marked on the section given to indicate distinct layers or places where bones were discovered. Eventually, however, these were grouped into three series:—(1) The upper inclined layers which had accumulated to the S.S.E. of the swallow hole, and from which they were evidently derived. By far the greater number of the specimens were found in this part of the cave. To the N.N.W. of the swallow hole very few bones were met with, and the deposit was of a more irregular character, seeming to indicate a different mode of origin.

(2) The second division included all that was obtained in a stratum about three feet in depth excavated below the level of the quarry floor, and extending throughout the length of the cave. Very few bones were found, but these included remains of hyæna and of a small deer which it was important to know were present at this early stage of the cave's history.

FIG. 1.—Hoe Grange Quarry, showing entrance to Cave. From photograph by H. Arnold-Bemrose.

(3) The third, and oldest series of deposits, were some highly inclined beds at the N.N.W. end of the cave, which were explored to a considerable depth in the hope of meeting with Pliocene mammals, such as were recognised by Prof. W. Boyd Dawkins in the cave at Doveholes in 1903, but unfortunately without finding any such remains. We wish the explorers had had more success in this deeper exploration; however, it is satisfactory to know that the search was made, even though the results were negative.

The number of bones yielded by this cave could scarcely have been less than 10,000, for the authors have accounted for 8000, and many were carried away before they began work. Nearly half these remains belonged to bovine and cervine animals, while between six and seven hundred of them are referable to hyænas. It seems pretty certain that this cave was a hyæna-den, and although no entrance was found except the swallow hole, yet it is possible that this was the means of access.

Some twenty-seven species of mammals, birds, and amphibia have been identified from Hoe Grange cave, but about half of these belong to the smaller forms of vertebrates, which as a rule have not been recorded in cave researches. The rich harvest of these small creatures which rewarded the patient labour of Mr. Lewis Abbott some ten years ago in the rock fissure at Ightham, Kent, has caused more careful search to be made for them in recent researches, and with good results, such as those of Mr. R. S. Ussher in his cave hunting in Ireland during the last two or three years, only a part of which have yet been published. Search was made for these smaller animals at Hoe Grange, but with only partial success. Among the larger animals represented in the cave, the lion will perhaps attract most attention, and one of the few specimens obtained is part of the lower jaw of a cub with some of the milk teeth still in place. The hyæna, wild cat, wolf, fox, grisly bear, and badger are the other carnivores which have been identified.

Rhinoceros remains occurred in some abundance, and the teeth show that they belong to the *Rhinoceros leptorhinus*, not to the woolly rhinoceros, the form hitherto found in Derbyshire. The elephant is re-

[1] "On an Ossiferous Cave of Pleistocene Age at Hoe Grange Quarry, Longcliffe, near Brassington (Derbyshire)." By H. H. Arnold Bemrose, J.P., M.A., and E. T. Newton, F.R.S. (*Quart. Journ.* Geol. Soc. vol. lxi. p. 43, 1904.)

presented by a single specimen, part of a milk molar of *Elephas antiquus;* this again is peculiar, the elephant previously met with in Derbyshire being the mammoth (*E. primigenius*). The presence of *Elephas antiquus* and *Rhinoceros leptorhinus,* as we learn from the discussion following the paper, led Prof. Dawkins to regard the deposits at Hoe Grange as belonging to the older Pleistocene group of caves.

Among the numerous bovine remains there are no horn-cores and frontal bones to indicate the species to which these remains belong, and the measurements of several metacarpals given in the paper show that limb-bones alone are not sufficient to indicate whether the remains are those of Bos or of Bison.

The Cervidæ are represented by four species, the

FIG. 2.—Mammalian Bones from Hoe Grange Cavern. 1, Lion-cub, lower jaw; 2 Wild Cat, femur; 3, Wild Cat, humerus; 4, Bear, molar tooth; 5, 5A, *Elephas antiquus*, milk tooth; 6, Fallow deer, three molar teeth.

great Irish deer (*Cervus giganteus*), the red deer (*C. elaphus*), the roebuck (*Capreolus caprea*), and another form, intermediate in size between the last two, which is regarded by the authors as fallow deer (*Cervus dama*). Bones and teeth of the last-named form were very numerous, nearly 1600 specimens having been found. If these remains are indeed parts of Pleistocene fallow deer, and we see no way to any other conclusion, they are of the greatest interest. The fallow deer has not hitherto been accepted, at least by modern writers, as a member of the British Pleistocene fauna, but is thought to have been introduced to this country probably by the Romans.

There are two points, however, which have to be settled before we can accept this addition to our Pleistocene mammals:—(1) Are these remains certainly those of fallow deer? and if so (2) Is the deposit in which they were found really of Pleistocene age?

It is to be regretted that there are no sufficiently well preserved antlers to define the species clearly, but the limb-bones and teeth are of such a size that if there had been no question of age there would have been little or no doubt in referring them to fallow deer. In the circumstances the authors have carefully measured the teeth and made comparisons with both fallow and red deer, and feel compelled to regard these remains as parts of fallow deer or of a closely allied species. The only Pleistocene species of a size which might compare with these bones and teeth is the *Cervus Browni* described by Prof. Boyd Dawkins from Pleistocene beds at Clacton, and this is only known by its antler, which is distinguished from that of the fallow deer by the presence of an additional tine. It has been shown, however, that modern fallow deer sometimes have this additional tine (see NATURE, vol. xi., p. 210), and it thus becomes very doubtful whether *C. Browni* is really a distinct species. Although there are no antlers from Hoe Grange cave that can be compared with *C. Browni,* yet it seems almost certain that the authors are correct, and that these Hoe Grange remains are representatives of the fallow deer.

We have now to consider the age of the Hoe Grange deposits. There can be no question as to the Pleistocene age of the elephant, rhinoceros, hyæna, and lion, and there is no doubt as to the fallow deer bones being found with the remains of those animals; but it is just possible that the fallow deer was living in the neighbourhood at a time when a previously existing Pleistocene deposit was washed into this cave, and so the more modern animal got mixed with the older forms. In order that such a re-deposition of large bones might take place there must have been a considerable supply of water, and seeing that the cave at the present time is near the top of the plateau there is no collecting ground for water; and it becomes necessary to suppose that, at the time of the re-deposition of the bones, the land was much higher than it is now, and that it has since been denuded. But it must be remembered that this would mean a very large amount of denudation, and, if we are to accept the fallow deer as a Roman importation, this denudation must have taken place since Roman times, which seems extremely improbable. We think, therefore, that the authors are justified in regarding these particular cervine remains as those of fallow deer, and as good evidence that the species lived in this country in Pleistocene times.

A fallow deer's antler has been recorded recently by Dr. Herlaf Winge from an interglacial deposit in Denmark; and this early extension of the species so far north on the Continent makes its occurrence in England in Pleistocene times still more probable. It is remarkable that *Cervus dama,* or rather its equivalent, *C. Browni,* should have been so rarely found, hitherto, in Pleistocene deposits, seeing that it is so abundant in the Hoe Grange cave.

A word regarding the illustrations accompanying this paper, two of which, by the courtesy of the council of the Geological Society, we are able to reproduce. The views of the cave are very creditable reproductions, but we have nowadays become accustomed to good things of this kind. It is rarely, however, that we have seen such satisfactory reproductions of photographs taken directly from the fossils as we have in the two plates. Most of the good collotype reproductions of fossils that have recently appeared are from photographs of water-colour drawings, and some of them are certainly very effective; but there is the artist's equation to allow for. In the present case, no such allowance has to be made, and the figures of the lion's jaw as well as of the teeth of the fallow deer and elephant are admirable. These plates do credit to all concerned in their production.

FIJIAN FOLK-TALES.[1]

ETHNOLOGISTS have all along suspected that Mr. Fison has plenty of unpublished information concerning Fiji. They are grateful to him for what he has already published in the *Journal* of the Anthropological Institute, but they clamoured for more, and even now they will not remain satisfied with the handsome book that has just been issued by the De La More Press. This new book contains a dozen folk-tales capitally told; "each contains a genuine legend as its skeleton, for the flesh with which that skeleton has been covered, the most that can be claimed is that it is of the native pattern." The tales are interesting as stories, and have increased value when compared with other tales from Oceania, but their greatest importance rests in their value as evidence of the ideas and actions of the natives before the white man came. In the introduction Mr. Fison gives a long discussion concerning cannibalism, and he sums it up thus:—

"It is impossible to establish a certainty as to the origin of cannibalism, and the question resolves itself into a comparison of probabilities, the balance being in favour of the strongest motive. This is undoubtedly Hunger. It is stronger than Superstition; it is stronger than Revenge. Man is a carnivorous animal, whatever the vegetarians may say; and in a savage state of society, if he cannot get the food for which his stomach craves, he will '*kusima*' (crave, or hunger after flesh) until he eats his brother."

For, as Mr. Fison argues, the Fijians were formerly scantily supplied with animal food. The serious student is occasionally tantalised by hints of further information, and by allusions to possible discussions of social and other questions, all of which are passed by as not being suitable for a popular book; doubtless Mr. Fison was wise in restraining himself, but, for the sake of science, it is sincerely to be hoped that he will give all his information to the world in some form or another. In the meantime we thank Mr. Fison for this publication, which can be recommended to those who like interesting information about real savages told in a pleasing manner.

FIG. 1.—Bau, Fiji. From Fison's "Tales from Old Fiji."

[1] "Tales from Old Fiji." By Lorimer Fison. Pp. xlv+175; illustrated. (London: A. Moring, Ltd., the De La More Press, 1904.) Price 7s. 6d. net.

NOTES.

On Friday last, March 17, the worlds of science and art combined to do honour to a man who has rendered to both services of the utmost value and of a nature that time cannot diminish for so long as the human throat is capable of emitting musical sounds, and so long as throats are liable to disease, the great invention of Manuel Garcia will hold its place among vocalists and laryngologists. The celebration of Señor Garcia's centenary was held in the hall of the Royal Medical and Chirurgical Society, Hanover Square, under the direction of Sir Felix Semon, chairman of the Garcia committee. Señor Garcia sat alone on a daïs, while in front of him were ranked the representatives of kings, governments, universities, scientific societies, and his old pupils who had gathered to do him honour. Sir Felix Semon announced that that morning the King had invited Señor Garcia to Buckingham Palace, and with his own hands invested him with the insignia of Commander of the Royal Victorian Order, and had expressed a desire to be represented at the banquet in the evening by his Lord-in-Waiting, Lord Suffield. The Marquis de Villalobar then delivered a congratulatory message from the King of Spain, and added, "In the name of His Majesty and your motherland, I invest you with the Royal Order of Alfonso XII. as a reward of your merits and the services you have rendered to mankind. I desire also to make public the sentiments of my beloved Sovereign and of his Government to King Edward VII. for the distinction he has conferred upon our compatriot, and the hearty gratefulness of Spain to all who have come here to-day to honour Don Manuel Garcia." Other tributes followed thick and fast during a crowded hour. Prof. Frankel presented on behalf of the German Emperor the great gold medal of science. Sir Archibald Geikie, Mr. Francis Darwin, and Prof. Halliburton, representing the Royal Society, presented an address, recalling the fact that their *Proceedings* for March 22, 1855, contained the epoch-making paper in which Señor Garcia laid the foundations of the experimental study of the voice. The Royal Prussian Academy of Sciences, the University of Königsberg, the Victoria University, the Medical Faculty of Heidelberg, the Royal Academy of Music, and the Royal College of Music sent distinguished representatives, who in rapid succession laid before the maestro illuminated addresses in rich profusion, until the table in front of him was heaped. We have not space to give the long list of public institutions and societies, laryngological and other, which brought tribute; but every quarter of the globe was represented, and during the proceedings a constant stream of telegrams poured in. After the addresses a portrait of Señor Garcia, painted by Mr. Sargent, R.A., and subscribed for by friends and admirers in all parts of the world, was unveiled and presented to him by Sir Felix Semon. The proceedings were concluded by a remarkably eloquent speech by Señor Garcia. In the evening Señor (now Don) Garcia was entertained at a banquet held in his honour at the Hotel Cecil.

We learn from the *Times* that further papers have been published by the Government of India in respect to the late Mr. J. N. Tata's offer of an endowment in the shape of properties valued at 200,000*l.* for the creation of an institute of Indian research at Bangalore. Certain conditions in respect to Government assistance were attached to the offer, which was first made six years ago, and these have been the subject of prolonged discussion and correspondence between the Government, Mr. Tata during his lifetime, and his representatives. The papers now published show that the difficulties in the way of a settlement have been removed. Guarantees have been offered by the representatives of the donor to secure the full income estimated from the endowment properties, and the management of the latter is vested in a board the chairman of which is to be an officer selected by the Bombay Government. In addition to making a grant of 2½ lakhs of rupees (16,666*l.*) towards the construction of the necessary buildings and provision of scientific apparatus, the Government will make an annual grant to the institute of half the local assets up to a limit of 1½ lakhs of rupees, provided that the institute is conducted on lines approved generally by the Government. The scheme will provide for the reference of certain questions to the advisory committee of the Royal Society, or to such other scientific authority as may be appointed for the purpose. The Governor-General in Council disavows any desire to be intimately associated with the actual administration of the institute, or to claim a determining voice in the settlement of the lines of research to be followed or the methods of instruction to be employed. The Government will exercise no more than that degree of influence and control which is justified by the grant in aid that has been promised.

Prof. Emil Warburg, of Berlin, has been appointed president of the National Physical Laboratory at Charlottenburg, and his place in the university is to be taken by Prof. Paul Drude, of Giessen.

The magnificent collection of birds' eggs possessed by the British (Natural History) Museum has been largely augmented by the gift of the splendid series brought together by Mr. W. Radcliffe Saunders, of High Bank, Tonbridge. This collection comprises close on ten thousand specimens of the eggs of Palaearctic species, together with one hundred and sixty-five nests.

We regret to record the death at the age of seventy-six of Mr. Jeremiah Slade, one of the founders of the Geologists' Association. Mr. Slade had for many years been a teacher of geology, mineralogy, zoology, and botany at the Working Men's College, the Birkbeck Institution, and the City of London College. He was an ardent microscopist and member of the Quekett Microscopical Club.

The anniversary dinner of the Chemical Society will be held on Wednesday, March 29.

The sixth International Congress of Applied Chemistry will be held at Rome next year, probably during the week following Easter.

The French Société d'Encouragement pour l'Industrie nationale has awarded the Lavoisier medal to M. Héroult in recognition of his electrometallurgical researches. In recommending the award the committee refers to his work in connection with the manufacture of aluminium, and the preparation of steel in the electric furnace.

Official statistics show that the production of natural gas in the United States in 1903 was greater than in any previous year. The production had a value of 7,143,000*l.*, or 16 per cent. more than that of 1902. Four States, Pennsylvania, West Virginia, Indiana, and Ohio, furnished together 94 per cent. of the supply of gas. The total volume of the gas at atmospheric pressure was 6757 million cubic metres, representing in heating value 12,129,468 tons of bituminous coal.

Reuter's Agency has received some details of an expedition which went to British New Guinea in September, 1903, and has lately returned to England. The expedition was organised by Major W. Cooke-Daniels, an American traveller, and it also included Dr. C. G. Seligmann, Dr. W. M. Strong, and Mr. A. H. Dunning. The objects were primarily ethnographical, but studies were also made in other branches of science, and a number of general pathological observations were made. A collection of photographs was secured by Mr. Dunning, and the travellers have brought back kinematograph pictures and a selection of phonographic records.

A CORRESPONDENT writing to the *Times* from Florence directs attention to the fact that the famous Tower of Galileo, on the hill of Arcetri above Florence, is now practically destroyed. This historic thirteenth century building—known locally as the Torre del Gallo—has for some months past been concealed in scaffolding set up for the purpose of raising its castellated tower by a third of its former height, of placing in its walls new windows, of adding a loggia, and, in fine, of converting the world famous "Star Tower" into a pretentious modern erection. To the Anglo-Saxon race Galileo's Tower possessed a special interest, in that it was the scene of the classic meeting between Milton and Galileo.

IN No. 1395 of the *Proceedings* of the U.S. National Museum, Mr. C. D. Walcott continues his account of American Cambrian brachiopods, describing several new genera and species. It is explained that these notes and their forerunners are published in the hope that they may be of service to students prior to the appearance of the full monograph promised on the subject.

WE have received the reports of the Wellington College and of the Felsted School science societies for 1904. The former, which is illustrated, contains summaries of a number of lectures delivered before the society, among which one by Mr. H. W. Monckton on the geology of the London district deserves special mention. In the Felsted report attention is directed to the lack of keenness displayed by the members of the zoological section, who failed to take nature-study seriously. Although one prize was offered for an account of the birds of the district, and a second for the best collection of butterflies and moths, there were no competitors.

IN addition to the *Bulletin* on the fauna and flora of the plateau of Baraque-Michel, already noticed (from an author's copy) in NATURE of March 16 (p. 468), No. 12 of the *Bulletin* of the Belgian Royal Academy contains two biological articles of considerable interest. In the first of these, Miss J. Wery discusses the attractions offered to bees by flowers, and, as the result of direct experiments, arrives at the following conclusions. Brilliantly coloured flowers offer much greater attraction when entire than when the petals, &c., have been cut away; honey has no attractive power; artificial flowers are just as attractive as natural ones if both are under glass shades; flower perfume by itself offers but little attraction; while colour and form, apart from scent, are powerfully attractive; the mingling of the three factors, form, colour, and scent, constitutes the most powerful attraction of all. Finally, if the latter item be reckoned as 100, the attractive power exerted by form and colour will be 80 per cent., while the other factors (pollen, nectar, and scent) will only rank as 20 per cent.

IN the second of the two articles from the *Bulletin* of the Belgian Academy referred to above, Prof. A. Lameere discusses Darwin's theory of female sexual selection as the primary factor in the production of secondary sexual characters in the male, and comes to the conclusion that such an hypothesis offers an inadequate and untenable explanation of the phenomenon. In place of this, the author suggests that such features in the male are the equivalents of maternity in the female, that is to say, the products which in the female are required for generative purposes are superfluous in the male, and are accordingly employed for sexual ornament. If we mistake not, the same theory has been already promulgated by Captain Barrett-Hamilton.

WE have received copies of four articles from the third volume of "Marine Investigations in South Africa." In describing, in two of these, the polychætous annelids collected by Dr. Gilchrist, Prof. McIntosh directs attention to the community of type between South African and European marine annelids generally, many of the types from the two areas being specifically identical, while others, in a more or less modified form, extend eastwards into the Indian and Pacific Oceans, and westward to America. A nearly similar feature has been recorded in the case of crustaceans, and it thus seems that the distribution of invertebrates in these seas is governed by very different laws from those which obtain, for instance, in the case of the commoner food-fishes. The anatomy and variation of the Flabellum-like corals form the subject of the third article, in which Mr. J. S. Gardiner has found himself compelled to dissent from the classification of corals proposed by the late Prof. P. M. Duncan. In the fourth fasciculus Dr. Gilchrist continues his investigation into the development and life-history of South African fishes, describing and figuring a number of larvæ, some of which cannot at present be specifically identified.

IN the *Monthly Review* for March, Mr. W. E. Hodgson discourses very pleasantly on certain problems connected with salmon-fishing. After pointing out the inaccuracy of the common opinion that the north of Scotland in spring is necessarily colder than the south of England, the author proceeds to discuss the reason why loch-fishing for salmon is carried on with a minnow instead of with a fly. One reason seems to be that salmon lie deeper in the water than trout, and will consequently, owing to the set of their eyes, see the approach of a boat at a greater distance. A minnow trolled behind a boat is probably, therefore, the best lure for *Salmo salar*; but whether the boatmen are right in giving a sinuous course to the boat is very questionable. In the first place a boat may be rowed right over a deep-lying salmon without being seen by the fish; secondly, there is considerable reason to believe that disturbed water is conducive to the salmon biting; and thirdly, it is not unlikely that the fish which takes the trailing lure has not been lying in the wake of the boat, but may have made a dash from the side. Mr. Hodgson, who is by no means convinced that salmon fast during their sojourn in fresh water, thinks they take the minnow for a wounded fish, and dash at it owing to the impulse which makes most animals attack a cripple.

PART IV. of the third volume of *Biometrika* contains several memoirs of interest. Mr. Punnett contributes a careful study of variation in *Spinax niger*, showing, from an analysis of the characters of 263 adults and 304 embryos, that a well-marked sexual dimorphism exists in this shark, and that the variability of male embryos considerably exceeds that of male adults, this pointing to a more stringent selection in the case of the male. Homœosis rather than intercalation or excalation is held by the author to be the more feasible explanation of the various relative positions occupied by the structures examined—this supporting Gegenbaur's theory of the origin of limbs. The same material is thought by Mr. Punnett to favour the hypothesis of gametic purity—a view from which Prof. Pearson dissents for reasons given. Dr. Beddoe's craniometric formula, lately published in *L'Anthropologie*, is vigorously impugned by M. A. Lewenz and Prof. Karl Pearson, who produce in evidence the "auto-icon" of Jeremy Bentham preserved at University College. In another paper, Prof. Edmond Gain deals with variation in the flower and heterostylism in *Pulmonaria officinalis*. Local races are shown to present significant differences in the former respect. The miscellanea include interesting applications of a new method of determining correlation.

The Bureau of Forestry of the United States Department of Agriculture has erected an extensive plant on the grounds of the St. Louis Exposition for carrying out a series of experiments under the direction of Drs. von Schrenk and Hatt on the value and methods of preserving timber. According to the general programme, which is outlined in the *Press Bulletin*, No. 62, the timber will be subjected both to static and impact tests. Preliminary results indicate that steaming reduces the strength of the timber in proportion to the pressure and duration of the process.

Under the title "Place-constants for *Aster prenanthoides*," Mr. G. H. Shull has contributed to the *Botanical Gazette* (November, 1904) a biometric article based upon the number of bracts and florets which were counted on the inflorescences of this plant as collected in a specified area during the autumn of 1903. In general, the first head to bloom on any stem had the highest number of parts, and the last to bloom the lowest, but precocious flowering on the part of the weakest individuals produced a low mean at the beginning of the season, and the belated flowering of a few vigorous specimens caused a rise towards the end.

A practical and detailed comparison of the cost of production of sugar on a muscovado estate and in a central factory using the vacuum pan with triple effect, such as that given by the Hon. R. Bromley, administrator of St. Kitts, in vol. v., No. 3, of the *West Indian Bulletin*, should carry conviction to the planters of Barbados and other islands, who, trusting to the high saccharose yield of their canes, and the profit on molasses, have preferred to retain their simple process of manufacture. Apart from the advisability of manufacturing a product of the best quality, the figures show that the profit per ton of sugar prepared in a central factory is four times that obtained on a muscovado estate.

The Société Helvétique des Sciences naturelles celebrated, at its eighty-seventh congress at Winterthur, the fiftieth jubilee of the discovery of ancient pile dwellings, described by Dr. Ferdinand Keller. The report and appreciation of the work of Keller and others is written by M. F. A. Forel. The same authority lately directed attention (*Gazette de Lausanne*, January 19) to the discovery at Boiron, near Morges, by the Lake of Geneva, of a tomb or place of burial of the Bronze Age—the age of the old lake-city of Morges. Human bones, cinders and burnt earth, bronze trinkets, vases and other pottery were found, but of special interest was the discovery alongside the calcined human bones in the burial chamber, of leg-bones of a goat uninjured by fire, and evidently deposited with the flesh as an offering to the shades of the departed. M. Forel concludes from the evidence that a belief in the resurrection of the dead was held in the Bronze Age.

We have received a copy of the results of the meteorological observations made at the stations in connection with the Deutsche Seewarte (Hamburg) for the year 1903. The stations number sixty-nine, and include hourly readings at four first-order observatories. The tables are arranged as in previous years, and leave nothing to be desired either in thoroughness of discussion or in detailed explanation of the methods employed. Mid-European time was adopted in Germany in April, 1893, but the observations are recorded according to local time as before, with the exception of the occurrences in the remarks column, which are stated in Mid-European time. A table is given showing the difference of these times for each of the stations.

The last published *Bulletin* of the Philippine Weather Bureau (for August, 1904) contains, in addition to the usual useful summaries of meteorological and seismological observations at various stations, a valuable discussion of the cyclones which affected the archipelago, with a map showing their tracks. The director of the central observatory at Manila, the Rev. J. Algué, S.J., author of the valuable work, "The Cyclones of the Far East," makes a special study of these interesting phenomena, and his discussion of their behaviour is most instructive. During the month in question five typical cyclones are dealt with. One of them (August 17–21) moved at the rate of thirty miles an hour; this storm was experienced by the U.S. Army transport *Sherman*, near Formosa, and an interesting account of it is given by the second officer of that vessel.

A summary of the present state of knowledge in regard to long range weather forecasts, by Prof. E. B. Garriott, has been published by the Weather Bureau of Washington. It is accompanied by a paper by Prof. C. M. Woodward on the planetary equinoxes. Prof. Garriott finds that at the present time practically no value is to be attached to weather predictions based on astronomical phenomena or observations of birds, animals or plants. At the same time, every attention is being given to the advancement of meteorology on such a basis as may lead to substantial improvements in weather forecasting. In his prefatory report Mr. Willis L. Moore remarks:—"It is to be regretted that so many newspapers not only give space to these harmful predictions, but actually pay for them. Forecasts of this description may properly be classed with advertisements of quack medicines—they are both harmful in the extreme."

In the February number of the *Bulletin de la Société astronomique de France*, M. J. Loisel presents his annual summary of the climatology of the past year. On one chart he shows the rainfall, the daily temperatures, the humidity, the barometric pressure, the insolation, the amount of cloud, and the declination and phase of the moon. Each of the atmospheric elements is then discussed in detail month by month. Among other outstanding features, one sees that the temperature during July, 1904, was abnormally elevated, whilst that of December was higher than that obtaining during November. The figures and the curve indicating the number of hours of sunshine are especially interesting, and show that in each of the months May, June, July and August there only occurred one day when the sun was completely obscured at Juvisy, whilst in July the number of hours of effective sunshine amounted to 72 per cent. of the theoretical number. A comparison of the solar radiation during 1903 and 1904 shows an increase of about 23,134 calories, or rather more than 16 per cent., in the latter year.

More than ten years ago Prof. Landolt described a series of experiments which were considered to throw doubt on the law of the conservation of mass in chemical action, and in 1901 Heydweiller concluded that a change in the total mass had been experimentally established in a number of cases. In a paper published by Antonino Lo Surdo in the *Nuovo Cimento* (1904, series 5, vol. viii.), the question is re-investigated. By excluding all possible sources of error, such, for instance, as a difference of temperature in the two arms of the balance, differences of volume of the vessels used, it is established that the change of mass due to the interaction between iron and basic copper sulphate, which by Heydweiller was considered to be about 0·2 milligram, in reality falls within the limits of the error of weighing, being certainly less than 0.02 milligram. In the experiments described, the sealed tubes in which the interaction took place were not removed from the balance during the whole of the series of weighings, and an ingenious mechanism was designed by which the tubes and weights were manipulated within the case.

The operations of the Smithsonian Institution during the year ending on June 30, 1904, and the work of the U.S. National Museum, the Bureau of American Ethnology, the International Exchanges, National Zoological Park, and the Astrophysical Observatory, are described in Dr. S. P. Langley's report which has just reached us. Among the matters mentioned is the removal of the remains of James Smithson, founder of the Smithsonian Institution, from the British cemetery at Genoa to America, at the beginning of last year. The report states that the remains rest temporarily in a room at the Smithsonian Institution containing a few personal relics of Smithson, awaiting their final disposal by the Regents. Dr. E. W. Scripture, of Yale University, has been awarded a grant from the Hodgkins fund for the construction of a "vowel organ." Dr. Scripture expects to be able to construct an organ which can sing the vowels, or a vowel register which, attached to a pipe organ, may be used effectively in church music. An exploration of some of the glaciers of British Columbia has been undertaken by Dr. W. H. Sherzer, under the auspices of the Smithsonian Institution, for the purpose of gathering definite information regarding glacial phenomena, such as the nature and cause of the ice flow, the temperature of the ice at various depths, and its relation to air temperatures, the amount of surface melting, and the possible transference of material from the surface to lower portions. Reference is made in the report to the new building of the National Museum in course of erection in the Smithsonian Park. The floor area in the four stories of the new building will be about 9½ acres. The accessions to the museum in the year covered by the report amount to 241,547 specimens, which bring the total number of objects in the collections up to nearly six millions. The work of the astrophysical observatory has been chiefly concerned with solar radiation, and its possible variability. The investigations point to the conclusion that the radiation supplied by the sun may perhaps fluctuate within intervals of a few months through ranges of nearly or quite 10 per cent., and that these fluctuations of solar radiation may cause changes of temperature of several degrees centigrade nearly simultaneously over the great continental areas of the world.

The latest report issued by the Engineering Standards Committee deals with British standard specification for structural steel for marine boilers. Copies may be obtained from Messrs. Crosby Lockwood and Son at 2*s*. 6*d*. net.

Messrs. Henry Sotheran and Co. have issued a new catalogue of second-hand books, containing works on mathematical, astronomical, physical, and chemical subjects. The works catalogued include the library of the late Prof. A. W. Williamson, F.R.S., and many important foreign works on the exact sciences published within the past twenty years.

OUR ASTRONOMICAL COLUMN.

The Alternating Variability of Martian Canals.—During 1903 Mr. Lowell observed an apparent alternation in the visibility of the Martian canals Thoth and Amenthes, which he suggested might be due to the artificial regulation of a deficient water supply for irrigation purposes (Nature, vol. lxix. p. 496).

In a telegram, dated March 10, communicated to Prof. E. C. Pickering and published in No. 4003 of the *Astronomische Nachrichten*, Mr. Lowell announces that he has again observed "a functional alternative visibility" of these two canals, both of which are double.

Discovery of Jupiter's Sixth Satellite.—In No. 100 of the *Publications* of the Astronomical Society of the Pacific, Profs. Perrine and Aitken describe the first observations of Jupiter's sixth satellite, and abstracts of their communications are published in No. 4002 of the *Astronomische Nachrichten*.

Prof. Perrine states that several years ago it was proposed that the Crossley reflector, when reconstructed, should be employed in a search for additional satellites to the outer planets. In accordance with this programme, photographs of Jupiter were taken on December 3, 8, 9 and 10, 1904, and a comparison of them showed that the planet, which was slowly retrograding at the time, was apparently accompanied by an object of the fourteenth magnitude. Photographs taken on January 2, 3 and 4 showed that the newly discovered object was following Jupiter in such a manner as to suggest its dependence on that body. The greatest elongation (west) of the new satellite, about 50′, seems to have been passed on December 25, and the inclination of its orbit to the ecliptic appears to be greater than those of the inner satellites. The direction of the satellite's motion, although apparently retrograde, cannot be determined until further observations have been made.

On January 28, Prof. Aitken, using the 36-inch refractor under unfavourable atmospheric conditions, found the satellite quite easily, using the position predicted from the Crossley photographs, and, after a few minutes' observation, the identification was confirmed by the motion in right ascension. Following the object for nearly an hour, he found it to have an hourly motion in R.A. of about +20″, and this agrees with the photographic result. A comparison with neighbouring faint stars showed that the satellite was about as bright as a star of the fourteenth magnitude.

Forthcoming Oppositions of Mars.—As during the oppositions of Mars in 1905, 1907, and 1909 the planet will become successively more favourable for observation, Mr. R. Buchanan has communicated to *Popular Astronomy* (No. 3, vol. xiii.) the following figures, showing the respective conditions for each opposition:—

Year	Mars passes perihelion	Opposition	Distance from Earth	Brilliancy
1905	Nov. 7	May 8	0·543	36·8
1907	Sept. 22	July 5	0·411	75·4
1909	Aug. 13	Sept. 25	0·390	86·6

The sun's distance from the earth is taken as the unit of the mean "distance from earth." In the oppositions of 1901 and 1903 the respective apparent brilliancies of the planet were 20·0 and 23·4.

Variable Radial Velocity of Sirius.—In No. 70 of the Lick Observatory *Bulletins*, Prof. Campbell discusses the spectrographic observations of the bright component of Sirius made at Lick since 1896, thirty-one plates in all.

Before treating the main subject, however, he discusses the difficulty experienced in binary star work through the employment of numerous different systems of nomenclature to define the orbital elements, and then propounds a new system which would be readily adaptable to all requirements, visual or spectroscopic.

The observations of Sirius have been made under varying conditions, instrumental and otherwise, and a better accordance in the individual results might be obtained by making the observations under uniform conditions. The resulting value, obtained from all the plates, gave the velocity of the system of Sirius as $-7\cdot36$ km. per second. There is a marked progression among the individual values obtained for the velocity of the primary which is attributed to the effect of orbital motion. The sense of this progression indicates that the positive value of i (the inclination of the plane of the orbit) should be used. The above value, whilst disagreeing with others, agrees very well with the value obtained by Profs. Frost and Adams in 1901–2.

The values of the radial velocities of the centre of the system and of the primary and secondary components are given in a table, with yearly intervals, for a whole revolution, *i.e.* from 1870·09 to 1918·09, the time of the apastron passage being 1918·5110.

CONSTANT ERRORS IN MERIDIAN OBSERVATIONS.—In an address delivered to the astronomy section of the St. Louis International Congress of Sciences and Arts, Mr. J. G. Porter discussed the various sources of error to which meridian observations are peculiarly subject, and proposed various methods whereby the constant errors might be eliminated.

Among other methods for eliminating the magnitude error which affects right ascension determinations, he recommends the one proposed by Prof. Turner wherein the transits would be registered on a regularly moving photographic plate, the reticule wires being replaced by spots of light projected on to the plate at regular intervals from a fixed source.

Regarding declination observations, the error due to varying refraction is the most important, and Mr. Porter suggests that this might be eliminated by having a perfected system of fundamental stars well distributed over the sphere, from observations of which, on any evening, the deviation of the actual refraction from the assumed law might be determined and used to correct the observations. Another, more costly, method would be to have a number of observatories widely distributed in latitude, so that zenith observations, where refraction is non-effective, of more stars might be made. Mr. Porter considers the solution of this constant error difficulty in meridian observations to be one which is eminently suitable for international cooperation (*Popular Astronomy*, No. 3, vol. xiii.).

THE NATIONAL PHYSICAL LABORATORY.

ON Friday last the annual general meeting of the governing body of the National Physical Laboratory was held at that institution, when the report of work done in 1904 was received and the programme of work proposed for the forthcoming year approved. A number of guests were invited to meet the members of the general board and inspect the laboratory. Among those present were about thirty Members of Parliament, several colonial agents-general, and a representative gathering of leading physicists and engineers.

In the 45-page report submitted by the director, Dr. Glazebrook, are found particulars regarding the various researches and tests carried out during the past year, with special reference to the newer developments. The test work at Bushy for the year shows a marked growth, the total number of separate tests made having increased from 1330 in 1903 to 1906 in 1904, the increase being spread over almost all the different departments of the laboratory. These figures are distinct from the work of Kew Observatory, where in all more than 26,000 instruments were verified during the year.

In the engineering department, Dr. Stanton has made considerable progress with the research on the distribution of wind pressure over large areas, which forms a continuation of the important work embodied in his paper read at the Institution of Civil Engineers last session. A steel tower fifty feet high has been erected in the grounds, carrying large and small pressure plates with the necessary gauges. From the general results of the observations made it would appear that the distribution of pressure on the windward side of a large plate in the open air falls off more rapidly from the centre to the sides than in the case of a small plate, but that the ratio of the pressures on the windward and leeward sides appears to be practically the same in both cases.

The research on the specific heat of superheated steam by the continuous flow method has been continued by Mr. Jakeman, who has been mainly occupied in contending with certain experimental difficulties, such as the attainment of sufficiently high insulation between the various parts of the electrical superheater, especially at low superheats. Some preliminary figures have been obtained which do not appear to confirm the rapid rise in specific heat shown by the results of some recent observers.

A testing machine for studying the effect of alternating stresses of varying periodicity on engineering materials has been constructed and was described in last month's *Engineering* by Dr. Stanton. It has already been used on a set of nickel-steel specimens, which are the basis of a research in the metallurgical department.

A new building has been erected to house the new standard leading-screw machine, which is now at work. Several standard screws have been cut and measured for use in Government arsenals.

Dr. Chree, at the observatory department, has been occupied with some important investigations on terrestrial magnetism, and the measurement and tabulation of some of the old Kew magnetic records. The men of science of the British Antarctic Expedition have, since their return in September last, had the opportunity of again comparing with recognised standards many of their instruments, and arrangements have been made for cooperation with them in the reduction of the mass of magnetic and meteorological data they brought home with them.

In the physics department numerous researches have been in progress. We have only space for mention here of some of the more important. Dr. Harker, in the thermometry division, has been occupied with preliminary work on which it is hoped may ultimately be based some new direct electrical method of very high temperature measurement. With this object he has undertaken a study of the resistance and thermoelectric properties of solid electrolytic conductors such as are used in Nernst lamps. The existence at high temperatures of large thermoelectromotive forces between rods of the various earths made up as ordinary thermojunctions has been securely established by direct electrometric methods, and a new form of electric furnace has been designed capable of continued use at temperatures above 2000° C. By means of these furnaces and a number of thermojunctions of widely different properties, a careful re-determination of the melting point of platinum was made. More than sixty determinations concorded in giving a value which differs considerably from that now accepted. The results of this work are embodied in a paper just sent in to the Royal Society.

The research on the specific heat of iron, which has been extended to temperatures above 1100° C., is complete, and will shortly be published.

In the electrical standards department, Mr. Smith has been mainly occupied with work on the standard ampere balance designed by the late Prof. Viriamu Jones and Prof. Ayrton for the British Association committee on electrical standards. The weighing mechanism was constructed by Mr. Oertling, and the four marble cylinders carrying the coils have been successfully wound and insulated at the laboratory. On each cylinder are two double helices of bare copper wire. Though the air space between the consecutive turns is less than 0·006 inch, an insulation resistance over 30,000 megohms was finally secured for each of the coils. Many accessories have been constructed, and the outlook for a speedy determination of the absolute unit of current to at least one decimal place further than hitherto attained is very hopeful.

In electrotechnics, Mr. Paterson has installed large cells for ammeter verification, and for alternate current measurements a specially constructed set of Mr. Addenbrooke's instruments, and a Kelvin voltmeter with circular scale of $2\frac{1}{2}$ metres radius. In photometry have been included investigations on several Harcourt 10-candle pentane lamps and a number of Fleming large bulb standard electric glow lamps, which now form the working standards of candle-power. Intercomparisons have been made by means of glow lamps with the National Standards Bureau of Washington, the Electrical Standardising Laboratories of New York, and the Berlin Reichsanstalt.

In the general electrical department, Mr. Campbell has devised a method for obtaining for inductance measurements alternating currents having very high frequencies and a wave form almost a pure sine-curve. A large amount of new apparatus has been set up for testing purposes, much of it of a novel character.

The standard current balances and electrostatic voltmeters have been studied, and it has been found that the allegation that the Kelvin balance, when used with alternating current, is affected by eddy currents in the metal parts near the coils is without foundation for all ordinary frequencies.

Researches on the distribution of temperature in field coils of dynamos and motors, and on the behaviour of insulating materials under heat treatment, have been made by Mr. Rayner, and form the subject of a report to the engineering standards committee communicated to the Institution of Electrical Engineers at their last meeting.

In the department of metallurgy, Dr. Carpenter and Mr. Keeling, during the early part of the year, completed their work on the range of solidification and critical ranges of iron-carbon alloys, and an account of the work was read at the meeting of the Iron and Steel Institute in May last. The value of Dr. Carpenter's work was recognised by his election as Carnegie scholar. On Mr. Keeling's leaving the laboratory, Mr. Longmuir, also a Carnegie scholar, was appointed on the staff, and Dr. Carpenter and he have since been carrying on, in cooperation with Mr. Hadfield of Sheffield, an elaborate systematic research on the properties of the nickel-steels. In all, seventeen different kinds of physical, mechanical, and chemical tests have been performed on the different samples used, which contained varying amounts of nickel up to 16 per cent. The results obtained will shortly be submitted to the alloys research committee of the Institution of Mechanical Engineers.

An investigation on modern high-speed tool steels, such as those shown in use in the engineering department on Friday last, has also been completed by Dr. Carpenter, cooling curves and photomicrographs having been obtained showing clearly the various modifications in structure after different heat treatment.

The optical department is rapidly being organised, and, in addition to lens testing, the work has included the accurate measurement of the angles of prisms and determination of the optical constants of numerous samples of glass.

In the weights and measures department, the chief work has been the study of the master screw of the new leading-screw lathe, which has been carefully calibrated throughout its entire length.

The foregoing serves to indicate the substantial progress made by the laboratory, and to prove that though it has only been at work a little more than three years, it has already begun to make its mark on the science and industry of the country, and to justify in a large measure the expectations of its promoters.

FUNGI.[1]

HAVING pointed out that the attempts to derive the word fungus from *funere*, or *funus* and *ago*, *fungor*, &c., have been shown to be failures—that it comes from the Greek σπογγος, and is the same word as sponge, the lecturer proceeded to give illustrations of the fungi known to the ancients. These were, of course, all of the larger kinds, since no knowledge of micro-fungi was possible. Nevertheless, references in the Old Testament show that certain diseases—mildew, smuts, &c.—were known to the Hebrews, but of course their connection with fungi was not suspected.

[1] Abstract of a discourse delivered at the Royal Institution on February 24 by Prof. H. Marshall Ward, F.R.S

The Greeks and Romans not only knew several forms of Amanita, Agaricus, Boletus, Polyporus, and of Truffles, Morels, &c., but they discriminated clearly between the poisonous and wholesome species.

Their ideas as to the nature and origin of such fungi seem childish to us, but they were consistent with the naif attitude of the Greeks towards natural objects. Theophrastus, about 320 B.C., Dioscorides, about 60 B.C., and Pliny, for example, argued that since truffles and other fungi had no roots, leaves, stems, &c., they are objects apart. They arise spontaneously from earth, or by fermentation from the sap of trees, or from water.

It is interesting to note that *Polyporus officinalis* was imported and used as an article of medicine not only during classical times, but also for centuries afterwards.

In mediæval times the herbalists chiefly copied from Galen, Theophrastus, &c., and as they had no figures the early herbals give us little information. In 1576, however, Clusius gave a series of wood-cuts which are well worth looking at, and in 1601 he made a series of water-colour sketches of eighty-two of the fungi of Austria—the first drawings of the kind known. Figures in Dalechamps, 1536, Dodoens, 1583, and Parkinson, 1640, may also be compared.

The next step forward was only possible after the microscope had come into use as a scientific instrument.

It is a curious point that abundant and conspicuous as the powdery spores of the fungi are, no one seems to have observed their importance until Micheli, in 1729, collected and sowed a series of them, and with results, for he obtained mycelia, and in a few cases even sporophores; but it was not until a century later, 1820, that Ehrenberg, in his classical "De Mycetogenesi," traced the larger fungi to their mycelial filaments, collected and sowed spores, and grew several species of Moulds, and especially discovered the sexual act in Zyzygites. For although Micheli's ideas had been confirmed by Gleditsch in 1753 and by Schaeffer in 1762, Rudolphi and Persoon had more or less denied the germination of spores, and insisted on the spontaneous generation of the moulds.

However, before 1840 Nees von Esenbeck had cultivated a Mucor from spore to spore, and Dutrochet, 1834, and Trog, 1837, had seen the "puffing" of asci and practically established the doctrine of wind-distribution of spores.

By these and similar successes the era of the Mould-fungi was initiated, and the labours of Corda, Tulasne, Pringsheim, Cohn, and De Bary soon introduced system into their study, and especially the exact study of life-histories showed what important results for morphology lay in the biological investigations of these micro-fungi.

The lecturer here gave illustrations of the commoner types of mould fungi, with notes on their botanical importance, and some remarks on the points he wished to emphasise later.

An early outcome of the investigations of the moulds and their allies was the discovery of what curious substrata some of them grow upon. A rapid survey of all saprophytic fungi shows that while the majority grow on the soil, on plant remains, or on dung of various kinds, peculiar forms or species occur on such bodies as resin, cork, bees' and wasps' nests, bones, limestone, insect-remains, horn, hair, feathers and hoofs, fats, and in chemical solutions such as picric acid, copper sulphate, arsenic, and poisons such as atropin, muscarin, and so forth.

Here, also, the lecturer gave some notes on details, of which the most striking was, perhaps, his own proof that the horn-destroying fungus will not act until its spores have been passed through the alimentary tract of an animal, or subjected to the influence of gastric juice.

In 1866, the year of publication of De Bary's book on mycology, a revolution in the study of fungi was brought about by the first morphological proof of parasitism and infection, and the clear distinction drawn between the saprophytic micro-fungi or "moulds" and the parasitic fungi which induce "diseases." The matter was of especial importance as explaining away prevalent erroneous ideas according to which these disease-fungi were outgrowths (*exanthemata*) from the moribund tissues of the host-plant itself.

De Bary's great service was to prove that a spore of a fungus arrived from outside, and after germinating on the leaf or other organ of a plant, bored its way in, or through a stoma, and entered the tissues. Here it lived, as does a plant in any other medium, at the expense of the substances in the tissues, which it eventually kills. It then emerges and develops its spore on the outside.

Thus was founded the "germ theory" of disease.

The lecturer here gave illustrations of the kinds of parasites referred to, and showed how the spotting of leaves is brought about by various epiphytic and endophytic forms, such as Oidium and Erysiphe, Phytophthora, Ustilagineæ and Uredineæ, &c., and directed attention to certain special genera, such as Botrytis, Aspergillus, &c.

That the ancients were acquainted with the phenomena of rot in timber is attested by remarks of Theophrastus on hollow trees and the decay of oak; but it was not until about 1830 that any idea of connecting the phenomena with fungi can be traced, and even then Theod. Hartig, who discovered hyphæ in the rotten wood, thought they originated from the wood-fibres themselves. Schacht, in 1850 and 1863, figured many instances of hyphæ in wood, and showed that the fungus fed on the starch, pierced the cell-walls, and in some way induced their putrefaction; and to these and Willkomm's researches, in 1864, we may trace the origin of our knowledge of fungi as the causes of decay in timber.

Meanwhile the palæontologists also were bringing forward examples of fungus-hyphæ in fossil woods.

But the real founder of this important subject was R. Hartig, who in his works, 1874 and 1878, proved that not only are there several kinds of wood-rots in different species of trees, each induced by different forms of fungi, but that the different woods show special markings, and break up in peculiar manner for each case, so that particular kinds of rot can be recognised by particular symptoms. Hartig, moreover, showed how the fungi got into the tree, and that these wound-fungi have special peculiarities. He traced their hyphæ into the vessels and wood-elements, showed how they pierce the cell-walls, and, most important of all, proved that they dissolve out from the wood-elements the lignified constituents to which their fundamental physical properties—as wood—are due, and either leave the delignified walls soft and cellulose in character or dissolve them to a jelly.

Here the lecturer showed illustrations of the mode of action of dry rot, of *Polyporus igniarius*, and of other wood-destroying fungi, and referred to Czapek's recent discovery of Hadromal, the probable uniform constituent of wood hitherto vaguely known as Lignin.

In another direction activity was turned to the fungi which attack insects, and which are now known often to become epidemic, to the great advantage of areas devastated by locusts, cockchafers and other grubs, caterpillars, &c.

It is a remarkable fact that whereas the diseases of plants due to fungi are numbered by their thousands, only some two hundred or so of animal maladies due to fungi proper are known. Whether this is due to the more acid nature of vegetable sap, to the high temperature of animal tissues, or to the greater abundance of the anti-bodies in animals cannot be decided.

The lecturer gave illustrations of caterpillars with their destroyers, Cordyceps, Isaria, &c., growing from their mummified bodies, and referred to Torrubia's "Vegetable Wasp" legend of 1749. He also showed photographs of the "plant-worms" used in Chinese medicine, and rapidly surveyed the work of Cesati, Pasteur, De Bary, Cohn, &c., on Muscardine, Entomophthora, Empusa, Saprolegnia, and other insect-killing fungi.

But these entomophagous fungi are merely particular cases of mycoses. Every group of animals from the Protozoa and Infusoria upwards have their fungus parasites; hyphæ penetrate the ceratin of sponges and the calcareous walls of corals, and fishes and amphibia are by no means immune.

Birds and mammals suffer particularly from certain mycoses due to fungi which we have been in the habit of regarding as harmless moulds, *e.g.* Aspergillus, and even man is sometimes in danger from such fungi.

When, in 1869–70, Grohe and Block showed that small doses of the spores of Penicillium and Aspergillus are fatal to kittens, their statements were emphatically disbelieved; but Grawitz confirmed them, and the body of evidence showing that Aspergillus contains poisons toxic to birds and higher animals can no longer be overlooked. Some of these forms of aspergillosis are very serious diseases indeed.

While the new era of mycology was stimulating observers to new investigations into the life-histories of moulds, and of the parasites of animals and plants, and into the ætiology of the timber-destroying fungi, and so forth, on the one hand, it was, on the other, gradually attracting to its domain areas of investigation which had grown up independently out of the past, and which the older thinkers could never have dreamed of associating with fungi.

A conspicuous example was the study of fermentation, which, since Janssen in 1590 had brought forward a microscope of several lenses, and Leeuwenhoek had applied an improved form of it to the animalculæ in putrefying liquids, had undergone the initial stage of passage into the hands of the naturalists.

The lecturer then sketched in rapid outline the history of the theory of fermentation, from the early days when the lees or sediment (yeast) were known as the "*Faeces Vini*"—apparently owing to the shrewd suggestion of a Venetian doctor, who, in 1762, said putrefactive and fermentation processes are due to the vital activity of minute worms, the excreta (*faeces*) of which induce the turbidity and mal-odour of the liquid—to the days when the living plant-nature of these "*faeces*" was gradually established by the work of Astier, 1813, Desmazières, 1826, Quevenne, 1838, and Persoon, and especially by Erxleben, 1818, Kützing, 1834, Cagniard Latour and Schwann, 1837.

At the same time, the sketch included an outline of the first great controversies regarding abiogenesis or spontaneous generation, brought forward from its ancient strongholds in the ignorance of the classical and mediæval writers—*e.g.* Pliny, Bock, Van Helmont—by Needham in 1745, and confuted by Spallanzani, 1765–76, Schultze, 1836, Schröder and Dusch, 1854; and to which the *coup de grâce* was given by the work of Pasteur, 1862, Cohn, 1870–75, and Tyndall.

Information derived from the brewing of quass, saki, pulque, kava, toddy, koumiss, mead, metheglin, spruce and other beers and wines by peoples all over the world has only confirmed the ideas, of Pasteur especially, that all such fermentations are due to the presence of fungi; and although the discussions as to the process itself being due to catalytic actions and the communication of internal movements to the molecules of sugar broken up, initiated by Stahl in 1697, and revived in various forms by Liebig, 1839, and Naegeli, 1879, culminating in Buchner's views on the discovery of zymase in 1896–97, have modified the older forms of the vitalistic theory of Cagniard Latour and Pasteur, they have not dissociated fermentation from the life of the cell.

The lecturer then passed to a survey of the enzymes, those remarkable bodies which, though not themselves living, are capable of breaking up organic substances apart from the protoplasm of the cells which secrete them, and showed that since the discovery of diastase in malt by Payen and Persoz in 1833, of pepsin in gastric juice by Schwann in 1836, and of invertase in yeast by Berthelot in 1860, numerous other special enzymes have been isolated, and all the principal forms of sugar-inverting, starch-saccharifying, cellulose-dissolving, fat-splitting, proteid-converting, and oxidising enzymes occur in the fungi. Bourquelot has shown the presence of nine such enzymes in *Polyporus sulphureus* and of seven in Aspergillus alone.

The presence of certain deadly poisons in putrefying fish, flesh, &c., and the researches consequent on the increasing knowledge of septic poisoning of wounds—with which Lister dealt so practically at the time—led to researches which, in the hands of Brieger, Sonnenschein, Armand Gautier, Selmi, and others resulted in the isolation of more or less specific bodies, such as sepsin, cadaverine, ptomaines, leucomaines, &c. In 1876 Neucki obtained an unusually pure form, and the doctrine of ptomaine poisons may be regarded as thereby established.

For us, the point of interest here is that these poisons proved to be analogous, if not identical as a class, with a number of vegetable poisons, such as atropine, brucine, nicotine, strychnine, or at any rate presented striking resemblances to them in their physiological actions.

As close, or even closer, resemblances were found in the poisons extracted from the fungi; amanitin, bulbosin, cornutin, sphacelotoxin, &c., all came under the same general category. In 1880 Pasteur showed that fowl cholera could be produced by means of the poison excreted by the bacilli, from which the bacilli themselves had been removed; and

Brieger, in 1885, then showed the same to be true for tetanus and typhoid. Löffler, 1887, and Hankin, 1890, then showed the same to be true for diphtheria and for anthrax, and the toxins of tetanus, cholera, &c., were obtained shortly afterwards.

Thus was founded the doctrine of toxins. The bacilli of disease do not merely induce the formation of ptomaine poisons in the decomposing tissues; they form the toxins in their own cells, and then excrete them.

The lecturer then referred to the similarities of the venenenes of snakes, scorpions, and spiders; of the toxins in eels' blood; and of the vegetable toxins ricin, robin, &c., emphasising the fact that all these bacterial, animal, vegetable, and fungal poisons belong to one and the same great family of toxic bodies.

The horribly intoxicating and poisonous drink made by certain Siberian and Kamschatkan peoples from the fly Agaric, the dry gangrene and paralysis due to ergotism, now a rare disease in western Europe, and the effects of the toxins of tetanus, diphtheria, and other bacilli, all have points in common with the poisons of snakes, of certain seeds, and so on—certain Australian species of Swainsonia impel horses which have eaten it to behave as if trying to climb trees, or to refuse to cross a twig as if it were a large log, reminding one of the effects of *Amanita muscaria* on man.

In great part, if not entirely, owing to an experiment of Nuttall's in 1888, in which he found that normal blood has bactericidal properties, researches were undertaken which resulted in the discovery that the sera of animals, either normally or if rendered immune by minimal doses of toxins, contain antidotal substances to the toxins. Behring and Kitasato, in 1890, who demonstrated the antitoxic power of blood immunised with diphtheria or tetanus to the toxins of these bacilli, were followed in rapid succession by Brieger, Ehrlich, Pick, and others, and the doctrine of the anti-enzymes and antitoxins was established.

The lecturer then gave two illustrative cases. Dunbar, in 1903, showed that hay-fever, as already maintained by others, was not only due to the pollen of grasses, but he isolated from the pollen-grains a toxin which itself induces all the symptoms of the malady.

Not only so. He showed that the serum of horses, &c., to which the hay-fever is communicated becomes antitoxic to the malady. This antitoxin has been distributed, and the statistics uphold the accuracy of Dunbar's views.

That pollen-grains contain enzymes has long been known, and the experiments of Darwin and others have shown that some pollens are poisonous to the stigmas of the wrong plant. Another suggestive illustration is that given by Woron, in which, bees having conveyed pollen, together with the spores of a Sclerotinia, to the stigmas of certain species of Vaccinium, the pollen-tubes and the fungus-hyphæ race each other down the style, and the latter usually win, and destroy the ovules. Moreover, everyone knows how corrosive and destructive the pollen-tubes of pines, &c., are in the tissues, and we must not forget that pollen-grains are spores.

The second case dwelt on by the lecturer is that of pellagra, a disease to which the ill-nourished peasantry of maize-growing countries are liable in bad seasons, when the crops are poor and mouldy.

Cene and Beste, in 1902, referred the malady to the presence of an Aspergillus in the bad grain. They also extracted from this mould a highly toxic body. Mariani, in 1903, then showed that the blood of patients cured of pellagra is antitoxic to the poison of the disease.

The lecturer pointed out that, without committing ourselves to any premature opinion as to the absolute accuracy of these views, there are two increasing classes of evidence which support his suspicion that numerous as yet insufficiently examined cases of this kind will turn out to be due to what he calls "lurking parasites" in bad grain and fodders.

The first is the large class of mycoses now referred to the poisonous action of such a "mould" as Aspergillus, a fungus shown to abound in enzymes and toxic bodies. The second is the increasing number of cases of poisoning by fodder and grain-plants, normally wholesome, but found to be deleterious in certain circumstances or years.

Cases of poisonous wheat, oats, &c.—the "Taumel-Getreide," "Taumel-Roggen" of the Germans—have long been known, and the lecturer quoted cases where similar noxious effects are traced to the presence of Ustilagineæ, Helminthosporium, Cladosporium, and other fungi.

A notable case is that of the Darnel, a tiresome weed in some countries. The ancients—*e.g.* Galen—knew that darnel in bread causes dizziness, headache and sickness, and thought that neglected wheat, &c., was transformed into darnel. Hofmeister, in 1892, examined and extracted the toxic bodies, and confirmed the repeated statements as to their deleterious and even fatal action on animals.

Yet it was not until 1898 that Vogl discovered the existence of a mycelium in the seed-coats of the poisonous darnel, and in the same year this was confirmed by Hanausek and Nestler, though they did little beyond recording the presence of a fungus.

In 1903, Freeman, in the lecturer's laboratory at Cambridge, worked out the details, and left no doubt that the poisonous property is due to the fungus.

The lecturer then pointed out that a whole series of questions concerning these and similar diseases now being investigated in his laboratory lie under suspicion of connection with grain-poisoning, or at any rate with poisoning of fungi introduced as food.

To say the least, we want further and extensive researches from this point of view into the ætiology of Acrodymia in Mexico, Algeria, &c., and of the Colombian Pelade, of the "trembles" of cattle and sheep, and of the "milk sickness" of the North American prairies, and even diseases like beri-beri, &c.

The conclusions, the lecturer pointed out, to which we are driven may be thus summarised:—

(1) Fungi, like animals and other plants, including bacteria, excrete enzymes, and utilise them in the same way and for the same purposes.

(2) The poisons of the fungi are toxins, not only similar in character to the poisonous alkaloids, toxalbumens, &c., of the bacteria, and of the higher plants, the venenenes of the snakes, &c., but their poisonous actions in the paralysis of nerve-ends, &c., are essentially the same.

(3) These poisons, &c., introduced into the blood of animals, call forth the activities of antitoxins and anti-enzymes, as do the toxins of animals, bacteria, &c., in similar circumstances.

(4) The presumption is, therefore, justified that the action of the enzymes and toxins of parasitic fungi on the proteid cell-contents of their plant-hosts is similar in principle to that on animal proteids, and that the host reacts by means of anti-enzymes and antitoxins.

The lecturer then adverted to the difficulties of obtaining the toxins and antitoxins from sap, and concluded by showing in specific cases—the rusts of wheat and grasses—how probable it is that, since no anatomical features explain the facts of predisposition and immunity, and the latter cannot be referred to climatic conditions or to peculiarities of soil, &c., the above considerations will be found to apply, a matter dealt with elsewhere by the lecturer.

TRYPANOSOMIASIS AND EXPERIMENTAL MEDICINE.[1]

THE greater portion of the first Report deals with the subject of human trypanosomiasis, particularly in the Congo district. The trypanosomata are flagellated protozoa, which have been found to be parasitic in many animals, sometimes causing no symptoms, as in the rat, but sometimes associated with serious effects, as in the tsetse-fly disease of the horse. During the last few years trypanosomata have been found to be parasitic in man in various districts of West and Central Africa. If the infected person shows irregular fever without other marked symptoms the condition has been termed trypanosomiasis; if in addition there is somnolence and stupor, and later wasting, convulsions, and fatal coma, the condition is the

[1] "Reports of the Trypanosomiasis Expedition to the Congo, 1903–1904." Liverpool School of Tropical Medicine. Memoir xiii. Pp. 111. (1904.) Price 15*s*.
"The Thompson-Yates and Johnston Laboratories Report." Vol. vi. (New Series), Part i., January, 1905. Pp. 205. (University Press of Liverpool; London: Williams and Norgate.) Price 12*s*. 6*d*.

dreaded sleeping sickness which has destroyed tens of thousands of lives in Central Africa. Much of the matter in the volume under review deals with the relationship between these two diseases.

The first article is a report by Messrs. Dutton, Todd, and Christy on an expedition into the Congo Free State, undertaken at the request of the King of the Belgians. At the hospital at Boma, and during a journey into the cataract region, a number of patients were seen who were regarded by the district medical officers as cases of sleeping sickness, but in whom the somnolence, so characteristic of the disease in Uganda, was completely absent. Nevertheless, trypanosomes were found in the blood both of those cases in which the diagnosis of sleeping sickness was certain and of those which were atypical. But in addition trypanosomes were frequently seen in the peripheral blood of apparently healthy individuals.

In the next article, the relationship of human trypanosomiasis to Congo sleeping sickness is discussed by the same observers. The conclusion is arrived at that the *Tr. gambiense* of the first-named condition is the probable cause of Congo sleeping sickness; but it must be admitted, in spite of the positive statements which have been made on the subject, that something remains to be cleared up. This view is confirmed by Dr. Christy's researches on the cerebro-spinal fluid in sleeping sickness. He considers that all that can definitely be stated is that (1) on the whole the presence of the trypanosome parasites in the cerebro-spinal fluid tends to increase the gravity of the case, (2) in many cases trypanosomes never find their way into the cerebro-spinal fluid, and (3) in the vast majority of cases death is the result of complications, mainly bacterial infections.

Fig. 1.—Flies, pupa and larvæ (nat. size) of the Congo Floor Maggot.

The identity or non-identity of the various trypanosomes of man has been investigated by Dr. Thomas and Mr. Linton, who conclude that the parasites found (*a*) in the cerebro-spinal fluid of Uganda sleeping sickness, (*b*) in that of Congo Free State sleeping sickness, (*c*) in the blood of Uganda trypanosomiasis cases, and (*d*) in the blood of Congo Free State trypanosomiasis cases, are all identical in morphology and animal reactions with the *Tr. gambiense.*

In an interesting paper, Messrs. Dutton, Todd, and Christy describe the Congo floor maggot, a blood-sucking dipterous larva extensively found in various parts of the Congo Free State, and identified by Mr. Austen as the *Auchmeromyia luteola*, Fabr. These larvæ seem to lurk in the cracks and crevices of the mud floors of the native huts, from whence they emerge at night and attack the persons sleeping there. The volume concludes with a note by Mr. Austen on tsetse-flies. Since his monograph on the tsetse-flies was issued, further observation has convinced Mr. Austen that the *Glossina tachinoides*, regarded by him as a variety of *G. palpalis*, must be reckoned as a distinct species.

The volume of the Thompson-Yates and Johnston Laboratories Report contains the reports on trypanosomiasis, &c., described above, and several additional papers of interest. Dr. Stephens describes a new hæmogregarine from an African toad, two cases of intestinal myiasis (fly larvæ) observed in children in Liverpool, a note on swellings of uncertain ætiology in a tropical patient, and a note on non-flagellate typhoid bacilli. The last named were from an old laboratory strain which had been subcultured for some years, and seemed completely to have lost their flagella and motility. Mr. Shipley describes a new human trematode parasite from German West Africa, and Mr. Dutton defines the intermediate host of a lymph worm (filaria) of an African swift; this is found to be the louse which infests these birds. Prof. Moore and Mr. Roaf contribute an important experimental study of the physical chemistry of anæsthesia, from which they conclude that chloroform forms an unstable chemical compound or physical aggregation with proteid and hæmoglobin, and is carried in the blood in such a state of combination, the compounds so formed limiting the chemical activities of protoplasm and inducing anæsthesia. Mr. Edie describes the action of chloroform on serum proteids and hæmoglobin, and, lastly, Mr. Roaf and Mr. Edie describe a simple method for the preparation and determination of lecithin which seems to be a great improvement on the methods hitherto in use. Both volumes are beautifully printed and illustrated, and appear in a new cover, which, artistically, is a great improvement on the old one.

R. T. Hewlett.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The General Board of Studies has appointed Mr. T. S. P. Strangeways, St. John's College, Huddersfield lecturer in special pathology, from Lady Day, 1905, until Michaelmas, 1909, and the appointment has been confirmed by the Special Board for Medicine. Mr. R. P. Gregory, of St. John's College, has been appointed senior demonstrator in botany for four years, until June 24, 1909.

The list of successful candidates for open scholarships at Downing College is so far unusual that all the winners are natural science students. It is as follows:—A. W. Bourne, Rydal Mount School, Colwyn Bay, 50*l.*; A. C. Johnson, Merchant Taylors' School, 40*l.*; W. G. Stevens, The Leys School, Cambridge, 40*l.*; I. K. Matthews, Merchant Taylors' School, Crosby, Liverpool, 40*l.*

Oxford.—The university has resolved to contribute a sum not exceeding 1000*l.* towards the printing of that portion of the British section of the International Astrographic Catalogue which has been executed at the university observatory.

By a statute passed in 1904, the university established a "diploma in scientific engineering and mining subjects," and the committee appointed to arrange the details of the scheme has now issued the regulations concerning the diploma. Members of the university will be eligible for the diploma who have passed at the examinations required for the degree of B.A., and have satisfied the examiners in certain special subjects mentioned in the following list, after an approved course of study in those subjects extending over two years, and have also gone through an approved course of practical training lasting four months, either at a mine or in engineering works. The subjects that may be offered are :—(*a*) mathematics for applied science ; (*b*) physics and chemistry ; (*c*) French and German translation ; (*d*) engineering principles and machine drawing ; (*e*) surveying ; (*f*) geology ; (*g*) mineralogy ; (*h*) mining and engineering, hygiene and mine-ventilation ; (*i*) electricity ; (*j*) assaying. For the ordinary diploma candidates will be required to pass in (*a*), (*b*), and (*c*), and in not less than three of the remaining subjects, provided that (*f*), (*g*), and (*i*) are not taken together without one or more of the others. Candidates who propose to become colliery managers and desire to obtain exemption from two of the five years' underground work required by the Home Office as a qualification for a certificate as colliery manager, must obtain a special diploma by passing in the subjects (*a*), (*b*), (*c*), (*h*), and three (not being *f*, *g*, *i*) of the remainder, and by taking their four months' course of practical training at a mine.

PROF. W. JAMES, of Harvard University, has accepted, *Science* reports, the acting professorship of philosophy at Stanford University. He will lecture at Stanford during the second half of the next academic year, and will organise a department of philosophy for the university.

A GENERAL meeting of the Association of Teachers in Technical Institutes will be held on Saturday, March 25, at the Regent Street Polytechnic, London, when an address, to be followed by a discussion, will be delivered by Mr. W. J. Lineham, head of the engineering department, Goldsmiths' Institute, entitled "Technical Training—a Teacher's Views."

IN connection with the International Exposition to be held at Liége, Belgium, from April to November during the present year, it is proposed to hold an International Congress of Childhood on September 17–20. The congress will be organised in four sections, as follows :—(1) education of children ; (2) study of children ; (3) care and training of abnormal children ; (4) parents' associations, mothers' clubs, and other supplementary agencies for the improvement of youth.

THE council of Liverpool University has accepted an offer from the president, Mr. E. K. Muspratt, to provide for an extension and equipment of the chemical laboratories at an estimated cost of 10,500*l*. The following contributions for the extension and maintenance of the chemical department have also been acknowledged by the council :—100*l*. per annum for five years from the United Alkali Company, Ltd., 100*l*. each from Mr. George Wall, West Kirby, and Mr. T. Threllfall, London.

A NEW technical college and secondary school at East Ham was opened by the Prince and Princess of Wales on Saturday. The building has been erected and equipped at a cost of about 24,000*l*., towards which the Essex County Council has contributed 6000*l*., and the remainder has been made up by the East Ham Corporation. The accommodation includes a botanical room, chemical class-room and laboratory, physics laboratory, carpenter's shop, and provision for the pursuit of various crafts—plumbing, metal-work, brickwork, &c. In replying to the address presented by the Mayor of East Ham, the Prince of Wales said :—It is difficult to realise that only ten years ago these crowded streets were green lanes, that your population has multiplied nearly twentyfold in the last thirty years, and that within your borough one industry alone employs more than 10,000 men. You have very rightly recognised that this remarkable growth carries with it serious responsibilities. The vast and rapidly increasing population of the borough necessitates the provision of suitable secondary and technical education, and in this institution you are furnishing that educational equipment for the rising generation which is indispensable if we intend to maintain our place in the great struggle for commercial supremacy. My heart is with you in all such undertakings as that which we are about to inaugurate, and I trust that every success may attend your useful and patriotic efforts.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 16.—"Further Observations on Slip-Bands.—Preliminary Note." By Walter **Rosenhain**. Communicated by Prof. Ewing, F.R.S.

The paper describes what the author believes to be a novel method of investigating the micro-structure of metals, and some preliminary results obtained by its aid. The method was devised in order to throw further light on the true nature of slip-bands, and the preliminary results relate mainly to this question.

A direct means of examining the surface configuration of a piece of metal upon which slip-bands have been produced would be presented by a transverse section of such a specimen, provided that the section could be produced with an absolutely sharp edge, but no useful result can be obtained by cutting the specimen through and simply polishing the exposed section. The edges of specimens prepared by the usual methods of polishing are always rounded off, so that it becomes impossible to focus upon any definite edge with high-power lenses ; and even apart from this defect, there would be no guarantee that the edge represented a true section of the pre-existing surface.

FIG. 1.—Transverse Section of Slip-bands. Vertical illumination × 1000 diameters.

The author has adopted the principle sometimes used in optical work of supporting the surface, which in section becomes the edge, by means of an adherent layer of hard material ; but the conditions which such a layer must satisfy for the purposes of metallography are very stringent. In order to satisfy them, the author uses a deposit of another metal obtained by electrolytic means, and this method has proved satisfactory.

The specimens used consisted of strips of the mildest steel, and after preparation an electro-deposit of copper was applied to them. By first bending the strips into a flat **U** shape, short portions of their length could be polished in the usual manner for microscopic examination ; subsequently the strips could be readily strained in tension. The slip-bands and other features of the specimens having been satisfactorily observed, electro-deposition was proceeded with, care being taken to avoid chemical action on the prepared surface by the preliminary use of a bath of copper cyanide.

The specimens were then cut across. In order to obtain a satisfactory polish, the ordinary method of polishing had to be modified ; it was found that polishing with rouge rapidly eroded a deep groove between the copper and iron, thus defeating the object of the method. A satisfactory polishing medium for this and other purposes where surface erosion is undesirable was found in calcined oxide of magnesium, the magnesia powder being used in the same way as rouge.

The section, when polished by means of magnesia, is not yet ready for examination, as it is found that a considerable amount of metal is smeared or dragged over the surface, more or less obliterating the true boundary line which it is desired to examine. To overcome this obstacle, it is arranged that the last rubbing on emery paper shall be done in a direction approximately parallel to the boundary of the two metals; the direction of rubbing during the final polishing should then be at right-angles to the boundary, the unavoidable tendency to drag or smear then being such as to draw the iron over the copper on the side where the boundary is to be examined.

The film of metal smeared over the boundary in these circumstances is extremely thin, and can be removed by slight etching with picric acid. This treatment leaves a clearly defined boundary line appearing under a certain incidence of "vertical" illumination as a narrow black line, and under other illumination being visible merely by the colour-contrast between the iron and copper.

When a previously polished and etched specimen of iron which has had slip-bands developed upon its surface by strain is treated and examined in this way, the boundary line shows well-marked steps or serrations, readily visible under a magnification of 1000 diameters. To show that these steps were not due to any of the processes gone through by the specimen, such as the initial etching of the prepared surface or the electro-deposition itself, a series of test specimens was prepared and treated in a similar manner, except that either the preliminary etching, or the deformation, or both, were omitted. The stepped boundary was always found in specimens where slip-bands had been produced, but not otherwise.

The author therefore feels justified in concluding that the steps seen in transverse sections of strained specimens are the sectional views of slip-bands. It will be seen that the steps, although very minute, are perfectly distinctive, and that they could not be mistaken for generally rounded foldings of the surface; they possess, in fact, a general geometrical character, which the author regards as conclusive evidence that they are caused by slip on cleavage or gliding planes of the crystals, and not by any folding or crumpling of the metal.

"The Effects of Momentary Stresses in Metals." By Prof. Bertram **Hopkinson.** Communicated by Prof. Ewing, F.R.S.

If a wire be hung from a firm and massive support, and if a falling weight strike a stop at the lower end of the wire, with a velocity V, it is easy to calculate the strain at any point in the wire at any subsequent time, if it be assumed to be perfectly elastic. When the weight strikes, a wave of extension starts up the wire and travels with a velocity $a = \sqrt{E/\rho}$, where E is Young's modulus, and ρ is the density. For steel a is about 17,000 foot-seconds. When the wave reaches the top end, it is reflected down the wire. The history of the strain at any point of the wire is as follows:—When the wave reaches it, the strain, which was zero, suddenly becomes V/a; it then diminishes as the wave passes over it, according to an exponential law, until the reflected wave reaches it, when it again increases by V/a. Each bit of the wire is, therefore, subjected to strain which rises suddenly, and then very rapidly diminishes. The maximum strain at any time or place occurs at the top of the wire, where it is $2V/a$ at the moment when the wave arrives there. For a height of fall of 10 feet, and an iron wire, $2V/a$ is 0·003, and the corresponding stress is about 42 tons per square inch, so that momentary strains greatly exceeding the elastic limit may be produced in this way.

In the experiments described in the paper, the momentary extension in the top 20 inches of the wire, produced by a blow, was measured by electrical means, and compared with that given by the elastic theory. Where the two agree, and not much permanent extension is left, it follows that the theory is correctly applied, and that the material is substantially elastic up to the maximum stress, so calculated, if applied for the time given by the theory. In this way it is proved that a metal wire will stand a load, momentarily exceeding that which (steadily applied) would break it, with but very small permanent extension. In the case of the iron wire, the elastic limit was 17.8 tons per square inch, and the breaking stress 28.5 tons; and it was found that a load reaching $33\frac{1}{2}$ tons, and exceeding the elastic limit for 1/1000 sec., produced very little permanent extension. Similar results were found for copper wire.

February 23.—"On a New Rhabdosphere." By George **Murray,** F.R.S.

The author refers to the interest which the rhabdospheres and coccospheres possess, not only to naturalists, but to geologists and students of deep-sea deposits. He names it *R. Blackmaniana,* after Mr. V. H. Blackman, his fellow author in an exhaustive study of such organisms (*Phil. Trans.*, B., vol. cxc., 1898). It was obtained by Mr. Murray on the outward voyage to the Cape of the *Discovery,* in lat. 28° 25′ S., long. 23° 56′ W., and differs from the only other forms, two in number, known to science in possessing tapering, acute, spinous processes in contrast to the trumpet-shaped and club-shaped processes of the two known species. No sign of the new form has yet been detected in the deep-sea deposits or geological formations, Mr. Murray accounting for this by the minuteness and extreme tenuity of the spines.

March 2.—"Further Researches on the Temperature Classification of Stars, No. 2." By Sir Norman **Lockyer,** K.C.B., F.R.S.

The paper contains a discussion of the more recent photographs obtained with a calcite-quartz prismatic camera. Each negative contained the spectra of two stars, obtained under identical conditions of altitude, exposure and development, the relative temperatures of which were estimated by comparing the relative intensities of their ultra-violet and their red radiations. The term "temperature" is understood to include the possible effects of electrical variations. In a previous paper, communicated to the society in February, 1904, the author showed that by thus comparing the relative temperatures of those stellar genera which were placed on different levels of the chemical classification temperature curve, their arrangement on that curve was vindicated. In the recent research the relative temperatures of the genera placed on the *same* horizons, but on the opposite sides, of the curve were similarly compared, with the result that their equality of temperature, as suggested by the chemical classification, was confirmed. The results also indicate that *specific* differences exist which will necessitate the subdivision of the previously proposed "genera" into "species."

Entomological Society, March 1.—Mr. F. Merrifield, president, in the chair.—*Exhibitions.*—(1) An example of *Oxypoda sericea,* Heer, taken in Dulwich Wood, June 17, 1904, a species new to Britain; (2) *O. nigrina,* Wat., with a type lent by Mr. E. A. Waterhouse, to demonstrate that it is not synonymous with *sericea* as stated on the Continent; (3) *O. exigua,* which is also regarded there as synonymous with *nigrina*: H. St. J. **Donisthorpe.**—Series of *Colias edusa,* with var. *helice,* bred from one ♀ *helice,* sent by Dr. T. A. Chapman from the South of France, to show the proportion of type and variety obtained: H. **Main** and A. **Harrison.** The results of similar experiments with *Amphidasys betularia,* bred from a ♂ var. *doubledayaria,* and a type ♀ taken in cop. at Woodford, Essex, in 1903, were also shown.—Specimen of *Helops striata,* showing an abnormal formation of the right antenna, which was divided into two branches from the fifth joint: R. **Priske.**—(1) Examples of *Hydrotaea pilipes,* Stein, ♂ and ♀, the latter sex being previously unknown; (2) several specimens of *Hydrotaea tuberculata,* Rond., not hitherto recorded as British, captured in various localities; P. H. **Grimshaw.**—Cocoons, and perfect imagines of hybrid Saturniids, including ♀ and ♂ of *S. pavonia,* L., × *S. pyri,* Scheff., with added specimens of both sexes of the parent forms for comparison, the cross product resembling a large *S. pavonia* rather than a small *S. pyri.* The exhibit further included three ♂ ♂ and three ♀ ♀, of which the ♀ parent was *S. pavonia,* and the ♂ parent a hybrid between *S. pavonia*, ♂, and *S. spini*, ♀, viz. the cross product to which Prof. Standfuss has given the name *S. bornemanni*: Dr. F. A. **Dixey**.—(1) Groups of synaposematic Hymenoptera and Diptera captured by Mr. A. H. Hamm, of the Hope Department, Oxford University Museum; (2) three much worn specimens of *Papilio hesperus*, taken at Entebbe in 1903, by Mr. C. A. Wiggins, to show that the tails of a Papilio, if untouched by enemies, can endure a great deal of wear; (3) Nymphaline butterflies from northern China, apparently mimetic of the male *Hypolimnas misippus*, which is not known to occur in this region: Prof. E. B. **Poulton**, F.R.S.—Examples of *Pyrameis atalanta* and *Aglais urticae*, illustrating the effects of cold season breeding by Mr. Harwood, of Colchester, some of them lent by Mr. R. S. Mitford: the **President**.—*Papers*:—Butterfly hunting in British Columbia and Canada: Mrs. De la B. **Nicholl**.—On three remarkable new genera of Microlepidoptera: Sir George **Hampson**.—Descriptions of some new species of diurnal Lepidoptera, collected by Mr. Harold Cookson in northern Rhodesia in 1903–4. The Lycænidæ and Hesperiidæ described by Hamilton H. Druce: H. **Druce**.—Descriptions of some new species of Satyridæ from South America: F. Du Cane **Godman**.—Additions to a knowledge of the homopterous family of Cicadidæ: W. L. **Distant**.

Faraday Society, March 6.—Recent developments in electric smelting in connection with iron and steel: F. W. **Harbord**. The paper embodies the principal results of the investigations made by the commission sent to Europe last year by the Canadian Government for the purpose of reporting upon the different thermoelectric processes for the smelting of iron ores and the manufacture of steel at work in Europe, together with some additional information bringing the subject up-to-date. The author acted as metallurgist to that commission. The following general conclusions are stated in the paper:—(*a*) Steel, equal in all respects to the best Sheffield crucible steel, can be produced even in this country, either by the Kjellin, Héroult, or Keller proceses, at a cost considerably less than the cost of producing a high-class crucible steel, assuming electric energy to cost 10*l*. per E.H.P.-year. (*b*) At present, structural steel, to compete with Siemens or Bessemer steel, cannot be economically produced in the electric furnaces, and such furnaces can be used commercially for the production of only very high-class steel for special purposes. (*c*) Speaking generally, the reactions in the electric smelting furnace are similar to those taking place in the blast furnace. By altering the burden and regulating the temperature by varying the electric current, any grade of iron, grey or white, can be obtained, and the change from one grade to another is effected more rapidly than in the blast furnace. (*d*) Pig iron can be produced on a commercial scale at a price to compete with the blast furnace, only when electric energy is very cheap and fuel very dear. Under ordinary conditions, where blast furnaces are an established industry, electric smelting cannot compete; but in special cases, where ample water-power is available, and blast furnace coke is not readily obtainable, electric smelting may be commercially successful.

Zoological Society, March 7.—Dr. W. T. Blanford, F.R.S., vice-president, in the chair.—Pictures of the zebra in "Aldrovandus" (1640) and the "Commentarius" of Ludolphus (1691): H. **Scherren**. In the course of his remarks Mr. Scherren said that in the seventeenth century zebras (now known as *Equus grevyi*) had been sent by the ruler of Abyssinia to the governor of the Dutch East India Company at Batavia, and to the Sultan of Turkey, so that the species was seen in Europe two centuries before the type of *Equus grevyi* reached France in 1882. In proof, passages were cited from Philostorgius Ludolphus, Jean de Thévenot, and other writers.—A series of spirit-specimens of fishes from Lake Chad and the Chari River, collected and presented to the British Museum by Captain G. B. Gosling: G. A. **Boulenger**.—Exhibition of hybrid ducks bred at Cambridge: J. L. **Bonhote**. The crosses exhibited dealt chiefly with four species, of which the following were shown:—*Anas boschas* × *A. poecilorhyncha*, *Anas boschas* × *A. poecilorhyncha* × *Dafila acuta*, *Anas boschas* × *A. poecilorhyncha* × *A. superciliosa*, *Anas boschas* × *A. poecilorhyncha* × *A. superciliosa* × *D. acuta*.—Ecology and deposits of the Cape Verde marine fauna: C. **Crossland**. The author pointed out that so far as the Cape Verde group was concerned there was no evidence of any common tropical marine fauna, though certain species were found in both the Atlantic and Indian Oceans. Reef animals were remarkably few in number, the fauna in their place having a considerable subtropical constituent. Rock simulating coral-rag was formed at the low-tide level by serpulid tubes fused together by Lithothamnion, and by the latter and Foraminifera between 5 and 20 fathoms. The absence of reefs might be due in some degree to the remarkably steep coasts of the islands, but it was more especially owing to the extraordinary dominance of boring sponges, worms, and molluscs. Beach sandstone was formed by the deposition of calcareous cement where the fresh water met the salt; it was only found in certain situations, and was everywhere being slowly eroded away by the sea.—A revision of the South-American cichlid genera, Crenacara, Batrachops, and Crenicichla: C. Tate **Regan**. Twenty-three species were described, four of them new to science.—A new antelope from British East Africa: Captain R. **Meinertzhagen**.

Royal Astronomical Society, March 10.—Mr. W. H. Maw, president, in the chair.—Description of the spectroheliograph of the Solar Physics Observatory: Dr. W. J. S. **Lockyer**. The complete instrument consists of a siderostat to throw the solar beam in a horizontal and southerly direction, a lens placed in this beam to form the solar image, and the spectroheliograph itself to photograph in monochromatic light the image thus formed. The apparatus was fully explained and illustrated by photographs on the screen. Specimens of results obtained were also exhibited, the photographs of the sun showing the fine network covering its surface, becoming thicker and more agglomerated in middle and low latitudes to form the calcium flocculi. The sun-spots appear to be closely related to these flocculi, but the prominences bear no relation to them, though they give brilliant images in the "K" or calcium light.—The large sun-spot of January 29 to February 11, and the contemporaneous magnetic disturbances: **Astronomer Royal**. A series of photographs, taken at the Royal Observatory, Greenwich, was shown on the screen.—Spectroscopic observations of the recent great sun-spot and associated prominences: A. **Fowler**. The paper dealt with the reversed lines, the widened lines, &c., and the spectra of the chromosphere and prominences overlying the spot on the western limb.—Observations of the great sun-spot made at Stonyhurst, and photographs of the spectra: Father **Cortie**.—Reply to criticisms of a paper on sun-spots and the associated magnetic disturbances: E. W. **Maunder**.

Physical Society, March 10.—Dr. R. T. Glazebrook, past-president, in the chair.—On direct reading resistance-thermometers, with a note on composite thermocouples: A. **Campbell**. The paper describes two methods by which the reading of a resistance-box in connection with a platinum resistance-thermometer gives directly the actual temperature without the use of any formula or table.—On the stresses in the earth's crust before and after the sinking of a bore-hole: Dr. **Chree**. In NATURE, October 20, 1904, there appeared letters by Mr. G. Martin and the Hon. C. A. Parsons dealing with the size of the stresses in the earth's crust and speculating as to what would happen if a hole were bored to a depth of 12 miles. The present paper discusses the subject, treating the earth as an elastic solid, and points out the various uncertainties that exist. Solutions are presented of a number of mathematical problems having a bearing on one or other of the possibilities discussed. The principal novel case considered is that of a composite earth, consisting of a core of incompressible material and of a crust which may be compressible or incompressible.—On the lateral vibration of bars of uniform and varying sectional-area: J. **Morrow**. Lord Rayleigh has given a method by which the approximate period of vibration of a rod can be calculated without the use of transcendental equations. The question has recently been further discussed by Mr. Garrett and Dr. Chree. The object of the paper is to show that, by assuming a type of vibration consistent with the conditions obtaining at the ends of the bar, the period can be obtained approximately in a simple manner, and that by a process of continuous approximation the period and the type of the vibration may be determined, in a large number of cases, with great accuracy.

Royal Meteorological Society, March 15.—Mr. Richard Bentley, president, in the chair.—The growth of instrumental meteorology: **President.** After briefly touching on the historic and non-instrumental era of meteorology, reference was made to the seven great weapons of meteorology—the thermometer, and of later years the heliograph, for temperature, the hygrometer and rain-gauge for moisture, the barometer for pressure, and the anemometer and kite for the study of the upper air—and of the great foundation of instrumental meteorology laid by Galileo, Torricelli, Wren and Hooke. The president, in dwelling upon our indebtedness to Italy in science (as well as in art) from Galileo to Marconi, pointed out that the theory of rainfall was correctly enunciated as early as the beginning of th fourteenth century by Dante. He also dwelt on the great services rendered to the community by meteorologists, largely by volunteers at their own expense, and referred to the close observation kept by rain-gauges on the steadily diminishing water supply of the country, by anemometers protecting the traffic over some of our lofty and more exposed railway viaducts, by the use of the barometer for storm warnings and for the safety of miners in our pits, by the heliograph with relation to the ripening of fruits and crops, and regretted how much of the immense mass of information daily accumulating had still to be analysed and put to use. It was disappointing to find in so wealthy a country as this, and where the results could not fail to be of the greatest practical utility to the nation, that the means of digestion of this vast data are so meagre, and the aid given by the Government is so slender as to be a constant source of reproach when compared with the large provision made for the same purpose in other countries for their own benefit.

DUBLIN.

Royal Dublin Society, February 21.—Dr. W. E. Adeney in the chair.—(1) On the transmissibility of tuberculosis of the monkey to the ox and goat; (2) on the use of tuberculin in the detection of tuberculosis: Prof. A. E. **Mettam.** (1) The tuberculous material was obtained from a drill monkey. After passage through guinea-pigs, emulsions of the organs of the latter were inoculated into a bull and into a goat. Both animals have been infected with tuberculosis, though free from the disease prior to injection, local lesions having been established and reaction to tuberculin being pronounced. (2) Experiments were carried out with the object of determining if an increased dose of tuberculin would reveal tuberculosis in an animal which had already a short time previously received a dose of tuberculin, and if any immunity to tuberculin was established as to how long it lasted. It was shown, as Vallée maintains, that a double dose of tuberculin would reveal tuberculosis even if the animal had received a prior dose a few days before, and that the immunity to an ordinary dose was evident for ten days to a fortnight after injection.—Secondary radiation and atomic structure: Prof. J. A. **McClelland.** Every substance gives off a secondary radiation of β particles when acted upon by the β rays of radium. The intensity of this secondary radiation, in the case of elementary substances, depends on the atomic weight; the greater the atomic weight the greater is the secondary radiation. This very general law has been found to hold true for all the elements tested, which were twenty-one in number. The paper further discusses this result from the point of view that all atoms are groups of similar electrons.

Royal Irish Academy, February 27.—Prof. R. Atkinson, president, in the chair.—A list of the Irish jelly-fishes, corals, and sea-anemones: being a report from the R.I.A. fauna and flora committee: Jane **Stephens.** This is a catalogue of all the species of Cœlenterata hitherto recorded for the coast of Ireland. The list, containing about 250 species, includes the fresh-water hydroids. In a prefatory note a short account of the Irish Cœlenterates is given; there is also a bibliography of the papers (which date back to the year 1755) dealing with the subject.—Notes on the homotaxial equivalents of the beds which immediately succeed the Carboniferous Limestone in the west of Ireland: Dr. Wheelton **Hind.** The counties of Clare and Limerick contain the Carboniferous sequence of the west of Ireland in the form of a basin, the western side of which has been cut off by the sea, and consequently the geological structure is well seen in the line of cliffs from Black Head, co. Clare, to Ballybunion, co. Kerry. In the north of Clare the beds dip gradually at 5°, and there are few or no faults. In the south of the county and in co. Limerick there have been stronger earth movements, and faulting is more frequent. The sequence shows Coal-measures (Foynes coalfield), olive grits, flags and sandy shales, black shales with bullions, Carboniferous Limestone without shales or detrital beds. The whole series is conformable and fossiliferous. The Carboniferous Limestone is characterised by the same fossils as occur in the Carboniferous Limestone and Yoredale rocks of England, and at the top of this series is a great faunal change. The black shales with bullions, which overlie the Carboniferous Limestone, contain *Posidoniella laevis, P. minor, Posidonomya membranacea, Pterinopecten papyraceus, Glyphioceras diadema, G. spirale, G. davisi, G. reticulatum, Dimorphoceras gilbertsoni, G. descrepans, Nomismoceras spirorbis,* and many others which characterise the Pendleside series and the Lower Culm of England. The marine bands intercalated in the olive grit and flag series, and the shales, recall the marine bands in the Millstone Grits. Hence it is interesting to find the same faunal sequence in the west of Ireland as exists in the midlands of England, and it is erroneous to classify the beds which succeed the Carboniferous Limestone in the west of Ireland as either Yoredales or Coal-measures, but they are the homotaxial equivalents of the Pendleside series and Millstone Grits.

PARIS.

Academy of Sciences, March 13.—M. Troost in the chair.—On surfaces applicable to the paraboloid of revolution: Gaston **Darboux.**—On the laws of sliding friction. Paul **Painlevé.** A discussion and extension of a paper on the same subject by M. Lecornu.—On the pressures developed at each instant in a closed vessel by colloidal powders of different forms: R. **Liouville.** The work of M. Vieille on the explosion of gun-cotton powders in a closed vessel led him to conclude that the speed of combustion is proportional to a power of the pressure, about 2/3. On account of the difficulty introduced into ballistic calculations, it is usual to consider the speed of combustion as proportional to the pressure. An investigation is given showing the accuracy of Vieille's exponent, and indicating where further experimental work is required.—On the explosive wave: E. **Jouguet.** The numerical data given in a previous note were calculated on the assumption that the combustion was total in the explosive wave, and that the dissociation could be neglected. In the present paper the dissociation is taken into account, the formula of Gibbs being adopted. Figures are given for mixtures of oxygen with acetylene, cyanogen, and methane, and it is shown that the dissociation may be considerable without seriously affecting the velocity of the explosive wave.—On the emptying of systems of reservoirs: Ed. **Maillet.**—On the dangers of atmospheric electricity for balloons and the means of remedying them: A. **Breydel.**—On halation in photographs: Adrien **Guébhard.**—On the atomic weights of hydrogen and nitrogen, and on the precision attained in their determination: A. **Leduc.** The value obtained by the author for the atomic weight of nitrogen from his density measurements was 14·005, but the figure still adopted by the International Committee on Atomic Weights is 14·04. It is pointed out that the lower number is confirmed by the recent experiments of Guye and Bogdan, and Jaquerod and Bogdan.—On dextrorotatory lactic acid: E. **Jungfleisch** and M. **Godchot.** The preparation of *d*-lactic acid in a pure state from its salts is complicated by the tendency to pass over into the inactive acid and by the formation of lactyl-lactic acid. The precautions necessary to avoid both these changes are given in detail, and the properties of the pure acid described.—The action of magnesium amalgam upon dimethylketone: F. **Couturier** and L. **Meunier.** The chief product of the reaction is pinacone. By the dry distillation of the magnesium compound there is produced acetone, isopropyl alcohol, pinacoline (the principal product), and mesityl oxide. The yield of pinacoline is 21 per cent., and this forms the most rapid and advantageous method of preparing this substance.—On oxyethylcrotonic acid and ethylerythric acid: M. **Lespieau.**—On a method for the volumetric estimation of hydroxylamine: L. J. **Simon.** The method is based upon the conversion of the hydroxylamine salt into the oxalate by the addition of sodium oxalate, and titration in neutral solution by potassium permanganate. The influence of dilution and of excess of the sodium oxalate has been studied.—The glycerophosphates of piperazine: A. **Astruc.** A description of the preparation of the acid glycerophosphate of piperazine, and a method for its estimation based on the use of two indicators, phenol-phthalein and methyl orange.—On the experimental bases of the reticular hypothesis: G. **Friedel.**—The requirements of the tobacco plant in fertilising materials: A. Ch. **Girard** and E. **Rousseaux.** The average amounts of lime, potassium, phosphoric acid and nitrogen required per 1000 kilograms of dried leaves are given.—The genesis of the gametes and anisogamy in Monocystis: Louis **Brasil.**—On the Alpheidæ of the Laccadive and Maldive Islands: H. **Coutière.**—Sterility and alopecy in guinea-pigs previously submitted to the influence of ovarian extracts of the frog: Gustave **Loisel.** The ovarian extracts of the frog contain a poison which acts by causing the atrophy of a certain number of ovules. Other effects of the poison are noted.—On the antidote to nicotine: C. **Zalackas.** Experiments on rabbits and guinea-pigs show that strychnine has not the effects as an antidote to nicotine usually attributed to it. The effects of eserine are more favourable, and an extract of *Nasturtium officinale* led to still better results, the effects of a mortal dose of nicotine being entirely removed by the injection of the latter substance.—On the lowering of the arterial pressure below the normal by d'Arsonvalisation: A. **Moutier** and A. **Challamel.** In certain cases the use of high frequency, high tension currents leads to a lowering of the blood pressure under the normal. It is therefore necessary to measure this pressure with great care when d'Arsonvalisation is being used therapeutically.—A modification of the spectrum of methæmoglobin under the action of sodium fluoride: J. **Ville** and E. **Derrien.**—On the Middle Eocene deposits in Senegal: J. **Chautard.**—On the phenomena of the deviation of water courses dating from the seventeenth, eighteenth, and the commencement of the nineteenth centuries, proved my maps: E. **Fournier.** In a series of five maps of a valley near Lons-le-Saunier, dated 1658, 1748, 1790, 1841, and the present day, the various changes undergone by the water courses can be traced.—The results of a year's study of the electrical conductivity of the water of the Rhone at Lyons: M. **Chanoz.** The water supply of Lyons, obtained from the Rhone, contains mineral matter in relatively constant amounts throughout the year, as indicated by the freezing point and electrical conductivity.

DIARY OF SOCIETIES.

THURSDAY, MARCH 23.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: The Reception and Utilisation of Energy by the Green Leaf: Dr. Horace T. Brown, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Report of Experiments carried out at the National Physical Laboratory: On the Effect of Heat on the Electrical and Mechanical Properties of Dielectrics, and on the Temperature Distribution in the Interior of Field Coils: E. H. Rayner.—*Discussion:* On Temperature Curves and the Rating of Electrical Machinery: R. Goldschmidt.

ROYAL INSTITUTION, at 5.—The Reasonableness of Architecture: Thomas G. Jackson.

FRIDAY, MARCH 24.

ROYAL INSTITUTION, at 9.—A Pertinacious Current: Sir Oliver Lodge, F.R.S.

PHYSICAL SOCIETY, at 5.—Note on the Voltage Ratios of an Inverted Rotary Converter: W. C. Clinton.—On the Flux of Light from the Electric Arc with varying Power Supply: G. B. Dyke.—The Application of the Cymometer and the Determination of the Coefficient of Coupling of Oscillation Transformers: Prof. J. A. Fleming, F.R.S.—Exhibition of Cymometers and other Instruments.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Wanki to Victoria Falls Section; Victoria Falls Railway: C. T. Gardner.—Design of a Double-Line Plate-Girder Railway-Bridge: H. S. Coppock.

SATURDAY, MARCH 25.

ROYAL INSTITUTION, at 3.—Electrical Properties of Radio-active Substances: Prof. J. J. Thomson, F.R.S.

MONDAY, MARCH 27.

SOCIETY OF ARTS, at 8.—Telephone Exchanges: H. L. Webb.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Liberia: Sir Harry Johnston, G.C.M.G., K.C.B.

INSTITUTE OF ACTUARIES, at 5.—Bonuses in Model Office Valuations and their Relations to Reserves: Dr. James Buchanan.

TUESDAY, MARCH 28.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Coolgardie Water-Supply, C. S. R. Palmer.

ROYAL INSTITUTION, at 5.—Vibration Problems in Engineering: Prof. W. E. Dalby.

SOCIETY OF ARTS, at 4.30.—The Manufactures of Greater Britain—Australasia: The Hon. W. H. James.

WEDNESDAY, MARCH 29.

SOCIETY OF ARTS, at 8.—British Woodlands: Sir Herbert Maxwell, Bart., M.P.

THURSDAY, MARCH 30.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Observations of Stars made in some British Stone Circles (Preliminary Note): Sir Norman Lockyer, K.C.B., F.R.S.—On the Distribution of Velocity in a Viscous Fluid over the Cross-section of a Pipe, and on the Action at the Critical Velocity: J. Morrow.—The Direct Synthesis of Ammonia: Dr. E. P. Perman.—The Determination of Vapour Pressure by Air Bubbling: Dr. E. P. Perman and J. H. Davies.—Note on Fluorescence and Absorption: J. B. Burke.—The Determination of the Specific Heat of Superheated Steam by Throttling and other Experiments: A. H. Peake.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

FRIDAY, MARCH 31.

ROYAL INSTITUTION, at 9.—The Scientific Study of Dialects: Prof. J. Wright.

SATURDAY, APRIL 1.

ROYAL INSTITUTION, at 3.—Some Controverted Questions of Optics: Lord Rayleigh.

CONTENTS.

THURSDAY, MARCH 30, 1905.

THE CLASSIFICATION OF THE SCIENCES.

Philosophy as Scientia Scientiarum and a History of Classifications of the Sciences. By Robert Flint, D.D., LL.D., F.R.S.E. Pp. x+340. (Edinburgh and London: William Blackwood and Sons, 1904.) Price 10s. 6d. net.

THE relation of science to philosophy is, in theory, filial. It is, perhaps, no contradiction of the filial relationship that in practice it has an unfortunate tendency to run to mutual recrimination. The man of science too often ignores the philosopher, or despises him as an obscurantist who habitually confounds abstraction with generalisation. To the metaphysical philosopher, on the other hand, the typical specialist in science is a variety of daylabourer, dulled by the drudgery of occupational routine. Amidst such conjugal plain-speaking on both sides, it is no wonder that we hear much of what is called the divorce of philosophy and science; and yet there are many problems which for their adequate treatment surely require the combined resources of both science and philosophy. Is not the problem of the classification of the sciences one of these? Yet the comparative isolation of the scientific and philosophic approaches to this subject is a conspicuous fact, well attested by some recent instances. One of the most eminent of European men of science quite recently brought forward, as an original contribution, a scheme of classification which the philosophical critics at once detected as almost identical with that of Auguste Comte. Another very eminent man of science not long ago published a critical survey of some of the best known schemes of classification. His criticsm of Comte's scheme was apparently based upon an allusion in the practical treatise (the "Positive Polity"), the critic himself being presumably in ignorance that Comte's treatment of the subject can only be adequately studied in the "Positive Philosophy," where indeed the general theory of science is so elaborately worked out as to extend over several volumes.

Then again, there is that stupendous work, the "International Catalogue of Scientific Literature," itself a classification of the (natural) sciences in being. For the taxonomic preparations antecedent to this, the Royal Society was mainly responsible. It would be interesting to know if the Royal Society, in preparing its scheme, consulted either the Aristotelian Society (as the leading corporate representative of philosophy in England), or any individual philosopher, known, like Herbert Spencer, to have made a special study of the classification of the sciences. Had a precedent been wanting for the explicit and formal cooperation of science and philosophy, a not unworthy one might have been cited in the collaboration of Whewell, sought and obtained by Lyell, for the classification and nomenclature of Tertiary geological strata.

Prof. Flint's new book should serve as a mediating influence between philosophical and scientific interests. It brings together into one convenient source the leading attempts made, from Plato to Karl Pearson, towards a classification of the sciences. This, it seems, is the first time in the history of the subject that an exhaustive endeavour has been made to collect these data. How invaluable a service Prof. Flint has thus rendered to future investigators, can be appreciated only by those who have tediously toiled at the scattered literature of this subject. Its bibliography appears hitherto to have been left unorganised —having escaped even the ubiquitous zeal of German scholarship. As a special study, the classification of the sciences has been singularly little cultivated in Germany, though Wundt went too far when, first taking up the subject himself, about a generation ago, he declared that German sources were nil.

In point of purely taxonomic requirement, the first questions evoked by the problem of classification of the sciences are:—(1) What order of phenomena is it that falls to be classified? (2) Which (if any) amongst existing sciences deal with this particular order of phenomena? Can we, without leaving the assured ground of scientific method, adequately determine the first of these two questions? Does science itself yield criteria for determining its own order of phenomena? Science, to be sure, when self-contemplative, is more often in a postprandial mood than in a critical one. But when the man of science, in a metaphysical moment, does critically turn his eye inwards, and surveys the whole scientific domain, does he not see a manifold complexity of very partially analysed phenomena? Truth to tell, the evolution of science itself—*i.e.* its rationalised history and its methodology—considered as a department of scientific research, is one that has scarcely begun to be cultivated. It would be interesting, incidentally, to inquire whether the establishment of a chair of the "History of Science" in the Collège de France (due to positivist advocacy) has been followed by any similar initiative elsewhere; while as to methodology, what chance would even the most eminent amongst men of science have as a candidate for a chair of logic?

The few great men of science who have contributed to these departments of study have done so as philosophers rather than as men of science. Personal and individual views on the history and the methods of science—views of the first value and significance —have time and again been emitted, but there has scarcely yet been initiated in this field, that system of cooperative, impersonal, detached research which ensures continuity and consensus—the essential criteria of science. Not far short of a hundred systems of classification come within Prof. Flint's survey. The great majority of these have been put forward explicitly in the name of philosophy. Perhaps less than a dozen may be counted as having issued from professed men of science; and of these, each is, like the philosophical schemes, a personal and individual production, generated in comparative isolation from other similar endeavours. Hence it is, that while there is no generally recognised system of arranging the sciences in any rational order, there is a whole series of competing pseudo-classifications, each characterised by the particular qualities and defects of its individual originator. One of the unfortunate results, is that the problem itself has fallen into some disrepute. Prof. Flint's book will help substantially to rescue the problem both from neglect and obloquy.

With existing resources, what tentative lines of orderly development may be discerned in the evolution of science which may help towards this preliminary problem of classification? Looking at the sciences collectively, and their field of investigation as a whole, we may without transcending scientific limits take several standpoints in turn. These may be held to include the following:—

(1) Science, collectively considered as a body of knowledge, differentiated from other bodies of knowledge (*e.g.* common knowledge on the one side and philosophy on the other) by its more systematic character, its greater quantitative precision, its more fully and explicitly known sources of origin and methods of growth, the more certain verifiability of its generalisations, the greater exactitude of its forecasts. Here, from this standpoint, science appears as a system of symbolism, a methodised scheme of notation, an organisation of interdependent formulæ —in short, a well-made language, as Condillac said.

(2) Science considered as a psychological process—*i.e.* as a power or faculty which, under certain definable conditions of heredity, training, and environment, the individual mind may acquire and utilise in the course of its normal growth. Here, from this standpoint, science appears as an artificial Psychic Organ, a portable illuminant like the miner's lamp, a racial eye adjustable to the individual brain—an eye that discerns the obscurities of the present, penetrates the past, and reveals the future. In short, science is here a rational development of instinct, by means of which the individual may be educated to possess himself more fully of the accumulated social heritage; and, in turn, more fully contribute to it, from his personal experience—the individual being here postulated as unique.

(3) Science considered as a social process, *i.e.* as a growth of racial experience, accumulated by an infinitude of contributions from cooperating individuals and generations in endless succession. It is a social process differing in its development from parallel growths of racial experience, chiefly in being more capable of consciously directed control and guidance, and therefore able to yield more verifiable ideals. Here, from this third point of view, science appears as a Social Institution, aiming at the organisation of communitary experience by a collective process in which the intervention of any given individual is a negligible quantity. The personality of the individual man of science is here to be observed as a social fact of a definitive order, and interpreted as itself the product of past and contemporary social evolution. The individual is here postulated, not as unique, but as a type. The existing body of men of science make up, at any given moment, the temporary and evanescent personnel of one amongst abiding social institutions. They constitute one of a number of competing and cooperating social groups, composed of types of personality which are material for observation and study, like any other commensurable objects of natural history. And in this observational study of types of scientific personality would, of course, be included the corresponding study of their mental products—*i.e.* their contributions to science.

Here, then, are three aspects of science, under which it may approach the problem of its own structures and functions, its own history and ideals. The first approach is that of the nascent science of methodology (inheriting the philosophical traditions of logic and epistemology); the second is that of the well-established science of psychology; and the third, that of the nascent science of sociology (inheriting the traditions of philosophy of history and social philosophy). As each of these three sciences develops, it must, in pursuit of the first of scientific ideals—that of an over-evolving order—work out an increasingly natural classification of the phenomena with which it deals. The whole field of science would be surveyed from each of these points of view, and it would follow that in course of time there must emerge several classificatory schemes, each with a scientific status and validity of its own. But, given these several taxonomic systems—logical, psychological, sociological, and perhaps also æsthetic and ethical—there would, of course, remain the problem of their unification. Here surely would be scope for the activities of the philosopher; and yet the man of science would presumably decline to delegate that supreme taxonomic survey of his own domain. As sociologist, he may even propose a scientific survey of the philosophical field! For are not systems of philosophy themselves to be observed and classified as sociological facts, and interpreted as products and factors in social evolution?

What, then, is the right division of labour between science and philosophy? Is it not expressed in the simple and homely ideal—every man of science his own philosopher? Does not the existing fashion of exclusive devotion, either to speculation or to observation, tend to a multiplication of individuals who are neither philosophers nor men of science, but degenerate variants known to American psychologists as respectively "lumpers" and "splitters"? Is it not an alternation of speculation and observation, of the philosophical and the scientific mood, that most prolongs and intensifies each of these two complementary phases of mental activity? That surely is the lesson to be learned from the lives of the great initiators in science—of Faraday and Darwin, of Virchow and Helmholtz, of Bichat and Claude Bernard. The ordinary working man of science is ready enough, like Claude Bernard, to put off his imagination with his coat when he enters the laboratory. Only let him remember, like Claude Bernard, to put it on again when he leaves, for without it he cannot cultivate philosophy.

ELEMENTARY MATHEMATICS.

(1) *Elementary Pure Geometry, with Mensuration.* By E. Buddon, M.A., B.Sc. Pp. viii+284. (London and Edinburgh: W. and R. Chambers, Ltd., 1904.) Price 3*s.*

(2) *Lessons in Experimental and Practical Geometry.* By H. S. Hall, M.A., and F. H. Stevens, M.A. Pp. viii+94+iii. (London: Macmillan and Co., Ltd., 1905.) Price 1*s.* 6*d.*

(3) *The Elements of Geometry, Theoretical and Practical.* By B. Arnett, M.A. Books i., ii., and iii. Pp. viii+195, viii+238, and viii+242. (London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd., 1904.) Price 2*s.* each volume.

(4) *The Elements of Trigonometry.* By S. L. Loney, M.A. Pp. xii+339+xiv. (Cambridge: The University Press, 1904; London: Macmillan and Co., Ltd., 1904.) Price 3*s.* 6*d.*

(5) *Elementary Algebra, Part II.* By W. M. Baker, M.A., and A. A. Bourne, M.A. Pp. viii+277 to 468+lxxvi. (London: George Bell and Sons, 1904.)

(6) *Clive's Shilling Arithmetic.* Edited by W. Briggs, LL.D., M.A., &c. Pp. viii+154. (London: W. B. Clive, 1905.) Price 1*s.*

(7) *Graphic Statics.* By T. Alexander, C.E., and A. W. Thompson, D.Sc. Pp. viii+50. (London: Macmillan and Co., Ltd., 1904.) Price 2*s.*

(1) THE geometry of Mr. Buddon is a notable addition to the elementary text-books which owe their appearance to the freedom of the last few years. The subject is introduced by experimental work, very suggestive in character, and leading by induction to fundamental definitions and theorems. Thus from the sliding and folding of flat cards and the like the author arrives at his definition of a plane as "a surface, infinite in extent, which can be folded about any two points of the surface so that one part lies entirely on the other." The definition of a straight line naturally follows as the infinitely extended fold of a plane. A plane angle is clearly and rationally defined. Parallel lines are those having the same direction in a plane, direction being measured by the angle made with any reference line. It is pointed out that a plane, a plane angle, and a straight line can in each case be reversed on itself, and thus symmetrical properties are satisfactorily established in which the two halves are alike but of opposite aspect. Then follow general cases of congruence. In dealing with ratio and proportion the idea of a continually subdivided decimal scale is introduced; this enables all numbers which can be expressed as continuous decimal fractions, *e.g.* 1·4142. . . ., to be included, and to any degree of approximation. In later chapters the subject-matter comprises a very full treatment of the properties of circles; elementary trigonometry; an introduction to projective geometry; conic sections treated by modern methods; and solid geometry with the mensuration of the simple geometrical solids. The book contains in profusion sets of graphical and deductive exercises. The figures are drawn with thick, thin, and dotted lines on a systematic plan to distinguish more readily between the data, the construction lines, and the result. The use of variable type serves to differentiate parts of greater or less importance. In fact, the book on every page bears witness to the great care and thought bestowed on its production. There is a stimulating freshness in the matter and its method of presentation. Some will doubt the wisdom of carrying on at school the study of pure geometry to the extent covered in the book; others may wish that the geometry of vectors had been included; but all will agree that the author has produced one of the most important of the new elementary text-books, and one that should be known to every teacher interested in the subject.

(2) The "Lessons in Experimental and Practical Geometry" by Messrs. Hall and Stevens might very fittingly be incorporated in the authors' "School Geometry," to which it forms an excellent introduction as well as supplement. The subject is treated in the masterly way that is found in the mathematical text-books of these writers. Young pupils are fortunate who obtain their first notions of geometry from a course such as the one outlined in its pages. They will become accustomed to the use of compasses, squares, scales, and the protractor by interesting quantitative and experimental work, fundamental propositions being at the same time inductively established. They will have practice in the application of geometrical problems; will learn how to measure areas; and will be introduced to the simpler geometrical solids. The authors make good use of tracing paper. The list of instruments and apparatus which they give might with advantage have included the drawing and compass pencils, with a caution added against the employment of soft blunt leads.

(3) In the preface of his elementary geometry Mr. Arnett states that the work "has been written for the use of candidates who are being prepared by a master for the different examinations conducted by the universities and the Civil Service Commission." The subject-matter is confined to plane geometry, and is almost wholly deductive. The first book gives definitions and axioms, and investigates some of the properties of lines, angles, parallels, triangles, and quadrilaterals. The second book deals mainly with the circle and with ratio and proportion, and the last book treats of areas and of similar figures. The principal feature of the work is the very large number of exercises provided, a few of which are numerical or graphical, the great bulk, however, being of the nature of geometrical riders. The text-book is not at all suitable for beginners, for general school work, or for private study except under the direction of a tutor who could direct the student as to which parts should be read and which omitted, and who would probably re-arrange the order in which the theorems and problems should be taken.

(4) Mr. Loney's "Elements of Trigonometry" is mainly taken from part i. of the author's "Plane Trigonometry," and is designed as an easier text-book. The subject is treated in the usual way, and there is nothing to call for special mention. The first chapters relate to acute angles and right-angled

triangles. The definitions are then extended to angles of any magnitude, and formulæ are established for the sum and difference of angles, and for multiple and submultiple angles, &c. There is a chapter on logarithms, and a number of four-figure tables are given. This work leads up to the properties and solution of triangles with applications. Inverse functions are introduced, and general expressions established for angles having given trigonometrical ratios. There are a large number of examples, any necessary answers to which are given at the end of the book.

(5) Part ii. of Messrs. Baker and Bourne's excellent algebra begins by formally establishing the laws of operation of algebraical symbols. It contains chapters on surds and indices, proportion, logarithms, progressions, series, scales of notation, permutations and combinations, the binomial theorem, interest and annuities, exponential and logarithmic series and partial fractions. There are numerous groups of examples, and special sets of revision papers at intervals, the answers being all given in an appendix. A special feature of the book is the frequent use of graphs and of geometrical illustrations. This text-book must give satisfaction wherever used.

(6) Clive's shilling arithmetic is intended for the use of teachers who adopt almost entirely the oral method of instruction, and who only require a class-book containing concise statements of rules, with graduated sets of exercises, and with the formal proofs of theorems omitted. Thus a small volume is sufficient to cover the range of subjects usually taught in schools, and which this manual contains. The book can be obtained with answers included at an extra cost of threepence.

(7) In the graphical statics of Messrs. Alexander and Thompson the authors first give a set of sixteen graduated problems on coplanar forces, solved by means of force and link polygons; these include couples, centres of area and moments of inertia of beam sections. Then follows a set of seventeen examples showing applications to roof trusses, girders, walls, and masonry arches. The treatment is somewhat fragmentary and arbitrary, but, if supplemented by the teacher, the course would prepare a student for a systematic study of graphic statics, and the book is intended more particularly as an introduction to the author's "Elementary Applied Mechanics."

SALT-BEDS AND OCEANS.

Zur Bildung der ozeanischen Salzablagerungen. By J. H. van 't Hoff. Pp. vi+85. (Brunswick: Vieweg and Son.) Price 4 marks.

THIS work will be welcomed alike by chemists, geologists, and oceanographers. It forms the first instalment of the collection into one publication of the results of some forty memoirs of the author and his collaborators on the formation of double salts.

The principal object of the work was the study of the problem of the natural salt beds. As these beds have in all probability been formed by the evaporation of a body of water comparable with the existing oceans, which certainly contain some of everything, it was necessary to set limits to the investigation. This was effected by confining attention to the principal constituents of the salt-beds. These are chloride of sodium, in great preponderance, and the chlorides and sulphates of magnesium and potassium with their water of crystallisation. The latter form a series of more complex bodies which appear and disappear with the changing equilibrium of the solution. After these come the calcium salts, such as anhydrite and polyhalite; but they are held over for treatment in the next fascicule.

The work is a gigantic exercise in physical chemistry, which the author carries through on strictly scientific lines, while at the same time touch is kept with the important applications of his results in the economy of nature, and chemistry is thus vindicated as a branch of natural history.

The experimental part of the work is of especial interest to physical chemists, and the publication of it in a connected and condensed form will be welcomed by them. It is proposed here to notice only the application of it to the occurrence of salts in nature in beds and in solution.

The experimental basis of the work is the determination of the solubility, at certain temperatures, of the common salts of the sea, in water and in solutions of each other. With the information so obtained, it is possible to follow exactly the crystallisation of a solution containing all these salts, as it gradually loses water by evaporation at the temperature of the experiment. The temperature most used is 25° C., which is fairly representative of the temperature of sea water evaporating in salt gardens, such as those of Hyères or Cadiz in summer.

When average sea-water has been evaporated down to the point at which chloride of sodium begins to crystallise, the liquor contains (in molecular proportions) 100 $NaCl$, 2·2 KCl, 7·8 $MgCl_2$, 3·8 $MgSO_4$; and this mixture of salts is associated with, roughly, 1000 mol. H_2O (exactly 1064). On allowing this liquor to evaporate at 25° C., the crystallisation follows a definite route, which can be traced exactly, and without difficulty, on one of those marvellous charts representing the march of physical and chemical phenomena with which the resourceful inventiveness of van 't Hoff has familiarised us.

The crystallisation takes place in four acts corresponding to the regions in the chart.

(1) Rock-salt: separation of chloride of sodium in great abundance. Of the 100 NaCl present when crystallisation began, only 4·6 NaCl remains dissolved; the remainder, 95 NaCl, has been deposited.

(2) Kieserite region: separation of chloride of sodium, sulphate of magnesium, and kainite

$$(MgSO_4KCl3H_2O).$$

The salt separated in this act consists of 4·42 NaCl, 2·02 KCl, and 3·07 $MgSO_4$; or, 4·42 NaCl, 1·05 $MgSO_4$, and 2·02 kainite.

(3) Carnallite region: separation of chloride of sodium, carnallite ($KMgCl_3,6H_2O$), and kieserite ($MgSO_4.H_2O$), and the amounts separated are 0·03 NaCl, 0·1 carnallite, and 0·35 kieserite.

(4) Final liquor: what remains solidifies to 0·15

NaCl, 7·62 $MgCl_2$ (bischofite), 0·08 carnallite, and 0·38 kieserite.

	Rock salt	Kieserite	Kainite	Carnallite	Bischofite
(1)	95·4	—	—	—	—
(2)	4·42	1 05	2·02	—	—
(3)	0·03	0·35	—	0 1	—
(4)	0·15	0·38	—	0·08	7·62
	100·00	1·78	2·02	0·18	7·62
		3 8	2·2	7·8	
	NaCl	$MgSO_4$	KCl	$MgCl_2$	

Within the limits of a notice of this kind it is impossible to give an adequate account of so important a work. It is hoped, however, that the above extract will show that it has an interest for others as well as for chemists. J. Y. B.

EVOLUTION FOR BEGINNERS.

An Outline of the Theory of Organic Evolution; with a Description of some of the Phenomena which it Explains. By Dr. Maynard M. Metcalf, Professor of Biology in the Woman's College of Baltimore. Pp. xxii+204. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1904.) Price 10s. 6d. net.

THIS is one of the best popular accounts of the theory of evolution that have come under our notice. The author makes little or no claim to originality, but he has on the whole succeeded in his aim of providing a clear and intelligible statement of evolutionary doctrine in most of its recent developments. Technicalities have been largely avoided; but, as the author truly says, "the subject is somewhat intricate, and cannot be presented in so simple a manner as to require no thought on the reader's part." With regard to controverted points, the position taken is generally sound; Dr. Metcalf has no difficulty in recognising the supreme importance of natural selection, or in rating at their true value the speculations of the Lamarckian school, whether new or old. He rightly lays stress on the great fact of adaptation as affording the most conclusive evidence of the controlling power of selection; "adaptation," as he remarks, "is the key-note of organic nature." To some readers his faith in the beneficial character of certain modifications will seem a trifle too robust; but for the most part he treats this branch of the subject with sound judgment and the force born of reasoned conviction.

An excellent feature of the book is its wealth of pictorial illustration. Many of the figures are already well known, but it is of great advantage to the ordinary reader to have them grouped together in such a way as to throw fresh light on each other, and thus materially to assist his comprehension of the subject. Many of the reproductions of original photographs are particularly good; to "find the woodcock" in plate l. makes an interesting puzzle. The representation of the snow grouse in plate lvii., and of the sargassum fish in plate lxv. are also admirable, while the copies in colour of Tegetmeier's figures of fancy poultry, though a little rough in execution, are amply sufficient for their purpose.

A few points call for criticism. The author is occasionally betrayed into a slipshod or unmeaning expression, as when he speaks of the sun "moving along its appointed daily course under the control of gravitation." A sentence on p. 31 is entirely misleading, unless the word "artificial" be substituted for "natural." The factors to which special attention has been directed by Osborn, Baldwin and Lloyd Morgan, though not ignored, are rather inadequately treated; the author, moreover, falls into some confusion between individual and specific plasticity. On p. 134 Fritz Müller's interpretation of "synaposematic" resemblances is erroneously attributed to Bates. Indeed, the whole subject of common warning colours, which is one of the most interesting and complicated in the entire range of evolution, deserves more extended and more accurate treatment than it receives at Dr. Metcalf's hands. On plate lxxvi. *Papilio merope* (*caeneae*) is somewhat uncritically assumed to be edible, and on plate lxxvii. we meet with the astonishing statement that the male of *Perrhybris* (*Mylothris*) *pyrrha* is edible, and "imitates the inedible Heliconidæ," while the female of the same species "is not a mimic"; the fact being that it is one of the best mimics known, probably of the Müllerian kind. The lettering of many of the plates stands in need of revision. F. A. D.

OUR BOOK SHELF.

Précis de Chimie physiologique. By Prof. Allyre Chassevant. Pp. iv + 424; illustrated. (Paris: Félix Alcan, 1905.) Price 10 francs.

THIS is a very excellent text-book of physiological chemistry, and it presents the subject in an attractive way. It treats first of the chemical substances found in the body, then of the various liquids and tissues of the organism, and finally of function.

The work contains all the essential facts of this branch of science, without going exhaustively into details; references are given throughout to the names of investigators, but not, as a rule, to their writings. The subjects treated most fully are the urine, the milk, and diet, for the work aims at being not only academic, but also of practical use to the clinical investigator.

The author is well known for his original work in chemical physiology, and he will be personally known also to many in London, as he was one of those who joined in the recent visit of French medical men to London. He possesses what is rarely absent in French writers, a power of clear and lucid exposition. He is fully conversant with recent progress in science, as evidenced by the way he deals with questions in which physical chemistry is involved.

The line between physiology and pathology is never a well defined one, and thus we find in the book subjects like immunity, serum diagnosis, and serum therapy to the fore. It is inevitable that this should be so, for a proper understanding of ferments and anti-ferments, the prime factors in animal chemistry, cannot be attained except through the knowledge and new ideas which were in the first instance the outcome of study in pathological fields.

M. Chassevant is to be congratulated on his interesting work. He has furnished the student, the investigator, and the teacher with what will be useful to all of them. W. D. H.

Unsere Pflanzen. By F. Söhns. Dritte Auflage. Pp. iv+178. (Leipzig: Teubner, 1904.) Price 2·60 marks.

Children's Wild Flowers. By Mrs. J. M. Maxwell. Pp. viii+171. (Edinburgh: David Douglas, 1904.) Price 7*s.* 6*d.* net.

The derivation of many botanical names being very uncertain, it is probable that the subject appeals more to the philologist than the botanist. Who shall say, for instance, whether the speedwell takes its name from a saint Veronica, or should be derived from "vera icon" or "vera unica"? Vernacular names are perhaps more easily explained, but vary greatly in different districts. Similar difficulties occur with German popular names, so that Mr. Söhns has a number of problems of an indeterminate nature to solve in his book, which deals with the nomenclature of plants and their place in mythology and folklore. Generally the author's arguments are carefully deduced and convincing, and, as might be expected, the correct derivation is not always obvious. Tausendgueldenkraut, the popular name of *Erythraea centaurea*, suggests a connection with "centum aurum," but the specific name is undoubtedly given in honour of the Centaur Chiron, who was skilled in medicine, and the German name, which was at first hundert guelden Kraut, has apparently given place to Tausendgueldenkraut, where thousand is used in a hyperbolic sense, and thus the Centaur's plant has become associated with a fanciful expression. In addition to etymology, the book contains many references to popular superstitions. On account of the dissimilarity between German and English popular names it cannot be expected that the book will appeal strongly to English readers, but a third edition points to its success in Germany.

The book by Mrs. Maxwell is intended to interest children in wild flowers by narrating the legends and stories connected with them. Scientific description is practically limited to habitat and comparative characters for distinguishing between the species of a genus, and coloured illustrations are provided as a means of identification of the plants. Obviously the purpose of the writer is not to train the powers of observation or inculcate accuracy, but rather to stimulate the faculties of imagination.

Superstitions about Animals. By Frank Gibson. Pp. 208. (London and Newcastle-on-Tyne: Walter Scott Publishing Co., 1904.) Price 3*s.* 6*d.*

This is an unpretentious little book which will interest many people. It brings together some of the most common superstitions about animals, "dealing with them in a light and popular way," with copious quotations from the poets. One of its aims is to sweep away those superstitions that are foolish and degrading, to clear the air for a free appreciation of the real wonders of nature. For "there is no subject under heaven which will give more pleasure or lasting and real profit than that of Natural History." Mr. Gibson deals first with omens, such as the ticking of the death-watch and the baying of a dog; he goes on to distortions of facts of natural history, such as "salamanders in the fire," "crocodile's tears," "the hibernation of swallows"; he ends up with creatures of the imagination, like the "basilisk," the "phœnix," and the "griffin." The author is a devout admirer of the real things of nature with an unusual knowledge of the poets both great and small. He has not seriously tackled the difficult side of his subject—the attempt to account historically and psychologically for the origin and persistence of the more important superstitions. He has forgotten the salt.

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 Great Oxford Discovery.

In a recent study of some eighteenth century naturalists' writings I was a good deal struck by the amount of attention devoted to the problem of whether the white man was a sport from negroid stock or the negro a sport from a white race. The matter was discussed from every standpoint, physiological, geographical, and theological, but the consensus of opinion, based chiefly on the existence of albinotic and pied negroes, and on the misunderstood effects of leucoderma, was that the white might be a negro sport, but that there was no evidence of a black sport in the case of the white races. If such an opinion were correct, and the white man only a negro sport, we should certainly expect to find the negroid cranial type common among the white races. Two distinguished Oxford men of science have just thrown remarkable light on this problem. They have given a very simple series of conditions by which crania can be classed into skulls of negroid, non-negroid, and intermediate types. These conditions depend entirely on a classification of nasal and facial indices, and by their processes our authors are able to distinguish between the negroid, non-negroid, and intermediate types among prehistoric Egyptian crania. Not being an anatomist, I am quite unable to judge of the processes by which they have reached their criteria, and the photographs which accompany their volume are of so obscure a character—indeed, in the present state of cranial photography somewhat unworthy of a university press—that they hardly allow the uninitiated even with a lens to appreciate the justification which the authors find for their classification in the outward appearances of their cranial groups. I think, however, we may safely give the greatest weight possible to a judgment formed by the Oxford professor of human anatomy and the Oxford reader in Egyptology in a folio volume just issued by the syndics of the University Press.

Taking their classification as beyond discussion, I have applied it:—

First, to a fairly long series of admittedly negro crania, all males. I find 7·3 per cent. are non-negroid, 39·0 per cent. are truly negroid, and 53·7 per cent. are intermediate. It is clear that we only need to let the negroes change their skins, and a sensible percentage will be non-negroid.

Secondly, to a fairly long series of English skulls, male and female. I find of Englishmen 20 per cent. are negroid, 46 per cent. non-negroid, and 34 per cent. are intermediate in type. Among Englishwomen 11 per cent. are negroid, 48 per cent. non-negroid, and 41 per cent. are of intermediate type. Thus of the whole English population slightly more than 50 per cent. are either pure negroid or partially negroid; while in an outwardly pure negroid group, upwards of 60 per cent. are non-negroid or mixed with non-negroid elements.

I have not yet had time to apply Prof. Thomson and Mr. Randall-Maciver's test to Asiatic races, but I have not the least doubt that I shall find there also pure negroid and intermediate negroid elements. But that the Englishman should have as large a negroid element in his constitution as the prehistoric Egyptian, and only half as little pure negroid element as admitted negroes, is to my mind an epoch-making discovery, which will at once attract attention to Oxford as a centre for a novel school of craniometry and anthropology. Karl Pearson.

University College, London.

Inversions of Temperature and Humidity in Anti-cyclones.

In Nature of February 16 Mr. W. H. Dines cited an example of a large temperature inversion, observed with kites during the prevalence of very high barometric pressure in England, and remarked on the possible connection between the two phenomena.

Observations with kites at Blue Hill during the past ten years, and with balloons elsewhere, show that inversions of temperature occur at some height in the free air under almost all weather conditions. In a discussion of the kite observations at Blue Hill, published in 1897 in part i., vol. xlii., *Annals of the Astronomical Observatory of Harvard College*, Mr. H. H. Clayton probably first pointed out that marked inversions of temperature at heights of from a quarter to half a mile in the free air occur in the rear of anti-cyclones. He gives one example of a rise of 26° F. between 2180 feet and 2530 feet, accompanied by a corresponding fall of 50 per cent. in the relative humidity, this rise of temperature being more than twice that mentioned by Mr. Dines.

Prof. Hergesell's soundings with kites on board the Prince of Monaco's yacht last July, in the permanent high barometric pressure south of the Azores, showed a decrease of temperature of 6° F. up to about 1800 feet, when the temperature suddenly rose 14° F., and so remained throughout a stratum 3000 feet thick, above which it fell at the adiabatic rate, the relative humidity decreasing 50 per cent. with the rise in temperature. It would appear, therefore, that such inversions of temperature and relative humidity at a moderate height are characteristic of areas of high barometric pressure, both over the land and water.

A. LAWRENCE ROTCH.

Blue Hill Meteorological Observatory, Hyde Park, Mass, U.S.A., March 13.

The Planet Fortuna.

ONE point of interest to Airy's brother men of science has not been noticed—that he either misunderstood or wilfully misapplied the lines of Juvenal. The "Purists" urged that planets had always been named after deities, and that Fortuna was not a deity. Airy said that she was, and quoted "nos te, nos facimus, Fortuna, deam." What did Juvenal really say? He said, "the wise see *no* divinity in Fortune; it is only human folly that calls her goddess, and assumes for her a place in heaven." As Gifford renders it:—

"We should see
If wise, O Fortune, nought divine in thee;
But we have deified a name alone,
And fixed in heaven thy visionary throne."

"Nullum numen *abest*" belongs to a numerous class of misquotations, and spoils the whole tenor of the passage. The supreme authority on Juvenal, J. E. B. Mayor, does not even condescend to cite it.

W. T.

CITY DEVELOPMENT.[1]

THE elegant volume under notice was written by Prof. Patrick Geddes in response to an invitation by the Carnegie Dunfermline Trust. The report is copiously illustrated, and embodies a very great amount of valuable and important information, plans, and suggestions as to the laying out of the public park, and as to the buildings, in or around it, needed or desirable for carrying on the work of the trust.

The author set to work by having a complete photographic survey made of the park and its environments. All those photographs, however, could not be incorporated in the report, but they will be preserved as a permanent record of the appearance of the park and its surroundings before any changes were inaugurated by the trust. Not content with mere photographs and maps, the author strongly recommends the construction of a relief model of the park, bearing on its surface pasteboard models of the new buildings proposed, in order that the general effect of these buildings on their surroundings may be clearly anticipated, and thus the erection of structures out of harmony with their surroundings may be avoided.

[1] "City Development, a Study of Parks, Gardens, and Culture Institutes." A Report to the Carnegie Dunfermline Trust. By P. Geddes. Pp. 232. (Westminster: Geddes and Co., 5, Old Queen Street.) Price 21*s*. net.

At the beginning of the report a general plan of the park is given, showing the proposed improvements. At first sight the plan appears very elaborate and overcrowded with detail, but this is due

FIG. 1.—View down House Dene, showing back of old Mansion-house to left (south), and on opposite bank, a little nearer than the large tree, Wallace's Well, fallen in. Old paths effaced. From "City Development"

to the fact that its designer has endeavoured to show all the essential details in the plan, in order to reduce the number of blocks in the text, and a little study is all that is required to show that the proposed improvements are not of such a radical nature as a first impression might convey. The proposed treatment is essentially a conservative one, and the suggested changes and improvements have been designed to interfere as little as possible with the existing features, views, and even details of the park and glen.

About one-half of the report is devoted to a detailed consideration of the park, its environs, gardens, and nature museums. The possible approaches and entrances are carefully considered and selected. These must render easy access to, and be in keeping with, the important centre to which they lead. The park must not end abruptly where the town begins, but its environs or setting should be such that a harmonious blending—one with the other—is secured, and in this connection the author seems to have made the most of the material at his disposal.

FIG. 2.—The same view, with Wallace's Well simply re built, and roughly rustic foot-bridge, uniting old paths now renewed. The Mansion-house shows also one of the proposed new turrets. From "City Development."

As regards the laying out of the park, the proposed lakes, gardens, tennis courts, cricket pitches, bowling greens, and other recreation grounds, its pavilions, band-stands, museums, walks, and groves, are too numerous to be noticed individually here. Shortly stated, the author has given the benefit of his extensive knowledge and wide experience in the planning, equipment, and arrangement of parks and all their accessories. Every practical expedient that ingenuity can suggest to encourage that open-air life and physical exercise so necessary and beneficial for young and old has been adopted in the schemes and plans submitted by the author of the report.

A word or two about the nature palace may not be out of place. This very important building has been designed to serve several different purposes, such as a winter garden adapted to receptions and conversaziones, and it also could be used as a promenade and popular assembly room, and as a centre for bazaars, periodic industrial exhibitions, flower shows, &c. The author further proposes to give this building the additional and educational interest of a great museum—a museum which, however, should not aim at having a large general collection of geological, botanical, zoological, and anthropological material, such as those which already exist in larger cities. Indeed, the author points out that it would be cheaper for the trust to send whole schools to the museums of Edinburgh than to attempt to possess an independent institution containing, say, the sixth best collection of skeletons in Scotland or the like. This museum in the nature palace is to be something apart from any existing type of museum; in the words of the author, "A museum not primarily of geology, botany, natural history, anthropology, and so on, yet the whole of these within the living unity of nature, scene by scene—in short, a museum of geography." So far as the special requirements of the various natural sciences are concerned, the author recommends as a model the Perth Museum, with its well chosen collection of types.

The latter half of the report, forming book ii., deals with the culture uses of museums and institutes. In this part of the volume, art, music, history, and science are all provided for and suitably housed, with a view not merely to their immediate wants, but ample allowance and provision are made for the future development and expansion of each and every phase of human activity bearing on culture and industry.

In this handsome volume, the author has included a vast amount of detailed information and convincing arguments to show the value of parks, gardens, museums, and culture institutes in the social advancement, education, and well-being of communities.

NATURE'S WAYS.[1]

UNLIKE the great majority of works of the same class, this little volume takes no notice of birds, but, as its title implies, is entirely devoted to the lower forms of life which may be met with during rambles in different parts of the country, including both animals and plants. As in the case of his earlier book, all the articles have previously been published in various periodicals and journals; and the opportunity for revision given by their re-publication ought to have enabled the author to correct certain deficiencies in style and expression by which the present issue is disfigured.

For example, on p. 29, Mr. Ward manages to introduce the word "which" three times in the course of a single sentence without the use of any higher stop than a comma. On p. 2 we find an obtrusive instance of the *ego et rex meus* class; and on p. 172 we are told that *occasionally* examples of a certain organism are not *uncommonly* met with. Again, on p. 204 the reader, owing to the misuse of the pronoun "they," is informed that the jaws of a snail possess neither jaws nor teeth; while in the

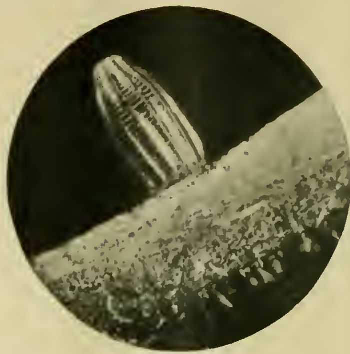

FIG. 1.—Magnified egg of the orange-tip butterfly, on a flower-stalk. From "Peeps into Nature's Ways."

second paragraph on p. 91 we observe a plural pronoun used in connection with a substantive in the singular. The misprint in the first sentence on p. 181 is perhaps excusable; but the statement (p. 186) that

FIG. 2.—A sprig of broom, showing fertilised and unfertilised flowers. From "Peeps into Nature's Ways."

carbon chemically combines with the water sucked up by plants is scarcely an exact definition of what takes place.

Apart from blemishes like the above, the author may

[1] "Peeps into Nature's Ways; being Chapters on Insect, Plant, and Minute Life." By J. J. Ward. Pp. xviii + 302; illustrated. (London: Lister and Co., 1905.)

be heartily congratulated on his work, which is interesting and readable from start to finish; while the illustrations, reproduced from his own photographs, are in most cases exquisite, as our readers may see for themselves from the two examples furnished herewith. Although he appears to have little or nothing new to record, Mr. Ward is evidently a careful and accurate observer, with the faculty of recording his facts in language that "can be understanded of the people."

With the exception of one chapter on the hydra and a second on the "tongues" of molluscs, Mr. Ward's work is restricted to insects and plants. In his opening chapter he details the fascinating life-history of the orange-tip butterfly, showing how its coloration harmonises with the plants it frequents, and how the beautiful green mottling on the hind wings is produced by the blending of dots of black and yellow. As an example of the author's skill in microscopic photography, we reproduce from this chapter his enlarged figure of the egg of the butterfly in question.

Another chapter we have read with special interest is the one on the gorse, in which the author points out how this plant retains evidence of its relationship to the clovers in the form of its seed-leaves; while he also suggests that the broom may be regarded as in some degree representing a plant in course of evolution to the gorse type, but that its career to this goal has been checked by the fact of its having a bitter taste, which renders its leaves, unlike those of the gorse, uneatable by cattle, so that a protective panoply of spines is superfluous. As a specimen of the author's exquisite photographs of plants, we reproduce the one showing the broom in blossom. Of the other chapters dealing with plants, one is devoted to their hairs and scales, in the course of which the author expresses his belief that he has brought to notice a hitherto undescribed type (in the Auricula); a second chapter is accorded to the sensitive plant, a third to the flowers of woodland trees, a fourth to plant-battles, and a fifth to plants that catch flies.

Reverting to the zoological series, it may be mentioned that the devotion of two chapters to the biographies of a couple of nearly allied species of hawk-moth is perhaps an ill-judged arrangement, as giving too much importance to one group. Be this as it may, the chapter entitled "Living Files and Rasps," in which are described and figured the lingual ribbons of a number of species of gastropods, can scarcely fail to be generally interesting, although it would have been better had the author in every case particularised the genus and species to which his specimens pertain, instead of merely labelling them "snails." In the chapter on mosquitoes and gnats the author does his best to clear up the popular misconception with regard to these insects, and shows how the female, so far as mankind is concerned, is the source of all harm and evil.

While, as already stated, it is somewhat marred by errors and inelegances of style, the book as a whole may be pronounced decidedly interesting and attractive, and free from all cant and faddism.

R. L.

GERMAN EDUCATIONAL EXHIBITS AT ST. LOUIS.

THE German educational exhibit at St. Louis was, as is usual with German exhibits, remarkably complete, and to enhance its value a series of descriptive catalogues was issued. Among the science catalogues were three on scientific instruments, chemistry, and medicine respectively which have special interest for readers of Nature. They are all on the same plan, and include a general introduction explanatory of the scope of the work, and a detailed account of the apparatus, &c., exhibited. They served a twofold purpose, that of informing visitors to the exhibition as to what there was to see, and also that of bringing together an account of the best products of German workmanship in the respective subjects of the catalogue.

In the catalogue of scientific instruments the introductory description is very full and of real use; special reference is made to novel instruments. Dr. Lindeck, of the Reichsanstalt, who edited the catalogue of the German exhibit in Paris in 1900, is responsible for this, while Dr. Krüss had charge of the section.

The description of the instruments which follows is arranged alphabetically according to the names of the exhibitors. The system of classification with cross references is somewhat less complete than that adopted in the 1900 catalogue, but by aid of the introduction it is easily possible to find any given kind of apparatus. A glance through the catalogue is sufficient to show its utility, and it is to be hoped that the support given to the proposed optical convention and exhibition in May next will be sufficient to justify the committee in issuing a catalogue of English optical goods which will serve the same purpose.

The chemical section at the exhibition contained a reading-room and library, and in this an interesting collection of alchemistic work was shown. Besides these most of the important modern German works on chemistry were to be found on the shelves. Two very interesting exhibits were the alchemistic laboratory, containing partly original apparatus, partly copies of old examples from the museum in Nuremberg, and the Liebig laboratory, a faithful copy of the well-known laboratory at Giessen. The rest of the exhibition illustrated modern chemical apparatus, methods and preparations.

The object of the medical exhibit is said to have been "to show how the German universities deal with the subject of medical instruction," and this was attained by judiciously grouping the articles shown, and by carefully selecting the apparatus. Naturally, various methods are adopted in the different branches; thus, in the department of internal medicine a complete clinical lecture on the diagnosis and therapeutics of tuberculosis is included, the objects required for demonstrating it being exhibited.

Among the apparatus, the microscopes and projection apparatus of Karl Zeiss occupy a prominent place.

It is noteworthy that among the infectious diseases and disease germs tuberculosis comes first.

The catalogue contains a full list of the exhibits with some account of the principal among them, and it is clear that great pains have been taken to secure that the primary object of the exhibition should be carried out.

The three catalogues, in their completeness and orderly arrangement, are examples of the German plan of carrying the teaching and method of science into everyday life.

NOTES.

The council of the Linnean Society has appointed a committee to consider the question of zoological nomenclature.

Prof. Lancereaux has been elected president for 1905 of the Société internationale de la Tuberculose.

The Canadian Government has decided to place a Marconi wireless telegraph station on Sable Island. The station will come into operation by August 1 next.

M. Paul Labbé has been appointed general secretary of the Paris Society of Commercial Geography in succession to the late Ch. Gauthiot.

MR. ALFRED BEIT has informed the honorary treasurers of the Institute of Medical Sciences Fund, University of London, that he has decided to increase the amount of his donation to the institute from 5000*l*. to 25,000*l*.

SENOR DON IGNACIO BOLIVAR, of Madrid, has been elected an honorary fellow of the Entomological Society. Profs. W. G. Farlow, H. S. Jennings, E. B. Wilson, and R. B. Wood have been elected honorary fellows of the Royal Microscopical Society.

THE King's Institute of Preventive Medicine was opened at Madras on March 11. The institute supplies animal vaccine to the whole of the Presidency, besides preparing curative and prophylactic sera. On the opening day there was an exhibition of bacteriological and sanitary engineering appliances.

A MOUNTED specimen of the great auk, formerly in the Hawkstone collection, has been sold by Rowland Ward, Ltd., of Piccadilly, to one of the American museums for 450*l*. This is the "record" price, the next highest being 350*l*. obtained some years ago by the same firm for a specimen now in a private museum.

DR. A. R. WALLACE recently presented to the British Museum a number of pencil drawings of fishes from the Rio Negro which were saved some fifty years ago at the time the veteran explorer's collections were burnt at sea on his return from the Amazonian journey. These drawings, some fifty in number, were exhibited at one of the meetings of the Zoological Society, when it was stated that while some of the species depicted had been identified, others appeared to be still unknown to science. This should stimulate investigation of the fish fauna of the Amazonian system.

M. JULES VERNE, whose works are better known in this country than those of any other French writer, died on March 24 at seventy-seven years of age. Jules Verne was one of the first novelists to recognise and utilise the store of scientific knowledge as a source of material from which attractive romances could be constructed. The charm of his style and the realism of his pictures have done much to encourage the study of science among boys and girls. Few writers, indeed, have produced healthier and more stimulating stories, or weaved fancy and fact together so successfully.

ON Saturday next, April 1, Lord Rayleigh will deliver the first of a course of three lectures at the Royal Institution on some controverted questions of optics. On Tuesday, April 4, Mr. Perceval Landon will give the first of two lectures on Tibet, and on Thursday, April 6, Prof. Meldola will commence his course of two lectures on synthetic chemistry, experimental. The Friday evening discourse on April 7 will be delivered by Mr. Alfred Mosely on American industry, and on April 14 by Lord Rayleigh on the law of pressure of gases.

THE Estimates for Civil Services for the year ending March 31, 1906, provide for education, science, and art, the total sum of 16,328,947*l*., being an increase of 533,409*l*. over the grants for 1904–5. There is an increase of 46,100*l*. for university colleges, the grant being raised from 54,000*l*. to 100,000*l*. Of the increase 416,790*l*. under Board of Education, the greater proportion must be described as automatic in character, due to the anticipated growth in the number of scholars in average attendance, and to the larger number of teachers for whose training provision is made by the State. The principal increase, 262,704*l*., is in respect of the elementary education grants. With a view to the further development of the National Physical Laboratory, Parliament is being asked to sanction an increase of 1500*l*. on the grant in aid of salaries and other expenses of the laboratory, and also an additional grant of 5000*l*. in aid of new buildings and equipment for the same institution. Further provision is also included for investigations in connection with the North Sea fisheries.

THE fourth International Ornithological Congress will be held in London in Whitsun week, June 12–17. The organising committee has been able to obtain from the University of London accommodation for the meeting at the Imperial Institute, and from the trustees of the British Museum the use of the Natural History Museum for the purpose of a conversazione on one evening of the week of the congress. The Prince of Wales has consented to become the patron; and the two honorary presidents are Prince Ferdinand of Bulgaria and Dr. A. R. Wallace, F.R.S. The president-elect of the congress is Dr. Bowdler Sharpe. The congress will be divided into general meetings and meetings of sections, of which there will be five, as follows:—(1) systematic ornithology; general distribution, anatomy and palæontology; (2) migration; (3) biology, nidification, oology; (4) economic ornithology and bird protection; and (5) aviculture. It is proposed to devote one day to an excursion to Tring to inspect the collection of birds belonging to Mr. Walter Rothschild. On June 16 the congress will be received by the Lord Mayor of London at the Mansion House. At the close of the proceedings in London, on the invitation of the Duke of Bedford, an excursion will be made to Woburn to view the collection of live animals in Woburn Park, and the following day will be spent at Cambridge, where Prof. Newton will welcome the members at Magdalene College. Finally, a journey has been planned to Flamborough Head, in Yorkshire, of special interest to ornithologists.

THE programme of arrangements for the Optical Convention shortly to be held in London is now beginning to assume a definite shape. The convention will be formally opened with an address from the president, Dr. R. T. Glazebrook, F.R.S., on the evening of Tuesday, May 30, and the gathering will extend over the four following days up to and including Saturday, June 3. The mornings will be devoted to papers and discussions, and in view of the interesting series of papers already announced, there is no doubt that this most important section of the proceedings will result in valuable contributions to optical science, and will fulfil the aims which those who have been active in promoting the convention have set before them. In addition to the papers, demonstrations of apparatus of special interest will be given in the afternoons in the laboratories of the department of technical optics of the Northampton Institute. An exhibition of optical and scientific instruments will be held at the Northampton Institute, and will be open from May 31 to June 3, both dates inclusive. The catalogue is now in active preparation. The arrangement made by the "exhibition and catalogue" subcommittee that each section should be dealt with by an expert in the construction of the instruments represented in the section, together with an independent scientific member of the committee, will ensure that all classes of instruments shall be adequately dealt with and described. In addition to the presidential address to be given on the evening of May 30, there will be an evening lecture by Prof. S. P. Thompson, F.R.S., on the polarisation of light by Nicol prisms and their modern varieties. On a third evening it is proposed to hold a conversazione, and for Saturday afternoon, June 3, a visit to the National Physical Laboratory is proposed. Further particulars will be announced later, when the programme is more definitely settled. The hon. secretary, Mr. F. J. Selby, Elm Lodge, Teddington, Middlesex, will be glad to hear from those wishing to join the convention.

IN an account of a journey to Lake San Martin, Patagonia, published in the *Geographical Journal* for March, Captain H. L. Crosthwait directs attention to the magnetic and meteorological observatory established by the Argentine Government on New Year Island—a small island situated in lat. 54° 59′ S., and about five miles off the north coast of Staten Island. The observatory, which is complete in every respect, is superintended by four Argentine naval officers, and is here illustrated from Captain Crosthwait's paper. The observatory was opened in February, 1902, and during the time which has since elapsed, the temperature conditions recorded there by the officers are:—highest temperature recorded, 55°·4 F.; lowest temperature, 16°·4 F.; annual mean temperature, 41° F. The magnetic observatory is kept at an almost constant temperature of 64° F. Many interesting facts about Tierra del Fuego are given by Captain Crosthwait in his paper. He directs attention to the astonishing number and variety of the glaciers, and to the fact that most of the larger ones show signs of shrinkage. Of San Martin Lake he says it undoubtedly occupies what was once a strait joining the Atlantic and Pacific Oceans. The level of the water of the lake rises and falls in a peculiar manner. Exact measurements of these "seiches" show that the movements are irregular, but on an average they amount to about five inches, having a period of about four minutes between two successive high waters. The surface of the water to the eye is perfectly smooth.

FIG. 1.—Magnetic and Meteorological Observatory, New Year Island.

THE "Fauna of New England," in course of publication by the Boston Society of Natural History, has reached its fourth part, which is devoted to the echinoderms, the author being Mr. H. L. Clark.

BEAVER-DAMS on the Slate River, Colorado, form the subject of a paper by Mr. E. R. Warren in the *Proceedings* of the Washington Academy (vol. vi. p. 429), in the course of which the author shows how largely these rodents have altered the features of the valley.

IN the *Biologisches Centralblatt* of March 1, Mr. S. J. Wasmann continues the account of his theory of the origin of slavery among ants, Mr. H. Prandt discusses reduction processes and "karyogamy" among infusorians, while Prof. von Hansemann reviews the so-called heterotype cell-formation in malignant tumours, more especially in connection with the recent cancer investigations of Messrs. Farmer, Moore, and Walker.

To the *Proceedings* of the Boston Society of Natural History (vol. xxxii., No. 3) Miss Emerson contributes an account of the anatomy of *Typhlomolge rathbuni*, the blind salamander first made known by specimens thrown up by an artesian well in Texas in 1894. Despite its external resemblance to the olm (Proteus) of the Carniola caves, the author is of opinion that the creature is a member of the family Salamandridæ, and most nearly related to the American Spelerpes.

THREE American publications on fishes have reached us this week. In the first Messrs. Jordan and Starks (*Proceedings* U.S. Nat. Mus., No. 1391) describe a collection from Corea, containing several new generic and specific types, while in the second (*loc. cit.*, No. 1394) Mr. T. Gill discusses the generic characters of Synanccia and its allies. Of more general interest is the much larger memoir by Dr. S. E. Meek on the fresh-water fishes of Mexico north of the Isthmus of Tehuantepec, issued in the zoological series of the publications of the Field Columbian Museum (vol. v.). In this memoir, which is very fully illustrated, the author discusses the physiography of Mexico in connection with its fish fauna in considerable detail.

IN July, 1902, Dr. Merkel, of Wiesloch, was fortunate enough to discover in an overflow of the Leimbach a large number of the generally rare phyllopod crustacean *Limnadia lenticularis*. The specimens then collected form the basis of a paper on the anatomy of this species by Mr. M. Nowikoff, which appears, with numerous illustrations, in vol. lxxviii., part iv., of the *Zeitschrift fur wissenschaftliche Zoologie*. In the same issue Mr. L. Cohn describes the subocular tentacle of the remarkable frog *Dactylethra calcarata*, the function of which, in the absence of living specimens, cannot yet be definitely determined. The third article in this part forms the completion of the account by Mr. F. Voss of the anatomy of the thorax of the house-cricket, with special reference to the comparative anatomy and mechanism of the organs of flight in insects generally.

IN the second part of an essay on the structure and relationships of the opisthocœlian, or sauropod, dinosaurs, issued in the geological series of the Field Columbian Museum publications (vol. ii., No. 6), Mr. E. S. Riggs dissents from the view that these gigantic creatures were semi-aquatic, or at least marsh-haunting in their habits. Although the massiveness of their vertebræ recalls cetaceans, yet there is no trace in the latter group of the lightening of this part of the skeleton by means of hollowing and fluting which is so characteristic of these reptiles. More important evidence is afforded by the structure of the limbs, which appears to conform strictly to the terrestrial type. The species described in this paper, *Brachiosaurus altithorax*, is regarded as the type of a family characterised by the great relative length of the fore-limb, the humerus in this genus being as long as the femur.

From Dr. Florentino Ameghino we have received a copy of a paper published at Buenos Aires entitled "Nuevas Especies de Mamíferos, Cretáceos y Terçiarios, de la República Argentina," and purporting to be a reprint from vols. lvi.–lviii. of the *Anales* of the Scientific Society of Argentina. It contains a large number of new generic and specific names, which in the absence of illustrations can scarcely be regarded as of much scientific value; and it may be suggested that, despite their admitted richness, the Argentine extinct faunas can scarcely include such a number of forms as the author would have us believe. Moreover, we feel sure that naturalists will display great reluctance in admitting the occurrence of ancestral forms of Tragulus and Galeopithecus in the Argentine Tertiaries, while they will most certainly refuse to follow the author in regarding the latter genus as a member of the Typotherium group of ungulates.

We have been favoured with a copy of the *Schriften* of the Philosophical Society of Danzig for 1904 (new series, vol. xi., parts i. and ii.). To the naturalist the most interesting of its contents is perhaps the long article by Dr. W. Wolterstoff, director of the Magdeburg Museum, assisted by several specialists, on the fauna of the districts of Tuchel and Schwetz, in west Prussia ("Beiträge zur Fauna der Tucheler Heide"). A systematic zoological survey of this well-wooded area appears to have been undertaken in 1900, and the general results of this are summarised in the introductory chapter. Specialists are responsible for the determination of the specimens collected, Captain Barrett-Hamilton having undertaken this duty in the case of the mammals, represented only by three mice and one vole. The amphibians receive special attention, a coloured plate indicating the distinctive features of *Rana esculenta* and *R. arvalis*.

The nuclear divisions in the embryo sac of *Fritillaria imperialis* have been studied by Dr. B. Sijpkens, who has published his results in the *Recueil des Travaux botaniques neerlandaises*, No. 2.

The scope of plant morphology, and the nature of the fundamental problems in this subject which await investigation at the present day, could have no better exponent than Prof. Goebel, who has expressed his views in the *Biologisches Centralblatt* (February). Distinction is drawn between structural morphology, originally based upon systematic study, but later concerned with comparison and phylogeny, and causal morphology, which, inquiring into circumstances and conditions, can only be determined by experiment. The question whether a sporophyll is a modified leaf, or a vegetative leaf a sterilised sporophyte, is not without interest to botanists, but whether it is possible to control development and produce at will a vegetative life or a sporophyll is a problem of much greater significance.

Amongst American horticulturists engaged in plant breeding with the object of improving certain definite characters of flowers and fruit, Mr. L. Burbank, of California, holds a high position. The improvement of plums by hybridisation and selection is a subject which has received much attention, and by crossing the Japan plum with American species he has produced such fine varieties as the Golden, Climax, and the Wickson. More remarkable are the raspberry-blackberry hybrids, of which the Primus, a cross between the western dewberry and the Siberian raspberry, ripens its fruit several weeks before either of its parents, and is superior in productiveness and size of fruit. The first part of an appreciative article by Mr. W. S. Harwood appears in the *Century Magazine* for March.

We have received a copy of the observations made at the Hong Kong Observatory in the year 1903. In addition to the usual tables for the year in question, the report contains a valuable summary of hourly and monthly results of the various elements for the ten-yearly period 1894–1903. During this period the maximum shade temperature recorded was 77°, in August, and the minimum 37°·5, in January, and the highest solar radiation was 160°·1, in September. The greatest daily rainfall was 10·19 inches, and the maximum hourly fall was 2·86 inches. A comparison of the daily weather forecasts with the weather subsequently experienced gave a total and partial success of 92 per cent. The extraction of observations from the logs of ships for the construction of trustworthy pilot charts has been continued; the number of days' observations collected during the year was 9428. This useful work is undertaken by Miss Doberck.

The rainfall of the six months September, 1904, to February, 1905, is summarised in *Symons's Meteorological Magazine* for March, and forms an interesting supplement to the account we published last week from the official reports of the Meteorological Office. The results obtained from fifty-five representative stations are tabulated, and referred to the average rainfall of the thirty years 1870–1899, and although, as Dr. Mill points out, the circumstance is not unprecedented, it very rarely happens that the general rainfall of the country remains below the average for each of six consecutive months. The great advantage of graphical representation in dealing with such data is clearly shown by the map which accompanies the discussion; from that it is seen at a glance that while the rainfall for the six months reached, and even slightly exceeded, the average over a narrow strip in the west of Scotland, and amounted to 75 per cent. in the north of that country, in the north-west of Ireland, in the English Lake district, and a small part of the Welsh coast, all the rest of the British Isles had less than three-quarters of the usual fall. In two large areas it fell short of 50 per cent. of the average, viz. in the south-east of Scotland and in the midland counties of England. Taking each country separately, the rainfall of the six months was:—for England and Wales 60 per cent., Scotland 78 per cent., and Ireland 75 per cent. of the average for the thirty years referred to. The necessity of economising the water supply had already made itself felt in several large towns within the dry area before the end of February.

Prof. G. Torelli, of Palermo, contributes to the Naples *Rendiconto* (physical and mathematical section), x., 12, some new formulæ for calculating the totality of prime numbers below a given limit. The formulæ are non-asymptotical, and they are applicable to an arithmetical progression as well as to natural numbers.

In the *Annals of Mathematics* for January, recently received, Prof. G. A. Bliss discusses the proofs of the existence of solutions of the differential equation of the first order in terms of initial values, and Prof. L. Wayland Dowling discusses the conformal representation of triangles, with special reference to cases in which the solution can be represented by hyperelliptic integrals of given deficiency.

In a contribution to the Berlin *Sitzungsberichte* (1904, lii.), read December 8, Prof. Leo Koenigsberger discusses the extension of the principle of energy to a system having a kinetic potential of any order, and any number of variables dependent and independent. The paper forms a continuation of Prof. Koenigsberger's researches on the dynamics of systems in which *time*, instead of being one dimensional, may be of two or more dimensions.

Prof. Garbasso has published a short note (Genoa, Angelo Ciminago, 1904) in which he proposes a new theory to account for the duplication of lines in the spectra of variable stars. According to this theory, it is assumed that the phenomena are due to the presence of an element the atoms of which are formed of two separate conductors, and that these atoms are mostly in a state of dissociation. The paper consists of a mathematical investigation of the periods of a system of electric oscillators forming a model of the supposed atoms.

In 1890 a paper was presented to the Lincei Academy by Prof. Filippo Keller entitled "An itinerary guide to the principal magnetic rocks of Latium," of which only an abstract was printed. Since Prof. Keller's death in 1903 the complete paper has been brought out by Dr. G. Folgheraiter as No. 11 of his series of *Frammenti* dealing with the geophysics of the environs of Rome. It is accompanied by a map of the district and a portrait and biographical notice of Keller, the latter by Prof. S. Günther. It is printed by Panetto and Petrelli, of Spoleto.

The *Revue générale des Sciences* for February 28 contains a reprint of the paper read at Breslau by Dr. A. Kohler (Jena) on photomicrography by ultra-violet-light. It is illustrated by figures showing the arrangement of the microscope and camera, and the illuminating apparatus. It is pointed out that, independently of the increase of resolving power, ultra-violet light often affords a method of differentiating between organic tissues in virtue of their different degrees of transparency to the rays, and, further, it in some cases can be used to excite interesting phenomena of fluorescence in microscopic objects.

The *Atti dei Lincei*, xiv. (1) 3, contains a short account of some experiments by Mr. Alessandro Artom on wireless telegraphy with the use of circular or elliptically polarised waves. The experiments were divided into four groups, and in every case established the predicted property that it would be possible to send methods in definite directions by the use of these waves. Thus, in the last series of experiments, signals were sent from Monte Mario (Rome) to the island of Maddalena without any effects being noticed at the island of Ponza, which is situated some way off the line joining the first two stations. Further, it appears that with the use of circular waves the height of the aërial conductors can be reduced.

The ninth supplement to the present series of *Communications* from the Physical Laboratory of the University of Leyden contains an address delivered in commemoration of the 329th anniversary of the University of Leyden by Dr. H. Kamerlingh Onnes, Rector Magnificus of the university. It deals with the importance of accurate measurements at very low temperatures, a need which, it is pointed out, was first appreciated by Boyle. An important application of such observations has arisen in connection with van der Waals's theory of corresponding states, and Dr. Onnes points out that further researches at low temperatures are required for the problems of the mechanism of the atom that have been forced upon us by recent discoveries. Dr. Onnes emphasises the very important work done by Dewar in rendering such low temperature observations possible.

"Mathematical Progress in America" forms the subject of Prof. Thomas B. Fiske's address to the American Mathematical Society published in the *Bulletin* of the society for February. Prof. Fiske divides the history of pure mathematics in America into three periods, the first extending up to the foundation of the Johns Hopkins University in 1876, the second extending from 1876 to 1891, when the New York Mathematical Society was converted into the present American Mathematical Society and began to issue the *Bulletin*, and the third covering recent times. The *Bulletin* contains, further, the continuation of the report on last summer's congress at Heidelberg by Dr. E. B. Wilson, and a report of the meeting of the Deutsche Mathematiker Vereinigung by Mr. R. E. Wilson. The *Bulletin* thus furnishes a summary of mathematical progress of a cosmopolitan character such as does not exist in this country.

Of the increasing attention which is being devoted on the Continent to the history of the sciences, and in particular to that of mathematics, abundant proof is afforded by vol. xii. of the *Atti* of the International Congress of Historical Sciences, which met in Rome in April, 1903. This volume is devoted entirely to the proceedings of the section which dealt with the history of mathematical, physical, natural, and medical sciences, and it occupies 330 pages. It includes general discussions by Prof. Elia Millosevich on the iconography of solar eclipses, by M. Paul Tannery dealing with proposals for advancing the history of science, some remarks by Messrs. D. Barduzzi, P. Giacosa, and Gino Loria on the introduction of university courses on history of sciences, and proposals by Prof. Gino Loria for the publication of Torricelli's works, and by Prof. Pietro Giacosa for a catalogue of the scientific manuscripts in Italian libraries and archives. Among the papers read, the two mathematicians associated with the solution of the cubic, Tartaglia and Cardan, receive mention at the hands of Mr. Tonni-Bazza and Prof. Moritz Cantor; Prof. M. Darvai deals with the life of Bolyai; Prof. A. von Braunmühl contributes an interesting paper on the history of the integral calculus; Prof. R. Amalgià writes on early theories of the tides; Prof. Icilio Guareschi on the alleged plagiarisms of Lavoisier. Altogether the volume contains no less than thirty-four papers.

Attention has already been directed to the important series of papers on applied mathematics now being issued by Prof. Karl Pearson, F.R.S., under the title "Drapers' Company Research Memoirs." Two further numbers have now reached us. One of them is the fourteenth of Prof. Pearson's mathematical contributions to the theory of evolution, and deals with skew correlation and non-linear regression. The highly specialised character of the work may be inferred by quoting one of four conclusions on p. 53:—"The correlation between auricular height of head and age in girls is cubical, of nomic heteroscedasticity and of anomic heteroclisy. It is probably really a case of isocurtosis." The other paper is by Mr. L. W. Atcherley and Prof. Pearson, and deals with the graphics of metal arches. In it the authors point out the impossibility of applying purely graphical constructions with any degree of accuracy to the very flat metal arches used in modern bridges, and they propose a kind of "semi-graphical" method, depending partly on analysis and partly on graphics. Some interesting conclusions are drawn as to the relative merits of doubly pivoted, three pivoted, and doubly built in arches. These memoirs are rendered more accessible by being issued with their pages cut. They show what a lot of good work may be done by the expenditure by a public body of a very moderate sum on the endowment of mathematical research. We have another example of the same fact in the Cambridge Smith's prizes and the large number of former winners of these prizes who are now Fellows of the Royal Society.

THE widely extended use of the freezing point and boiling point methods of molecular weight determination has been to a large extent rendered possible by the manufacture of sensitive thermometers of the now familiar Beckmann type. In the current number of the *Zeitschrift für physikalische Chemie* is a very interesting paper by Mr. Ernst Beckmann giving a complete history of the differential mercury thermometer, with especial reference to the modifications it has undergone since its first use in freezing point work. He mentions the fact that the original Beckmann thermometer was due to an accident. A costly instrument, divided into 1/100ths of a degree, was being carried in the hand down a corridor when it was broken in half by the sudden opening of a door. In order still to be able to use the thermometer, a small bulb was blown on above the capillary, and from this the present type was evolved through a series of instruments illustrated in the present paper. Some of the thermometers figured are masterpieces of glass-blowing, notably one combining a Beckmann and ordinary thermometer on one instrument.

MESSRS. JOHN WHELDON AND CO. have sent us their latest catalogue of scientific books they have for sale. The catalogue includes many scarce sets of *Journals* and *Transactions*, as well as selections from the libraries of the late Prof. Everett, Dr. C. W. Siemens, and others.

THE most recent addition to the report being issued by the Engineering Standards Committee is the "British Standard Specification and Sections of Flat-bottomed Railway Rails." Copies of the publication may be obtained from Messrs. Crosby Lockwood and Son. The price is 10s. 6d. net.

WE have received from Mr. Nasarvanji J. Readymoney, of Bombay, a copy of a publication he has prepared entitled "An Outline of Descriptive, Defining Nature-History Tables, Illustrated; or Nature-History Research Thinking Tables; or Work of Genesis Minutely Tabulated." The object of the tables is to enable the student to summarise and classify "all events in nature or creation" in a philosophical manner.

THE February number of the *Journal* of the Straits Branch of the Royal Asiatic Society has reached us from Singapore. Among other important papers we notice contributions by Dr. Charles Hose on various methods of computing the time for planting among the races of Borneo, by Mr. P. Cameron on descriptions of new species of Iphiaulax and Chaolta (Braconidæ) from Sarawak, Borneo, and by Mr. H. W. Firmstone on Chinese names of streets and places in Singapore and the Malay Peninsula.

A NEW and revised edition of the volume of Prof. W. Schlich's "Manual of Forestry" dealing with forest management has been published by Messrs. Bradbury, Agnew and Co., Ltd. The mathematical problems have been simplified, and some of the calculations have been shortened. The appendices have been considerably altered. In the preface to the new edition Prof. Schlich directs attention to the fact that the most urgent need of British forestry is the collection of statistics, which will enable the proprietor and his forester to gauge the economic value of forest operations. He insists that the fully equipped forester must have a good knowledge of mathematics if he is to secure the best results.

A NEW encyclopædia, prepared and printed by Messrs. T. Nelson and Sons, is to be published in forty fortnightly parts under the title of the "Harmsworth Encyclopædia." Three of these parts, each of 160 pages, have been received, and judging from these we do not hesitate to say that the complete work should be a useful aid to students and a responsive friend to general readers. So far as we have tested the parts received, we have found the information accurate and confined to essential points. Of course, it must be understood that within the limited space allotted to any subject only bare outlines can be described; but as references are in many cases given to authoritative works, inquiring readers may be led to pursue their search for information, inspired by what they find in this encyclopædia. The work is liberally illustrated, and as a convenient guide to information which men and women often seek to know it will be of service.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN APRIL:—

April 4. 2h. Mercury at greatest elongation (19° 11′ E.).
5. 23h. Mercury in conjunction with the Moon. (Mercury 7° 28′ N.).
6. 6h. Jupiter in conjunction with Moon. (Jupiter 3° 35′ N.).
9. 11h. 4m. Minimum of Algol (β Persei).
12. 7h. 53m. Minimum of Algol (β Persei)
15. Venus. Illuminated portion of disc = 0·049; of Mars = 0·975.
17. 8h. 18m. to 9h. 12m. Moon occults η Virginis (mag. 4·c).
20–22. Epoch of Lyrid meteors (Radiant 271° + 33°).

DISCOVERY OF A NEW COMET, 1905 *a*.—A telegram from the Kiel Centralstelle announces the discovery of another new comet by M. Giacobini at Nice on March 26.

The position of the comet at 8h. 11·8m. (M.T. Nice) was R.A. = 5h. 44m. 14s., dec. = +10° 56′ 56″, and its daily movement in R.A. = +3m., in dec. −1° 15′.

This shows the object to be in the constellation Orion, about 6m. W. and 3° 34′ N. of Betelgeuse, or a little more than one-fourth the distance from Betelgeuse to ζ Geminorum, along a straight line joining the two. Apparently the comet passed very near to Betelgeuse on March 29.

COMET 1904 *c* (BORRELLY).—A continuation of the daily ephemeris for comet 1904 *c* is given by Dr. E. Strömgren in No. 4004 of the *Astronomische Nachrichten*.

The ephemeris extends from March 29 to May 4, and from it we see that on the first named date the comet will apparently be situated very near to ζ Aurigæ, and will have a brightness of 0·24. Travelling thence in an E.N.E. direction it will enter the constellation Lynx, its computed position on May 4 being R.A. = 7h. om., dec. = +45° 17′, whilst its brightness on that date will be 0·12. The brightness at time of discovery (about mag. 10) is taken as unity.

OBSERVATIONS OF THE RECENT ECLIPSE OF THE MOON.—In No. 9 (1905) of the *Comptes rendus* is published a paper by M. Puiseux wherein he discusses a series of twelve photographs taken between 7h. 32m. and 8h. 12m. on the occasion of the partial lunar eclipse which occurred on February 19.

Amongst other conclusions he states that the apparent changes in the aspects of the circles Messier and Messier A are simply due to differences of illumination and not to actual variations, and that, whilst the recent observations of these two circles and of Linné are not in accordance with the records obtained prior to 1866, there is no substantial evidence for recent changes in these features such as have been announced by several selenographers. M. Puiseux believes that many of the circles are undoubtedly of later origin than certain systems of divergent streaks seen on the lunar surface.

NEW VARIABLE STARS IN THE REGION ABOUT δ AQUILÆ.—In No. 4005 of the *Astronomische Nachrichten* Prof. Wolf publishes a list of thirty-six newly discovered variable stars in the region about δ Aquilæ. Their variability was detected by the comparison of two plates taken with the Bruce telescope on July 12, 1902, and July 6, 1904, respectively. The positions (1875·0) of the new variables are given in the catalogue, and, together with the positions of four others which are also probably variable, are shown on thirty-two circular charts accompanying the paper, each chart including a field twenty-one minutes of arc in diameter. In a second table the magnitudes of the stars on the two plates mentioned above are compared with the magnitudes as shown on a third plate taken on August 11, 1898.

ORBIT OF THE BINARY STAR CETI 82.—The orbit of the binary star Ceti 82 (designated 395 in Prof. Burnham's catalogue) is discussed by Prof. Aitken in *Bulletin* No. 71 of the Lick Observatory.

The Lick observations confirmed the rapid orbital motion, but have also indicated a very different orbit from that previously published by Prof. See (*Astronomische Nachrichten*, vol. cxliv., p. 359, 1897).

The elements obtained by Prof. Aitken show a period of 24·0 years, and give the G.M.T. of periastron passage (T) as 1899·7. The elliptical orbit is graphically presented, and shows the differences between the observed and computed places. The eccentricity of the ellipse is 0·15, and the apparent length of its semi-major axis 0″·06 of arc. Prof. Aitken also gives an ephemeris extending from 1905·7 to 1910·7.

RADIAL VELOCITIES OF CERTAIN STARS.—In No. 70 of the Lick Observatory *Bulletins* Prof. Campbell and Dr. H. D. Curtis discuss the radial velocities of Polaris, η Piscium, ε Aurigæ, and Rigel from the spectrograms obtained at Lick during the last eight years.

In the case of Polaris, the measurement of groups of plates taken during the last four years indicated that the velocity of the centre of mass of the rapid pair in this triple system is changing very regularly with a period of at least eleven or twelve years, but the period may be found to be much longer when further observations are completed.

The radial velocity of η Piscium was suspected by Prof. Lord to be variable with a long period, but as no spectrograms of this star were secured at Lick during the period covered by him, the Lick observations do not settle the question, although the values obtained only range from +16·6 to 13·3 km. per second, whilst Prof. Lord's range was from +9·5 to 25·4 km.

The spectrograms obtained of ε Aurigæ fully confirm Prof. Vogel's conclusion that this star is a spectroscopic binary with a period of several years.

Prof. Vogel's view that Rigel has a variable radial velocity is not confirmed by the Lick observers, who rather favour the conclusion arrived at by Profs. Frost and Adams that the apparent variation is only a function of the difficulty experienced in measuring the wide lines.

STAR PLACES IN THE VULPECULA CLUSTER.—In No. 4004 of the *Astronomische Nachrichten* Dr. H. Meyer gives a catalogue of the positions of thirty-five stars in the Vulpecula cluster. The catalogue contains the B.D. number, the magnitude, and the positions, the latter referred to the equinox of 1900·0 for the epoch of observation 1901·6. The precession and the secular variation in each coordinate are also given for each star, and in the case of fourteen of the brighter ones the proper motion, as determined from the discussion of previous catalogues, is likewise given.

THE U.S. COAST AND GEODETIC SURVEY.

THE report of the Coast and Geodetic Survey for 1904 is a record of manifold labours and results which have for their theatre of action an area practically coterminous with that of the United States and all its island possessions. The main body of the report contains a detailed account of the wide range of duties devolving upon this bureau, and in the appendices we have a presentation of discussions and results which must prove of great economic value and interest to surveyors, engineers, navigators, and physicists.

The re-surveys and developments imperatively required to show the changes in harbours and approaches due to works of improvement or the ceaseless action of natural causes along the Atlantic, Pacific, and Gulf coasts of the United States, and to meet the ever-increasing demands of commerce and the Navy for up-to-date charts, particularly of the waters of Alaska, Porto Rico, Hawaii, and the Philippines, gave constant employment to the eleven vessels available for these duties.

In Alaska the work included the continuation of the survey of Prince William Sound, the survey of Controller Bay, and a deep-sea examination from the Strait of Juan de Fuca to Prince William Sound, preliminary to the laying of a deep-sea cable from Seattle to Valdez. The Porto Rico work was continued in certain bays and harbours as well as in the development of the conditions in the off-shore waters. In the Philippine Archipelago the Survey has secured the cooperation of the Insular Government, and a detailed *résumé* shows a most satisfactory progress of the triangulation, hydrographic, topographic, magnetic, and astronomical operations.

The reconnaissance for the primary triangulation along the 98th meridian was completed to the Canadian border, and a scheme was extended eastward connecting this work with the triangulation of the Mississippi River Commission. The execution of the primary triangulation in the Dakotas and Texas was prosecuted at a rate which surpassed even the notable record which had already secured an enviable reputation for the geodetic operations along the 98th meridian, the total extension amounting to 300 miles (500 kilometres). An equal distinction must be accredited to similar work in California and Oregon, whereon remarkable progress has been made in connecting the Transcontinental Arc work with Puget Sound.

The progress of the magnetic work is shown in detail in Appendix No. 3, which includes a table of results of the magnetic declinations, dip and intensity of force observed on land and sea during the year, this being supplemented with full descriptions of the magnetic stations occupied and meridian lines observed. (This report has been noticed separately, NATURE, March 9, p. 449.)

The determination of the longitude of Manila from San Francisco, thus completing the first longitude circuit of the earth, was one of the astronomical events of the year, and in Appendix No. 4 is a comprehensive illustrated report on the various instruments and operations used in the undertaking, with a comparative *résumé* of the various links and results from which the longitude of Manila had been determined from the westward. The generous cooperation of the Commercial Cable Company, through the patriotic enterprise of which the work was made feasible, is gratefully acknowledged. The results of the determinations from the eastward and westward differ only by 0·006s., or about 8·8 feet. The other results of this expedition are the determinations by the telegraph method of the longitudes of Honolulu and Midway and Guam Islands.

The third attempt at representing the tide for the world at large, the first having been made by Whewell and Airy and the second by Berghaus, is described in Appendix No. 5. The advancement in recent years of the general use of the harmonic analysis, and the greatly improved tidal data that are now obtainable for such a great part of the globe, coordinate to make a new presentation of this subject very opportune. The theoretical discussion of the problems involved, the wide range of data and authorities consulted and referred to, the graphic presentation of the cotidal lines, the results presented, and the conclusions deduced, make a most suggestive paper, and one which will be highly interesting to all students of the subject.

The results of the precise levelling operations for the year are published in Appendices Nos. 6 and 7, which submit them in a detail that makes them immediately available for the requirements of surveyors and engineers. These extend the precise level net, as previously published, six hundred miles to the westward, from Red Desert, Wyoming, to Owyhee, in eastern Idaho, and from Holland, Texas, two hundred miles south-west, to Seguin, Texas. An interesting feature is an account of the change in the manner of support for the levelling rods, with the comparative discussion of the old and the new methods, and the consequent confirmation of the importance of the new system.

The account of operations submitted by the assistant in charge gives the story of the work of the various computing, drawing, engraving, and chart divisions of the office in which the results of the field work are discussed or prepared for the publications and charts wherein they are placed at the service of the public.

A full account of the first recording transit micrometer devised for use in the telegraphic longitude determinations of the Coast and Geodetic Survey is submitted in Appendix No. 8, with an account of the exhaustive tests it was subjected to, and a recapitulation of the results of experience with this form of instrument, mainly in Europe, during the last thirteen years. The results of these experiments indicate that with the transit micrometer the accuracy of telegraphic longitudes may be considerably increased if desirable, or the present standard of accuracy may be maintained at much less cost than formerly.

The results of all triangulation in California south of the latitude of Menterey Bay are printed in the concluding appendix in full, including descriptions of stations as well as their latitudes and longitudes and the lengths and azimuths of the lines joining them. In compact and convenient form there is given all the information in regard to this triangulation that is needed by an engineer or surveyor who wishes to utilise the results in controlling and checking surveys or in constructing maps or charts. The locations of more than 1300 points are accurately fixed by this triangulation.

The report, in addition to the details of the foregoing operations and results, contains a record of a wide range of important work for which the aid of the Survey was sought because of the special training of its officers.

PROTECTIVE RESEMBLANCE.

AN interesting paper on "Protective Resemblance in the Insecta," by Mr. Mark L. Sykes, is published in the *Proceedings* of the Manchester Field Club (vol. i., part ii). After briefly describing the law of natural selection, as propounded by Darwin, the evolution of new species through variations, and the elimination of the least fit during long periods of time, reference is made to the colours of insects, to the advantage of conspicuous adornment, and the consequent easy identification of those of them which possess some feature repellent to the insect-eating animals. The absence in young animals of an intuitive faculty of discrimination between edible and inedible material in the selection of food is emphasised, and reference is made to authors who have experimented on the subject.

Müller's theory of mutual protection, through similarity of colours and patterns, amongst inedible Lepidoptera, and Bates's explanation of the "mimicry" or simulation of distasteful species by edible species, are described, and the superficial resemblances between entirely different species and genera are attributed to the influence of natural selection and elimination, and the transmission and accumulation of variations. The method by which many of these likenesses are produced is shown by a number of camera lucida drawings of the wing scales of many of the butterflies and moths referred to and illustrated in the article; and the scale variations, in colour, size, pattern and arrangement, which produce a common resemblance in the insects, are described. Another branch of the subject, treated in some detail, is protective resemblance of environment, as seen in the striking similarity of many insects, especially amongst the Lepidoptera and Orthoptera, to leaves, twigs, moss, &c.; and a number of illustrations are given of resemblance to natural surroundings, three of which we select as examples.

FIG. 1.—*Embusa gongylodes* (Ceylon) at rest on twi

Among the many curious and interesting insects which are found in Ceylon, *Empusa gongylodes* is one of the most singular. It is a brown insect. The thorax is like a long

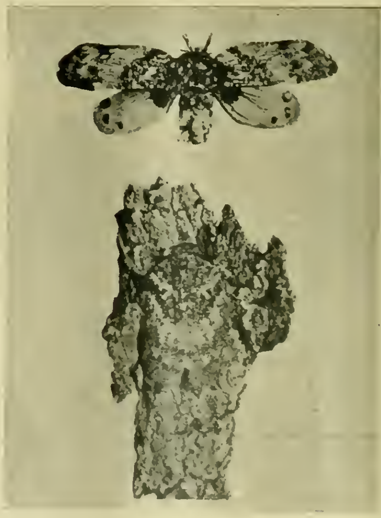

FIG. 2.—*Eurybrachis Westwoodii* (Ceylon) with the wings expanded, and at rest upon a piece of bark.

thin twig, with a wide leaf-like expansion immediately behind the head. The wings are broad, veined and crumpled, like dried leaves, and the long legs, which are spread out in any direction as the animal is at rest, harmonise so closely with the twigs to which they cling that it is difficult to see where one begins and the other ends. Fig. 1 illustrates this insect in the attitude in which it was resting before being captured.

Another interesting insect from Ceylon is one of the moths, *Eurybrachis westwoodii*. The fore wings of this insect are marked in a mottled pattern of green, grey and brown, the hind wings being white, with deep claret-coloured marks near their base, and when it is on the wing the moth is an attractive-looking creature. But its appearance alters when it is at rest, with the mottled wings folded over the back. In Fig. 2 it is shown with the wings expanded as it appears when flying, and below is a piece of bark with the same insect resting upon it, where it was discovered by the keen sight of the collector—a clever capture, as will be admitted when it is noticed how excellently the wings and bark harmonise, and how they seem almost to merge one into the other.

There is found in Madagascar a small beetle which, looked at apart from its natural surroundings, has nothing specially interesting about it except that it is a conspicuous, rugged-looking, pure white and black insect, about three-quarters of an inch long. It feeds upon a species of fungus, which grows upon the bark of trees in mixed cream and black coloured patches. The beetle is shown at the

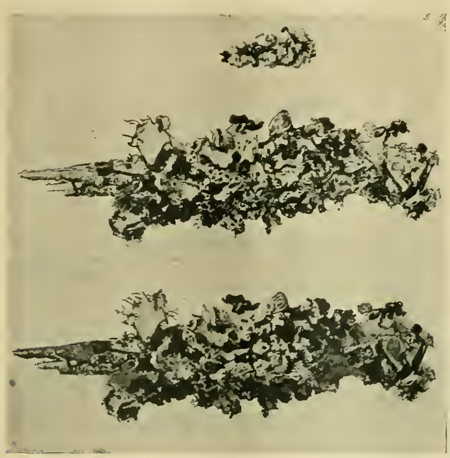

FIG. 3.—*Lithinus nigrocristatus* (Madagascar). The upper figures show beetle and bark separately, and in the lower figure *the beetle is on the bark*.

top of Fig. 3, and beneath it a piece of twig with the fungus growing upon it. At the bottom of the same illustration the same piece of fungus-covered twig is shown, but here the beetle is resting right in the middle of the fungus, effectually concealed amongst the vegetation upon which it feeds.

The paper is very fully illustrated by more than two hundred figures of the insects described, with the localities in which they were taken, covering the whole subject treated by Mr. Sykes.

Exception is taken to the use of the words "imago" and "imagine," introduced by Linnæus, as representing the final stage of insect metamorphosis, and "matura" (maturo = to ripen) is suggested and employed as a substitute, conforming conveniently with the accepted terms for the earlier stages—larva and pupa. The word "mimicry" is also adversely criticised, as implying conscious resemblance, which is not known to exist, and "simulism," "simulation," "simulating," are substituted "as being at once expressive, explanatory and euphonious, and free from the inference of designed and cognitive resemblance."

REPORT OF THE CARNEGIE INSTITUTION, 1904.[1]

IN NATURE for January 7, 1904, a list was given of the awards made by the Carnegie trustees for the prosecution of inquiries in various scientific directions. The third year book, just published by the board of trustees, contains reports upon most of these researches, but the time is far too short to gather in the full harvest, which may hereafter be expected, from so lavish and, presumably, judicious expenditure. There is abundant evidence that many well-known men, engaged in every department of science, have been enabled to attack problems which must otherwise have been neglected, or pursued with inadequate material and less energy. Beyond this general fact, the present volume does not, in most instances, enable us to estimate the results. The balance sheet attached shows that the trust is in a very flourishing condition, and that 267,000 dollars have been provided for inquiries, which the management discuss under the three heads of large, special, and minor grants.

Under the division of large grants, we have a description of the station erected, or adapted, for the study of experimental evolution at Cold Spring Harbour, some twelve miles from New York. Plans of the building are given, and a full account of the opening ceremony, at which Dr. Hugo de Vries gave a scientific address. The objects sought to be gained by such an institution are typical of the uses of the trust, and legitimately appeal to a liberal consideration. The investigations must be long continued, the results may be doubtful or negative, and it is a research which no individual or institution is likely to undertake on a scale sufficiently broad to produce decisive results.

Another far-reaching scheme, the Marine Biological Laboratory at Dry Tortugas, Florida, under the care of Dr. H. G. Mayer, is quite in its first stages of development, but one whose usefulness may be confidently predicted in due time. The buildings that have been erected consist of a main laboratory, 100 feet long, one story high, and with special arrangements for keeping the building cool in the hot weather of those latitudes. A feature in the construction of the laboratory and of the smaller buildings connected with it, is that all are made portable, so that they can easily be removed from their present site and erected elsewhere if thought desirable. Attached to the station is a sea-going vessel of light draft, fifty-seven feet over all, and sixteen feet beam, with a 20 h.p. naphtha engine. There is sufficient accommodation for seven men on board, and the vessel is specially designed to dredge in depths of 500 fathoms or less. Among other projects for which large grants have been made is the subject of economics, whose many subdivisions include, among others, population and immigration, mining and manufactures, banking and finance, social legislation and the labour movement, &c. Reports on all these subjects have been added, showing the scope of the respective inquiries and the progress that has been made. Historical research and terrestrial magnetism are the remaining two subjects which come under the division now being considered. On the latter subject we have some of the results of the discussion of the magnetic disturbance observed during the eruption of Mont Pelée, which are of special interest, since the inquiry discloses the fact that in certain respects the disturbance resembled those storms which are believed to be of cosmic origin.

The Transcaspian archæological expedition and geophysical research are the subjects of special grants. The former is under the charge of Prof. Pumpelly, who left America in December, 1903, and began excavations in the following March, first attacking Anau, in Turkestan. By means of excavations in tumuli and by shafts sunk in the city of Anau, the exploring party has traversed some 170 feet of the accumulations of successive generations of peoples, extending from recent times, through the iron and bronze civilisations, and some 45 feet deep into the stone age. Among the objects of this investigation is the hope of throwing some light on the source of our domestic animals.

The reports on the subjects of the so-called smaller grants cannot be particularly referred to here. The inquiries cover

[1] Carnegie Institution of Washington. Year Book, No. 3, 1904. (Washington: Published by the Institution, 1905.)

the whole ground of physical science, and are in many instances of the greatest importance, but generally have reference to definite researches undertaken by individuals not calling for wide cooperation. A list of papers, prepared possibly to pave the way for future applications, is added, in which are discussed the conditions of solar research at Mount Wilson, by Prof. Hale; the southern observatory project, by Prof. Boss; fundamental problems of geology, by T. C. Chamberlin; plans for obtaining subterranean temperatures, by G. K. Gilbert; magnetic survey of the Pacific Ocean, by L. A. Bauer; and geological research in Eastern Asia, by B. Willis.

THE RECEPTION AND UTILISATION OF ENERGY BY A GREEN LEAF.[1]

THE subject of my lecture is derived from the series of papers laid before the society to-day by my colleagues and myself, dealing with some of the physiological processes of green leaves. In giving an account of some of these investigations I shall dwell mainly on their relation to the *energetics* of the leaf, and shall endeavour to show how the leaf behaves under various conditions when regarded from the point of view of the exchange of energy between itself and its surroundings.

One of the problems which we attempted to solve was to draw up a "revenue and expenditure account" of energy for a green leaf, showing the proportion of the incident energy absorbed, the amount of this absorbed energy which is used up for the internal work of the leaf, and the proportion which is dissipated by re-radiation and the losses due to the convective and conductive properties of the surrounding air under varying wind-velocities.

Of these various factors, the one I have last mentioned, which presupposes a knowledge of the *thermal emissivity* of the leaf-surface, presented by far the greatest difficulty; but during the past year Dr. W. E. Wilson and I have been able to devise a suitable method for determining the thermal emissivity of a leaf-surface in absolute units, so that our story is now fairly complete.

The discussion of the thermal relations of a leaf to its surroundings will be simplified if we first consider the case of a leaf when it is shielded from solar radiation. We will assume that a detached leaf, freely supplied with water, is placed in an enclosure the walls of which are non-reflective and are maintained, along with the enclosed air, at a perfectly uniform temperature t. We will further assume that the air is saturated with water-vapour.

Under these conditions the system would remain in thermal equilibrium if it were not for the respiratory processes going on within the leaf-cells. These are exothermic in their final result, so that the state of complete thermal equilibrium can only be attained when the temperature of the leaf has risen to a point t', somewhat higher than t. The magnitude of the difference $t'-t$, representing the maximal thermometric disturbance between the leaf and its surroundings, will depend on three main factors:

(1) On the rate of evolution of the heat of respiration.

(2) On the rate at which this heat is dissipated by the thermal emissivity of the leaf-surface, and,

(3) On the magnitude of the slight rise of partial pressure of the water-vapour in the interspaces of the leaf, which gives rise to a certain amount of diffusion of water-vapour through the stomata.

The rate of evolution of the heat of respiration can be deduced with sufficient exactness from the amount of carbon dioxide liberated per unit area of the leaf-lamina in unit of time, since there is evidence that the carbon dioxide proceeds from the oxidation of a carbohydrate with a heat of combustion which cannot be far removed from 3760 calories per gram. Taking the concrete example of a leaf of the sunflower respiring at the rate of 0·70 c.c. of carbon dioxide per square decimetre per hour, it can be shown that the heat of respiration in this case amounts to about 0·00582 calorie per square centimetre of leaf-lamina per minute. From the known weight of a square centimetre of the leaf-lamina, and its specific heat, this spontaneous liberation of energy within the leaf might conceivably raise its temperature through $0°{\cdot}033$ C. per minute, provided there were no simultaneous losses due to radiation, conduction and convection of the surrounding air, and internal vaporisation of water. All these sources of loss, of course, become operative immediately the temperature of the leaf exceeds that of its surroundings. We shall see presently that the thermal emissivity of this leaf in still air is 0·015 calorie per square centimetre of leaf-surface per minute, for a difference of temperature of 1° C. between the leaf and its surroundings, so that the temperature of the leaf, under the conditions postulated, cannot exceed that of its surroundings by more than

$$0{\cdot}00582/2\times0{\cdot}015=0°{\cdot}019 \text{ C.}$$

But this is assuming that transpiration has been in abeyance, which is certainly not the case, so that this small temperature difference of $0°{\cdot}019$ C. will be still further reduced.

The main point which I wish to bring out here is that the thermometric disturbances due to the processes of respiration are very small, so small, in fact, that they may be neglected in considering the large disturbances induced by other causes.

Let us now suppose our leaf to be placed under the same conditions as before, but in air which is not fully saturated with aqueous vapour for the temperature t.

The conditions are manifestly unstable owing to the excess of the partial pressure of the water-vapour in the saturated air of the interspaces of the leaf over that of the vapour in the unsaturated air outside.

The diffusion-potential thus set up will result in water-vapour passing outwards through the stomata, and the temperature of the leaf will fall. This fall will continue until the gradient of temperature between the surroundings and the leaf is sufficiently steep to allow energy to flow into the leaf from without at a rate just sufficient to produce the work of vaporisation, at which point a steady thermal state will be established which will remain constant so long as other conditions are unaltered. The leaf will then have assumed a temperature t', which in this case will be *lower* than that of its surroundings.

Now it is manifest that when this steady thermal condition has been attained, the amount of water vaporised per unit of area of the leaf in unit of time must be a measure of the energy flowing into the leaf for the gradient of temperature represented by $t-t'$, and provided we determine the amount of water lost by the leaf, and the temperature difference between the leaf and its surroundings under the steady conditions, we have all the data necessary for finding the *coefficient of thermal emissivity* of the leaf-surface in absolute units, that is to say, the rate at which a leaf-surface will emit or absorb energy from its surroundings in still air for a difference of temperature of 1° C.

Following out this idea, Dr. Wilson and I have successfully determined the constants of thermal emissivity for leaves of different kinds, both under "still-air" conditions and in air-currents of determinate velocity. The results are interesting from several points of view, since amongst other things they enable us to estimate the rate at which the excess of solar radiant energy falling on a leaf is dissipated by mere contact with the air moving at any ordinary wind-velocity, and they also give us, under certain conditions, a means of deducing the actual rate of transpiration from mere observations of temperature-differences.

Before proceeding to show more in detail the manner in which the thermal emissivity of a leaf is determined, we will turn for a moment to the magnitude of the difference of temperature between a leaf and its surroundings which may be expected from a given rate of transpiration. We will assume that the leaf of a sunflower, transpiring into the unsaturated air of the enclosure, when the steady thermal condition is attained, is losing water at the rate of 0·5 gram per square decimetre per hour, or 0·0000833 gram per square centimetre per minute.

The heat required to vaporise this amount of water at 20° C. is $0{\cdot}0000833\times592{\cdot}6=0{\cdot}04938$ calorie, which, on the theory of exchanges, must represent the amount of energy entering and leaving a square centimetre of the leaf-lamina per minute. The thermal emissivity of this leaf

[1] The Bakerian lecture, delivered at the Royal Society, March 23, by Dr. Horace T. Brown, F.R.S.

is 0·015 calorie per square centimetre of leaf-*surface* per minute, for a temperature gradient of 1° C., so that the temperature difference $t-t'$ will be represented by

$$0{\cdot}04938/2\times 0{\cdot}015 = 1^{\circ}{\cdot}64 \text{ C.}$$

For the simultaneous determination of the temperature difference $t-t'$ and the amount of water transpired, we employed two differential platinum-resistance thermometers each consisting of about 2·4 metres of fine wire arranged in a mica and ebonite plate so as to form a flat grid, against the two sides of which two similar leaves were lightly pressed and held in position by ebonite frames furnished with cross-threads of silk. The two leaf-laminæ were thus in close apposition to the resistance-coils, which were favourably placed for rapidly acquiring the mean temperature of the leaves, which were supplied with water from two small tubes attached to the frames. A definite area of leaf-surface was exposed, amounting in each case to 139·4 square centimetres. The loss of the water of transpiration was determined by weighing the apparatus at suitable intervals.

The difference in temperature between the two coils was determined by means of a Callendar's recorder. Instead of determining the difference of temperature between the leaf and the surrounding air, it was found more convenient to clothe both coils with leaves, but to arrange them in such a manner as to produce differential transpiration between the two pairs, a result which can in most cases be brought about by arranging one pair of leaves with their dorsal sides turned to the platinum coils, and the other pair with their dorsal sides facing outwards. Owing to the comparatively rapid thermal adjustment which takes place, the results are not affected by the gradual closing of the leaf stomata during an experiment, provided the record is correctly integrated so as to give the mean difference of temperature. From this mean difference of temperature between the two pairs of leaves, and the differential transpiration corresponding to this, the thermal emissivity of the leaves is readily calculable.

As an example, we may take an experiment with the leaves of *Liriodendron tulipifera*, in which the experiment lasted 129 minutes. The difference in the amount of water transpired by the two pairs of leaves was 0·510 gram, and the mean temperature difference was 1°·41 C. Taking the latent heat of water at 593·6 calories, it follows that $0{\cdot}510\times 593{\cdot}6 = 302{\cdot}7$ represents in calories the excess of energy which must have entered the cooler pair of leaves from their surroundings, an excess which is conditioned solely by the temperature gradient of 1°·41 representing the difference of temperature between the two sets of leaves. The surface area of the leaves exposed was 139·4 square centimetres, so that the *thermal emissivity* of a square centimetre of leaf-surface per minute for a 1° C. temperature gradient will be

$$302{\cdot}7/129\times 139{\cdot}4\times 1{\cdot}41 = 0{\cdot}01194 \text{ calorie.}$$

As examples of the extent to which the thermal emissivities of leaves of various plants differ, the following may be given. They represent the emissivity under conditions of still air:—

Thermal Emissivity of Leaves of Various Species of Plants, under Still-air Conditions.

Species of Plant	Therma emissivity in calories per sq. cm. of leaf-surface for a 1° C. excess of temperature	
	Per minute	Per second
Liriodendron tulipifera (*a*)	0·0119	0·000199
„ „ (*b*)	0·0127	0·000212
Helianthus multiflorus	0·0150	0·000249
Tropoeolum majus	0·0142	0·000237
Tilia europoea	0·0159	0·000266

Under ordinary outdoor conditions we never have to deal with perfectly still air, and the inquiry had therefore to be extended to the influence of *moving* air currents on the thermal emissivity of leaves.

This was investigated by observing the differential temperature and differential transpiration when the two pairs of leaves were placed in a shaft through which a current of air was passed having a definite and steady velocity. The results of two such experiments with leaves of *Liriodendron tulipifera* and *Helianthus multiflorus* are given in the figure. It will be seen that the effect of the cooling or heating due to the air is a linear function of the velocity, the coefficient of thermal emissivity of the leaf-surface increasing at the rate of 0·017 calorie per square centimetre per minute for an increased velocity of the air current of 100 metres per minute. This effect of moving air in dissipating the excess of radiant energy falling on a leaf is a very important fact in the economy of some plants in which transpiration is reduced to a minimum, and it is one of nature's means for preventing the rise of temperature in strongly insolated plants from reaching a dangerous point.

We must now turn our attention to the thermal relations of a leaf to its surroundings when it is receiving direct solar radiation, and here again, for the purpose of simplifying my argument, I must ask you to imagine an ideal set of conditions under which a healthy leaf, well supplied with water, is exposed to sunlight of constant intensity, and that there is no variation in the temperature, humidity, or degree of movement of the surrounding air, or in the dimensions of the leaf stomata.

As in the previous case, a state of thermal equilibrium will be speedily established between the leaf and its environment, when the simultaneous loss and gain of energy will just balance.

When this condition is attained, let R represent the total radiation falling on 1 square centimetre of the leaf

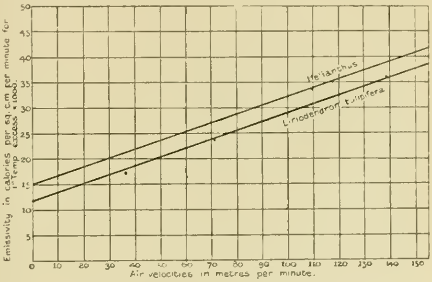

FIG. 1.—Influence of moving air on the thermal emissivity of leaves.

in one minute, and, further, let the "coefficient of absorption" of the leaf for this radiation be represented by a; then Ra will represent the radiant energy absorbed per square centimetre of leaf-lamina per minute.

At this stage it is of some interest to give absolute values to R and a in order to see what would be the thermometric effect produced on a leaf by ordinary sunshine in default of there being some ready means of dissipating the absorbed energy.

If we denote the mass of a square centimetre of the leaf-lamina by m, and its specific heat by s, then on the above assumption the rise of temperature of the lamina per minute will be represented by Ra ms.

Let R=0·8 calorie per square centimetre per minute, which represents the intensity of ordinary summer sunshine in these latitudes.

Let a, the coefficient of absorption, be 0·78, a value which is determinable by a method presently to be described; further, let the mass, m, of a square centimetre of leaf be 0·020 gram, and its specific heat $s = 0{\cdot}879$, then the rise of temperature of the leaf under the conditions postulated will be at the rate of

$$0{\cdot}8\times 0{\cdot}78/0{\cdot}02\times 0{\cdot}879 = 35^{\circ}{\cdot}4 \text{ C. per minute,}$$

a result which would be speedily fatal to the leaf.

The dissipation of the absorbed energy necessary to keep the temperature of the leaf within working limits is provided for, on the one hand, by the internal work of the leaf, consisting mainly of the vaporisation of water, and to a less extent of the endothermic process of photosynthesis, and on the other hand by the losses due to thermal emissivity, which even in still air are considerable, and may assume large dimensions if the air is in movement.

First, as regards the energy used in internal work, that portion which produces the vaporisation of water, and which I will denote by W, is determinable from the weight of water lost by a given area of the leaf in a given time, and from the known latent heat of water-vapour. On the other hand, the amount of the absorbed energy which is used up in the photosynthetic process, and which I will denote by w, is deducible from the actual amount of carbon dioxide which enters the leaf, on the legitimate assumption that the synthesised product is a carbohydrate, the heat of formation of which is approximately known.

The generalised form of the thermal equation of a leaf which is receiving solar radiation, and has acquired a state of thermal equilibrium, may therefore be represented by $Ra = (W + w) \mp r$.

When Ra is greater than $W + w$, that is to say, when the energy absorbed by the leaf in a given time is more than sufficient to perform the whole of the internal work, r is a positive quantity, and represents in absolute units the sum of the losses due to radiation and convective cooling, and it is the only portion of R which can produce a rise of temperature in the leaf.

Provided we know the thermal emissivity of the particular leaf which we are using, the actual rise of temperature of the leaf-lamina above its surroundings can be determined from r; for if e is taken to represent the emissivity, then the temperature difference between the leaf and its environment, that is to say, $t' - t$, will be $r/2e$.

On the other hand, when Ra is less than $W + w$, that is to say, when the absorbed radiant energy is insufficient to perform the whole of the internal work, r is a negative quantity, and the excess amount of energy requisite to perform the internal work must be drawn from the surroundings of the leaf; in other words, when thermal equilibrium is established the temperature of the leaf under these conditions must be *below* that of its surroundings. Here again, however, the thermometric difference expressed by $t - t'$ will be $r/2e$.

The true measure of the photosynthetic work effected by suitable radiation is, strictly speaking, not given exactly by the amount of atmospheric carbon dioxide absorbed by the leaf, but by this amount *plus* the small amount of carbon dioxide which would have been evolved by respiration if photosynthesis had been in abeyance. This is a correction which has to be taken into account in certain special cases, but it does not affect the generalised thermal equation I have given, since the heat of respiration is opposite in sign to that of the heat of re-formation of the carbohydrate, and these values, representing a concurrent gain and loss of energy by the leaf, must exactly balance each other if the carbohydrates standing at the two ends of the reversed process are identical, and if they are not identical the difference in their thermal relations must be so small as to be inappreciable.

Before proceeding to show how these general views can be applied to the construction of a revenue and expenditure account of energy for a leaf, I must briefly refer to the mode in which the various factors have been determined. We have already considered the manner in which the thermal emissivity of the leaf e is determined, a value which is all-important in considering the temperature of the leaf, and I have also sufficiently indicated how we can determine the work of transpiration, and consequently the value of W.

R, the intensity of the solar radiation falling on the leaf-surface, was measured by means of a specially constructed Callendar's radiometer, the coils of which were enclosed in a flat rectangular case mounted on an adjustable stand so that the orientation of the receiving surfaces could be made to correspond with that of the leaf under experiment. The radiometer was connected with a Callendar's recorder furnished with a planimeter which automatically integrated the curve recorded on the drum.

The constants for the instrument were determined for us by Prof. Callendar, and the planimeter readings were readily convertible into water-gram-units of energy incident on unit area of surface in unit of time, thus giving a mean value of R.

The proportions of the radiant energy of sunlight respectively absorbed and transmitted by the leaf-lamina were determined with the same instrument by observing in steady sunlight the amount of radiation which reaches the radiometer with and without the interposition of the leaf. This gives a measure of the coefficient of absorption of the leaf a with a close approach to accuracy, if we neglect the amount of reflected radiation, which is very small in cases of perpendicular incidence.

The coefficient of absorption, as might be expected, varies considerably with leaves of different species of plants, as shown in the following table, and there are also small individual differences in leaves of the same plant.

Coefficients of Absorption (a) and Transmission (1 − a) of the Radiant Energy of Sunlight for Leaves.

Plant	Coefficient of absorption (a)	Coefficient of transmission ($1 - a$)
Helianthus annuus	0·686	0·314
Polygonum Weyrichii	0·647	0·353
Polygonum Sachalinense	0·691	0·309
Petasites officinalis	0·728	0·272
Silphium terebrinthaceum	0·699	0·391
Arctium majus	0·728	0·272
Verbascum olympicum	0·758	0·242
Senecio grandifolius	0·774	0·226

In the generalised thermal equation the value w, representing the amount of energy expended in photosynthesis, measures the effective internal work of a useful and constructive kind, for the due performance of which the leaf may be said to exist, and the relation which this bears to the total energy flowing into the leaf gives an estimate of the true *economic coefficient* when the leaf is regarded as a thermodynamic engine.

In the five or six years during which these researches occupied Mr. Escombe and myself at the Jodrell Laboratory, a large share of our attention was given to determining the best means of estimating the rate of photosynthesis in green leaves exposed to sunlight in air containing the normal amount of carbon dioxide.

At the time we commenced our experiments the only practical method was a gravimetric one introduced by Sachs, by which the amount of material assimilated by a leaf in a given time is deduced from variations in the dry weight of known areas of the leaf-lamina. Unfortunately, we found that the errors to which this method is liable tend on the whole too much in one direction, and their sum, which frequently exceeds the value we are trying to estimate, is swept into the final result.

The method which we finally adopted was one based on the measurement of the intake of carbon dioxide at a partial pressure somewhere near that at which it exists in normal air, *i.e.* 3/10,000 of an atmosphere.

It is evident that such experiments must be conducted on a relatively large scale, both as regards the area of leaf-surface exposed and the volume of air passed over it.

(The nature and disposition of the apparatus were shown in a diagram on the screen.)

The leaf, which, if desired, may still remain attached to its plant, is enclosed in a glazed case through which a stream of air is drawn by a water-pump, the volume of the air being measured by a suitable meter. Between the leaf-case and the meter there is a Reiset's absorption-tube filled with a solution of caustic soda, which ensures the complete absorption of the carbon dioxide remaining after the air has passed through the case.

A duplication of the meter and absorption apparatus allows of a simultaneous determination of the carbon dioxide in the air before it passes over the leaf, and the difference between these values measures the carbon dioxide taken up by the leaf. This is referred to unit area of the leaf by measuring, by means of a planimeter, the area of the photographic impression of the lamina on sensitised paper.

A very delicate method was used for titrating the absorbed carbon dioxide in the alkali, and when all proper precautions are taken the errors of experiment are small.

and with certain modifications there is practically no limit to the scale on which the experiments can be conducted.

It is evident that with this apparatus the mean carbon-dioxide content of the air in contact with the leaf must be somewhat less than that of the entering air, so that a correction of some kind is necessary in order to obtain an estimate of the rate of assimilation under free-air conditions. This is afforded by the fact, established early in our work, that when all other conditions are the same, the rate of assimilation by the leaf is *directly proportional to the partial pressure of the carbon dioxide*, provided this does not exceed five or six times that of the carbon dioxide of normal air.

In deducing the amount of energy used up in the photosynthetic work from the amount of carbon dioxide absorbed by the leaf, we have assumed, as we are entitled to do, that the product of assimilation is a carbohydrate. If the particular form of carbohydrate is known, the amount which corresponds to a definite mass of carbon dioxide absorbed by the leaf is of course determinable; and, further, the energy used up in synthesising this amount of carbohydrate will be represented by its heat of combustion.

No sensible error will be introduced into this calculation by selecting one of the carbohydrates existing in a leaf in preference to another. We have based our calculations on the assumption that we have to deal with a *hexose* having a heat of combustion of 3760 calories per gram. On this basis the assimilation of 1 c.c. of carbon dioxide corresponds to the absorption of 5·02 water-gram-units of energy; hence by multiplying this value by the number of c.c. of carbon dioxide assimilated per unit area of leaf in unit of time we obtain the value of w for the generalised thermal equation.

In using the apparatus I have just described we found, amongst other things, that the actual rate of photosynthesis induced in a leaf which is bathed by ordinary air remains practically constant within very wide limits of insolation. This is due to the fact that the special rays which produce photosynthesis are present in solar radiation of even moderate intensity far in excess of the demands of the assimilatory centres for dealing with the atmospheric carbon dioxide which reaches them by the process of diffusion. The proof of this is afforded in the first place by the enhanced assimilatory effect which is produced by increasing the partial pressure of the carbon dioxide in the air surrounding the leaf, and, secondly, by the fact that we can reduce the intensity of ordinary summer sunlight to a very considerable extent by using revolving radial-sectors placed in front of the leaf, without sensibly affecting the rate of photosynthesis.

It follows from this that the *economic coefficient* of the leaf, which is the ratio of the energy utilised for photosynthesis to the total radiation falling on the leaf, must necessarily increase with diminished insolation, until a point is reached at which practically the whole of the special rays which are active in producing assimilation are utilised. At this point the economic coefficient of the leaf must be at a maximum with respect to a given partial pressure of carbon dioxide; in other words, the leaf regarded as a thermodynamic engine is then working with the least possible waste of energy.

In order to illustrate this I will take the case of a leaf under the influence of moderate sunlight of an intensity of 0·50 calorie per square centimetre per minute, and assimilating at the rate of 2·07 c.c. of carbon dioxide per square decimetre per hour. This corresponds to an economic coefficient of 0·34 per cent. On gradually diminishing by suitable means the radiation falling on the leaf, it was found possible to reduce it to 1/12 of the original amount before any appreciable difference in the rate of assimilation was observed. The economic coefficient was thereby raised to the maximum of a little more than 4·0 per cent. This 4 per cent. will also approximately measure the proportion of the special grade of energy in the original radiation which is capable of inducing photosynthesis.

It is, however, only under very exceptional conditions that we can obtain anything like this maximal "duty" from the leaf.

The following table, showing the results with leaves of *Polygonum Weyrichii* under varying degrees of insolation, will give some idea of the values of the economic coefficient ordinarily met with:—

The Economic Coefficient of Leaves of Polygonum Weyrichii under Various Degrees of Insolation.

Radiant energy falling on 1 sq. cm. of leaf per minute, in calories R	Economic coefficient $w/R \times 100$
0·612	0·42
0·194	1·59
0·150	1·66
0·143	1·32

Turning once more to the generalised thermal equation

$$Ra = (W + w) \mp r,$$

we must not lose sight of the fact that this represents a set of conditions in which all the determining factors, both internal and external, remain constant for a sufficient time to allow of the attainment of steady *thermal equilibrium* between the leaf and its surroundings.

In practice this ideal state is never attainable. In the first place the incidence of solar radiation is subject to rapid oscillations of considerable magnitude, even under the most fair-weather conditions, and every variation of this kind necessarily alters the value of Ra, the energy absorbed by the leaf, and will produce its effect on r, on which the temperature of the leaf depends. This, again, will influence the amount of water-vaporisation, and so affect the value of W. In addition to this, complex disturbances may be introduced by the automatic opening or closing of the stomata, by variations in the hygrometric state of the air, and, perhaps more important than all, by changes in the velocity of the air blowing over the leaf, which will alter its rate of emission.

With all these varying factors acting and reacting on each other in endless complexity, it will be readily understood that under natural open-air conditions the thermal relation of a leaf to its surroundings must be undergoing constant re-adjustment, and that the point of thermal equilibrium must change from moment to moment with every passing cloud, with every gust of wind, and with each change of inclination of the leaf-lamina to the incident radiation.

In the absence of means for instantaneously recording all these variations, it is manifestly impossible to determine the thermal conditions for any particular moment of time, and perhaps there would be no special advantage in doing this even if it were possible. It is, however, quite practicable to determine the *mean* values of the varying factors and the average effects which they produce during a period of time, say of several hours' duration, and we can then introduce these mean values into our equation, which will thus give us all the information we require.

I will now proceed to illustrate the application of these general principles by the consideration of a few concrete examples.

The first is that of a leaf of the sunflower, in which the experiment lasted for about four hours. The results are expressed in water-gram-units (calories), and the units of area and of time are the square centimetre and the minute respectively.

The conditions were such that the total solar radiation absorbed by the leaf was in excess of that required to perform the internal work of transpiration and photosynthesis; in other words, Ra was greater than $W+w$. Hence r was a positive quantity, and the temperature of the leaf was consequently somewhat higher than that of its environment.

CASE A.—*Leaf of Helianthus annuus.*

Total solar radiation	R 0·2569	calorie.
Coefficient of absorption, $a = 0·686$, ∴ solar energy intercepted, ...	$Ra = 0·1762$	,,
Water vaporised = 0·000209 gram, ∴ W, the internal work of vaporisation = 0·000209 × 592 6	0·1243	,,
Rate of photosynthesis = 0·000355 c.c. CO_2, hence w, absorption of energy due to assimilation = 0·000355 × 5 02 ...	0·0017	,,

$$Ra = W + w + r$$
$$0·1762 = 0·1243 + 0·0017 + 0·0502$$

Velocity of wind = 25·7 kilometres per hour = 428 m. per minute.
Thermal emissivity of leaf-surface in still air = 0·0150 cal.
Thermal emissivity (e) in air of velocity of 428 m. per minute = $0·0150 + 0·00017 \times 428 = 0·0577$ calorie.
Hence mean temperature of leaf *above* that of surroundings = $r/2e = 0·0502/2 \times 0·0577 = 0°·43$ C.

The disposal of the incident radiant energy deduced from these data is given in the next table, the total incident energy R being taken at 100.

Case A.—*Disposal of Incident Solar Energy by leaf of Helianthus annuus.*

w	Energy used for photosynthesis	0·66
W	,, ,, transpiration	48·39
$W + w$	Total energy expended in internal work ...	·05
$R - Ra$	Solar energy transmitted by leaf	31·40
r	Energy lost by thermal emission	19·55
		100 00

We will not consider another case in which the facilities for the performance of the internal work of vaporisation of water were more than sufficient to use up the whole of the direct solar radiation absorbed by the leaf, *i.e.* Ra was less than $W + w$.

Such conditions are afforded by fully opened stomata, high temperature, and a low degree of humidity of the air. The leaves used were again those of the sunflower, but in this case one-half of the solar radiation was intercepted by the revolving sectors.

Case B.—*Helianthus annuus.*

Solar radiation incident on leaf R ... ... = 0·2746 calorie
Coefficient of absorption, $a = 0·686$, ∴ solar energy intercepted, Ra ... ... = 0·1884 ,,
Water vaporised = 0·000618 gram, ∴ W, the internal work of vaporisation = 0·000618 × 592 6 ... ... = 0·3668 ,,
Rate of photosynthesis = 0 000657 c.c. CO_2, hence w, absorption of energy due to assimilation ... . = 0·0033 ,,

$$Ra = (W + w) - r$$
$$0·1884 = 0·3668 + 0·0033 - 0·1817$$

Velocity of wind = 12 kilometres per hour = 200 m. per minute.
Thermal emissivity of leaf-surface in air of this velocity = $0·015 + 200 \times 0·00017 = 0·0490$ calorie.
Hence mean temperature of leaf *below* that of surroundings = $r/2e = 0·1817/0·0490 = 1°·84$ C.

Case B.—*Disposal of Energy Received by Leaf from Solar Radiation and from Heat Conveyed from Surroundings.*

$R + r = 100.$

w	Energy used for photosynthesis	0·72
W	,, ,, transpiration	80·38
$W + w$	Total energy expended in internal work ...	81·10
$R - Ra$	Solar energy transmitted by leaf	18 90
		100·00

During the time at my disposal I have only been able to give a brief outline of the general principles underlying an attempt to deal with the main functions of a foliage leaf from the point of view of its energetics, and I must refer those of my hearers who are specially interested in the subject to the papers themselves for the further elaboration of the argument and for the facts on which it is based. I trust, however, that this short account of the work may be sufficient to indicate that we have experimental means of studying quantitatively the reception of various grades of energy by a leaf, the proportion of this which is utilised for the two main kinds of internal work, and also the thermal relations of a leaf to its surroundings under given conditions.

In conclusion, I wish to anticipate a possible objection which may be raised on theoretical grounds to some of the views I have expressed. I have assumed throughout that the second law of thermodynamics is applicable to the phenomena we have been discussing. The statement of that law by Lord Kelvin limits its application to "inanimate objects," and doubtless if the living elements of the leaf-cells possess any power of dealing with the individual molecules of the surrounding medium so as to select and utilise the kinetic energy of those which are moving faster than the "mean square speed," it may well happen that a leaf may be able to perform some kind of internal work without there being any difference of mean temperature between it and its surroundings. In this event the views I have put forward would doubtless require some slight revision, but I think we may well wait until this restriction of the second fundamental principle of thermodynamics has received some experimental support.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Mr. H. O. Arnold-Forster, M.P., will distribute the medals, prizes, and certificates at Woolwich Polytechnic on Saturday, April 1.

Dr. E. O. Lovett, professor of mathematics of Princeton University, has been elected professor of astronomy in succession to Prof. C. A. Young.

The Prince of Wales is to visit Cardiff toward the end of June, when he will lay the foundation stone of the Welsh University College in Cathays Park.

Dr. Peter Thompson has been appointed professor of anatomy, and Prof. Arthur Dendy, of the South African College, Cape Town, professor of zoology, at King's College, London.

The celebration of the jubilee of the Cheltenham Ladies' College and the opening by Sir Henry Roscoe of the new science laboratories and lecture rooms will take place on Friday and Saturday, May 12 and 13. The Marquis of Londonderry, President of the Board of Education, has promised to be present.

Private munificence has provided further sums for the promotion of higher education in the United States. We learn from *Science* that by the death of Mrs. George L. Littlefield, Brown University becomes the recipient of the bulk of the Littlefield estate, estimated at 100,000*l*. The will provides that the corporation shall apply the money as it sees fit, except that 20,000*l*. shall be used for the establishment of the George L. Littlefield professorship of American history. By the will of the late Mr. William F. Milton, of New York, his estate will go to Harvard University on the death of Mrs. Milton. The daily papers state that it is worth between 200,000*l*. and 400,000*l*. Columbia University has received 20,000*l*. from Mr. Jacob H. Schiff to endow a chair of social work, and the new professorship has been filled by the appointment of Dr. Edward T. Devine.

In the House of Commons on Monday Mr. Clancy asked the First Lord of the Treasury whether there are any requirements, statutory or otherwise, in the case of grants in aid of university colleges in England, that four times the amount is required from local subscriptions before anything is derived from the public funds. In reply, the Chancellor of the Exchequer said that there has been such a requirement in regard to the grant in past times. But proposals in regard to the future allocation of the grant are now under the consideration of the Government. Mr. Clancy asked whether it was not proposed that there should be a grant of 100,000*l*. a year to the university colleges mentioned in the report; and whether there was any requirement, statutory or otherwise, in regard to this grant. The Chancellor of the Exchequer answered: There is a proposal by the committee that the distribution should be governed by the amount of voluntary subscriptions obtained by these colleges. The Government has not yet come to a decision on the subject.

At a meeting of the Association of Teachers in Technical Institutes on March 25, Mr. W. J. Lineham, chairman of the association, delivered an address on technical training in

England. He insisted that in considering the future education of a boy who has completed his primary education—say, at thirteen—the subject must be regarded from the point of view of his future livelihood. Mr. Lineham sketched what he called an ideal scheme of technical education. After the child has followed a good primary education from the ages of six to thirteen, his education must be continued with some idea of his future occupation. If he is to be educated for a commercial pursuit he should now attend a purely secondary school; but if he is to enter a trade or technical profession he should attend what is known as a day technical school until the age of sixteen, having spent three years therein, the first part of which should be mainly literary, the middle scientific, and the last technical. His apprenticeship should then begin. But the apprentice must not now lose the lessons learnt in the technical day school. On the contrary, he must continue his studies to an even higher level by attendance at an evening technical school simultaneously with his apprenticeship. As to the apprenticeship itself, its character should entirely depend upon the trade or profession to be followed.

SOCIETIES AND ACADEMIES.

LONDON.

Anthropological Institute, March 14.—Sir T. H. Holdich, K.C.M.G., K.C.I.E., in the chair.—Manners and customs of the Melanesians: Rev. W. H. **Edgell**. The ethnographical objects and lantern slides shown included views of the different types of people, and illustrated the development of canoes and houses. One of the finest of the slides illustrated a Melanesian waiting to shoot a fish. He was poised on one leg, and the lecturer stated that he had seen natives waiting motionless for hours by the side of the rivers waiting for an opportunity to shoot. Of particular interest was the lecturer's statement that some of the natives have entirely lost the art of canoe making, although they still make paddles, which they use to propel rafts made of bamboos.

Entomological Society, March 15.—Mr. F. Merrifield, president, in the chair.—*Exhibits*.—Butterflies from Natal presented by Mr. G. A. K. Marshall to the Hope Department at Oxford: Dr. F. A. **Dixey**. Dr. Dixey read a note upon his experiments conducted with a view to ascertaining whether the assumption of the wet or dry season form of various African butterflies could be controlled by exposure in the pupal state to artificial conditions of temperature and moisture.—Drawings of the genitalia of noctuid moths, and also a number of slides showing the respective peculiarities of many members of the genus: F. W. **Pierce**. Among other things, attention was directed to the fact that in the case of the Tæniocampidæ the genitalia were widely dissimilar, while the author's investigations had led him to conclude that Ashworthii, at present ranked as an Agrotis, should more properly be included in the Noctua group.—A specimen of the North American longicorn, *Neoclytus erythrocephalus*, discovered in a sound ash tree in the neighbourhood of St. Helens, Lancashire: W. E. **Sharp**. Some palings of American ash in the vicinity suggested the origin of the progenitors of the colony, but it was not known how long they had been erected. The beetles were taken in their galleries in the summer dead, which seemed to indicate a weakening of the species under the conditions in which they found themselves. Mr. Sharp also showed examples of *Amara anthobia*, Valle, new to the British list (with a series of *A. familiaris*, Duf., and *A. lucida* for comparison) from Leighton-Buzzard, where they occurred not infrequently at the roots of grass in sandy places.—Mutilated Stenobothrus from the Picos de Europa, Spain: M. **Burr**. These grasshoppers were taken at a height of about 1300 metres, on turfy ground exposed to north wind from the Atlantic, and covered with tufts of a short, dense, tough, and spiky shrub, together with heather. Of the grasshoppers occurring on this spot, almost every specimen had the wings and elytra more or less mutilated, sometimes actually torn to shreds, entirely altering their appearance. A notable exception was *St. bicolor*, of which no single specimen was found mutilated.

PARIS.

Academy of Sciences, March 20.—M. H. Poincaré in the chair.—Thermochemical researches on brucine and strychnine: MM. **Berthelot** and **Gaudechon**.—A determination of the heats of combustion and formation of the two alkaloids, together with measurements of the heats of neutralisation with various acids. The equilibrium between strychnine and ammonium salts was also studied thermochemically.—On the variations of brightness and the total eclipses of primary images formed on the retina by very feeble luminous sources of constant value: A. **Chauveau**. A discussion of a recent paper by M. Lullin, in which the latter describes an experiment with phosphorescent screens, the visibility of which depends on the visual angle, and on the duration of the observation.—On the valency of the atom of hydrogen: M. **de Forcrand**. A discussion of the assumptions upon which the monovalency of hydrogen is based. The author brings forward the cases of Ag_2F, Ag_4O, ICl_3, and others, and suggests that the difficulty of explaining these can best be met by adopting the convention that the hydrogen atom is divalent.—On the photography of the solar corona at the summit of Mont Blanc: A. **Hansky**. Hitherto, attempts to photograph the solar corona at other times than during a total eclipse have not met with much success. By the use of a disc of blackened brass, the diameter of which is a little larger than that of the image of the sun at the focus of the telescope used, combined with coloured screens capable of absorbing the spectrum about up to $\lambda = 660\ \mu\mu$, photographs of the solar corona have been obtained.—Remarks on the preceding note: J. **Janssen**. Reproductions of two of the photographs mentioned in the preceding paper are given.—The notion of distance in the functional calculus: Maurice **Fréchet**.—On the calculation of closed arcs: M. **Pigeaud**.—The distribution and control of actions produced at a distance by electric waves: Édouard **Branly**. The three effects chosen for control at a distance by means of electric waves are the starting of an electric motor, lighting incandescent lamps, and producing an explosion. Details are given of the apparatus by which this has been done in the laboratory. The succession of the effects can be varied at will.—On the variation of the specific inductive power of glass with the frequency: André **Broca** and M. **Turchini**. Glass Leyden jars may be used in the production of currents of high frequency, between the limits 10^5 and 3×10^6 per second, on condition that the capacity introduced into the formulæ is about one-half that measured with charges of 0·1 sec., or 0·7 of the capacity measured with the frequency of an ordinary rotating sector.—On the coefficient of specific magnetisation and magnetic susceptibility of salts: Georges **Meslin**. The results of measurements for a considerable number of paramagnetic and diamagnetic salts are given.—On photographic halation. Reply to a note of M. A. Guébhard: P. **Villard**. The author regards the explanation of his experiments given by M. A. Guébhard as inapplicable. Particulars of an experiment are given for which an explanation is at present wanting.—On the ionisation produced between parallel plates by the radium emanation: William **Duane**.—The diazoamines of diphenylamine, derivatives of the homologues of aniline and naphthylamines: Léo **Vignon** and A. **Simonet**.—The characterisation of lactones by means of hydrazine: M. **Blaise** and A. **Luttringer**. The lactone is heated on the water bath with a slight excess of hydrazine hydrate. The crystalline mass which separates on cooling is re-crystallised from boiling ethyl acetate, and its melting point, which is usually well defined, serves to characterise the lactone. The melting points of six of these compounds are given.—On menthone derived from the hexahydrothymols: Léon **Brunel**. In a preceding note the preparation of two thymomenthols has been described; the present paper describes the thymomenthone obtained by the oxidation of these products.—On monobromoacetal: P. **Freundler** and M. **Ledru**. By attention to some details the yield of bromoacetal by Fischer's method has been raised from 50 per cent. to 115 per cent. of the acetal employed. Magnesium reacts violently on this bromine compound at 110°, giving rise to vinyl ethyl ether.—Remarks on the diphenylamine reaction with nitric acid: Isidore **Bay**. The blue coloration is produced by a large number of oxidising agents, and is not characteristic of nitric acid.—On the antiseptic properties of certain kinds of smoke and on their utilisation: A. **Trillat.** In previous papers the author has shown that formaldehyde is a constant constituent of chimney smoke. He now finds that a polymerised formaldehyde is always present in soot, in proportions varying from 0·28 per cent. to 0·34 per cent.—The effects of phosphorus on the coagulation of the blood. The origin of fibrinogen: M. **Doyon,** A. **Morel,** and N. **Kareff.**—The duration of the process of stimulation for different muscles: M. and Madame L. **Lapicque.**—On the anatomical and functional independence of the lobes of the liver: H. **Sérégé.** The arguments from the anatomical and physiological points of view are summarised and shown to be all in favour of the independence of the lobes.—An experimental study of the relations between the arterial pressure and the pulmonary circulation in anæsthesia by chloroform. The determining cause of chloroform accidents: J. **Tissot.**—On the measurement of disposable energy by a self-registering integrating dynamometer: Charles **Henry.** The apparatus consists essentially of a rubber ball filled with mercury. The pressure of the hand on this raises a mass of iron up and down a graduated tube, this iron being connected with the registering apparatus. The area registered measures the statical work done by the pressure of the fingers.—The cardiac area in cured consumptive cases: H. **Guilleminot.**

DIARY OF SOCIETIES.

THURSDAY, MARCH 30.

ROYAL SOCIETY, at 4.30.—On the Observations on Stars made in some British Stone Circles (Preliminary Note): Sir Norman Lockyer, K.C.B., F.R.S.—On the Distribution of Velocity in a Viscous Fluid over the Cross-section of a Pipe, and on the Action at the Critical Velocity: J. Morrow.—The Direct Synthesis of Ammonia: Dr. E. P. Perman.—The Determination of Vapour Pressure by Air Bubbling: Dr. E. P. Perman and J. H. Davies.—Note on Fluorescence and Absorption: J. B. Burke.—The Determination of the Specific Heat of Superheated Steam by Throttling and other Experiments: A. H. Peake..—The *Rôle* of Diffusion in the Catalysis of Hydrogen Peroxide by Colloidal Platinum; G. Senter.—The Theory of Photographic Processes. Part II. On the Chemical Dynamics of Development, including the Microscopy of the Image: S. E. Sheppard and C. E. K. Mees.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

FRIDAY, MARCH 31.

ROYAL INSTITUTION, at 9.—The Scientific Study of Dialects: Prof. J. Wright.

SATURDAY, APRIL 1.

ROYAL INSTITUTION, at 3.—Some Controverted Questions of Optics: Lord Rayleigh.

MONDAY, APRIL 3.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—On the Formation of Sulphuric Esters in the Nitration of Cellulose and their Influence on Stability: C. Napier Hake and R. J. Lewis.—The Proof of Percussion Caps: H. W. Brownsdon.

SOCIETY OF ARTS, at 8.—Telephony: H. L. Webb.

VICTORIA INSTITUTE, at 4.30.

TUESDAY, APRIL 4.

ROYAL INSTITUTION, at 5.—Tibet: Perceval Landon.

FARADAY SOCIETY, at 8.—Alloys of Copper and Antimony and Copper and Bismuth: A. H. Hiorns.—Refractory Materials for Furnace Linings: E. Kilburn Scott.—Electrically Heated Carbon Tube Furnaces. Part I.: R. S. Hutton and W. H. Patterson.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Continued Discussion*: Coolgardie Water-Supply: C. S. R. Palmer.

WEDNESDAY, APRIL 5.

GEOLOGICAL SOCIETY, at 8.—On the Divisions and Correlations of the Upper Portion of the Coal-measures, with Special Reference to their Development in the Midland Counties of England: R. Kidston, F.R.S.—On the Age and Relations of the Phosphatic Chalk of Taplow: L. Treacher and H. J. O. White.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Determination of Higher Alcohols in Spirits. I.: Dr. Philip Schidrowitz and F. Kaye.—The Action of slightly Alkaline Waters on Iron: C. H. Cribb and F. W. F. Arnaud.—Notes on Preservatives: E. G. Clayton.

SOCIETY OF ARTS, at 8.—Ancient Architecture of the Great Zimbabwe: R. N. Hall.

THURSDAY, APRIL 6.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On Reciprocal Innervation of Antagonistic Muscles, Seventh Note: Prof. C. S. Sherrington, F.R.S.—The Influence of Cobra-Venom on the Proteid Metabolism: Dr. James Scott.—Further Experiments and Histological Investigations on Intumescences, with some Observations on Nuclear Division in Pathological Tissues: Miss E. Dale.—On the Toxin-Antitoxin Reaction, with Special Reference to the Neutralisation of Lysin by Antilysin: J. A. Craw.—On the Nature of the Silver Reaction in Animal and Vegetable Tissues: Prof. A. B. Macallum.

CHEMICAL SOCIETY, at 8.—The Basic Properties of Oxygen at Low Temperatures. Additive Compounds of the Halogens with Organic Substances containing Oxygen: D. McIntosh.—Note on the Interaction of Metallic Cyanides and Organic Halides: N. V. Sidgwick.—The Chemical Dynamics of the Reactions between Sodium Thiosulphate and Organic Halogen Compounds. Part II. Halogen-substituted Acetates: A. Slator.—The Chemical Kinetics of Reactions with inverse Reactions. The Decomposition of Dimethylcarbamide: C. E. Fawsitt.—The Tautomerism of Acetyl Thiocyanate: A. E. Dixon and J. Hawthorne.—A Method of Determining the Specific Gravity of Soluble Salts by Displacement in their own Mother Liquor, and its Application in the Case of the Alkaline Halides: J. Y. Buchanan.—The Combination of Mercaptans with Unsaturated Ketonic Compounds: S. Ruhemann.—A new Formation of Acetylcamphor: M. O. Forster and Miss H. M. Judd.—Preparation and Properties of 1:4:5-Trimethylglyoxaline: H. A. D. Jowett.—Bromomethylheptylketone: H. A. D. Jowett.—On the Existence of a Carbide of Magnesium: J. T. Nance.—The Action of Carbon Monoxide on Ammonia: H. Jackson and D. N. Laurie.—Isomeric Salts of the Type $NR_1R_2H_3$. A Correction. Isomeric Forms of *d*-Bromo- and *d*-Chloro-camphorsulphonic Acids: F. S. Kipping.—Isomerism of a-Bromo- and a-Chloro-camphor: F. S. Kipping.—*l*-Phenylethylamine: F. S. Kipping and A. E. Hunter.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Discussion of the Report to Council on the International Electrical Congress at St. Louis, by W. Duddell, and of Papers on Systems of Electric Units Published in Part clxx. (last issue) of the *Journal*.

ROYAL INSTITUTION, at 5.—Synthetic Chemistry: Prof. R. Meldola, F.R.S.

RÖNTGEN SOCIETY, at 8.15.—Exhibition Evening.

LINNEAN SOCIETY, at 8.—Intra-axillary Scales of Aquatic Monocotyledons: Prof. R. J. Harvey Gibson.—A further Communication on the Study of *Pelomyxa palustris*: Mrs. Veley.

SOCIETY OF ARTS, at 4.30.—The Prospects of the Shan States: Sir J. George Scott.

FRIDAY, APRIL 7.

ROYAL INSTITUTION, at 9.—American Industry: Alfred Mosely.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Cofferdams for Dock Use: R. G. Clark.—Bath Corporation Waterworks Extension: J. R. Fox.

SATURDAY APRIL 8.

ROYAL INSTITUTION, at 3.—Some Controverted Questions of Optics: Lord Rayleigh.

THE ESSEX FIELD CLUB, at 6.30. (At Essex Museum of Natural History, Stratford).—Twenty-fifth Annual Meeting.—Natural History Museums: F. W. Rudler.

CONTENTS.

THURSDAY, APRIL 6, 1905.

PSYCHOLOGY AND PHYSIOLOGY.

Grundzüge der physiologischen Psychologie. Von Wilhelm Wundt. 5th edition. Vols. ii. and iii. Pp. viii+865, ix+796 and 133; and Gesamtregister. (Leipzig: Engelmann, 1902-3.) Prices 13s., 14s., and 3s.

Principles of Physiological Psychology. By Wilhelm Wundt. Translated from the fifth German edition by E. B. Titchener. Pp. xvi+347. (London: Swan Sonnenschein and Co., Ltd., 1904.) Price 12s.

WITH these two volumes Prof. Wundt concludes what in all probability is the last edition of this great work prepared by his own hand. The single volume of the first edition of 1874 is now expanded to three large volumes comprising 2168 pages. Founded, as it is, chiefly upon the author's own researches and those of his pupils, the treatise forms a splendid monument to his life-long labours in a field in which he has been for long a pioneer and the most prominent figure.

The main part is an expansion and development of the views expounded in earlier editions in accordance with the data that have accumulated so rapidly in recent years. For, as Wundt points out, psychology has now happily achieved methods of research by which any intelligent and industrious worker may add something, however small, to the mass of empirical data on which the future science is to be built up, and in so doing has assured its place among the progressive sciences. To this edition a final section is added, in which the veteran thinker sets forth his matured conclusions on the general principles of psychology and on its relations to other sciences. To the exposition of one of the most important of these principles this article may profitably be devoted. Not many years ago most writers who discussed the functions of the brain postulated what they called a *sensorium commune*, a central nervous organ or "centre" in which the afferent nerves of all the sense-organs were supposed to come together, and to the substance of which each such nerve was supposed to communicate its specific mode of activity, generally assumed by those writers to be some peculiar form of molecular vibration. It was supposed, therefore, that when two or more sensory nerves of different functions are simultaneously stimulated, this "centre" becomes the seat of a complex resultant physical process, embodying the specific characters of the two or more kinds of neural process. And this hypothetical physical resultant was held to be the immediate correlate or excitant of the complex affection of consciousness. In this way it was sought to explain the unitary character of the state of consciousness resulting from the simultaneous stimulation of different sensory nerves. To every part of the brain that is median and therefore has no symmetrically disposed duplicate, this position of honour has been assigned by one or other writer—to the pineal gland by Descartes, to the pons by Spencer, to the basal ganglia in general by Maudsley and Carpenter, to the *septum lucidum* and to the third ventricle by others, to some undefined region by Herbart and Lotze. Under the powerful impulse of this supposed necessity others, notably G. H. Lewes, E. v. Hartmann and Ed. Montgomery, have made the whole brain the *sensorium commune*, assuming that the specific mode of vibration initiated in each kind of sensory nerve thrills throughout the whole or the greater part of the mass of the brain.

In the *Psycho-physik* (1860) Fechner clearly exposed the untenable character of all such assumptions and showed that "the psychically unitary and simple are resultants from physical manifolds, the physically manifold gives rise to a unitary or simple (psychical) resultant." This principle was accepted by Helmholtz, and by Lotze in his later writings; and the progress of our knowledge of the brain achieved since that time has made patent to all the impossibility of assigning the psycho-physical processes, the processes immediately correlated with psychical processes, to any one part or "centre" of the brain.

Nevertheless, in dealing with concrete instances of unitary psychical resultants from multiple sensory stimulations, as in the case of the compound colour sensations or of the fusion of the effects of stimuli applied simultaneously to corresponding areas of the two retinæ, many, perhaps most, physiologists and psychologists still postulate a fusion of the underlying neural processes to a unitary physical resultant. It is more difficult to refute this view in such special cases than to prove the erroneousness in principle of the conception of a *sensorium commune*, but fortunately Prof. Sherrington's recent research on the functional relations of corresponding retinal points[1] demonstrates in the clearest manner the separateness of the physiological effects in the brain-cortex of stimuli simultaneously applied to corresponding retinal areas, the instance of fusion of effects to which the doctrine of physiological fusion has been most confidently and plausibly applied; and many pathological and experimental observations bear out this view, both in this case and in other similar cases of fusion of effects of sensory stimuli. The principle laid down by Fechner in the words quoted above may therefore be regarded as well established. This principle Wundt adopts, and he extends its application in a thorough-going manner to the relations of neural and psychical processes in general. Assuming that every "psychical element" is related in a constant manner to an accompanying neural process, he asks (vol. iii., p. 775), Is there any corresponding constant relation between the connections (*Verbindungen*) of those elements and the connections of these processes? "It goes without saying that this question must be answered affirmatively in the sense that to all the psychical elements that are comprised in a complex affection of consciousness, the corresponding physical processes must also be given in simultaneous connection." But that is by no means to say that these physical correlates will constitute a unitary resultant, which would correspond to the psychical resultant. "The complex psychical

[1] See *British Journal of Psychology*, part i. 1904.

formations are further removed from their physiological correlates (than the psychical elements), and this removal is greater the more complex the psychical compounds become. And it is just at this point that psychology as an independent science in the proper sense of the word takes up its task." That is to say, it is the task of psycho-physics to discriminate the elements of our psychical processes and to discover their physiological correlates, but it is the task of psychology proper to discover the purely psychical laws of the synthesis of these elements—a task which would remain to be carried out, though the workings of the brain "stood as clearly exposed to our eyes as the mechanism of a watch."

Wundt then formulates four such fundamental psychical laws or principles, of which the first and most important is the "principle of creative resultants," the principle "that the product arising from any number of psychical elements is more than the sum of those elements . . . . it is a new formation incomparable in all its essential attributes with the factors that contribute towards it." So "a clang is more than the sum of its partial tones." "In the same way every spatial percept is a product in which certain elements (the local signs) have yielded up their independence to impart to the product an entirely new property, namely, the spatial ordering of the sensations. In binocular vision the separate images of the two organs of vision disappear, to give rise in the common resultant image to the immediate perception of solidity and depth." On the other hand, the neural correlates of these elements remain a spatially ordered manifold, exhibiting no corresponding fusion or synthesis. The acceptance of this principle is of the first importance for the progress of physiological psychology, but whether it is compatible with adhesion to the doctrine of psycho-physical parallelism, as Wundt maintains, may be seriously questioned, as also whether it can properly be called a principle of psychical causation. It seems clear that if with Wundt we recognise this and the other psychical laws that he formulates, whether or not we admit them as principles of psychical causation, we cannot maintain the principle of psycho-physical parallelism in the rigid form in which it is so widely current at the present time.

It is a pleasure to welcome the appearance of the first part of an English translation of this great work. Prof. Titchener has accomplished this part of his difficult task with all the care and skill which his previous labours in this line have prepared us to expect.

In spite of the title of this work, it is as much a treatise on experimental as on physiological psychology, and in view of the common misconceptions of the relations of experimental to other methods in psychology the following quotation may fitly conclude this brief notice:—"We now understand by 'experimental psychology' not simply those portions of psychology which are directly accessible to experiment, but the whole of individual psychology. For all such psychology employs the experimental method: directly, where its direct use is possible; but in all other cases indirectly, by availing itself of the general results which the direct employment of the method has yielded, and of the refinement of psychological observation which their employment induces."

W. McD.

RADIUM AND RADIO-ACTIVITY.

Radium Explained. By Dr. W. Hampson, M.A. (Jack's Scientific Series.) Pp. x+122. (Edinburgh and London: T. C. and E. C. Jack, 1905.) Price 1s. net.

THIS little book, which is sold for the modest price of one shilling, will, we think, serve a useful purpose in giving an elementary acquaintance with the subject of radio-activity, so far as that is accessible to those with little scientific knowledge. The explanations given of the experimental properties of radium are, so far as we have observed, clear and accurate, and the get-up of the book, though not superb, is respectable. Probably one of the most valuable chapters in the book is that on the medical aspects of radium, and its possible uses in the cure of disease, for few writers on radio-activity generally are competent to discuss this part of the subject. Dr. Hampson is of opinion that the medicinal value of mineral waters is connected with their radio-activity. This question, we think, should easily be susceptible of a definite and conclusive answer. There would not be the slightest difficulty in giving baths of weak radium solution more potent by far than the richest mineral waters. Why not test the medicinal value of these? It is really urgent that this experiment should be tried by competent hands.

It is, we think, to be regretted that Dr. Hampson has plunged into an attack on modern views of the constitution of matter, as expounded by Prof. J. J. Thomson, Sir Oliver Lodge, and others. We have read these criticisms with the attention due to a worker like Dr. Hampson, who has done good service in the cause of science, but cannot admit that they possess any validity. To go fully into the questions which he raises would take us beyond the limits of this notice, but we may briefly discuss one or two of the points. At the outset, Dr. Hampson objects to the definition of mass by means of inertia. Mass, he says, is quantity of matter; inertia is dependent on velocity as well as on mass.

It is true, no doubt, that the definition of mass as quantity of matter may be found in some old-fashioned text-books of repute. But such a definition has no value, for how is the quantity of matter to be ascertained? The choice practically lies between defining mass by inertia at a given speed or by gravity. So far as is known, exactly the same ratio between two masses of ordinary matter will result, whichever method of comparison is adopted. As, however, gravity depends on local circumstances, while inertia (at given velocity) does not, the latter property is preferred for the definition of mass, as being more fundamental.

No doubt, before it can be granted that the electron theory fully accounts for the observed properties of matter, it will be necessary to show that it will explain the phenomena of gravitation. This, at present, it makes no pretence of doing, as, of course, its distinguished authors would at once admit. But mass, as we have seen, is not conventionally defined with reference to gravity, but by means of inertia, or momentum at unit velocity. As a moving electric charge can be shown to possess this momentum, it is a strictly correct use of words to say that the electron theory explains the property of mass.

Dr. Hampson argues, in the second place, that electricity is a form of energy, and that it cannot therefore be identified with matter.

> "When an electrical machine . . . is used to charge a Leyden jar . . . there is no change in the quantity of material substance with which operations were started; it is the mechanical energy driving the machinery that has been converted into electricity" (p. 87).

The misconception here lies in confusing the separation of positive and negative electricity with the creation of either. Take the case of a Leyden jar. The coatings of the jar, according to modern views, initially both contain a number of chemical atoms, all with their normal complement of constituent electrons. The operation of charging consists in the removal of some of these electrons from the outer coating, say, and their transference to the inner one. This leaves the outer coat with a defect of electrons, and therefore positively charged, while the inner one acquires an excess of them, and consequently becomes negatively charged. The transference involves the expenditure of energy on the electrons, but no alteration in their number, and therefore no change in the amount of matter concerned.

We are sorry to have had to dwell principally on the parts of the book with which we disagree, as these are but a small portion of the whole, and do not detract from the usefulness of the rest.

R. J. S.

OIL FUEL.

Oil Fuel: Its Supply, Composition and Application. By S. H. North. Pp. viii+152. (London: Chas. Griffin and Co., Ltd., 1905.) Price 5s. net.

MR. SYDNEY H. NORTH has utilised the store of data collected whilst he was editor of the *Petroleum Review* to supply a most valuable addition to Griffin's scientific text-books in his work on "Oil Fuel" and to give his readers a concise and valuable record of the developments in the use of liquid fuel for the generation of power.

In the first chapter of the book he deals with the distribution and sources of supply of petroleum, and points out that the chief sources are now so geographically situated as to place the United Kingdom at a disadvantage in case of war, should the use of liquid fuel be largely adopted in the Naval Service, a fact which accentuates the importance of developing such fields as those of Canada and Burmah, and also of opening up new areas where possible in British Possessions.

In concluding this portion of the work, the author expresses his opinion that recent developments and extensions of oil-bearing areas are now progressing so rapidly that it is quite within the bounds of possibility that the liquid-fuel question may in the near future be placed above the control of price and geographical position.

In dealing with the economic aspect of liquid fuel it is pointed out that although the enormous advantages accruing from its use were early recognised, the prohibitive price prevented any great advance in its use, but that with the increase in output its utilisation now comes within the range of practical possibility, and that the advantages in winning, transporting, and storing and using the oil, especially for marine purposes, are so great that the supply of the liquid fuel is now the only factor checking its universal introduction.

In considering the absolute economy as a fuel, the author very properly leaves out the extravagant claims made by some of the early experimentalists, and only gives the best authenticated values, which vary from 12·5 to 16 lb. of water evaporated per lb. of liquid fuel. Variations in the use of oil as a fuel are of course largely dependent upon the method by which the oil is burnt, and too little stress is put upon the importance of the space factor, which is a most essential one, as, given plenty of combustion space in the boiler, the smokeless burning of liquid fuel is a perfectly simple problem, which, however, increases enormously in difficulty as the available space becomes more and more cramped.

The chapter on the chemical composition of fuel oils gives an excellent summary of analytical results, and this ends with a table showing the composition, calorific value and evaporative power of different descriptions of British coal. This, however, is liable to lead to misconception, as the value expressed in lb. of water evaporated per lb. of fuel is calculated, and not that obtained in practice, so that the reader who finds that by this table 1 lb. of Welsh coal will evaporate 14·98 lb. of water will be a little puzzled to see where the large economy comes in, when 1 lb. of oil only evaporates from 12·5 to 16 lb. of water. As a matter of fact, all recent work points to the relative evaporative results under the best conditions being 9 lb. of water per lb. of coal, or 15 lb. of water per lb. of oil, whilst the theoretical results give 14·98 lb. of water for coal, and 20 to 21 lb. for oil.

The section dealing with the conditions of combustion in oil furnaces is a useful reproduction of the views expressed by Messrs. Ord, Paul, and Lewes, and the author does not venture on any generalisation of his own.

Turning from consideration of the oil itself to the methods of burning it, the author gives a very useful historical summary of the early experiments down to the year 1883, when Mr. James Holden, whose name will always be inseparably connected with the subject of liquid fuel, introduced his method of consuming the oil on the Great Eastern Railway.

A chapter is then devoted to modern burners and methods, and steam, air, and mechanical injectors are discussed. The author very properly concludes that

> "for the successful use of liquid fuel it appears to be a *sine qua non* that auxiliary apparatus

and extraneous sources of heat must be avoided, and the furnaces made practically self-contained, if anything approaching perfection is to be attained. It must be upon simplicity, ease of working, and freedom from complicated parts that the progress of liquid fuel must chiefly depend.

"The direct pulverisation of the oil is now coming to be recognised as the proper method; it is the most efficient and the most economical."

The next two chapters are devoted to discussing the use of oil fuel for marine and naval purposes, but the division into two chapters is hardly needed, as the naval side of the question is scarcely touched upon, the bulk of the matter in that chapter being taken up with the trials of liquid fuel on the s.s. *Mariposa*, and the tests made on land by the American Liquid Fuel Navy Board.

The chapter on oil fuel in locomotives is an excellent summary of the work of Urquhart and Holden, whilst the use of oil fuel for metallurgical and domestic purposes also receives some attention.

The whole work compares very favourably indeed with the far more pretentious treatise on the subject which until now has been the only book of reference, and everyone interested in this important question will welcome Mr. North's excellent text-book.

THE DYNAMICS OF CHEMICAL CHANGE.

Chemical Statics and Dynamics. By J. W. Mellor, D.Sc. (N.Z.), B.Sc. (Vict.). Pp. xiii+538. (London: Longmans, Green, and Co.) Price 7s. 6d.

FOR some years past a marked increase of attention on the part of English chemists towards the rapidly developing physical chemistry has been observable. Until recently, however, the available English literature on the subject was confined to German translations, a state of things which is now being in a large measure remedied.

The present work forms one of the series of text-books of physical chemistry edited by Sir William Ramsay. According to the table of contents, four chapters are devoted to the consideration of homogeneous reactions, and in succeeding sections the initial periods in chemical change, heterogeneous reactions, equilibrium and dissociation, electrolytic dissociation, catalysis and the theory of chemical change, fermentation, the influence of temperature and pressure in chemical reactions, and finally explosions, are dealt with.

Since the appearance of van 't Hoff's "Etudes de Dynamique Chimique" a vast amount of work has been done in connection with the problems involved here, and the necessity for a summary of newly discovered facts, a criticism of recent theories, and an unbiased statement of our present position in regard to the dynamics of chemical change and allied problems must have been felt by many. Dr. Mellor's work will, therefore, receive an undoubted welcome.

The accumulated evidence on the nature of chemical change resulting from kinetic studies leads the author to favour the view that the "association" or "intermediate compound" theories describe in the most rational manner the mechanism of the majority of reactions. Simple consecutive changes determine the character of many apparently complex reactions.

In connection with the determination of the number of molecules taking part in reactions in gaseous systems the author sounds a very necessary warning note. The rate of decomposition of phosphine or arsine is a frequent text-book illustration of one of the methods employed, and the experimental data fit in with the assumption that the reaction is unimolecular and non-reversible. But there is another side to this and similar problems. It is not improbable that the reaction takes place on the surface of the walls of the containing vessel, and that its rate is conditioned solely by the rate of absorption of the gas by this surface. The course of the reaction will in this case also be that of a unimolecular change.

In the section on the measurement of chemical affinity we meet old and familiar friends in the illustrations of the thermal and density methods of comparing the affinities of two acids. The very moderate accuracy attainable in these methods, which involve the small difference between two experimental quantities, and in which corrections have frequently to be introduced in consequence of secondary changes, is scarcely ever sufficiently emphasised, and attention might have been directed to this point. A method depending upon the measurement of a property possessed by only one component of a system has obvious advantages, even if such methods are of limited application. Whether Thomsen's relative avidities and the relative ionic affinity coefficients are always identical conceptions is left for the reader to infer.

Chapter x., dealing with catalysis and the theory of chemical change, is most attractive reading. Here the processes of slow combustion or autoxidation are discussed in the light of the theories of Brodie, Schönbein, Clausius, van 't Hoff, Traube, Bach, Engler and Wild, and the interesting phenomena included under induced or sympathetic reactions are treated. In the chapter on explosions the account of older work is supplemented by many new and interesting facts.

In the reviewer's opinion Dr. Mellor's work is to be warmly recommended. The fact that it contains three thousand or so references to original papers is in itself evidence of its utility to the teacher, to the advanced student, and to the physical chemist engaged in research.

H. M. DAWSON.

RECENT EARTHQUAKES.

A Study of Recent Earthquakes. By Charles Davison, Sc.D., F.G.S. Pp. xii + 355; 80 illustrations. (London: Walter Scott Publishing Co., Ltd.) Price 6s.

IN this copiously illustrated volume Dr. Charles Davison, whose seismological investigations, especially those relating to British earthquakes, are so well known, gives a popular account of the results which have been arrived at by modern seismology. The method in which he treats his subject is one that appeals to the general reader. Rather than grouping seismic phenomena, as we should expect to find them in a text-book, the author has given a concise history of eight disturbances, each of which has a special interest. The Neapolitan earthquake is of interest from an historical point of view, the Ischian earthquakes illustrate the relationship between volcanic and seismic activities, a Japanese earthquake is described on account of the fault line which was produced at the time of its occurrence and the numerous after shocks by which it was followed, whilst a British earthquake illustrates the growth of a fault. From the work of Robert Mallet upon the first of these earthquakes, which in 1857 devastated a district to the south-east of Naples, and when upwards of 9000 people lost their lives, the scientific world learned that out of ruins much might be learned respecting the direction and intensity of the movements which had caused them. Although his methods of investigation, as, for example, those relating to the determination of the depths of seismic foci, may have been modified by new observations, Mallet directed attention to new problems for the solution of which he employed scientific methods.

The Andalusian earthquake in 1884, we are told, is chiefly remarkable from the fact that it was recorded at very distant stations, as, for example, by magnetographs near Paris, at which city the movements of the ground could not be felt. For this disturbance the depth of its origin is determined by means of angles of emergence calculated from the directions of fractures in masonry walls. That the direction of these fractures might be due to the varying steepness of the earth waves which produced the shattering is not considered

The peculiarity of the Charleston earthquake is that it occurred in a region where such disturbances are almost unknown, that it had two foci about thirteen miles apart, and that it illustrated the behaviour of different races when confronted by a terrible disaster. With the negroes there was wild fear, panic, and a "selfish rush for safety." With Europeans in similar circumstances similar conditions prevail, but we are told that with Japanese there is calmness. Our own idea is that Japanese like to save their necks as well as other people. They will bolt at the time of an earthquake, to return, not with hysterical and shattered nerves, but chattering and laughing as if earthquakes were very fine jokes.

A subject attractive to the general reader which is referred to in several chapters is an account of signs which have given warning of a coming earthquake. Underground sounds have been heard, springs have varied in their flow, horses, birds, dogs, and even human beings have been restless for some time before great earthquakes. In his reference to the Riviera earthquake in 1887, Mr. Davison remarks that as premonitions were noted at 130 different places within the central area, "there can be little doubt that they were caused by microseismic movements for the most part insensible to man." In these days of psychical research we think that the author has lost an opportunity for romantic speculation.

Although the book is intended more for the person of ordinary intelligence than for the specialist, here and there we come upon information of an uncommon kind. For example, it is pointed out that the areas over which earthquake sounds are heard is variable in different countries. One reason for this is that the limits of audibility vary with different races. From illustrations given it would appear that for certain sounds the Anglo-Saxon ear is more acute than the Neapolitan, and very much more than that of the Japanese. This relationship between the physiological structure of the human ear and earthquake music is, to say the least, extremely interesting, but while discussing the same the fact must not be overlooked that in the same country districts may be found where seismic sounds are frequent, whilst there are other districts where Pluto shakes the ground but mutterings are never heard.

Dr. Davison's book is well worth reading, whilst the manner in which its contents have been arranged should obtain for it a circulation amongst those who seek for general information.

OUR BOOK SHELF.

A German-English Dictionary of Terms used in Medicine and the Allied Sciences. By Hugo Lang and B. Abrahams. Pp. vi + 598. (London: J. and A. Churchill, 1905.) Price 15*s*. net.

There is undoubtedly a vacant place which would be filled by a well-compiled work bearing the above title. The book now under review has a certain claim on our regard in this connection, and in some respects is a useful work. It purports to be, in the first place, a medical dictionary, and, so far as we can judge, fulfils this promise in a satisfactory manner. With a few minor blemishes there is a complete vocabulary of medical terms, and as a rule these are very fairly rendered by their English equivalents. But in the allied sciences, which are also supposed to be included, there are curious lacunæ. Chemistry is pretty well represented—for example, we found most of the technical terms in Biedermann's "Chemiker Kalendar" duly set down—but the pathological vocabulary leaves much to be desired, and apparently physiology is not considered an allied science at all—at any rate, physiological terms are very seldom to be met with.

The authors have generally avoided the pitfalls set for the unwary in works of this kind, and there are few actual mistakes; occasionally it is difficult to ascertain the real meaning of a word without extraneous assistance. For example, the word "typhus" by itself is not correctly translated by "typhus"; it invariably means "enteric" (typhoid), and the English typhus fever is "fleck-typhus," the latter being, however, correctly entered in its place. The medical meaning of "Belastung" is given; the completely different signification when the word is applied to muscle is omitted. But the cardinal fault of the dictionary is the treatment of compound words. These are separately set forth at length instead of being collected under their first components, and this increases the bulk and cost of the work (already too great) without conferring any real ease of reference. The courteous way in which the authors in the preface invite suggestions disarms too caustic comments, and we merely hint gently that in the next edition the space that could be saved by the course indicated could be profitably employed by the insertion of a few additional pathological and physiological terms, and that it would be unwise to translate these in the fashion adopted at present in such words as "luftweg."

Règles internationales de la Nomenclature zoologique. Pp. 63. (Paris: F. R. de Rudeval, 1905.)

It has frequently been remarked that it is not of much use making laws and regulations unless you have the power to enforce their observation; and this trite saying applies, in our opinion, very forcibly to this code of regulations for zoological literature, drawn up by an international committee the deliberations of which have extended over some years. The code, which is published in three languages, is admirably drawn up, and for the most part free from ambiguity; but the question is, will naturalists agree to abide by it? In our opinion, a large number will refuse to accept it, since a rigid and slavish adherence to the law of priority is enjoined, and to many this is anathema. The rule that when a genus-name is changed this entails the change of the family title will be generally regarded as satisfactory. As regards emendation in names, this is held to be justifiable only when an error in transcription, a *lapsus calami*, or a misprint is apparent; but in the interpretation of this difficulties may arise, as in the well-known case of Neurogymnurus, which is *believed* to be an error for Necrogymnurus. Differences of opinion, again, are likely to arise with regard to the rejection of names on account of unsuitableness or similarity to others already in use. The retention of such names as Polyodon and Apus when applied to animals which do not properly come under such designation will, no doubt, be generally accepted; but what is to be said when, for instance, an essentially African species is named asiaticus? Such names as Polyodus, Polyodon, Polyodonta, Polyodontus, &c., are held not to come under the category of synonyms, although the converse rule is followed in many systematic works and catalogues, such as Dr. Trouessart's "Catalogus Mammalium."

As a "pious" expression of opinion on the part of the International Committee the "Règles" are, no doubt, valuable; but they would have been much more so had a *plebiscite* of zoologists and palæontologists agreed to accept and abide by the ruling of the committee.

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.*]

A New Thallium Mineral.

The element thallium, discovered by Sir W. Crookes in 1861, has up to the present been known as an essential constituent of only two minerals, viz. crookesite, a selenide of copper and thallium, and lorandite, a sulpharsenite of the latter element. To these minerals a third must now be added in hutchinsonite, a new sulpharsenite from the Binnenthal, which also contains thallium as an important constituent. The crystallographic characters of hutchinsonite were described about a year ago by Mr. R. H. Solly, who, of late years, has been particularly successful in discovering new mineral species in the Binnenthal. At the time of its discovery very little in the way of chemical investigation was possible owing to the extreme scarcity of the mineral, but during the past year additional crystals have been acquired for the British Museum, and from these about eighty milligrams of fairly pure material have been obtained for chemical analysis. Thallium is present (up to nearly 20 per cent.), together with lead, silver, and copper, in combination with arsenic and sulphur. A full description of the mineral will appear shortly in the *Mineralogical Magazine*.

G. T. PRIOR.

The Legendary Suicide of the Scorpion.

I HAVE recently come across the following passage in the Rev. John Campbell's "Travels in South Africa" (London, 1815), p. 38:—"Having caught a scorpion near our tent, we tried whether naturalists were accurate in relating, that if that animal be surrounded with fire, and sees he cannot escape, he will sting himself to death. However, it died as quietly as any other animal, only darting its sting from it, as if to oppose any ordinary assailant." The experiment was made near Zwellendam, Cape Colony, on February 20, 1813.

EDWARD B. POULTON.

Oxford, March 31.

Propagation of Earthquake Waves.

A FEW days ago I read Major C. E. Dutton's book on "Earthquakes in the Light of the New Seismology." While acknowledging the high merits of this book, I take the liberty of pointing out some statements which seem misleading.

I refer to chapter xiii., where the author, quoting the results of the experimental investigations of Mr. Nagaoka, gives the speeds V_1 and V_2 of the normal and transverse waves. Now a glance at the table on pp. 230 and 231 shows that for many rocks the two moduluses E_1 and E_2 perpendicular and parallel to the bedding planes are far from being equal; on the contrary, the quotient E_1/E_2 varies so much as from 1·43/2·49 for rhyolite tuff to 32·1/17·5 for rhyolite. Hence the physical properties of the rocks in question are different in different directions, and the speeds of propagation of waves are also different in different directions, so that the speeds V_1 and V_2 of the table being the same for all directions have no real meaning for many rocks.

Again, in chapter xiii. and in other chapters of the book, the author refers to normal and transverse waves in rocks. It would be better, perhaps, to speak of dilatational and torsional waves; but leaving the question of terminology out of consideration, I observe that it is only for perfectly elastic homogeneous and isotropic bodies that the separation of the dilatational (normal) from the torsional (transverse) wave takes place with certainty. We have no right to extend this property to æolotropic bodies. When the body is æolotropic the deformation of an element on the passage of a wave need not be of a purely dilatational (normal) or of a purely torsional (transverse) character; it is rather of a mixed nature.

I will not say that æolotropic bodies able to propagate purely dilatational and purely torsional waves cannot exist, but I observe that such bodies are to be considered rather as possible exceptions, inasmuch as certain special conditions must be fulfilled in order that the generation of purely dilatational and purely torsional waves should be rendered possible. So, for example, the elastic potential of a perfectly elastic homogeneous uniaxial body implies five independent constants. When we introduce the condition that purely dilatational waves may be propagated apart from torsional ones, we find that two definite relations between the constants must be satisfied so that the number of independent constants is reduced to three. But we have no reason to maintain *a priori* that the conditions in question must be always satisfied.

Of course it is to be understood that a perfectly elastic homogeneous uniaxial body cannot be considered as an exact "model" of stratified rocks; it is only very similar to them; but it is more than highly improbable that the effect of internal friction would neutralise the effect of æolotropism.

M. P. RUDZKI.

K. K. Sternwarte, Krakau (Austria), March 24.

NOTES ON STONEHENGE.[1]

V.—On the Star Observations made in British Stone Circles.[2]

THE work I have tried to do so far on our British stone circles has dealt with the observations of the sun made in connection with them, and the attempt to determine a date has been based upon the slow change in the obliquity of the ecliptic which is continually taking place.

In continuation of my work in Egypt in 1891, and Mr. Penrose's in Greece in 1892, I have recently endeavoured to see whether there are any traces in Britain of the star observations which I found connected with the worship of the sun at certain times of the year. We both discovered that stars, far out of the sun's course, especially in Egypt, were observed in the dawn as heralds of sunrise—"warning-stars"—so that the priests might have time to prepare the sunrise sacrifice. To do this properly the star should rise while the sun is still about 10° below the horizon.

I stated ("Dawn of Astronomy," p. 319) that Spica was the star the heliacal rising of which heralded the sun on May-day 3200 B.C. in the temple of Min at Thebes. Sirius was associated with the summer solstice at about the same time. The equinoxes were provided for in the same way in Lower Egypt, but they do not concern us now.

Mr. Penrose found this May-day worship continued at Athens on foundations built in 1495 B.C. and 2020 B.C., on which the Hecatompedon and older Erechtheum respectively were subsequently built, the warning star being now no longer Spica, but the cluster of the Pleiades.

It is generally known that Stonehenge is associated with the solstitial year, and I have recently suggested that it was originally connected with the May year; but the probable date of its re-dedication, 1680 B.C., was determined by Mr. Penrose and myself by the change of obliquity.

Now if Stonehenge or any other British stone circle could be proved to have used observations of warning stars, the determination of the date when such observations were made would be enormously facilitated. Mr. Penrose and myself were content to think that our date might be within 200 years of the truth, whereas if we could use the rapid movement of stars in declination brought about by the precession of the equinoxes, instead of the slow change of the sun's declination brought about by the change of the value of the obliquity, a possible error of 200 years would be reduced to one of 10 years.

In spite of this enormous advantage, so far as I know no one has yet made any inquiry to connect star observations with any of the British circles.

I have recently obtained clear evidence that some circles in different parts of Britain were related to the May year, a vegetation year, which we know was general over the whole of Europe in early times, and which still determines the quarter-days in Scotland.

If the Egyptian and Greek practice were continued here, we should expect to find some indications of the star observations utilised at the temple of Min and at the Hecatompedon for the beginning or the other chief months of the May year.

Following the clue given me in the case of the Egyptian temples, such as Luxor, by successive small changes of the axis necessitated by the change in a star's place due to precession, I have looked out for this peculiarity in an examination of many maps and plans of circles.

I have already come across two examples in which the sight line has been changed in the Egyptian manner. The first is the three circles of the Hurlers, near Liskeard, a plan of which is given in "Prehistoric Stone Monuments of the British Isles: Cornwall," by H. C. Lukis, published by the Society of Antiquaries, who were so good as to furnish me with a copy, and also some *unfolded* plans on which sight lines could be accurately drawn and their azimuths determined. I am anxious to express my obligations to the council and officers of the society for the help thus afforded me.

The second is at Stanton Drew, in Somerset, consisting of three circles, two avenues, and at least one outstanding stone. These were most carefully surveyed by Mr. C. E. Dymond some years ago, and he was good enough to send me copies of his plans and levelling sections.

How can such plans help us? The easiest way for the astronomer-priests to conduct such observations in a stone circle would be to erect a stone or barrow indicating the direction of the place on the horizon at which the star would rise. If the dawn the star was to herald occurred in the summer, the stone or barrow itself might be visible if not too far away, but there was a reason why the stone or barrow should not be too close; in a solemn ceremonial the less seen of the machinery the better.

Doubtless such outstanding stones and barrows would be rendered obvious by a light placed on or near them. Cups which could hold oil or grease are known in connection with such stones, and a light thus fed would suffice in the open if there were no wind; but in windy weather a cromlech or some similar shelter must have been provided for it.

Now if these standing stones or barrows were ever erected and still remain, accurate plans—not the slovenly plans with which Ferguson and too many others have provided us, giving us either no indication of the north or any other point, or else a rough compass bearing without taking the trouble to state the variation at the time and place—will help us in this way.

The work of Stockwell in America, Danckworth in Germany, and Dr. W. J. S. Lockyer in England has provided us with tables of the changing declinations of stars throughout past time, or enough of it for our purpose.

An accurate determination of either the *azimuth* (angular distance from the N. or S. points) or *amplitude* (angular distance from the E. or W. points) of the stone or barrow as seen from the centre of the stone circle will enable us to determine this declination.

This, of course, only gives us a first approximation. The angular height of the point on the horizon to which the alignment or sight-line is directed by the stone or barrow from the centre of the circle must be most accurately determined, otherwise the declinations may be one or two degrees out.

To come back to the two cases to which I have referred, the Hurlers and Stanton Drew. I will begin with a reference to the available descriptions of the circles.

The three circles of the Hurlers, some five miles to the north of Liskeard, are thus referred to by Lukis in the valuable monograph which I have already mentioned.

"On the moor, about a mile to the south of the singular pile of granite slabs, which rest upon and overlap each other, and is vulgarly called the Cheesewring, there are three large circles of granite stones placed in a nearly straight line in a north-north-east, and south-south-west direction, of which the middle one is the largest, being 135 feet in diameter, the north 110 feet, and the south 105 feet.

"The north Circle is 98 feet, and the south 82 feet

[1] Continued from p. 393.

[2] This article is generally based upon a note communicated to the Royal Society on March 15.

from the central one. If a line be drawn uniting the centres of the extreme Circles, the centre of the middle ring is found to be 12 feet 6 inches to the west of it.

"These Circles have been greatly injured. The largest consists of 9 erect and 5 prostrate stones; the north Circle has 6 erect and 6 prostrate, and a fragment of a seventh; and the south has 3 erect and 8 prostrate. In Dr. Borlase's time they were in a slightly better condition. A pen-and-ink sketch made by him, which is extant in one of Dr. Stukeley's volumes of original drawings, represents the middle Circle as consisting of 7 erect and 10 prostrate stones; the north of 10 erect and 6 prostrate; and the south of 3 erect and 9 prostrate. The stone to the east of that marked C in the plan of the middle Circle is the highest, and is 5 feet 8 inches out of the ground, and appears to have been wantonly mutilated recently. Two of the prostrate stones of the north Circle are 6 feet 6 inches in length.

"About 17 feet south from the centre of the middle Circle there is a prostrate stone 4 feet long and 15 inches wide at one end. It may possibly have been of larger dimensions formerly, and been erected on the spot where it now lies, but as Dr. Borlase has omitted it in his sketch it is probably a displaced stone of the ring.

"If we allow, as before, an average interval of 12 feet between the stones, there will have been about 28 pillars in the north, 26 in the south, and 33 in the middle Circle.

"At a distance of 409 feet westwards from K in the middle Circle there are 2 stones, 7 feet apart, both inclined northwards. One is 4 feet 11 inches in height out of the ground, and overhangs its base 2 feet 7 inches; the other is 5 feet 4 inches high, and overhangs 18 inches."[1]

I next come to Stanton Drew.

I will begin by giving a short account of the stones which remain, abridged from the convenient pamphlet prepared for the British Association meeting at Bristol in 1898 by Prof. Lloyd Morgan.

The circles at Stanton Drew, though far less imposing than those of Avebury and Stonehenge, are thought to be more ancient than are the latter, for the rough-hewn uprights and plinths of Stonehenge bear the marks of a higher and presumably later stage of mechanical development. Taken as a group, the Somersetshire circles are in some respects more complex than their better known rivals in Wiltshire. There are three circles, from two of which "avenues" proceed for a short distance in a more or less easterly direction; there is a shattered but large dolmen—if we may so regard the set of stones called "the cove"; and there are outlying stones—the "quoit," and those in Middle Ham—which bear such relations to the circles as to suggest that they too formed parts of some general scheme of construction.

The "quoit," lying in an orchard by the roadside, has nothing very impressive about its appearance—a recumbent mass of greyish sandstone; but it seems to be a brick in the Stanton Drew building. By some regarded as a sarsen block from Wiltshire, it is more probably derived from the Old Red Sandstone of Mendip. In any case it is not, geologically speaking, *in situ*; nor has it reached its present position by natural agency.

With regard to two of the megalithic circles, at first sight the constituent stones seem irregularly dotted

FIG. 13.—The Circles and Avenues at Stanton Drew. Photograph of 25-inch Ordnance Map, giving approximate azimuths of sight-lines.

[1] "The Prehistoric Stone Monuments of the British Isles: Cornwall." By William Collings Lukis, M.A., F.S.A., Rector of Wath, Yorkshire. P. 4.

about the field; but as we approach them the unevenly spaced stones group themselves.

The material of which the greater number of the rude blocks is composed is peculiar and worthy of careful examination. It is a much altered rock consisting, in most of the stones, of an extremely hard silicious breccia with angular fragments embedded in a red or deep brown matrix, and with numerous cavities which give it a rough slaggy appearance. Many of these hollows are coated internally with a jasper-like material, the central cavity being lined with gleaming quartz-crystals.

The majority of the stones were probably brought from Harptree Ridge on Mendip, distant some six miles. Weathered blocks of Triassic breccia, showing various stages of silicification, there lie on the surface; and there probably lay the weathered monoliths which have been transported to Stanton Drew. It is important to note that they were erected unhewn and untouched by the tool. A few stones are of other material—sandstone, like the "quoit," or oolite from Dundry.

In the great circle, of the visible stones some retain their erect position, others are recumbent, several are partially covered by accumulation of grass-grown soil. Others are completely buried, their position being revealed in dry seasons by the withering of the grass above them.

To the east of this circle a short avenue leads out, there being three visible stones and one buried block on the one hand, and two visible stones on the other. But one's attention is apt to be diverted from these to the very large and massive megaliths of the small N.E. circle. This is composed of eight weathered masses, one of which (if indeed it do not represent more than one), Prof. Lloyd Morgan tells us, is recumbent and shattered. From this circle, all the stones of which are of the silicious breccia, a short avenue of small stones also opens out eastwards.

The third or S.W. circle lies at some little distance from the others. The average size of the stones is smaller than in either of the other circles, and not all are composed of the same material.

"The Cove," which has been variously regarded as a dolmen, a druidical chair of state, and a shelter for sacrificial fire, is close to the church.

The dimensions and number of stones are as follow:—

Great Circle,	diameter 368 feet,	30 stones.
N.E. ,,	,, 97 ,,	8 ,,
S.W. ,,	,, 145 ,,	12 ,,

We now pass from general descriptions of the circles to the azimuths of the sight lines already referred to, so far as they can be determined from the published Ordnance maps.

To investigate them as completely as possible without local observations in the first instance, I begged Colonel Johnston, R.E., C.B., the Director-General of the Ordnance Survey, to send me the 25-inch maps of the sites giving the exact azimuth of the side lines. This he obligingly did, and I have to express my great indebtedness to him.

Of the various sight lines found, those to which I wish to direct attention in the first instance, and which led me to the others, are approximately, reading the azimuths to the nearest degree,

Hurlers Lat. 50° 31′ N.	Az.	Stanton Drew Lat. 51° 10′ N.	Az.
S. circle to central circle	N. 12° E.	Great circle to Quoit	N. 17° E.
Central to N. circle	N. 15° E.	S.W. circle to great circle	N. 20° E.
N. circle to tumulus	N. 19° E.		

For the purposes of a preliminary inquiry in anticipation of the necessary local observations with a theodolite, for which I am making arrangements; assuming hills half a degree high, which roughly compensate the refraction correction so that we may use sea-horizon values, we have the following declinations approximately:—

The Hurlers. Lat. 50° 31′	Stanton Drew. Lat. 51° 10′
Dec. N. $38\frac{1}{2}°$	Dec. N. 37°
,, 38°	,, $36\frac{1}{2}°$
,, 37°	

Here, then, we have declinations to work on, but declinations of what star? To endeavour to answer this question I prepared a diagram showing the declination of the three brightest stars in the northern heavens, having approximately the declinations in question for the period 0 to 2500 B.C. The calculations for 0 to 2000 B.C. are taken from the tables published by the Astronomisches Gesellschaft,[1] and have been completed from 2000 to 2500 B.C. by Dr. Lockyer.

Vega is ruled out as its declination is too high. The remaining stars Capella and Arcturus may have been observed so far as the declinations go. For time limits we have:—

Dec. N.	Capella.	Arcturus.
$38\frac{1}{2}$	500 B.C.	1550 B.C.
36°	1050 ,,	1150 ,,

The interesting fact must be pointed out that about 1000 B.C. the declination of the two stars was very nearly the same.

Now there is no question as to which of these two stars we have to deal with, for I find by the use of a precessional globe that for about 1400 B.C. and 800 B.C. the warning stars were as follows for the critical times of the year, *i.e.* May, August, November, February.

	1400 B.C.	Az.	800 B.C.	Az.
May	Pleiades rising		Pleiades rising	
Aug.	Arcturus rising	N. 14° E.	Sirius rising	
Nov.	Capella setting		Betelgeuse rising	
Feb.	Capella rising	N. 29° E.	Capella rising	N. 21° E.
		Dec. 34° N.		Dec. 37 N.

It is quite clear, then, that we have to deal with Arcturus, and this being so, the approximate dates of the use of the three circles at the Hurlers can be derived. They are:—

		B.C.
Southern circle aligning Arcturus over centre of	central circle	1600
Central ,, ,, ,,	N. circle	1500
Northern ,, ,, ,,	tumulus	1300

I have already pointed out that Mr. Penrose found the warning star for May morning at the date of foundation of the Hecatompedon, 1495 B.C., to be the group of the Pleiades. As the foundations of the Hecatompedon were only built some few years before the stones of the central circle of the Hurlers were used, we ought to find traces of the observations of the same May morning stars. We do; there is a stone with amplitude E. 15° N., which, when aligned from the S. circle, would have pointed out the rising place of the Pleiades in 1300 B.C., that is, the date we have already found from the observations of Arcturus. I regard this as an important confirmation of the time of the use of the temple, all the more as the high situation of the circles, not generally dominated by higher levels for some miles, renders it probable that large corrections for hills will not be required to be made.

There are alignments in connection with the N. circle which indicate the introduction of the solstitial year, but these and some others may wait until local observations have been made before more is said about them.

With regard to Stanton Drew, it is clear that we are there also dealing with Arcturus. Mr. Dymond's

[1] Dr. O. Danckworth, *Vierteljahrschrift der Astronomischen Gesellschaft*, 16 Jahrgang 1881, p. 9.

levels give an idea of the height of the hills, so with the Ordnance map azimuths, read to 1°, the dates of the use of the great and S.W. circles are approximately as under:—

	B.C.
Great Circle	1260
S.W. Circle	1075

We seem, then, to have made a step in advance. More accurate readings of the Ordnance maps and accurate determination of the heights of hills may vary the above values slightly. But that is an unimportant detail if it can be shown that we have a new method of dating what went on in prehistoric Britain at the time when the Athenians were building the Hecatompedon.

A great amount of local theodolite work has to be done, for while Mr. Lukis only referred to two outstanding stones at the Hurlers, there are many more marked on the Ordnance map; there are also others besides the "quoit" at Stanton Drew.

I am more rejoiced than I can say to know that this local work has already been begun under the best possible conditions. As it was impossible for me to leave London when the significance of the alignments was made out, I appealed to the authorities of University College, Bristol, and of the Royal Cornwall Polytechnic Society for aid. The principal of the college, Prof. Lloyd Morgan, together with Prof. Morrow and his engineering class, have already made observations at Stanton Drew, and Captain J. S. Henderson, of Falmouth, an accomplished surveyor, sent me last week from the Hurlers the angular heights along some of the alignments, the means of eight readings obtained with a 6-inch theodolite, both verniers and reversed telescopes being employed. Other students of science besides myself will, I am sure, feel their indebtedness for such opportune help.

Norman Lockyer.

BRITISH ASSOCIATION GEOLOGICAL PHOTOGRAPHS.

The geological photographs committee of the British Association and its indefatigable secretary, Prof. W. W. Watts, are to be congratulated on the third issue, which completes the first series, of their admirable photographs. There are twenty-four photographs in this issue, all of great interest, showing much skill in technique, and considerable artistic power in the choice of the point of view from which the objects were taken. They treat of a variety of subjects, chiefly the action of wind and rain, frost and ice, and sea-waves, igneous intrusion, the character of sedimentary rocks, and structures due to faulting and folding.

There are two good pictures of the remarkable rain-eroded pillars of Old Red Conglomerate which occur at Allt Dearg, on the Spey, Morayshire, and remind us of the similar forms which may be seen in much younger deposits on the right side of the Brenner as we travel towards Italy. They were first figured by Sir Archibald Geikie, who provides a description to the photographs, in which he directs attention to the comparative rapidity of their formation, as shown by the fact that "some of these isolated stacks of conglomerate are capped by boulder clay, and their capitals may here and there be seen to have retained their covering of thick peaty soil."

The photograph of the tower of Eccles Church, an object made so familiar by Lyell's "Principles," is the last that was taken (in 1886), and the last that will be taken, for the tower itself was destroyed in 1895. Prof. Reynolds's photograph of the great Axmouth landslip gives a good view of the "mighty chasm which separated the foundering mass from the land." The original describers of this were Buckland and Conybeare, and a water-colour copy by Ruskin of Mrs. Buckland's drawing still hangs in the University Museum at Oxford. Of queer forms the "Rock and Spindle," St. Andrews, Fifeshire, photographed by Mr. G. Bingley and described by Prof. Bonney, and "Lot's Wife," Marsden, Durham, a "breccia gash" transformed into a sea-stack, described by Prof. Lebour, are among the quaintest; they would be good puzzles to set a student in examination. The most novel subject is the wind-worn surface of granite disclosed beneath the Keuper marl in the Mountsorrel quarry, one of the several proofs discovered by Prof. Watts of the desert conditions which prevailed in these islands and elsewhere during a part of the Trias period. We have selected this for reproduction.

Fig. 1.—Keuper marl resting on terraced granite surface; Mountsorrel Quarry, Leicestershire. Photographed by Prof. H. E. Armstrong, F.R.S.

As this is the last issue of the first series it is usefully accompanied by some introductory letterpress, which includes the names of the committee, a preface, table of contents, and other information. We learn from the preface that the idea of forming a systematic collection of geological photographs originated with Mr. Osmond W. Jeffs in 1889; to carry it out a committee of the British Association was appointed in 1890, and Mr. Jeffs acted as secretary until 1896, by which time 1412 photographs had been contributed. In 1895 Prof. W. W. Watts became secretary, and by 1903 the collection had grown to the magnificent total of 3754. It is housed in the Museum of Practical Geology, 28 Jermyn-street, S.W. The series issued to subscribers and just completed consists of a selected number (72) of these photographs, taken from negatives generously lent by their owners, and furnished with descriptions by many of the leading geologists of the day.

The success of the scheme is shown by the fact that it has resulted in a considerable profit; of this one half has been returned to the subscribers in the form of additional whole-plate photographs, and the other half will provide funds for carrying on the work of the committee for at least four years. In a strictly business undertaking it is to be presumed that a good slice of the profits would disappear in "wages of superintendence," and subscribers may therefore regard their additional photographs as a gift from Prof. Watts.

THE SOCIETY OF ARTS AND THE LONDON INSTITUTION.

On Wednesday next a special meeting of proprietors of the London Institution will be held to consider a scheme for its amalgamation with the Society of Arts. Founded in 1805 by merchants and bankers of the City of London, given a charter two years later, and housed in its present imposing, if rather sombre, premises in 1819, the London Institution has done good work in its day. The object of its founders was to maintain, in what was then a central position, an extensive general library of reference, comprising works of intrinsic value and utility in all languages; to provide reading rooms for periodical publications and interesting contemporaneous pamphlets; and to promote the diffusion of knowledge by lectures and *conversazioni*. But since the foundation of the institution circumstances have greatly changed, and not to the advantage of the institution. In 1817, and for many years afterwards, the City contained a large residential population, which for a long time past has been gradually disappearing, until now the number of proprietors who use the institution as a centre of intellectual culture is comparatively small, and is more likely to grow smaller than to increase. In these circumstances the board of management has recognised that if the institution is to live and thrive some scheme must be devised for increasing its usefulness, and the proposal to amalgamate with the Society of Arts is the outcome of prolonged consideration of a difficult problem.

The Society of Arts carries on to a large extent work of the same nature as that for which the London Institution was founded, but whereas the institution has suffered from residential changes, the society was never more prosperous. But it, too, has had its ups and downs. In the early 'forties of the last century it began to show signs of decrepitude, and in 1841 a committee was appointed to examine its position and make recommendations. But little seems to have been done until measures were taken for obtaining a Royal Charter of Incorporation, which was granted in 1847. Then it was proposed to hold an exhibition of English industry. Prizes for modern industrial art were offered, and eagerly competed for, and by 1850 the membership had risen again to 1500. An exhibition of ancient and mediæval art was held which was very successful, and a proposal to hold an international exhibition culminated in the Great Exhibition of 1851. Since then the Society of Arts has done much good work in promoting industrial art and encouraging inventive genius. The prosperity of the 'fifties was followed by some lean years, but for a generation past it has been highly prosperous, largely owing to the sagacious guidance of its present secretary. Sir Henry Wood has always attached great importance to the constitution of the council of the society. He has not only sought for and found eminent men, he has got those who were willing to give time and attention to the affairs of the society, men like Sir Frederick Bramwell, Sir F. Abel, Sir W. Siemens, Sir Douglas Galton, Lord Alverstone, Sir J. W. Barry, Sir W. Preece, the Duke of Abercorn, and Sir W. Abney. All these gentlemen have served as chairmen of the council, and the society owes them much.

Both institutions are financially strong. The London Institution possesses a site which is worth at least 150,000*l.*, besides a fund invested in consols of the present value of 31,000*l.* Its income in 1903 was 3583*l.*, and its expenditure was 3616*l.* The Society of Arts has an annual income which last year exceeded 11,000*l.*, a capital fund of about 20,000*l.*, which has accumulated from surplus income during the last twenty years, and trust funds amounting to nearly 15,000*l.* What, then, are the inducements to the one institution and the other to consent to an amalgamation? It is not proposed that either should absorb the other. The suggestion is amalgamation into a single body for the promotion of science, art, and literature, and their practical applications, the members of each corporation preserving all their present rights, and sharing in the government of the new institution and in the direction of its future action.

The determining consideration with the Society of Arts is that the amalgamation would give it a permanent local building. The society does not own its premises. They were built for it by the Brothers Adam in 1774, but the lease has run out, and it is now practically a tenancy at will. Moreover, the building is inadequate for the growing needs of the society, and the funds at its disposal are not sufficient to enable it to build for itself, whereas by amalgamation with the London Institution, which would sell its Finsbury premises, ample funds would be available. It is believed that the accommodation required could be got for a sum of 100,000*l.*, and a suitable site found "east of Charing Cross and west of Chancery Lane." If it were decided to erect a building of sufficient size there are several other societies who would probably be prepared to join in the scheme, separate and distinct accommodation being provided for each, much as Burlington House now accommodates a number of independent institutions.

The amalgamation would give the London Institution a large accession of annual income, and the revenues of the new institution would justify the extinction in perpetuity of the annual payment of two guineas now required from the proprietors of the London Institution, while leaving them a permanent property in their shares disposable by will, or otherwise, as heretofore, the Society of Arts having approved of this as one of the terms of amalgamation. It would be part of the arrangement that any proprietor preferring to withdraw from the scheme and to surrender his share would be enabled to do so, and be paid 25*l.* in discharge of his rights and interests in such share. Those who remained would be members of an institution of very great importance and influence, well endowed, and in a position to carry into effect many objects of the highest public, scientific, and economic importance.

It is not to be supposed that the proposed amalgamation will be carried through without encountering opposition, but it will probably be found that a very large majority of both institutions is prepared to accept it. In the opinion of eminent counsel, the effect of its charter is to constitute the London Institution in a legal sense a charity, with the result that its property and funds are impressed with a charitable trust, and cannot be divided or applied to any other purpose than that prescribed by the charter. Consequently, the property could not be divided up without serious risk. If the amalgamation is to be carried through, the most convenient and least costly way of carrying it into effect would be to promote an Act of Parliament for the purpose, and, granted the authorisation of general meetings, this will be done. But an Act cannot be got until next year, and a site for the new building can hardly be secured before the Act is got, so that if all goes smoothly, a year or two must elapse before the united societies, to be known as "The Society of Arts and the London Institute," can receive their friends under the altered conditions, and in their new premises.

The idea of thus combining into a single body two scientific institutions, each of considerable importance, is a bold and novel one, and it is to be hoped that it may not fail of success. It would be a pity if any narrow views or selfish considerations hindered the carrying out of a very interesting experiment. Each of the two corporations can supply much of what the other lacks. The constitution of the London Institution is unfortunate. It consists of a body of shareholders, the descendants or heirs of the original founders, many of whom are naturally out of sympathy with the objects of the institution, and no means exist of introducing fresh blood or attracting to its membership the men who would most fitly carry on its proper work. Very early in its career the kindred Royal Institution altered its constitution, disendowed its proprietors, and adopted a more popular and democratic organisation. Its unfailing success ever since has proved the wisdom of the change. But the Finsbury institution possesses considerable property. It has a magnificent library. Its list of members is still a showy one. It only requires the infusion of fresh blood; it wants new life and vigour. The Society of Arts is a very popular and vigorous body, full of life and energy. It does much really useful public work. Its examinations, for instance, attract more candidates than that of any other private body in the kingdom. Its Cantor lectures (which are always freely open to London students) are a valuable educational agency. But it is hampered by want of larger offices, its library is far from being a credit to it, and it might well devote more attention and more funds to purposes of research and investigation.

A new institution such as should be formed ought to possess the good points of both its parents, while avoiding the weaknesses of either. It might also form a nucleus round which might gather many of the smaller societies, now often inadequately housed. In a suitable building accommodation might well be provided for many other societies, scientific, literary, and artistic, which are now scattered about in various quarters of London.

Even a larger scheme is conceivable. Burlington House can find room for but a small proportion of the scientific bodies of London. Why should not this proposed amalgamation lead to the erection of a second Burlington House, of which those of our larger and richer societies who are not satisfied with their premises should erect each their own part, independent certainly of one another, and yet combined under a common roof?

NOTES.

Lord Kelvin, who has been out of health for some time, underwent a serious operation on March 29. He passed a restless night on March 30, but has much improved since then, and appears to be making satisfactory progress toward recovery. The King and the Prince and Princess of Wales have made special inquiries as to his condition; and there have been numerous callers.

Sir William Ramsay, K.C.B., F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

It is reported by the Exchange Telegraph Company that a violent earthquake occurred at Lahore on Tuesday, April 4, causing serious loss of life and great damage to public buildings and other property.

A grant of 30,000*l.* has been authorised by the Carnegie Institution, *Science* states, for the solar observatory on Mt. Wilson. It is expected that the first equipment will cost about twice this sum.

We learn with sincere regret that Prof. Pietro Tacchini, formerly director for many years of the astronomical observatory of the Collegio Romano, and of the Central Office for Meteorology and Geodynamics at Rome, died on March 24 at sixty-seven years of age.

The *Times* states that the Chartley herd of white cattle has just been purchased by Mr. J. R. B. Masefield, of Cheadle, Staffordshire, on behalf of the Duke of Bedford, who has come forward and saved the herd from leaving the country or falling into the hands of the taxidermist.

An agricultural education and forestry exhibition will be held in connection with the show of the Royal Agricultural Society at Park Royal on June 27–30. Any offers of exhibits, or inquiries, should be addressed to the secretary of the society, at 13 Hanover Square, London, W.

The Easter excursion of the Geologists' Association will be to mid-Lincolnshire. The party will leave London for Grantham on Thursday, April 20, and after visiting several places of geological interest will leave Lincoln for London on Wednesday, April 26. The excursion secretary is Mr. W. P. D. Stebbing, 8 Playfair Mansions, Queen's Club Gardens, London, W.

A great historical pageant is in active preparation at Sherborne, Dorsetshire, to commemorate the 1200th anniversary of the founding of the town, bishopric, and school by St. Ealdhelm, A.D. 705. The pageant, which will be presented in the ruins of Sherborne Castle on June 12–15, will take the form of a folk-play written by Mr. Louis N. Parker and dealing with the chief historical events of the town.

The death of Dr. L. Bleekrode, of the Hague, is announced in the *Chemical News*. Dr. Bleekrode's work was principally connected with electrical matters, his first paper, in 1867, being on the influence of heat on electromotive force. In 1870 he wrote a paper on a curious property of gun-cotton; other papers dealt with electrical conductivity and electrolysis in chemical compounds, observations on the microphone, &c.

We regret to see the announcement of the death, on March 25, of the eminent German metallurgist, Prof. Bruno Kerl, at the age of eighty-one. He was professor of metallurgy at the Clausthal School of Mines, and subsequently at the Berlin School of Mines, and was the author of a number of metallurgical works. His first book, on the smelting processes of the Upper Hartz, was published in 1852. His important treatise on metallurgy was translated into English by Sir W. Crookes and E. Röhrig in 1868. His books on assaying were also translated.

The importance of the application of mathematics to engineering problems has frequently been insisted upon in these columns. Another instance of the close connection between pure and applied science is afforded by an investigation of some disregarded points in the stability of masonry dams, by Prof. Karl Pearson and Mr. L. W. Atcherley, referred to by Sir William Garstin in connection with the scheme for raising the Nile dam, in a recent report to the Egyptian Council of Ministers. It appears that the theory of stresses upon masonry dams requires important modifications, which will have to be taken into consideration in all future designs for such works. We understand that much experimental work on the subject is at present in progress, and that results of great interest to hydraulic engineers may be expected.

The anniversary dinner of the Chemical Society was held at the Whitehall Rooms, Hôtel Métropole, on March 20, when the president, Prof. W. A. Tilden, was in the chair, and many leading representatives of the physical sciences were present. Sir William Church, in giving the toast of "Prosperity to the Chemical Society," spoke of the advances which chemical science has made, and declared that the advantages which have accrued to the United Kingdom, as a result of the work of chemists, cannot be over-estimated. Prof. Meldola submitted the toast of "Scientific Institutions," which was responded to by Prof. J. Larmor and Dr. R. T. Glazebrook. Sir William Ramsay proposed the toast of "The Guests," and in replying Mr. Haldane said that as science never stood still, but progressed continually, so the Government of this country must, if the nation is to hold its own, make an increasing use of science in all departments of the State service. He expressed the belief that in the course of the next few years the position of science in the Government of the country will be much more prominent, and that scientific methods will become much more general. Prof. Perry also spoke.

A meeting of the Institution of Naval Architects will be held at the Society of Arts, John Street, Adelphi, on April 12–14. Lord Glasgow, president of the institution, who will occupy the chair, will deliver his address on April 12; and Mr. W. E. Smith, C.B., Colonel N. Soliani, and Mr. Herbert Rowell will submit papers for discussion. On April 13 Prof. J. H. Biles will read a paper on the strength of ships, with special reference to experiments and calculations made upon His Majesty's ship *Wolf*, and other papers will be submitted by Mr. F. H. Alexander, Mr. J. Bruhn, Mr. R. E. Froude, Mr. C. E. Stromeyer, Mr. A. W. Johns, and Herr S. Popper. Among the papers to be read on April 14 is one on the Admiralty course of study for the training of naval architects by Mr. E. L. Attwood, and another on submarine signalling by means of sound by Mr. J. B. Millet, of Boston, U.S.A.

The Royal medals of the Royal Geographical Society for this year have been awarded to Sir Martin Conway (founder's medal) for his explorations of various mountain regions of the world, and his work among the islands of Spitsbergen; and to Captain C. H. D. Ryder, R.E. (patron's medal), for the important and extensive work which he accomplished while acting as principal survey officer on the recent Tibet Mission. The Victoria research medal, for distinguished service to the cause of geographical research, as distinguished from exploration, has been awarded to Mr. J. G. Bartholomew. The Murchison grant goes to Mr. William Wallace, C.M.G., Deputy High Commissioner of the Northern Nigerian Protectorate. Colonel F. R. Maunsell, R.A., has been awarded the Gill memorial for his explorations during many years' residence in Asia Minor; Mr. F. J. Lewis the Cuthbert Peek grant for contributions to the knowledge of botanical distribution by his researches into the geographical distribution of vegetation in the north of England; and Captain Philip Maud, R.E., the Back grant for survey work in 1903 along the southern border of Abyssinia.

The concluding issue of the *Proceedings* of the Philadelphia Academy for 1904 contains the reports of the secretaries and curators for that year, from which it appears that the society continues to be in a flourishing condition, both as regards its publications and its museum.

In an article published in *Naturen* for March, Mr. J. Rekstad shows the value of photography to illustrate the secular variation in glacier terminations, the respective differences between two glaciers in August, 1899, and September, 1903, being admirably exhibited. In both instances, it may be remarked, there has been very decided shrinkage in the length of the glacier. The value of photographs of this nature as a basis of comparison in the years to come will be very great.

We have been favoured with a copy of No. 17 of the *Boletin* of the Institute of Mining Engineers of Peru, which contains an account of certain annelid remains and ammonites in the Salto del Fraile and Morro Solar districts by Mr. C. I. Lisson. Both formations appear to be of Neocomian age, the higher beds of Salto del Fraile being remarkable for the number of borings of annelids of the genus Tigillites they contain, while the lower Morro Solar stratum is noteworthy for its ammonites of the group Sonneratia.

In the *Report and Transactions* of the East Kent Scientific and Natural History Society for the past year, the secretary takes occasion to direct attention to the general apathy towards matters scientific prevailing in that portion of the county he represents. Owing to this cause, the season's excursions were practically a failure, and there may be some connection between this apathy and the fact that it has hitherto been found impracticable properly to arrange and display the natural history collections in the Royal Museum.

The *Zoologist* for March opens with an article by Mr. Lydekker on the small Asiatic mountain antelopes known as gorals. The main object of the article was to describe the Burmese species; but in the course of his investigation the author was led to believe in the existence of two Himalayan representatives of this group, one of which he names *Urotragus bedfordi*, on account of the type specimen having lived in the park at Woburn. In the penultimate line on p. 84 we notice that the word "eastern" should be "western." The second article, by Mr. John Gurney, is devoted to Norfolk bird-life in 1904, and it is interesting to note that in the spring of that year the author had the good fortune to see two avocets and seven spoonbills on Breydon Broad.

From the fisheries branch of the Department of Agriculture and Technical Instruction for Ireland we have received a copy of No. 4 of *Scientific Investigations*, containing an account by Messrs. Holt and Tattersall of schizopod crustaceans from the north-east Atlantic slope, and a note on one genus of the same group by Dr. Calman. In proposing several new generic types, the authors of the first paper suggest that these may prove of only temporary value, and add the remark that these, if not forgotten, "will, at least, cease to be harmful whenever the fashion of reviving deservedly forgotten names has run its due course." Dr. Calman proposes the name Nematobrachion to replace his Nematodactylus of 1896, which he regards as preoccupied by Richardson's Nemadactylus. Evidently neither of the three authors are in sympathy with the rules for nomenclature in zoology drawn up by the Paris committee.

Dr. T. H. Montgomery, in the *Proceedings* of the American Philosophical Society for the last quarter of 1904, runs a tilt at the generally accepted view as to the morphological superiority of the male sex in animals. Among invertebrates, he urges, it is always the male which is of inferior size and development, while as regards vertebrates, although the males have in many cases secured superiority in the matter of bodily size and secondary sexual characters, yet, as regards the generative organs (notably the suppression in certain instances of one ovary), the advantage, from the point of view of specialisation and development, is largely on the side of the female. While admitting that different morphologists might estimate the value of these characters differently, the author is inclined to give the greatest morphological value to the higher development of the reproductive organs.

In discussing in the same issue the origin of the markings of organisms, the late Prof. Packard arrived at the conclusion that these are dependent on the physical rather than on the biological environment. The alleged instances of "Müllerian" mimicry he explained, for example, by convergence due to the action of similar physical and climatic causes, since he regarded the attacks of birds as a negligible factor. Again, the frequent instances of colour and pattern resemblance between different animals he attributed to pigmentation caused by exposure to sunlight and shade, due to the repetition of fundamental colours. "To claim that Müllerian mimicry," he added, "is due to the attacks of birds, is to overlook the fact of the existence of stripes, bars, and spots on the wings of palæozoic insects which flourished before the appearance of birds, and even of modern types of lizards."

The *Report* on the third outbreak of plague at Sydney in 1903 by Dr. Ashburton Thompson is interesting as showing how an epizootic of plague among the rats preceded the two cases of human plague. From July 15, 1902, to April 30, 1903, 31,075 rats were caught, of which 17,160 were examined and found to be free from plague. On May 12 a rat was found on certain premises which on examination proved to be infected with plague, and up to August 15 14,671 rats and mice were caught, of which 111 rats and 50 mice were ascertained to be infected with plague. From then until December, 1903, 13,389 rats and mice were captured of which none was infected. The two human cases occurred on June 20 and July 4, *i.e.* during the period when the epizootic existed among the rodents.

The February number of *Indian Public Health* (i., No. 7) contains several papers of interest, notably one criticising the plague policy of the Indian Government, in which it is concluded that the only way to grapple with the plague problem is the formation of a properly organised and equipped *permanent* public health service for the country.

In the course of a report on the characters and analyses of sweet potatoes cultivated in Jamaica, Mr. H. H. Cousins, writing in the *West Indian Bulletin* (vol. v., No. 3), records the fact that the process of cooking increases the sugar content of sweet potatoes very considerably. Further experiments are being undertaken to ascertain the exact chemical nature of the change. A comparison of tubers freshly dug with others that had been stored for some weeks indicated that during storage there is also a development of sugars at the expense of other substances in the tubers.

Various kinds of citrus fruits, including oranges, pomeloes, grapefruit, and more particularly lemons and limes, are liable to suffer from the ravages of a parasitic fungus, *Colletotrichum gloeosporioides*, which attacks the leaves, causes spot or canker on the fruit, or brings about abscission of the inflorescence. The fungus has been reported from various orange-growing countries, and on account of its partiality for limes, planters in the West Indies will do well to consult the account by Mr. P. H. Rolfs which is published in the *Bulletin*, vol. iii., part ii., of the Department of Agriculture, Jamaica.

The publication of pamphlets dealing with the cultivation, varieties, and market requirements of well known commercial plant products, as instituted by the director of the Royal Botanic Gardens, Ceylon, is a practical and important phase in the development of economic botany. In vol. ii., Nos. 23 and 25, of the *Circulars* of the gardens, Mr. H. Wright takes up the subjects of ground nuts and castor oil plants. The best quality of ground nuts, and these can be grown in Ceylon, are bought for eating, but the demand is limited; on the other hand, the requirement of the nuts for oil-crushing, although the price is less remunerative, is practically unlimited, and the cake furnishes an excellent cattle food. In the castor seed trade it does not appear that Ceylon will become a formidable rival to India.

The Cerro de Pasco silver mines are the most remarkable in Peru, having been worked since the year 1630. At the present day operations are chiefly confined to the reworking of old slags and waste heaps. On March 21, 1902, a Government Commission was appointed to make a survey of these mines, and the report of the commission has now been published in the form of a *Boletin* issued by the Peruvian Corps of Mining Engineers. Illustrations and descriptions of the smelting works are given, and it is noted that the output in 1903 amounted to 7213 tons of matte containing 4071 tons of copper. It is curious that these ancient silver mines should develop as copper mines in depth.

A note in Nature for January 26 (p. 305) referred to Adelaide, in South Australia, and Coolgardie, Western Australia, as the places having the highest maximum temperatures recorded in the British Empire. Mr. W. E. Cooke, Government astronomer of Western Australia, writes to say that Marble Bar, in the north-west division of that State, is very much hotter than Coolgardie. The *mean* of the daily maximum temperatures for January, 1905, was 109°·8, and the highest reading 120°·5. He adds that at Jacobabad, in India, the *average* daily maximum temperature is 111°·6 in May, 112°·7 in June, and 107°·8 in July, and at Duem, in the Egyptian Soudan, the mean maximum for March, 1902, was 114°·4, and the absolute maximum 127°·4.

We have received from Mr. J. van Breda de Haan a copy of a valuable series of meteorological observations made during the year 1901 at the State Botanical Gardens at Buitenzorg, Java. The observations are made with the view of explaining certain problems connected with vegetable physiology, and consequently special attention is given to air and underground temperature, humidity and sunshine, and more particularly to the intensity of rainfall showers. Observations and monthly means are given for several hours of each day, in addition to daily means.

The *Quarterly Journal* of the Royal Meteorological Society for January last contains an interesting paper on the decrease of fog in London during recent years. The results are given for months and for seasons for each of the thirty-three years 1871 to 1903, based upon the observations for London (Brixton) published in the daily weather report of the Meteorological Office. The mean annual number of foggy days is 55, of which 45 occurred in the winter half of the year. Dividing the thirty-three years into three equal periods, the result is, for the first period, a mean of 55, for the second 69, for the third only 41. Since the year 1888 a steady and uninterrupted decrease is shown in the mean annual number of fogs. Among the principal agencies which may have conduced to this desirable result must be mentioned the efforts of the Coal Smoke Abatement Society and the London County Council, also the use of incandescent gas light and electricity; but, as pointed out by Captain A. Carpenter and Mr. C. Harding, the increase of wind in recent winters is probably chiefly responsible for the decrease of fog. As we have remarked before, the geographical situation of London is, from a purely meteorological point of view, eminently favourable to the development of fog, and the only permanent improvement we can hope for is an abatement of its more injurious effects caused by the imperfect consumption of coal and gas.

We have received a copy of part i. of the "Katalog der Bibliothek der Naturforschenden Gesellschaft in Danzig," published at Danzig in 1904. Although the list of books included is not completely representative, this publication, containing the sections mathematics and astronomy, may be found useful to those desiring to refer to the works of certain authors on these two subjects. The range of subjects is a wide one, and the books are entered under the names of the authors.

Having occasion recently to devise a short-focus spectrograph, Prof. Wood, of the Johns Hopkins University, found it necessary to make a study of the distribution of light (monochromatic) in the different orders of a typical grating. His method, a beautifully simple one, is described and illustrated in No. 2, vol. xxi., of the *Astrophysical Journal*. The result showed that, in the typical grating experimented with, half the reflected light was concentrated in one spectrum, and as the grating reflected about 76 per cent. of the total incident light, this means that about one-third of this total was found in the one spectrum, which was one of the two first orders. It was also found that the ruling makes little or no difference to the total reflecting power of the speculum. Two flint prisms of 60° would give about the same average dispersion as that produced, and, according to Pickering's table in Kayser's "Handbuch," they would transmit a little more than twice the light reflected, in the first order of the grating used.

The *Psychological Bulletin*, ii., 2, contains reports of the proceedings of the thirteenth annual meeting of the American Psychological Association and of the fourth annual meeting of the American Philosophical Association, which were both held at Philadelphia on December 28–30. Abstracts of the papers are given. Invitations on behalf of Harvard University to hold the next annual meeting in Cambridge, Mass., to signalise the opening of the Emerson Hall of Philosophy were accepted by both associations, and it is proposed that the Western Philosophical Association and the Southern Society for Philosophy and Psychology shall also meet at the same time and place.

A coloured plate of a new species belonging to a new genus of Hydrachnidæ is given in the *Rendiconti* of the Lombardy Institution, xxxviii., 3, in illustration of a note by Mr. R. Monti on the new "find." This water mite was obtained in cold springs on the right bank of the Anza, near Ceppomorelli, and has been named *Polyxo placophora*. The same writer in another number of the same journal discusses the horizontal migrations of lacustrine plankton, and finds in mountain lakes that, in addition to the known vertical movements, there are well-marked diurnal migrations of the small crustacea to different parts of the lake depending on sunshine and shade.

In the March number of the *American Journal of Science* Mr. Charles S. Hastings utilises some observations of the power of accommodation of the eye for light of different wave-lengths to make a complete determination of the optical constants of the eye for all conditions of accommodation and for all colours. The results are given in two tables, by the use of which all problems connected with the purely optical properties of the schematic eye may be solved.

In the course of an investigation of radio-active muds which is published by Prof. G. Vicentini in the *Atti* of the Royal Venetian Institute (vol. lxiv., ii., 535), the connection existing between the ionisation produced by the mud and the quantity of material used is experimentally ascertained. When the mud is spread uniformly over a definite area, the intensity of the radiation increases as the thickness of the layer is increased, but a direct proportionality does not exist between them. After a certain point, moreover, the radio-activity is not increased by adding fresh material. Mr. H. S. Allen, in a paper read before the Royal Philosophical Society of Glasgow on January 25, also deals with radio-active water and mud, the material in this case being derived from the springs of Bath and Buxton. An interesting point which is established incidentally is that the fluorescence excited in a sensitive plate by the radium rays plays only a very minor part in the production by these rays of a photographic effect.

An interesting investigation of the secondary radiation produced when the β and γ rays of radium impinge on metallic plates is published by Prof. J. A. McClelland in the *Transactions* of the Royal Dublin Society (vol. viii., No. 14). It is shown that the secondary rays are not produced merely at the surface of the plate struck by the primary rays, but that they come from all parts of a layer of considerable depth. Apparently the less penetrating β rays are more efficient in producing a secondary radiation than the γ or highly penetrating rays. The nature of the secondary radiation depends largely on the character of the metal employed; the greater the atomic weight of the latter the greater is the amount of the secondary radiation produced by it. Of all the substances experimented with, lead gives rise to the greatest effect, both as regards the quantity of the secondary radiation and its penetrating power. The secondary radiation consists, apparently entirely, of a species of β rays, that is, of negatively charged particles capable of deflection in a magnetic field. Perhaps the most important feature of the paper lies in its directing attention to the necessity of considering secondary radiations in all measurements of the absorptive power of substances with regard to the rays produced by radio-active bodies.

We have received a copy of a memorandum on the construction and verification of a new copy of the imperial standard yard, by Mr. H. J. Chaney, superintendent of the Standards Department of the Board of Trade. Since the original standard yard of bronze was made some sixty years ago, it has been found that bars which are constructed of copper alloys do not retain their original length with that degree of accuracy now demanded for scientific purposes. The new copy (f.P.) is made of an alloy containing 89·81 per cent. of platinum and 10·10 per cent. of iridium, such an alloy being little affected by changes of temperature and not at all by oxidation; as the alloy admits of a high specular polish, the fine lines marking the extremities of the yard can be traced directly on the bar without the intervention of gold plugs or pins as in the older type. Instead of using the old solid 1-inch section, for the purpose of lightness the so-called "Tresca" section has been adopted. The memorandum gives full details of the verification of the length and a description of the apparatus used, including the thermometers by which temperature was measured and a new microscopic "comparator" similar to that used at Paris by the Comité international des Poids et Mesures. This instrument has been purchased by the Board of Trade and mounted in a special chamber at Old Palace Yard, Westminster.

Vessels of fused quartz can now be obtained commercially, and on account of the remarkable properties of this substance, a wide field of research at high temperatures would appear to be opened up by their use. In high temperature gas thermometry, for example, where glass is excluded on account of its comparatively low melting point, and platinum on account of its permeability to hydrogen, fused quartz promised to be an ideal envelope. Unfortunately, Villard has found that fused quartz is also permeable to hydrogen at high temperatures, well below its melting point, and Jacquerod and Perrot have proved that helium resembles hydrogen in this respect. In the current number of the *Comptes rendus* (March 27) M. Berthelot shows that the use of quartz vessels is still further limited, as both oxygen and nitrogen can penetrate into hermetically sealed quartz bulbs at 1300° C. Thus carbon, heated in sealed vacuous quartz tubes for half an hour at 1300° C., gave a mixture of nitrogen and carbon monoxide on cooling the tube and extracting the gases. Experiments were made on other substances, and all the facts pointed to the conclusion that at a high temperature fused silica behaves towards gases like an animal membrane, susceptible of endosmosis and exosmosis, the phenomenon depending partly on the thickness of the wall. It is clear, therefore, that before this substance can be used with confidence in high temperature work, a further study will have to be made of its defects in this direction.

The *Comptes rendus* for March 27 contain an interesting paper on the cryoscopic behaviour of hydrocyanic acid, by M. Lespieau. According to the views of Nernst and Thomson on the relation between the dielectric capacity and the power of electrolytic dissociation, the fact that the dielectric constant of prussic acid is higher than that of water should give the acid a higher dissociating power. M. Lespieau has accordingly carried out a series of experiments on the lowering of the freezing point of this substance by the addition of alcohol, chloroform, benzene, water, trichloracetic acid, sulphuric acid, potassium iodide and nitrate, and has found that for the first six substances the cryoscopic constant is between 19 and 20, whilst for the two latter it is approximately double. Hence the two acids, which are strongly dissociated in water, are not sensibly dissociated in prussic acid solutions of the same strength, and this is in accord with the experiments of Kahlenberg, who found that these solutions were bad conductors, these facts being in contradiction with Nernst's theory. On the other hand, the solutions of potassium salts in hydrocyanic acid were found by Kahlenberg to be better conductors than aqueous solutions of the same concentration, and this agrees with the cryoscopic results, according to which the two salts are nearly completely dissociated into their ions in prussic acid.

Mr. W. Woods Smyth will give a lecture on "The Bible in the Light of Modern Science" at Stafford Rooms, Tichborne Street, Edgware Road, to-morrow, April 7, at 5 p.m.

Messrs. Watts and Co. will shortly publish, for the Rationalist Press Association, Prof. Haeckel's "Evolution of Man," being a translation of the recently issued fifth edition of "Anthropogenie."

OUR ASTRONOMICAL COLUMN.

Comet 1905 *a* (Giacobini).—A second telegram from the Kiel Centralstelle announces that comet 1905 *a* was observed by Prof. Aitken at Lick on March 27. The position at March 27d. 7h. 57·1m. (Lick M.T.) was R.A. = 5h. 48m. 55s., dec. = + 12° 35′ 43″.

Apparently, then, the northern declination is increasing, and not decreasing as previously stated. An error in the key by which the code telegrams are translated substituted declination for N.P.D., so that the daily movement in declination should be read as *plus* 1° 15′.

The following elements have been computed by Dr. E. Strömgren from observations made on March 26, 28, and 30, and are given in *Circular* No. 76 of the Kiel Centralstelle, together with a bi-daily ephemeris extending from March 30 to April 23:—

Elements.

T = 1905 April 3·2098 (M.T. Berlin).

$$\left.\begin{aligned} \omega &= 357^\circ\ 9'\cdot49 \\ \Omega &= 156^\circ\ 7'\cdot94 \\ i &= 41^\circ\ 37'\cdot48 \end{aligned}\right\} 1905\cdot0$$

$\log q = 0\cdot05232$

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

1905	α h. m. s.	δ	log Δ	Brightness
April 7	6 31 16	+25 26·9	9·8661	0·98
9	6 40 5	+27 39·9		
11	6 49 13	+29 48·1	9·8745	0·93
13	6 58 39	+31 50·9		
15	7 8 22	+33 47·9	9·8855	0·87

Brightness on March 26 = 1·0.

Photography of the Corona without a Total Eclipse.—According to a note communicated to the French Academy of Sciences, and in the opinion of M. J. Janssen, M. A. Hansky has succeeded in photographing the corona of the uneclipsed sun. The photographs were taken with a 12-inch telescope in the exceptionally transparent atmosphere which obtains at the observatory situated on the summit of Mont Blanc.

After a number of preliminary experiments on the selective absorption of screens dyed with various aniline colours, M. Hansky obtained a combination which absorbed all radiations more refrangible than 660 $\mu\mu$, and, as the red radiations of the corona are very intense and do not suffer absorption or dispersion in passing through the terrestrial atmosphere, he used this screen in obtaining twelve negatives. The individual screens were prepared by soaking a fixed undeveloped Lumière film in each of the suitable dyes, and, between each exposure, they were re-arranged *inter se* so that no false effect due to any particular disposition of the "grain" might affect the resulting picture. The direct photospheric and chromospheric rays were prevented from reaching the plate by the interposition of a blackened brass disc slightly larger than the solar disc.

The resulting negatives showed distinct halos around the disc, and, notwithstanding the fact that some time elapsed between the successive exposures, these halos exhibited the same form, thus testifying to their solar origin. Some of the negatives were photographically intensified by repeated copying, and reproductions of them were submitted to the academy. In presenting the communication M. Janssen—to whom M. Hansky acknowledges his obligations for assistance and advice—stated that "the photographs actually show the solar corona with an intensity and a perfection only known on the photographs obtained during total eclipses" (*Comptes rendus*, No. 12).

Search-ephemeris for Tempel's First Periodic Comet (1867 II).—Although Tempel's first comet has not been seen during its last three perihelion passages, *i.e.* since 1879, M. A. Gautier, of the Geneva Observatory, thinks that the probability of its re-discovery this year is great enough to justify a careful search. For this reason he re-publishes, in No. 4008 of the *Astronomische Nachrichten*, the elements he prepared for the 1898 apparition, reduced to the mean equinox of 1905·0. As the probable time of perihelion is somewhat uncertain, he gives three ephemerides, extending from March 31 to July 13, in which this time is reckoned as May 2·5, April 20·5, and April 8·5 respectively, the mean date being the most probable. The declination varies from $-16°$ to $-31°$, so that the more southerly observatories are more likely to be successful in the research.

Right Ascensions of 2120 Southern Stars.—In an appendix to "Observations made at the Hong Kong Observatory during 1903," Prof. W. Doberck, the director, publishes the right ascensions of 2120 southern stars for the epoch 1900, as determined from observations made by Mr. J. I. Plummer and himself during the years 1898 to 1904.

The observations were made with a 3-inch Simms semi-portable transit instrument, which, together with the method of reduction and the comparisons with other catalogues, is briefly discussed in the director's preface.

In the catalogue itself, the number of the star as given in Lacaille, or Stone, or both, the R.A., epoch and magnitude, the variation of the R.A. from Stone's corresponding value, the proper motion, and several other particulars are given for each star.

The Iris Diaphragm in Astronomy.—In a communication to the French Academy of Sciences, M. Salet states that he has recently and usefully adapted the iris diaphragm to a telescope in which the magnification employed is 500. The diaphragm is placed very near to the plane of the micrometer wires in front of the field lens, and its *raison d'être* is to prevent the light from the sky, and from the illumination of the wires, from reaching the eye when feeble objects are being observed, the diaphragm being closed by an external cylinder when the object has been brought to the centre of the field. By reducing the extent of the micrometer wires, the diaphragm also reduces, or eliminates, the effect of astigmatism when observations of double stars are being made (*Comptes rendus*, No. 9).

Constancy of "Spark" Wave-lengths.—A question which is of first importance to those observers engaged in stellar line-of-sight work, viz. that of the constancy of wave-lengths in spark spectra taken under various conditions of discharge, has recently been re-investigated by Mr. G. W. Middlekauff at the Johns Hopkins University. A detailed description of the apparatus and methods employed, together with the results obtained, appear in No. 2, vol. xxi., of the *Astrophysical Journal*.

Mr. Middlekauff used a concave Rowland grating of 20,000 lines to the inch and a focal length of 21·5 feet. The self-induction in the spark circuit could be varied from 0·00007 to 0·0012 of a henry, and the capacity from 0·0085 to 0·0739 of a microfarad, and the results obtained afford strong evidence that in the case of a spark discharge in air, at atmospheric pressure, no "shift" in wave-length is produced by variations of self-induction or capacity within the above limits. A further result obtained was that the analogous wave-lengths in the arc and the spark spectra of the same elements are not measurably different.

STATISTICS OF VARIATION.[1]

A PAPER consisting mainly of a large number of elaborate records bearing on the important subject of variation has recently been issued by the Washington Academy of Sciences. The data, which have been collected with much care and industry, cannot fail to be of high interest to all students of evolution. They afford an excellent example of the peculiar value of insect studies in reference to many difficult problems in biology—a point which has lately received fresh emphasis from Prof. Poulton's valedictory address as President of the Entomological Society of London.

The authors start with an "Introduction," in which they declare their "belief in the marked betterment and effectiveness of practically all variation study when pursued from the point of view of the biometrician"; adding, however, that "from the writers' point of view the study of variation is a phase of biology, and not of mathematics." Dealing with the special advantages presented by insect data in this inquiry, they assert that the phenomena of complete metamorphosis afford a ready means of distinguishing "variations which are strictly blastogenic from others which may be in large part acquired." This, it may be remarked, is only true under certain limitations. It is not the case, for instance, as the authors appear to think, that the imaginal colour-patterns of lepidoptera are uninfluenced by the conditions obtaining during individual development.

Coming now to the main substance of the paper, we find a series of short articles or sections giving statistics of variation in some two dozen species of insects. Among the structures thus dealt with are the venation and costal wing hooks in bees and ants, the venation in gnats, the colour-patterns of sundry beetles, wasps and bugs, the eye-spots of certain butterflies, the tibial spines, tarsal and antennal segments, tactile hairs and elytral striæ of other insects of various orders. In the case of the hive bee it is incidentally shown that the parthenogenetically produced drones are as subject to variation in their wings as are the workers of biparental ancestry. The results are in many cases graphically summarised in the form of the frequency polygon; and the "mode," "standard deviation," "index of variability," and "coefficient of variation" are duly reckoned and recorded in accordance with approved biometrical methods. It is interesting but not surprising to observe that the frequency curve is usually in fair correspondence with the law of error.

The paper ends with a section devoted to "general results." Here we think that too much is made of the difficulty of distinguishing between congenital variation and acquired modification. For practical purposes the distinction is usually obvious enough. A little later the authors observe, "The most satisfactory answer to the question of the hereditary transmission of acquired characters will come as the result of a quantitative (statistical) study of variations known to be blastogenic compared with a similar study of variations known to be acquired, both studies to be made on complete series of individuals bred under quantitatively determined life conditions." This seems to us somewhat like using a steam-hammer to crack an egg. It is not astonishing to find that there is little or no evidence of differing selection-value in the variable number of spots on the elytra of a ladybird; but it hardly seems clear that the authors are justified in claiming this fact, together with an apparent change of "mode" between the years 1895 and 1901, as evidence in favour of "determinate variation." Before any such inference can properly be drawn, the question of possible correlation ought at least to be considered. The authors, however, arrive on the whole subject at the satisfactory conclusion that natural selection "is after all a logical necessity and undoubtedly an actual actively-regulative factor" in the formation of species.

F. A. D.

[1] "Studies of Variation in Insects." By Vernon L. Kellogg and Ruby G. Bell, of Leland Stanford Junior University. From the *Proceedings* of the Washington Academy of Sciences, vol. vi. (Washington, D.C., 1904.)

INTERRUPTERS FOR INDUCTION COILS.

It has been thought that an account of the more important forms of interrupter would not be unwelcome to readers of Nature.

A rotating air-break interrupter is shown in Fig. 1. An accurately balanced brass fly-wheel, F W, driven by a small motor, is fitted with two insulating segments, I S, let into its periphery. Bearing on the fly-wheel are two copper gauze brushes, B_1 and B_2; the circuit is interrupted as each brush slips over from the brass to the insulating

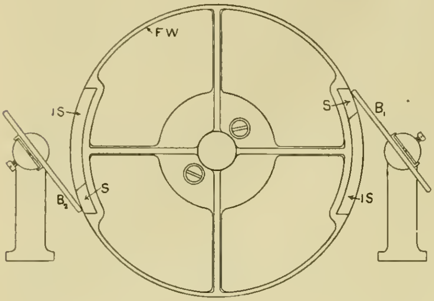

Fig. 1.

portion of the rim. It is evident that the arcing which occurs at the break necessitates the use of a fire-proof insulator. A small piece of slate (s in Fig. 1) is fitted immediately behind each brass segment, and this takes the spark; it is easily renewed, the remainder of each insulating segment consisting of vulcanised fibre.

So far as the writer is aware, this type of interrupter was first described by Wadsworth in 1894, and was used by Prof. Michelson in some Geissler-tube experiments (*American Journal of Science*, pp. 496–501, December, 1894).

As might be expected, the suddenness of the break depends

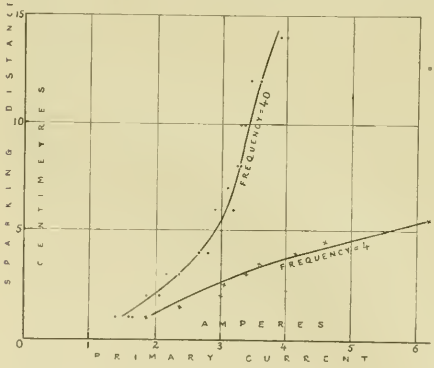

Fig. 2.

on the speed of the motor (or frequency of interruption). In Fig. 2 are plotted the results of some experiments bearing on this point. It will be seen that for a given value (root-mean-square) of the primary current, an enormously greater spark-length—especially with the larger currents—is obtained at the higher speed.

This form of interrupter is not very expensive, and works very satisfactorily so long as the primary current does not exceed about 5 amperes. It shares with the platinum interrupter the advantage of cleanliness. Renewals and repairs cost very little, as the only parts which are subjected to any considerable wear are the slate distance-pieces; the rim of the fly-wheel may occasionally require truing-up. It is important to keep the edges of the brass contact-segments and the surfaces of the slate distance-pieces clean by the occasional application of fine sand-paper.

In Fig. 3 are shown the essential parts of the mechanism of a "double-dipper" interrupter. The double motor-driven crank, C, carries two connecting-rods, C R, each of which is attached to a cross-head, C H. Each cross-head is fixed to the top of a stiff rod, R, which passes between the guide-springs, G S, and through the guide-block, G B. The latter is supported by a strong bracket, B, screwed to the stand supporting the motor. Each reciprocating rod ends in an amalgamated copper wire, C W, which dips into the mercury. It will be readily seen that by the adoption of the two-crank arrangement the frequency is doubled for a given speed as compared with the single-crank interrupter; for while with the latter there is only a single break per revolution, the former gives two breaks per revolution, one of the contact-rods or "dippers" entering the mercury shortly after the other has left it. The mercury cup itself is made adjustable in a vertical direction, and is, as usual, immersed in alcohol.

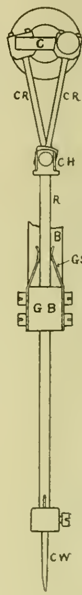

Fig. 3.

The curve marked "double dipper" in Fig. 4 gives the results of a test with this form of interrupter. The frequency of interruption was 22. The results correspond fairly well with those plotted in Fig. 2 for the rotary air-break interrupter at a frequency of 40.

This type of interrupter is comparatively cheap and simple, and works very steadily. There is no complicated mechanism to get out of order, and only a small quantity of mercury is required (about 2lb.).

One of the most successful types of rotary interrupter is the mercury jet interrupter. Several varieties of this have been used. One of the best known is shown in Fig. 5. The vertical motor-driven shaft, S, carries a cylinder, C, the lower portion of which is cut up into a number of teeth, T. The shaft S is continued downwards, and passes through the mercury pump casing. The mercury pump is of very simple construction, and is shown in Fig. 5 (*b*). Inside a flat oval box, which forms the pump casing, are arranged two thick toothed wheels. One of these is mounted on the lower end of the shaft S, which carries the toothed cylinder, Fig. 5 (*a*), and drives the other. The wheels fit the inside of the casing very closely, and are arranged to rotate as indicated by the arrows in Fig. 5 (*b*). The mercury imprisoned between the teeth of the wheels and the casing is consequently carried round and forced through the nozzle. The issuing fine jet of mercury, M J—Fig. 5 (*a*)—is directed against the rotating teeth, the break taking place at the vertical edge of a tooth. The height of the nozzle N is adjustable, and by this means the magnitude of the current may be regulated, as by raising the nozzle the jet will be directed against a tooth for a longer period, and the current will attain a larger value before the break takes place. The entire mechanism of this interrupter is contained in a strong cylindrical glass vessel, the lower portion of which contains mercury, in which the pump is immersed, and with which the pump chamber freely communicates by means of a suction orifice, while above the mercury is the usual alcohol filling the bulk of the vessel.

If in good working order, the mercury jet interrupter gives excellent results, as may be seen by referring to the curve marked "mercury jet" in Fig. 4, which corresponds to a frequency of interruption = 40. A comparison of this curve with that given in Fig. 2 for the rotating air-break interrupter at once shows the superiority of the jet interrupter. The mercury jet interrupter is much more expensive and complicated than the "double-dipper" type, and requires a larger amount of mercury; but it yields somewhat better results.

In Fig. 6 is shown the Wehnelt interrupter. A large rectangular glass vessel containing dilute sulphuric acid is fitted with an ebonite cover, E C, which supports the electrodes. The terminal T_2 is in connection with the lead plate, L P, which forms the kathode. The bridge-piece, B,

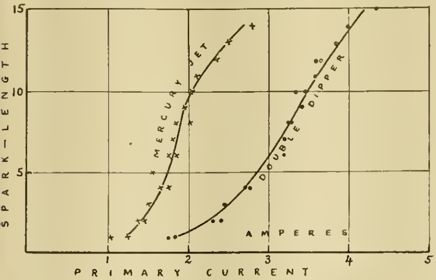

FIG. 4.

supports two rack rods, R, and the anode terminal T_1. Each rack rod is geared with a pinion by means of which it may be raised or lowered as required, M H being the milled heads for turning the pinions. The rack rods are continued downwards in the form of thinner rods encircled by glass

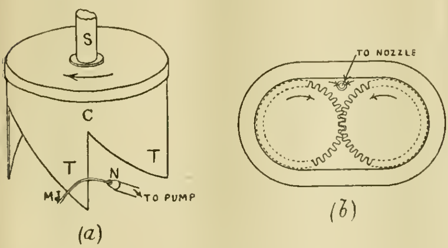

FIG. 5.

tubes, G T, and finally end in stiff platinum points, P P, around which the tapered ends of the tubes fit very closely. By raising or lowering either anode, a smaller or greater surface of it may be exposed to the surrounding electrolyte. The density of the acid depends on the voltage at which the

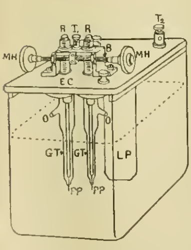

FIG. 6.

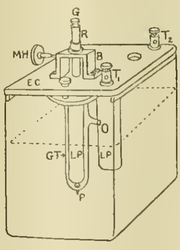

FIG. 7

interrupter is to be supplied. The interrupter is connected in series with the primary of the induction coil, and, if necessary, with an additional self-inductance. As soon as the circuit is closed, and provided the area of anode surface exposed to the electrolyte is not excessive, and the self-inductance not too small, the interrupter begins to act. A pink glow appears around the extremities of the anodes, the interrupter emits a loud note of definite pitch, and a shower of sparks is produced across the space between the secondary terminals of the coil. Bubbles of gas rush up each glass tube, G T, the electrolyte rises in each tube, and may overflow through the side openings, O.

Another form of electrolytic interrupter, originally due to Caldwell, but subsequently improved and modified in various ways by others, is shown in Fig. 7. The terminal T_2 is, as in the Wehnelt interrupter, connected to a lead plate. But instead of a platinum anode, a lead plate is also used for the other electrode. This second lead plate is surrounded by a glass tube, G T, which completely separates it from the remainder of the electrolyte except for a small perforation at the bottom of the tube, through which passes the pointed end, P, of a long glass rod, G, supported in a tubular rack rod, R, which may be raised or lowered by means of a pinion fitted with the milled head, M H. The area of communication between the electrolyte in the tube and that outside is controlled by raising or lowering the conical glass plug. Either electrode may be used indifferently as anode or kathode. The break takes place at the perforation of the glass tube.

In conclusion, thanks must be expressed to Mr. A. C. Cossor, of 54 Farringdon Road, E.C., who very kindly provided an induction coil and a number of interrupters required to carry out the tests recorded in this article.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is stated that Sir William MacDonald, of Montreal, has decided to give 800,000*l.* toward the erection of a normal school at St. Anne de Bellevue, a few miles distant from Montreal, and the erection and endowment of an agricultural college at the same place.

THERE is no sign of diminution in the interest shown by public authorities and by private benefactors for higher education in the United States. We learn from *Science* that by the will of Mrs. Stanford about 400,000*l.* is bequeathed to Leland Stanford Junior University. The university also comes into possession of the house built by Senator Stanford at San Francisco and its contents, which are valued at more than 400,000*l.* The legislature of North Carolina has appropriated 10,000*l.* for the erection of a chemical laboratory at the University of North Carolina.

WE have received a copy of the prospectus of courses of instruction in poultry-keeping held at University College, Reading, and the college poultry farm at Theale. The farm, which is of about 40 acres, largely meadow land, is used also as an experimental station. The courses are of varying lengths and different degrees of difficulty to meet the requirements of all grades of students. The practical work is exhaustive, and due attention is given to kindred technical subjects such as carpentry. It appears that this branch of the work of the college has had an important influence on the development of scientific poultry-keeping in Berkshire and neighbouring counties.

A STRONG committee has been formed for the purpose of securing suitable conditions of work, and providing opportunities for development, of Bedford College for Women in London. An appeal to the public on behalf of the college has just been issued. The college, which is a school of the University of London, must before long come to an end unless it can obtain a large amount of public support. A freehold site and a new building are essential, and it is estimated that their cost may amount to 150,000*l.* Experience has shown that the fees of the students and the allotted share of the Treasury grant to university colleges are not sufficient without considerable additional support to carry on the higher education supplied by the college, the cost of which is constantly increasing. To make the work of the college fully effective, it is therefore desirable to obtain further endowment to the extent of 100,000*l.*, or the equivalent income. The Senate of the University of London has shown approbation of the scheme for re-housing and endowing the college by passing the following resolution:—"That the authorities of Bedford College in issuing an appeal for funds in accordance with the scheme submitted to the Senate be permitted to state that the appeal is made with the knowledge and full approval of the Senate." The Princess of Wales has promised a donation to the funds, and Lady Tate has promised 10,000*l.* for a library to be called after the late Sir Henry Tate. Donations to the fund may be sent to Major Darwin, hon. treasurer of the college, or to Miss Henrietta Busk, hon secretary of the appeal fund, at Bedford College, Baker Street, W. Friends of higher education for women are urged to help in placing the college on an adequate and permanent basis.

Mr. Arnold-Forster, M.P., Secretary of State for War, distributed the prizes to successful students of the Woolwich Polytechnic on Saturday last. In his speech which followed the presentation of the prizes Mr. Arnold-Forster emphasised the importance of sound scientific and technical education. He said that the great lesson this country has to learn is the importance of scientific organisation. There was a time, not so long ago, when we were in the habit of laughing at the methods and ways in vogue on the Continent, and of considering ourselves immeasurably superior to Germany and other nations. But a change has taken place, and these other nations—not by following our example, but by organising on scientific lines—have become immeasurably more advanced and fit to succeed than those who preceded them one or two generations ago; and we have to exert ourselves to protect ourselves from defeat in the industrial contest. Referring to the importance of scientific organisation, Mr. Arnold-Forster spoke of an instance in which he discovered that the electric carbons in use by the Admiralty were largely manufactured in France. Realising the importance of this in case of war, he made inquiries, and, as the result of these and of experiment, it has been found possible to produce electric carbons in this country of the same perfection and accuracy as those formerly brought in from abroad. He expressed his pleasure that a great step forward has been made in the matter of standardising and testing, and that in both these departments this country is abreast of the times. A good deal could be done by scientific organisation, and he looked to such institutions as the polytechnics to accomplish much in that direction.

The address delivered by Prof. Henry T. Bovey, F.R.S., at the Universal Exposition, St. Louis, 1904, on the fundamental conceptions which enter into technology, has been reprinted as a pamphlet from the *McGill University Magazine*. After defining the "technologue" as an intermediary between the savant and the mechanic, translating the discoveries of the former into the uses of the latter, Prof. Bovey tries to ascertain the controlling ideas common to all technical experts. These, he says, have all observed that nature works in no arbitrary manner, but by fixed laws; that if these laws could be brought into right relation with us, we might be able to gear our small machines to the vast wheel of nature; that in the study of the laws of nature there is certainly revealed more of the infinite possibilities of our environment. In order to study to advantage, workers in pure and applied science must get into line with psychological laws, when it will be found that the apprehension of a fact by the mind requires the exercise of the power of observation, and the observations must be of a special character, minute, accurate, and selective. Observation, he says, means to see with attention, and as soon as concentration takes place, a process of analysis begins and the worker passes to classification and generalisation. Throughout this process the training of the hand stimulates the brain centres. Technology has a two-fold nature; first, learning by specialised study how to understand and apply the principles of mechanics to the construction of works of utility, and, secondly, training the mind to work easily along lines of scientific thought. The idea of utility, he maintains, seems to be the key to the distinction between pure science and technology; indeed, technology may be called the child of science on one hand, and of industrial progress on the other.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 16.—"On the Occurrence of Certain Ciliated Infusoria within the Eggs of a Rotifer, considered from the Point of View of Heterogenesis." By H. Charlton **Bastian,** M.A., M.D., F.R.S.

The weight of preconceptions against the possibility of the occurrence of heterogenesis has hitherto been so strong as to have made it almost impossible to obtain any adequate consideration for the actual evidence adduced in favour of this or that alleged instance. But of late, preconceptions in the domain of physics and chemistry have received severe shocks, and when we are told that a so-called "element" is daily being transformed and another is actually originating therefrom, there appears more chance of attention being paid to the alleged existence of phenomena in the organic world which would seem to be but the carrying on into a higher platform of the familiar but important phenomena known as allotropism and isomerism.

Hitherto, alleged instances of heterogenesis have, without adequate consideration of evidence, been almost always assumed to be results of "infection," but the writer claims that in the cases with which the present memoir is concerned, any such explanation is quite impossible in regard to one of the cases, at least, in which we have masses of living matter so large that they average $\frac{1}{8}$ mm. in diameter, being converted in the course of three days into great ciliated Infusoria of equal bulk.

The communication (which is illustrated by a large number of photomicrographs) deals with two sets of heterogenetic transformations occurring in the great eggs or "gemmæ" of one of the largest of the rotifers, namely, (1) the transformation of the entire contents of a Hydatina egg into a single great Otostoma; and (2) the segmentation of the Hydatina egg into twelve to twenty spherical masses, and the development of these sometimes into embryo Vorticellæ and sometimes into embryo Oxytrichæ.

(1) *The Transformation of the Entire Contents of a Hydatina Egg into a Great Otostoma.*—Having witnessed on very many occasions the stages of this remarkable transformation of the contents of a rotifer's egg into a ciliated infusorium, the author is desirous of acquainting the Royal Society with the simple procedure needful to enable zoologists to study for themselves the series of changes leading to a result which many of them may be disposed to deem incredible.

All that is necessary is to procure a good stock of these large rotifers by placing some surface mud, having a coating of Euglenæ, from a ditch in which Hydatinæ are known to exist, into a glass bowl, and to pour thereon water to a depth of about 4 inches. In the course of two or three days (with a temperature of 16° C. or 17° C.), if the Hydatinæ are abundant, a good crop of their large eggs will be seen at the surface of the fluid, where it is in contact with the glass.

By the aid of a scalpel passed along their track for a short distance, groups of twenty or thirty eggs may be taken up at one time, and gently pressed off the edge of the blade into a small, white stone pot full of water. Some of such small masses of eggs (mixed, perhaps, with a few Euglenæ) will float, and others will sink. After seven or eight of these masses have been gathered and deposited, the cover should be placed upon the pot so as to cut off from the eggs all light rays, both visible and invisible. Two other pots should be similarly charged.

When the pots have remained covered for thirty-six hours, one of them may be opened, and some of the small masses of eggs from the bottom of the pot should be taken up with a tiny pipette and placed in a drop of water on a microscope slip.

On examination by a low power it will be seen that there are many empty egg-cases, that within some eggs there are embryo Hydatinæ in different stages of development, while within the remaining eggs the contents will be wholly different, consisting of an aggregate of minute pellucid vesicles, each containing a few granules, together with a variable amount of granules interspersed among the vesicles.

When a second pot is opened two and a half or three days after the eggs have been placed therein, and portions of its contents are examined in the same way, a larger proportion of empty egg-cases will be seen. There may be very few or even no developing rotifers still within the eggs, and in other egg-cases, instead of the motionless vesicular contents previously seen, great ciliates may be found slowly revolving, or, under the influence of the light, rupturing the egg-case, struggling out, and swimming away with rapid movements, partly of rotation. Some of the Infusoria before they emerge undergo segmentation into two, four, or rarely, even into eight smaller ciliates.

The large undivided Infusoria have their bodies densely packed with large corpuscles (modified representatives of the vesicles of an earlier stage), and a large elongated nucleus which can be readily seen in some of them. They possess the characteristic ear-shaped mouth indicated by the name Otostoma, and cilia are distributed all over the body in longitudinal lines, so as to give the appearance of a delicate longitudinal striation.

As a control experiment it will be well at the time that the pots are charged to place two or three batches of the eggs with some of the same water into a watch glass, which is left exposed to light; and at the expiration of three or four days, as well as at later periods, to search among its contents for any of the same large ciliates, and also for any eggs in the intermediate vesicular stage above referred to. The author has invariably found that such a search yielded only negative results.

In taking batches of eggs, in the manner indicated, to be placed in the pots, individual eggs will necessarily be of different ages. It is only eggs that have not begun to develop which, under the cutting off not only of ordinary light, but probably of some invisible light rays, become speedily transformed into great ciliated Infusoria. Cutting off ordinary light rays alone from the eggs, by placing them in a small covered glass dish shut up in a cupboard or box and maintained at the same temperature as before, seemed at first not to lead to similar results, but it was subsequently ascertained that the transformation will occur under such conditions, though only after the lapse of about nine days. It looks, therefore, as if the stoppage of some invisible rays, capable of passing through wood but not through stone, notably hastens the process.

During the time that these observations were being made, and previously, no Otostomata had ever been seen in association with Hydatinæ, except those that had been taken from the experimental vessels. On two occasions since, though from wholly different localities, Otostomata had been found in association with Hydatinæ. The adult forms have been found to be much larger, having from two to three times the length of the great embryos which issue from the egg-cases, and also to be more highly organised.

Many of these adult specimens the author has been able to keep for two months, and he has seen them pass into an encysted condition, when they constitute masses the bulk of which is several times greater than that of Hydatina eggs. They are, likewise, enclosed in thick cyst walls, wholly unlike the thin egg-cases of the Hydatina.

A Hydatina egg could not possibly be confounded with an adult encysted Otostoma, and the embryo Otostoma which emerges from the egg-case embodies the whole of the transformed substance of the egg. *No minute Otostoma is ever to be seen within an egg, devouring its contents.* No ciliate is seen until the total contents of the egg having been transformed, the whole mass begins to revolve within the egg-case as a great embryo Otostoma.

(2) *The Origin of Twelve to Twenty Vorticellae or Oxytrichae from the Substance of a Single Hydatina Egg.*—These are most remarkable variations, which at different times have been occasionally met with in Hydatina eggs taken from the experimental vessels.

If the egg-substance is found to have segmented into twelve to twenty more or less equal spherical masses, there is at first no means of knowing whether such masses are to be developed into embryo Vorticellæ or into embryo Oxytrichæ. But if either of the masses is seen to be revolving within its own delicate cyst, we may be sure that this particular egg will not yield Vorticellæ, as these embryos do not revolve before rupturing their cysts, and the Hydatina egg produces either the one or the other form—never a mixture of the two.

It cannot be supposed that twelve to twenty of either of these ciliates in an embryo condition could penetrate the egg-case, could devour its contents without being seen, and would then, as embryos, encyst themselves (all in two days, or less)—only, almost immediately after, again to pass out of their encysted condition, and to appear as the active young Vorticellæ or Oxytrichæ the development of which the author has traced.

In its normal development the Hydatina egg never goes through changes in which it is converted into an aggregate of minute vesicles, or into a smaller number of separate and larger spheres, such as occurs as a prelude to the transformation of the egg-contents into ciliated Infusoria of this or that kind.

Geological Society, March 8.—Dr. J. E. Marr F.R.S., president, in the chair.—*Exhibits.*—A series of photographic views illustrating the geological structure and physical features of the mountains of Skye: A. **Harker.** The "Cullinan" diamond: Dr. F. H. **Hatch.** By means of lantern slides from photographs the diamond was shown from four points of view. The stone was a portion (probably less than half) of a distorted octahedral crystal. As it now existed, the stone was bounded by portions of four original octahedral surfaces and by four cleavage-planes. The former showed in places a slight curvature, a mammillary structure, striations, and triangular pittings, while the cleavage-surfaces were distinguished by greater regularity and smoothness. The stone weighed 3024¾ carats. Its greatest linear dimension was 4 inches. It was of remarkable purity for so large a stone, approaching "blue-white" in colour. It was found at the beginning of the present year, in the "yellow ground" of the Premier Mine, at a depth of 18 feet below the surface. The Premier Mine was a true "pipe," situated on the farm of Elandsfontein, twenty miles north-east of Pretoria (Transvaal).—*Papers.*—Observations on some of the Loxonematidæ, with descriptions of two new species: Miss J. **Donald.** Shells having more convex whorls, or less sigmoidal lines of growth than *L. sinuosum*, cannot be left within the genus Loxonema. The two new species described resemble the type in form and in the sinuosity of the lines of growth; but the whorls are ornamented with spiral striæ, two of which frequently stand out and give the shell a banded appearance.—On some Gasteropoda from the Silurian rocks of Llangadock (Caermarthenshire): Miss J. **Donald.** These fossils occur almost entirely in the state of casts and moulds. Eleven distinct forms have been made out, referable to seven genera; but only seven are sufficiently well preserved for specific determination. Five of these are new, including one described in the previous communication; a new genus is described, for the reception of *Euomphalus funatus.*

Chemical Society, March 15.—Prof. W. A. Tilden, F.R.S., president, in the chair.—It was announced that Prof. Percy Frankland had presented to the society the eudiometer made and used by the late Sir Edward Frankland for the analysis of ethyl in 1849; that Prof. Retzius, of Stockholm, had presented an engraving of Berzelius; and that Mr. Oscar Guttmann had presented a bronze medal struck in honour of Roger Bacon in Paris in 1818. The council, on behalf of the society, had expressed its thanks for these gifts.—The following papers were read:—The velocity of oxime formation in certain ketones: A. W. **Stewart.** The results of measurements of these velocities are generally in agreement with those already found for the addition of sodium hydrogen sulphite to ketonic compounds, and since the two reactions belong to different types, it seems probable that the hindrance to the reactions in the case of ketones containing many methyl groups near the carbonyl is due to stereochemical and not to purely chemical causes.—The ultra-violet absorption spectra of certain enol-keto-tautomerides, part ii.: E. C. C. **Baly** and C. H. **Desch.** The results indicate that the absorption band in these compounds is due to change of linking taking place when one tautomeric form passes into the other. It is possible to account for the formation of the absorption bands by adopting the physical conception of the atoms as a system of electrons, and in this way the formation of the bands is placed in the same category as other spectral phenomena.—Esterification constants of substituted acrylic acids: J. J. **Sudborough** and D. J. **Roberts.** The esterification constants of some twenty-two substituted acrylic and allied acids with methyl alcohol have been determined. The results indicate that a substituted acrylic acid is esterified less readily than the corresponding saturated acid, and more readily than the corresponding acetylenic acid, and that the effect of introducing substituents into acrylic acid is to lower the rate of esterification.—α-Chlorocinnamic acids: J. J. **Sudborough** and T. C. **James.**—Di*ortho*-substituted benzoic acid, part vi., conversion of methyl into ethyl esters: J. J. **Sudborough** and T. H. **Davies.**—Simple method for the estimation of acetyl groups: J. J. **Sudborough** and W. **Thomas.** The acetyl derivative is hydrolysed with benzenesulphonic acid and the mixture subjected to steam distillation.—Gynocardin, a new cyanogenetic glucoside: F. B. **Power** and F. H. **Lees.** This substance, obtained from the seeds of *Gynocardia odorata*, has the formula $C_{13}H_{19}O_9N$, and is readily hydrolysed by *gynocardase*, the enzyme present in the seeds, and with difficulty by boiling 5 per cent. hydrochloric or sulphuric acid yielding *d*-glucose, hydrogen cyanide, and an undetermined aldehyde or ketone. With alkalis it yields *gynocardinic acid*, $C_{12}H_{19}O_9.CO_2H$.—Catechin and acacatechin. Supplementary note: A. G. **Perkin.**—The action of ethyl dibromopropanetetracarboxylate on the disodium derivative of ethyl propanetetracarboxylate. A correction: W. H. **Perkin,** jun.—Glutaconic acid and the conversion of glutaric acid into trimethylenedicarboxylic acid: W. H. **Perkin,** jun., and G. **Tattersall.**—The transformations of highly substituted nitroaminobenzenes: K. J. P. **Orton** and A. E. **Smith.**—An asymmetric synthesis of quadrivalent sulphur: S. **Smiles.** It is shown that the two isomeric *d*- and *l*-methylethylthetine *l*-menthyl ester bromides are produced in equal amount from the interaction of methylethyl sulphide and *l*-menthyl bromoacetate.—The action of α-halogen ketones on alkyl sulphides: S. **Smiles.** It has been found that certain α-halogen-substituted ketones interact with alkyl sulphides, forming the halides of sulphine bases. Descriptions of the products formed in several cases are given.—Pinene *iso*nitrosocyanide and its derivatives: W. A. **Tilden** and H. **Burrows.** Pinene *iso*nitrosocyanide is shown to be a nitrile, and from it has been obtained the corresponding pinene *iso*nitrosocarboxylamide,

$$C_{10}H_{15}(:NOH).CO.NH_2,$$

which on hydrolysis with hydrochloric acid yields an oily substance which is probably the ketonic acid

$$O:C_{10}H_{15}.CO_2H.$$

—Some interactions of metallic cyanides with organic bases: R. de J. **Fleming-Struthers.** Descriptions of a number of compounds produced by the interaction of phenylhydrazine with various metallic cyanides are given.

Royal Microscopical Society, March 15.—Mr. A. D. Michael in the chair.—A review of the work done by metallographers: J. E. **Stead,** F.R.S. Illustrations were shown of the changes produced in metals by strains, a diagram of the apparatus by which rapid reversals of strains were effected being exhibited in illustration of this portion of the subject. The effect of the continued heating of an alloy of copper and tin in boiling mercury, and also that produced by immersion in liquid air, were demonstrated. Slides were also shown to illustrate "surface flow" in antimony, and the microscopic structure of the new silver standard.

Linnean Society, March 16.—Prof. W. A. Herdman, F.R.S., president, in the chair.—*Exhibits.*—Animated photographs of plants taken by the kammatograph, showing the natural movements of the plants accelerated so as to be followed readily by the eye: Mrs. D. H. **Scott.**

A series of thirty lantern-slides, from photographs, of bird-life in the Falkland Islands: R. **Vallentin.**—*Paper.*—Contributions to the flora of Liberia: Dr. Otto **Stapf.** Descriptions of 3 new genera and 56 new species, in a collection of about 260 species, collected by Mr. Alexander Whyte in the neighbourhood of Monrovia, in three different localities. The flora shows a specific likeness to that of Sierra Leone, and the new genera are not endemic.

Physical Society, March 24.—Prof. J. H. Poynting, F.R.S., president, in the chair.—Note on the voltage ratios of an inverted rotary converter: W. C. **Clinton.** The values of the voltage ratios usually given for an inverted rotary converter make no allowance for the resistance of the armature. In this note terms due to the effect of armature resistance are introduced into the ordinary theoretical equations. The resultant voltage on the alternate current side is found to be less than that given by the usual rule. The calculation is only made for open circuit conditions on the alternate current side.—On the flux of light from the electric arc with varying power supply: G. B. **Dyke.** The paper records the results of experiments made on the electric arc with the following objects:—(1) To obtain a series of curves for alternating and continuous arcs of different lengths showing the relation between the mean spherical candle-power and the power supplied to the arc; (2) to compare the efficiencies of the alternating and continuous arcs under different conditions of arc-length and power-supply.—On the application of the cymometer to the measurement of coefficiencies of coupling of oscillation transformers: Dr. J. A. **Fleming.** This paper deals first with the latest pattern of instrument called by the author a cymometer, designed for the measurement of the frequency of electric oscillations, and also the length of long electric waves.

CAMBRIDGE.

Philosophical Society, March 13.—Prof. Marshall Ward, president, in the chair.—On the relation in size between the megalosphere and the microspheric and megalospheric tests in the Nummulites: J. J. **Lister.** At the meeting of the society on October 31, 1904, the author directed attention to the fact that in the three English species of Nummulites, viz. *N. laevigatus, variolarius* and "*elegans*," both megalospheric and microspheric forms were represented and associated in the Bracklesham and Barton beds of the Hampshire basin. A comparison of the sizes of the megalospheres in these species suggested that a definite relation might exist between them and the sizes of the whole microspheric tests. To examine this question several species have been studied. Arranging these species in order of the sizes of the megalospheres, this is found to coincide with the order of the volumes of the microspheric tests (with the exception of the variety *obesus* of *N. perforatus*, the microspheric test of which falls one place out in the series).—The penguins of the Antarctic: E. A. **Wilson.**—The old moraines of South Victoria Land: H. T. **Ferrar.** The paper first dealt with the topography of South Victoria Land, a land consisting of a range of mountains some 800 miles long in a north and south direction, with a steep eastward face on an average 10,000 feet high, facing the sea and buttressing a vast interior ice-field. Details were given of the stranded moraines on Cape Adare, on the Possession Islands and on Franklin Island, as well as those high on the slopes of Mount Erebus and Terror. The latter could only have been landed there by the Ross ice-sheet being thicker than it is at present. Reversed glaciers, glaciers not reaching the sea, and beheaded glaciers were mentioned, all pointing to the same conclusion, a retreat of the ice. This retreat is now going on, so that increase of cold could not produce a greater glaciation. If this former greater extension was due to a warmer climate, why have the New Zealand glaciers decreased of late, and what is the connection of the "Ice-age" of Europe with the "Great Glacier Epoch" of New Zealand and Patagonia?—Notes on a collection of parasites from the museum of University College, Dundee: A. E. **Shipley.** The collection consisted of fifteen species of Nematoda and ten Cestoda, and came mainly from marine animals of the northern seas, as might have been expected from the importance of Dundee as a whaling centre.—On the maturation of the egg and early development in certain sawflies (Tenthredinidæ): L. **Doncaster.** In the eggs of sawflies which produce males when unfertilised (*Nematus ribesii, N. lacteus, N. pavidus*), the second polar nucleus conjugates with the inner daughter nucleus of the first polar body. The conjugating nuclei then break up into a group of chromosomes which contain twice the number that is found in the maturation mitoses. These chromosomes persist for some hours, but finally disappear. In the species which produce females from unfertilised eggs (*Poecilosoma luteolum*, *Hemichroa rufa*, *Croesus varus*) no conjugation between polar nuclei takes place. In all cases the egg-nucleus sinks into the yolk and gives rise to the cells of the embryo, and the chromosome number remains the same as that observed in the maturation divisions. Centrosomes were never seen in the maturation mitoses, but are present in the division-spindles of the yolk-nuclei and blastoderm of both fertilised and virgin eggs.—Densities of the earth's crust beneath continents and oceans compared: Rev. O. **Fisher**.

PARIS.

Academy of Sciences, March 27.—M. Troost in the chair.—On vessels of fused silica, their employment in chemistry, and their permeability: M. **Berthelot** (see p. 544).—The construction in an opaque homogeneous medium of luminous rays which penetrate by a plane face: J. **Boussinesq**.—On surra and the differentiation of trypanosomes: A. **Laveran** and F. **Mesnil**. An experimental comparison of the trypanosomes of surra arising in the island of Mauritius and in India shows that they are morphologicaly the same, but the pathogenic action upon animals in the laboratory showed some differences between the two trypanosomes. It seems clear that the trypanosomes of surra of Mauritius and of India are the same species. There are three species which differ in their virulence, the order of activity being India, Mauritius, and Mbori.—On the plants from the Coal-measures found in the borings at Éply, Lesménils, and Pont-à-Mousson: R. **Zeiler**. The impressions of plants found at Éply correspond to a well marked Westphalian flora. Of the specimens from the Lesménils boring two, *Lonchopteris Defrancei* and *Cingularia typica*, have hitherto been observed in the Sarre coal basin, and hence would appear to point to the beds now being explored being a prolongation of this field. The specimens from Pont-à-Mousson also point to the Sarrebrück stage of the Westphalian Coal-measures.—On the monochloro-derivatives of methylcyclohexane: Paul **Sabatier** and Alp. **Mailhe**. Chlorine acts readily upon methylcyclohexanone at the ordinary temperature, giving rise to numerous chlorinated derivatives. Of these a special study has been made of the monochlor-derivatives, the main product being shown to consist of two of the five possible isomers.—Prof. van 't Hoff was elected a correspondant for the section of mechanics in the place of the late Prof. Willard Gibbs.—The search for Tempel's periodic comet (1867, 2) in 1905: R. **Gautier**. This comet, first seen in 1867, and again in 1873 and 1879, did not make its reappearance as predicted in 1885, 1892, and 1898. The date of its possible appearance in 1905 is discussed, and its elements calculated. The author expresses the hope that a special search will be made over the regions indicated by observatories possessing instruments of sufficient power or equipped with photographic apparatus.—On Coulomb's law: L. **Lecornu**. A reply to some remarks of M. Painlevé on the same subject.—On a new arrangement for the use of the methods of interferential spectroscopy: Ch. **Fabry**. The method is specially adapted for the study of a spectrum formed of numerous brilliant lines, such as that of iron, in the electric arc. The apparatus is a modification of one previously described by the author. Instead of the interference bands being observed directly, they are viewed through a spectroscope, the slit of which may be left fairly large, unless rays very close together are under observation. The arrangement possesses several advantages over the earlier form, the chief being that there is no possibility of mistaking the radiation under examination.—An electrometer with sextants and a neutral needle: M. **Guinchant**. The theory of the instrument is given, together with its experimental verification. The instrument gave a deflection of 310 mm. for a potential difference of one volt, and the delicacy can be increased three times by a slight modification of the arrangements.—The oxidation of metals in the cold in presence of ammonia: C. **Matignon** and G. **Desplantes**. In the presence of ammonia the slow oxidation by oxygen at the ordinary temperature of a large number of metals takes place, including mercury, silver, nickel, cobalt, molybdenum, tungsten, and copper.—Cryoscopic studies made in hydrocyanic acid: M. **Lespieau** (see p. 544).—Ferric ethylate: Paul **Nicolardot**. The author has repeated the experiments of Grimaux, and concludes that the soluble ferric ethylate described by the latter does not exist. The compound always contains sodium.—On substituted ureas from natural leucine: MM. **Hugounenq** and **Morel**. From the carbimide of the ethyl ester of leucine the authors have prepared leucine-hydantoic acid, the mixed urea of leucine and aniline, and symmetrical leucine urea.—On some iodomercurates of pyridine: Maurice **François**.—On the heat of formation of calcium hydride and nitride: A. **Guntz** and Henry **Basset**. By distilling commercial calcium in a vacuum, with rapid cooling of the vapour, the authors succeeded in obtaining the metal in a pure state, and in a finely divided condition suitable for its conversion into the hydride and nitride. The calorimetric results show that all the heats of formation of calcium compounds, based on Thomsen's data, ought to be increased by 20·4 calories. This gives a positive instead of a negative heat of formation for calcium carbide.—Some applications of Watt's principle to the dissociation of the carbonates of lead and silver: Albert **Colson**.—The heat of formation of oximes: Ph. **Landrieu**. The amount of heat given off by the reaction between aldehydes and ketones has been studied in two ways: firstly, by the interaction of the two substances in aqueous solution in presence of soda, and secondly, indirectly, by the bomb calorimeter. Figures are given for oximes derived from acetone, acetaldehyde, methyl-ethyl-ketone, benzaldehyde, acetophenone, camphor, and diphenyl-ketone, good agreement being obtained between the two methods.—On the origin and composition of the essence of herb-bennet root: Em. **Bourquelot** and H. **Hérissey**. It is found that the essential oil does not exist preformed in the plant, but is the result of the interaction of a new enzyme upon a glucoside. The smell is due to the presence of eugenol, the latter being identified by conversion into its benzoyl ester.—On the experimental bases of the reticular hypothesis: G. **Friedel**.—On a case of commensalism between a species of Balanoglossus and *Lepidasthenia Digueti*: Ch. **Gravier**.—On the cause of the variations in the length of the intestine in the larvæ of *Rana esculenta*: Émile **Yung**. It is shown that the shortening is retarded by the presence of undigested substances, the shortening taking place when the intestine is empty.—On the growth in weight of the guinea-pig: Mlle. M. **Stefanowska**. The relation found between weight and age is shown in the form of two curves, algebraic expressions for which are also given.—On the heats of combustion of the nervous and muscular tissue of the guinea-pig, expressed as a function of the age: J. **Tribot**.—Contribution to the study of acid dyscrasia: M. A. **Desgrez** and Mlle. Bl. **Guende**.—The action of calcium permanganate upon the toxins of tetanus, diphtheria, and tuberculosis: J. **Baudran**.—On a case of osteomalacia causing extreme deformation of the skeleton, and terminated by a spontaneous retrocession of the lesions: P. **Berger**.—On the favourable action of the X-rays in some cases of non-suppurating tuberculous adenopathy: J. **Bergonié**.—The palæontological discoveries of M. de Morgan in Persia: H. **Douvillé**.—On the discovery of coal at Meurthe-et-Moselle: C. **Cavallier**.—On the boring for coal at Meurthe-et-Moselle: R. **Nicklès**.—The discovery of a workable seam of coal in French Lorraine: Francis **Laur**.—On the course of the solidification of the earth: A. **Leduc**. A discussion of the views on this question recently put forward by MM. Lœwy and Puiseux.—On the influence of eclipses on the movement of the atmosphere: W. **de Fonvielle** and Paul **Borde**.—The relation between the density and salinity of sea-water: A. **Chevallier**.

INDIA.

Asiatic Society of Bengal, March 1.—Earwigs of the Indian Museum: M. **Burr**. A list of the specimens in the Indian Museum, with descriptions of four new species.—On the fresh-water polype of the Calcutta tanks, with exhibition of living specimens: N. **Annandale**. The polype of the Calcutta tanks is identical with *Hydra viridis*, Linn. It varies considerably in colour. What is probably the same species has been seen in the botanic gardens at Penang.—The composition of the oil from Bir

Bahoti or the "rains insect" (*Bucella carniola*): E. G. **Hill.** An oil extracted from this mite is used medicinally by the Mohammedans of Allahabad. Analysis shows that its chief constituent is myristodiolein, with small quantities of stearin, cholesterol and colouring matter.—Contributions to Oriental herpetology, ii., notes on the lizards in the Indian Museum, with descriptions of new forms and lists of species recorded from British India and Ceylon, and of specimens collected on Sinkip Island (East Sumatra) by the late Prof. Wood-Mason's collector (part i.): N. **Annandale.** The present contribution deals with the collection of Oriental geckos, eublepharids, agamids, slowworms and monitors in the Indian Museum. Three new forms and a doubtful fourth are described, while notes on the distribution and systematic position of a number of others are given. Customs in the trans-border territories of the North-West Frontier Province: H. A. **Rose.** A contribution to the customary law of the trans-border tribes on the North-West Frontier of India.—The Agraharis of Sasaram: L. S. S. **O'Malley.**

DIARY OF SOCIETIES.

THURSDAY, April 6.

Royal Society, at 4.30.—On Reciprocal Innervation of Antagonistic Muscles, Seventh Note: Prof. C. S. Sherrington, F.R.S.—The Influence of Cobra-Venom on the Proteid Metabolism: Dr. James Scott.—Further Experiments and Histological Investigations on Intumescences, with some Observations on Nuclear Division in Pathological Tissues: Miss E. Dale.—On the Toxin-Antitoxin Reaction, with Special Reference to the Neutralisation of Lysin by Antilysin: J. A. Craw.—On the Nature of the Silver Reaction in Animal and Vegetable Tissues: Prof. A. B. Macallum.—On Endophytic Adaptation shown by *Erysiphe Graminis* DC. under Cultural Conditions: E. S. Salmon.—Ovulation and Degeneration of Ova in the Rabbit: Walter Heape.

Chemical Society, at 8.—The Basic Properties of Oxygen at Low Temperatures. Additive Compounds of the Halogens with Organic Substances containing Oxygen: D. McIntosh.—Note on the Interaction of Metallic Cyanides and Organic Halides: N. V. Sidgwick.—The Chemical Dynamics of the Reactions between Sodium Thio-sulphate and Organic Halogen Compounds. Part II. Halogen-substituted Acetates: A. Slator.—The Chemical Kinetics of Reactions with inverse Reactions. The Decomposition of Dimethylcarbamide: C. E. Fawsitt.—The Tautomerism of Acetyl Thiocyanate: A. E. Dixon and J. Hawthorne.—A Method of Determining the Specific Gravity of Soluble Salts by Displacement in their own Mother Liquor, and its Application in the Case of the Alkaline Halides: J. Y. Buchanan.—The Combination of Mercaptans with Unsaturated Ketonic Compounds: S. Ruhemann.—A new Formation of Acetylcamphor: M. O. Forster and Miss H. M. Judd.—Preparation and Properties of 1:4:5-Trimethylglyoxaline: H. A. D. Jowett.—Bromomethylheptylketone: H. A. D. Jowett.—On the Existence of a Carbide of Magnesium: J. T. Nance.—The Action of Carbon Monoxide on Ammonia: H. Jackson and D. N. Laurie.—Isomeric Salts of the Type $NR_1R_2H_3$. A Correction. Isomeric Forms of *d*-Bromo- and *d*-Chloro-camphorsulphonic Acids: F. S. Kipping.—Isomerism of α-Bromo- and α-Chloro-camphor: F. S. Kipping.—*l*-Phenylethylamine: F. S. Kipping and A. E. Hunter.

Institution of Electrical Engineers, at 8.—Discussion of the Report to Council on the International Electrical Congress at St. Louis, by W. Duddell, and of Papers on Systems of Electric Units Published in Part clxx. (last issue) of the *Journal*.

Royal Institution, at 5.—Synthetic Chemistry: Prof. R. Meldola, F.R.S.

Röntgen Society, at 8.15.—Exhibition Evening.

Linnean Society, at 8.—Intra-axillary Scales of Aquatic Monocotyledons: Prof. R. J. Harvey Gibson.—A further Communication on the Study of *Pelomyxa palustris*: Mrs. Veley.

Society of Arts, at 4.30.—The Prospects of the Shan States: Sir J. George Scott.

Civil and Mechanical Engineers' Society, at 8.—The Design of Concrete-Steel Beams: W. Noble Twelvetrees.

FRIDAY, April 7.

Royal Institution, at 9.—American Industry: Alfred Mosely.

Institution of Civil Engineers, at 8.—Cofferdams for Dock Use: R. G. Clark.—Bath Corporation Waterworks Extension: J. R. Fox.

Geologists' Association, at 8.—The Relative Ages of the Stone Implements of the Lower Thames Valley: M. A. C. Hinton and A. S. Kennard.

SATURDAY April 8.

Royal Institution, at 3.—Some Controverted Questions of Optics: Lord Rayleigh.

The Essex Field Club, at 6.30. (At Essex Museum of Natural History, Stratford).—Twenty-fifth Annual Meeting.—Natural History Museums: F. W. Rudler.

MONDAY, April 10.

Institution of Civil Engineers, at 8.—"James Forrest" Lecture: Unsolved Problems in Electrical Engineering: Colonel R. E. B. Crompton, C.B.

Royal Geographical Society, at 8.30.—The Problem of the Upper Yangtse Provinces and their Communications: Colonel C. C. Manifold.

TUESDAY, April 11.

Royal Institution, at 5.—Tibet: P. Landon.

Institution of Civil Engineers, at 8.—The Maintenance and Strengthening of Early Iron Bridges: W. Marriott.

WEDNESDAY, April 12.

Society of Arts, at 8.—The Industrial Resources of the State of Matto Grosso, Brazil: G. T. Milne.

THURSDAY, April 13.

Royal Society, at 4.30.—*Probable Papers*: A Quantitative Study of Carbon Dioxide Assimilation and Leaf-temperature in Natural Illumination: F. F. Blackman and Miss G. Matthaei.—On Colour Vision by Very Weak Light: Dr. G. J. Burch, F.R.S.—On a New Type of Electric Furnace, with a Redetermination of the Melting Point of Platinum: Dr. J. A. Harker.—The Refractive Indices of Sulphuric Acid: Dr. V. H. Veley, F.R.S., and J. J. Manley.—(1) The Improved Electric Micrometer: (2) The Amplitude of the Minimum Audible Impulsive Sound: Dr. P. E. Shaw.—On the Intensity and Direction of the Force of Gravity in India: Lieut.-Colonel S. G. Burrard, R.E., F.R.S.

Royal Institution, at 5.—Synthetic Chemistry: Prof. R. Meldola, F.R.S.

Institution of Electrical Engineers, at 8.—The Alternating Current Series Motor: F. Creedy.—Discussion of Mr. Bion J. Arnold's address to the joint meeting at St. Louis.

Institution of Mining and Metallurgy, at 8.—The Kedabeg Copper Mines: Gustav Köller.—Refining Gold Bullion and Cyanide Precipitates with Oxygen Gas: T. Kirke Rose.—Wood Gas for Power Purposes and Gas Generator: G. M. Douglas.—Notes on the Prestea District, Gold Coast Colony: P. Poore.—Notes on the New Dharwar Gold Field of India: R. O. Ahlers.—The Cause of Border Segregation in some Igneous Magmas: J. Park.

Mathematical Society, at 5.30.—On Irreducible Jacobians of Degree Six: P. W. Wood.—On Fermat's Numbers and the Converse of Fermat's Theorem: A. E. Western.—On the Strains that accompany Bending: Prof. A. E. H. Love.

FRIDAY, April 14.

Royal Institution, at 9.—The Law of Pressure of Gases below Atmosphere: Lord Rayleigh.

Physical Society, at 8.—On Ellipsoidal Lenses: R. J. Sowter.—(1) The Determination of the Moment of Inertia of the Magnets used in the Measurement of the Horizontal Component of the Earth's Field: (2) Exhibition of a Series of Lecture Experiments illustrating the Properties of the Gaseous Ions produced by Radium and other Sources: Dr. W. Watson, F.R.S.

Royal Astronomical Society, at 5.

Malacological Society, at 8.—Anatomical and Systematic Notes on Dorcasia, Trigonephrus, Corilla, Thersites, and Chloritis: Henry A. Pilsbry.—Some Account of the Anatomy of *Cassidaria rugosa*, L.: Alexander Reynell.—Notes on a small Collection of Shells from the Victoria Falls, Zambesi River: H. B. Preston.—Descriptions of Six New Species of Land Shells from South Africa: H. Burnup.

SATURDAY, April 15.

Royal Institution, at 3.—Some Controverted Questions of Optics: Lord Rayleigh.

CONTENTS.

THURSDAY, APRIL 13, 1905.

A DOCTOR'S VIEW OF THE EAST.

The Other Side of the Lantern. By Sir Frederick Treves, Bart. Pp. xvi+424. (London: Cassell and Co., Ltd., 1905.) Price 12s. net.

AN admirable book; a book written in terse and epigrammatic style, as full of cleverness as anything written by Kipling, and intensely interesting as illustrative of the first impressions conveyed to a highly trained and observant mind by the familiar and superficial details of eastern life. But there is nothing deeper in the book than first impressions, and it was perhaps inevitable that to the student of human nature under those aspects of sorrow and suffering which shadow the sick bed and the hospital, those first impressions should be tinged with the pathos and sadness rather than with the brightness and fulness of the east, and that the general tone of the book should be almost pessimistic. It is as if the lantern had proved to be no better than a common "bull's eye," with nothing on the far side but deep shadow and the policeman. Not that the book is wanting in humour by any means. On the contrary, some of the quaint outlines of men and things sketched in by the artist's hand are as full of humour as anything drawn by Phil May; but it is the grim humour of the man who complained in South Africa of the "plague of women and flies" rather than that of the ordinary holiday tourist infected with the light and sunshine of the eastern world.

The fascination of the book lies in the strength of it, and its appeal to ordinary experience. What Sir Frederick Treves describes with a few powerful and graphic touches of the pen is what we all know and have seen thousands of times for ourselves, and it is the reproduction of our own unwritten (and perhaps unrecognised) sensations that gives such pleasure to the understanding. The keen power of observation possessed by men who are trained by medical experience to judge character by the small superficial details of every-day action is sometimes almost uncanny to those who have eyes to see but see not, passing from country to country well wrapped up in a layer of self-satisfied insularity, regarding the changeful world of human existence as a sort of variety show with no reality at the back of it. Occasionally, no doubt, Sir Frederick permits an artistic fancy to introduce embellishments into the arena of actual observation; but where this occurs one cannot but recognise that he shares with Turner the great faculty of rendering his picture all the more truthful in realising the impression which he seeks to convey.

From the very start at Tilbury the author displays a powerful conception of all those minor features of the voyage eastward which are the framework and making of the voyager's daily experience. He begins with his fellow passengers:—"As an arena for the display of the resources of selfishness a departing ship has great advantages," and follows this up with a record of the mean little stratagems in which travellers will permit themselves to indulge on such occasions, and (it should be fairly admitted) on such occasions only. If there was anything of the usual good fellowship and interchange of little kindnesses which usually distinguishes the fellow voyagers of a P. and O. ship (many of whom are necessarily well acquainted with each other), Sir Frederick does not seem to have remarked them. He is impressed with the aspect of selfishness only. He is deeply interested in Gibraltar (the Rock of the past rather than of the present); charmed with the vision of Crete; inclined to relieve Port Said from the weight of universal anathema with which it is invested; and disappointed with India. At least, so one gathers from his book. He is profoundly impressed with the multitudes of India, and with the melancholy which tinges their whole existence. The truth is that the multitudes would not so much signify if they were equally distributed over the whole continent; and a comparison with France in the matter of population is ineffective for the reason that France much wants more people than she possesses. It is, however, the growing of the multitudes (checked even though it be by periodic famines over vast areas) that affords most serious consideration to Indian administrators.

The general prevalence of an atmosphere of melancholy pervading native life in India is real enough, and it is this which tends greatly to discount the chequered pleasures of European existence in that country. For it is an undoubted fact that in spite of isolation and exile in this "land of regrets" (the land of "grim extremes" Sir Frederick calls it), and the absence of so much that makes life worth living under European skies, life in India has more in it of pleasure than of pain. There are few who leave India quite of their own free will, and many who would gladly end their days there were it not for the disjointing of all ties of friendship by the departure to England of those whom they know best and love best in their own social circle.

Sir Frederick (perhaps naturally) appears to associate melancholy with misery. The association is by no means true of India whatever it may be in other lands; nor does he, with all his profound knowledge of human nature and the effect of environment and occupation thereon, quite appreciate the point of view from which the native looks at the conditions of his own existence. For instance, he finds in the Pahári (the hill men of the Himalayas) a class of people condemned to work as beasts of burden all their lives. Visiting Simla in the "off" season, he finds these men of the hills pervading the Tibet road, toiling painfully towards the Simla market loaded with planks of sawn wood. "They move slowly and they walk in single file, and when the path is narrow they must move sideways. In one day I met no less than fifty creeping wretches in this inhuman procession . . . if there were but a transverse beam to the plank, each one of these bent men might be carrying his own cross to a far-off place of crucifixion." If the author had waited until the "wretches" had stacked their planks for the evening, lit their fires for cooking, and gathered round for the day's ending, he would have found no cheerier, happier hearted folk on the face of the earth than they. There is nothing melancholy about the Pahári. It is perhaps extraordinary that any people who are content (for there is no necessity in this case) to take the place of beasts of burden should be so absolutely unaware of the depth of their own miserable degradation. But so it is, and they would no more thank Sir Frederick for drawing them as central figures in a picture of a "circle in Purgatory" than would the bare-backed inhabitants of the bazaar thank the good missionary for calling them indecent. If he tried to turn a Pahári into a hospital orderly, and to wean him from his mountains and his planks, the contract would not last for a week!

But it is necessarily only with the outward aspect of things Indian that the casual traveller can possibly deal, and it is the freshness and vigour of Sir Frederick's descriptions of native life, his love of colour and nature, that make the charm of his book. Can anything be better than his description of the small shopkeeper of the bazaar? He "lives in the street *coram populo*, and his inner life is generously laid open to the public gaze. In the morning he may think well to wash himself in front of his shop, and to clean his teeth with a stick while he crouches amongst his goods and spits into the lane. He sits on the ground in the open to have his head shaved and watches the flight of the barber's razor by means of a hand glass. The barber squats in front of him and from time to time whets his blade upon his naked leg. The shopkeeper will change his clothes before the eyes of the world when so moved. He also eats in the open, and after the meal he washes his mouth with ostentatious publicity and empties his bowl into the road."

In moving amongst the historical cities of India and in describing them in detail there is, of course, a danger of treading on the skirts of the guide book. Sir Frederick only escapes the peril by the strength and beauty of his descriptions of these relics of the past and his keen appreciation of the stories that these stones can tell; his power of investing palaces and forts with all the movement and glitter, the coming and going, of past races of kings, making these old walls live once more under the light of an India which shall never be again. It is all delightful reading, and the stirring India of Sir Frederick's imaginings owns an enchantment which is wanting in the shadowed India of his latter day observation. There is not much said about Calcutta. The flavour of the place, that "essence of corruption which has rotted for a second time" (Kipling), seems to have been too much for the author; and yet we know that Calcutta is reckoned (statistically, at least) to be one of the wholesomest cities of the world, even when judged by the European standard.

Passing from India to Burma one is not surprised at the air of relief which pervades his book when dealing with that bright and laughter-loving land. Not even the stern critic of woman's mission in camp and hospital can resist the fascination of the Burmese coquette; and his description of Burma and Ceylon (where, *en passant*, the eminent surgeon was introduced to the devil of appendicitis and found him "unreasonably noisy") includes the best and brightest chapter in the book.

China falls again within the shadows cast by the far side of the lantern. The "nightmare city of Canton," where "such peace as is to be found in the city lies only on the green hill side without the walls, where the dead are sleeping," gives the key note of the almost morbid view of Chinese social existence which is taken by the author; and yet throughout his story of China and Japan (which country he also finds somewhat disappointing) there is the same brilliancy of description, the same fertile power of supplying precisely the right touch that is required to complete the sketch, that marks the work as original from beginning to end. It is almost Kiplingesque (to coin a word) in its epigrammatic summary of the usually complicated view of eastern humanity and its environment. It is the best book of travel that has been written for years; and yet when one lays it down regretfully (regretfully because it has come to an end), a feeling of thankfulness steals over one that the endless procession of human life and all the sweet variety of nature in the east is usually ranged for view before our eyes untinted by the medium of medical spectacles. T. H. H.

A BOOK ON MUSEUMS.

Museums, their History and their Use; with a Bibliography and List of Museums in the United Kingdom. By D. Murray. 3 Vols. Vol. i., pp. xv+339; vol. ii., pp. xiii+339; vol. iii., pp. 363. (Glasgow: MacLehose and Sons, 1904.) Price 32s. net.

WE have read the text of the first volume of this work (the second and third are devoted to bibliography, &c.) from title-page to index with the greatest pleasure and satisfaction, and can therefore recommend it to the best attention of those interested in the history and progress of museums. The book itself offers an illustration of an evolution somewhat similar to that of many of those institutions, for it is based on an address delivered by the author, in his capacity as president, to the Glasgow Archæological Society so long ago as the winter of 1897, and from this slender foundation it has gradually grown to its present dimensions. Much of the original address appears to remain in the final chapter of the text, where we find the author comparing the state of museums in 1897 to what it was half a century earlier, and what he presumes it will be in the future.

The work, which claims to be the first really full and approximately complete account of museum history in general, is confessedly written from the standpoint of an archæologist rather than of a naturalist; and it is none the worse for this, although, as we shall point out, there are a few instances where it would have been well had the author taken counsel with his zoological colleagues. Before proceeding to a brief notice of some of the leading features of the text, it may be well to mention that the list of museums in the British Islands is based on the one prepared by the Museums Association in 1887, and that in the bibliographical and "museographical" lists forming the subject of the second and third volumes, reference is made only to museums of which there are printed catalogues or descriptions, or to which reference is made in other works. Consequently, many museums, including a few of some importance, are not referred to at all. In the case of large institutions like the British Museum, only such publications as refer directly to the building and its contents are quoted, so that the strictly scientific "catalogues" find no place in Dr. Murray's lists. That these lists, which must have involved an immense amount of labour in their preparation, will prove of great interest to "museographists" in the future can scarcely be doubted. We are unable, however, to find any reference to Dr. A. B. Meyer's well known survey of European and American museums.

In his first chapter the author discusses what we may call rudiments of museums, directing special attention to curiosities and rarities preserved in churches and cathedrals. Among these we miss a reference to the horn of the aurochs, or extinct wild ox, preserved in the cathedral at Strassburg up to the time of the French revolution. "Some Old Exhibits" forms the title of the sixth chapter, in which reference is made to our ancestors' extraordinary belief in the medicinal value of mummy, "unicorn's horn," and such like. In discussing the so-called giants' bones, the author makes a strange mistake (pp. 46 and 47) in regard to the bones which were assigned early in the seventeenth century to Teutobochus Rex, stating that they turned out to be those of a giant salamander, whereas they were really those of a mammoth. Dr. Murray has evidently confused these remains with Scheuchzer's *Homo diluvii testis*, based on the fossil salamander of the Œningen Pliocene.

Here we may take the opportunity of alluding to certain other errors in connection with zoological matters. On p. 58, for instance, we find the name of the red deer given as *Cervus elephas*, which might well be attributed to the "printer's devil" were it not that a few lines later the author deliberately states that this animal was the ἔλεφας of the Greeks! Again, in discussing the barnacle-goose myth, the author makes the following statement (p. 76):—

"Sir Robert Sibbald, about the same time, examined the whole subject personally, and showed that the Barnacle goose (*Bernicla leucopsis*) was a bird produced from an egg, and that the Barnacle shell (*Concha anatifera*) instead of being that egg was a *pholas*; the Scots piddocks."

If Sibbald made this misidentification, the mistake should have been pointed out—we scarcely dare think the author believes it to be true. As a minor error, it may be pointed out that the skeletons referred to on p. 187 as those of the mammoth are really referable to the mastodon. Finally, the statement on p. 136 that the Sloane herbarium "has recently been transferred from *Montague House* to the Natural History Museum" is scarcely exact or up to date.

Reverting to our survey of the contents of the first volume, we find in chapter vii. an account of some of the earliest museums, while in the eighth chapter those in existence at or about the date of the foundation of the Royal Society (1660) are discussed in considerable detail. A whole chapter is devoted to the history of the collections which formed the basis of the British Museum, and the gradual development of that institution. Museums for the exhibition of special subjects and the museums of Scotland next claim attention. From these the author passes on to museums which were "run" for profit, such as the well known museums of Lever and Bullock in London. Incidentally, it is mentioned how the former of these was disposed of *en bloc* by means of a guinea lottery; and from this there is an easy transition to the breaking-up of museums, with, in certain cases, the total loss of some of the most valuable of their contents.

In the fifteenth chapter Dr. Murray describes the arrangement—or rather want of arrangement—of the old style of museum, and takes occasion to express regret that a sample of one of these has not been preserved to our own day, as an illustration of museum evolution. Thence we pass on to modern museum arrangement, local museums, and the use of museums in general. In connection with museum buildings, it is interesting to note that Haltman, a pupil of Linnæus, advocated the importance of having a north light to the main galleries—advice which has been strangely neglected in the planning of many of our modern institutions. Of the importance of local museums, if run on right lines, and not made into mere curiosity shops, the author is fully convinced; but he is also equally convinced that they should not be left to the administration of local bodies, the members of which, as a rule, have but little conception of their true needs and purpose.

With regard to public museums in general, and especially those of the metropolis and our larger cities, Dr. Murray insists that modern methods of conservation and exhibition, and especially the labour of writing descriptive labels (which have to be from time to time renewed to keep pace with scientific progress), must entail constantly increasing expenditure, both in respect to the staff and to the upkeep of the whole establishment. In one passage (p. 280) he incidentally mentions that specimens shown in a museum do not grow out of date, apparently oblivious of the terrible effects of light in destroying so many zoological exhibits. His arguments for the increase of expenditure in the upkeep of museums are therefore, to a certain extent, understated rather than overestimated.

In regard to the general awakening of the country to the necessity of adequate training in every branch of culture and every department of industry, Dr. Murray writes as follows:—

"One of the most potent engines by which this is to be secured is the museum. Some of our museums are among the finest in the world; many are lending valuable assistance to the advancement and appreciation of art and science. A large number, however, are still content to be mere holiday resorts. All, even the best, must advance, and for this end enlightened and sympathetic administration and a liberal income are required. The museum of 1897 is far in advance of the museum of 1847; but it in turn will be old-fashioned by the end of twenty years, and when the coming (= present) century is half-way through, its methods and arrangements will probably be wholly superseded by something better."

With these words we take leave of a very instructive and fascinating book, which it may be hoped will in some measure serve to awaken greater public interest in museums, and thereby enable them to receive adequate financial support from those responsible for their management. R. L.

ELEMENTARY PHYSIOLOGY.

(1) *A Primer of Physiology.* By Prof. E. H. Starling, F.R.S. Pp. viii+128. (London: John Murray, 1904.) Price 1s.

(2) *Elementary Practical Physiology.* By John Thornton, M.A. Pp. viii+324. (London: Longmans, Green and Co., 1904.) Price 3s. 6d.

(1) ASSUMING an elementary knowledge of the main facts of chemistry and physics on the part of the readers, Prof. Starling has endeavoured to present with as few technical terms as possible the leading ideas which make up present-day physiology.

It is clear that within the limited space of about 120 short pages the accomplishment of such a task is well-nigh impossible, and except in the accuracy of the stated facts due to the author's mastership of his subject, we do not think that the present attempt is more successful than those of others which have preceded it.

The great difficulty in writing such diminutive primers does not lie in the direction of finding matter to insert, but in a superabundance of material which must be left out if the reader is not to be stifled by a congested mass of facts crammed together into the shortest possible space, and as a consequence expressed in the tersest and baldest of language.

It is the difficulty of freeing the mind from the bondage of detail and dealing only with broad outlines which makes such primers dry and uninteresting reading, and causes one to sympathise with the children who are forced to read and to attempt to digest them mentally.

The primer at present under consideration is no worse, and perhaps somewhat better, in this respect than many similar productions; still, it would have served its purpose better if much of the detail had been left out, and room so provided for more ample treatment of the prominent and important aspects of the subject.

In the small amount of space at his disposal the author deals not only with the anatomy and physiology of the mammal, but finds room for some instruction regarding toxins and antitoxins, and a short chapter upon the defence of the body against micro-organisms. The introductory chapter takes up the consideration of the animal as a thermodynamic machine, includes the famous candle-burning experiment and the use of the calorimeter, and then passes rapidly to adaptive reactions, adaptation to poisons, and finally to antitoxins, thus showing that the whole of life is a series of adapted reactions.

In this chapter even the junior chemist who may read the primer will object to the illustration which shows him soda-lime as a fluid in bottles 1 and 4 of the illustration on p. 5, and it is to be feared that the junior physicist will be inclined to regard the calorimeter shown in section on p. 8 as a somewhat impossible piece of apparatus.

The remaining chapters furnish accounts of structure, food, digestion, circulation of the blood, breathing, exertion, the skin and its uses, the history of the food in the body, the chemical factories of the body, the defence of the body against micro-organisms, the physiology of movement and the muscles, the central nervous system, feelings—the whole contained in 112 brief pages, and forming a veritable *multum in parvo*.

(2) It is somewhat difficult on first glancing through Mr. Thornton's book to understand why the word *practical* appears on its title-page, for by far the greater part of the text is purely descriptive, although at intervals directions for simple dissections and experiments are interspersed in an unobtrusive manner.

On looking at the page opposite to the descriptive title page, however, one discovers that it is a member of the "Practical Elementary Science Series" issued by the publishers, and intended, as the author states in his preface, to meet all the requirements of stage 1 (the elementary stage) as set forth in the syllabus issued by the Board of Education, and in similar syllabuses of other examining bodies. Hence both the "elementary" and the "practical" of the title form, so to speak, the "class name" of the series, and are suggested by the syllabus and examination which have evidently given rise to their existence.

It is, in the opinion of the reviewer, a pity that even elementary text-books of science should have to be written to suit the requirements of syllabuses and examinations, but it appears to be inevitable in view of the artificial manner in which a love of science is propagated in this country that the majority of our text-books must be so written.

It accordingly becomes a problem whether such books can best be written by experts engaged upon the particular subject treated, or by the schoolmasters engaged in teaching that subject along with others.

The schoolmaster can claim the advantage in that he is a teacher of children, and knows best how to put the subject so that they will understand it; also, being engaged year after year in preparing pupils for the examination, he knows the requirements of the situation so far as success in the examination is concerned; but his knowledge of the subject and his presentation of it must be chiefly second-hand, since the prosecution of the study is not his daily occupation. On the other hand, the specialist, while he can give a review of the subject from a living acquaintance with it, may fail signally in writing to suit the requirements of the syllabus and the examination, disappoint both teacher and scholars in this respect, and leave his publisher without a market.

The book before us will lead to no disaster in examination results, as a comparison of the sets of examination papers included at the end of the volume with the text of the book amply demonstrates, and it must be added that if an observant student carries out the simple experiments so clearly described at various places in the volume, he will have acquired a very desirable knowledge of the more important features of physiology. But so much cannot be said of the remainder of the text, which aims at far too much statement of detail for the space available, a matter in which the syllabus may be much more to blame than the author.

For example, the student who has learnt no chemistry previously will not be able to digest much from the description of the chemical elements given in a single page, and the same is true of the description of the chief inorganic compounds and the organic compounds of the body, each dismissed in less than a page.

The valuable habit of coordinating knowledge in the form of tables is visible at places in the book, but summaries have a way of becoming either too sweeping or too inexact, and we fear that the pupil, especially after such a concise training in chemistry as we have just indicated, may be in danger of concluding from a perusal of the table on p. 13 that the body contains "mineral salts" formed from a very strange combination of elements, or, from the table on p. 162, that these same "mineral matters" share only "in forming bone and assist in digestion," and not that they are found in every cell and tissue in the body, and form as essential a constituent there as the all-important proteids, which are in the same table represented as the only tissue formers.

B. Moore.

TERRESTRIAL MAGNETISM.

Terrestrial Magnetism and its Causes. By F. A. Black. Pp. xii+226. (London and Edinburgh: Gall and Inglis, 1905.) Price 6*s.* net.

With regard to the earth's magnetism, the general conclusions from observations made on its surface are that it is partly permanent, partly induced, and subject to the effects of electric currents in the earth's crust and the surrounding atmosphere. Moreover, that the direct action of the sun plays a comparatively subordinate part in producing the observed phenomena.

In this book, however, various reasons are submitted for the belief that the general magnetism of the earth, and the constant changes thereof as shown by the hourly variations of the needle, are due to causes external to the earth. In short, that the earth is to be considered as an electromagnet excited by electric currents proceeding from the sun and impelled towards the earth with inconceivable rapidity, the orbital and axial movements of the earth through these currents producing magnetic effects in a manner similar to the winding of an electromagnet through which a current passes.

In order that we may believe this to be the case, we must agree that the sun gives out electric waves continuously in every direction equal to the work of maintaining the earth as an electromagnet. For example, that during the forty-five years of the last century, when, according to computation from observed facts, the earth's magnetic moment hardly changed, these emanations were continuous. At present there does not appear to be any ground for such a belief.

In an endeavour to explain the hourly angular variations of the needle, it is submitted that the earth's magnetic poles probably occupy a considerable area round the centre of which certain centres of primary attraction in them make a daily circuit, due to the action of the sun as the earth rotates on its axis. In addition to the "primary" magnetic pole in North America, it is suggested that a "secondary" pole of a similar nature must exist in northern Siberia. The daily variations of the needle, both in declination and dip, in the northern hemisphere are then attributed to a battle for the mastery between the revolving centres of attraction in the two poles mentioned, modified as the magnetic equator is approached by the attraction of the south magnetic poles.

As one reads through several of the first chapters the fully expressed acceptance of the idea that the attraction of the needle by the magnetic poles is the immediate cause of its variations seems unaccountable, until a fundamental error is reached. This is when the author takes it as generally agreed that, in the same way as steel is attracted by the poles of an ordinary artificial magnet, the magnetic needle is attracted by the poles of that great natural magnet, the earth. Such a statement vitiates whole pages of the arguments adduced.

On the question of the position of the magnetic equator with regard to the terrestrial equator, the results of observation have also been too much ignored. There have not been four crossings of the two equators during the last sixty years, neither are the two known points of crossing regulated by the position of the magnetic poles as suggested. In the Atlantic region, the point of crossing seems to be chiefly regulated by local causes below the earth's surface.

It may be finally remarked that the chapter on magnetic storms is the most acceptable in the book.

OUR BOOK SHELF.

Mechanical Appliances, Mechanical Movements and Novelties of Construction. By Gardner D. Hiscox. Pp. 396. (London: Constable and Co., Ltd., 1905.) Price 12*s.* 6*d.* net.

This book is luxuriously printed, with clear figures, but it is difficult to say more in its praise. It consists of a series of short paragraphs, each with its illustration, describing some mechanical or constructional device. It is similar in plan to those "Centuries of Invention" of which the Marquis of Worcester's was the earliest (1746). The devices described are of the most heterogeneous character, old and new, important and unimportant, useful and useless. They are arranged in the roughest way in sections which have no relation to any natural order of classification. It is difficult to see to whom such a work appeals, but in fairness to the author it should be stated that a previous work of which this is a continuation appears to have reached a tenth edition.

Section ii. is on the transmission of power. The first example is a screw-driver, and the second a sewer rod coupling. Another example is a cash conveyor, which, as money is power, is no doubt an example of transmission of power. On the next page is a viscosimeter, though what power is transmitted in this case is less obvious. Nor would one naturally expect four examples of acoustic telephones to be found under this heading.

Section vii., on hydraulic power and appliances, commences with some very sketchy ideas for wave motors, and then describes a fog-horn buoy. There is no reasonably good account of any one of the important class of water turbines, but there is a quite impossible design for a "multinozzle turbine," and next to this a duplex steam feed pump. There is a figure of a Venturi meter, but the description does not explain its action, and the curiously inaccurate statement is made that the differential velocity produces a differential pressure in two tubes with mouths turned in "opposite" directions, and ends with the very misleading statement that "the measurement is made by a meter." The reader would not realise that the Venturi tube is the meter, and that what the author probably mistakes for a meter is a recorder.

Section viii., on air power, motors and appliances, contains the "pneumatic ball puzzle," an "aërial top," "grain elevators," "a magic ball," a "megascope," a "sailing wagon," a "tail-less kite," and a "sail-rigged merry-go-round"; but nothing about the air-compressors, air-motors, and pneumatic tools which are now so important.

Enough has been said to indicate the general character of the work. Many useful and important devices are described amongst many others which are mere inventors' schemes. There may be readers who like an olla podrida of this kind.

Perhaps the most curious section, and we think the longest, is that on perpetual motions. About these the author does not seem to have quite made up his own mind. He does warn the reader in the preface that the problem is "unsolvable." But later, p. 363, he remarks that "attempts to solve this problem would seem, so far, only to have proved it to be thoroughly paradoxical," a statement which would hardly get many marks in a science examination. Further, we are told on the next page that, although admitting difficulties in the way of its discovery, "many eminent mathematicians have favoured the belief in the possibility of perpetual motion"; also that "it is evident, therefore, that even mathematicians are not agreed."

Modern Theory of Physical Phenomena, Radio-activity, Ions, Electrons. By Augusto Righi. Authorised translation by A. Trowbridge. Pp. xiii + 165. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1904.) Price 5s. net.

IT is an interesting sign of the times that so many books have appeared during the last few months with the object of explaining in non-technical words the recent development of physical science. Part of the interest shown in these subjects by the general reading public is, no doubt, of the unintelligent and wonder-seeking order, which classes the more striking discoveries of natural science with the latest sensation of the law courts, or the cost of the flowers at a Transatlantic ball. But it is fair to hope that some, at all events, of those who read of the advance of knowledge do so with a desire to comprehend the method, as well as to admire the results, of scientific research. A more widely spread application of the open-minded and truth-seeking methods of science to the problems of individual and collective life is, for the sake of the community, greatly to be desired.

The little book before us deals in a light and interesting manner with the conceptions of the physical world which have been used of late in investigating the phenomena of light, electricity, and radio-activity. It states the results of recent inquiries in a clear and intelligible manner, and, if the account of the methods used in reaching the results sometimes seems inadequate, the difficulty of explaining those methods to non-scientific readers may be urged as an excuse.

After an introduction, the book contains chapters on electrolytic ions and electrons; electrons and the phenomena of light; the nature of the kathode rays; the ions in gases and solids; radio-activity; mass, velocity, and electric charge of the ions and of the electrons; and the electrons and the constitution of matter. The volume ends with a useful bibliography of the subjects considered.

The translation, on the whole, is well done, though a certain want of crispness in the literary style is felt in places.

In a future edition one or two corrections would be advisable. The period of vibration of light cannot be "expressed by a fraction whose numerator is unity and whose denominator is a number of fifteen places" unless it is understood that "a fraction" is a fraction of a second. The usual figure given to illustrate the opposite deflection by a magnetic field of the α and β rays from radium exaggerates greatly the deflection of the α rays compared with that of the β rays. This exaggeration is legitimate, in fact, necessary, in a diagrammatic representation; but it should be pointed out in the text, or misconception of the relative magnitudes of the two effects is sure to follow. In Thomson's method of determining the properties of the ions produced by the incidence of ultra-violet light on a metallic surface, the exactness is limited not only by the differing velocities of the ions, as stated in the book. Probably the ions are produced, not solely at the metallic surface, but also in a layer of the gas of finite thickness in its neighbourhood. Thus the distance from the surface reached against the influence of a magnetic field may be different for different ions even if their velocities be the same.

The Journal of the Royal Agricultural Society. Vol. lxv. Pp. clxvi + 392. (London: Murray, 1904.)

THE *Journal* of the Royal Agricultural Society makes its appearance this year in a rather slimmer form than usual, due, however, more to the use of a thinner paper than to a curtailment of the printed matter. The affairs of the society bulk largely as usual, taking up more than half the present volume, while the miscellaneous articles, to which the ordinary reader turns, only occupy about 150 pages. The volume is, in fact, burdened far too much with reports of council meetings and committees, which have lost all interest for the members by the time the annual volume reaches them, and which would be much more to the point if circulated as "proceedings" immediately after the meetings and not reprinted here.

The volume opens with a vivacious and readable account of Sir Humphry Davy by Mr. H. B. Wheatley, who well brings out the charm and fascination of Davy's personality. But we cannot help thinking Mr. Wheatley rates Davy's agricultural work altogether too highly; if any man is to be called "father of the science" it is De Saussure, and not Davy, who can be identified with no new discovery or novel point of view in agricultural science. In this respect Davy was somewhat like Liebig; both were great men who had the power of getting the world to listen to them, and when they turned their attention to agriculture the influence they wielded, each in their generation, and the stimulus they gave to the progress of agriculture were out of all proportion to the value of the knowledge or even of the ideas they contributed to the subject. Davy gave dignity to the study of agricultural science; where Davy had laboured no man in future need be ashamed to work. Two articles follow on fruit farming, by Mr. Charles Whitehead, and on vegetable farming, by Mr. James Udale. Both are sound enough, but they are rather jejune performances for the *Journal* of the Royal Agricultural Society, since from the inevitable limitations of space they are too lacking in detail to be of service to anyone but the amateur. When it comes to reproducing pictures of the wireworm from the Society's text-book of agriculture, instructions for making Bordeaux mixture, and similar elementary matters, the farmer reader may well wonder where the editor's blue pencil has been lying. Mr. Dudley Clarke writes on a burning question of the day, the cost of labourers' cottages, and gives a number of sensible plans, bringing out the cost of a brick and tile cottage with three bedrooms at about 150*l*., including the land and the cost of a well.

Mr. A. D. Hall writes on the agricultural experiments of Mr. James Mason, the well-known founder of the firm of Mason and Barry, who spent his later leisure in attempting to apply science to agriculture with some success, while the rest of the volume is occupied with the last Park Royal show, with reports of the experiments in progress at the Woburn Farm, and with other society matters.

Mediaeval Lore from Bartholomew Anglicus. By Robert Steele; with preface by William Morris. Pp. xv+195. (London: Alexander Moring, Ltd., 1905.) Price 1*s.* 6*d.* net.

THIS beautiful addition to the "King's Classics," of which Prof. Gollancz is the general editor, is likely to prove of interest to students of science. Written by an English Franciscan, probably before 1260, to explain the allusions to natural objects met with in the Scriptures and elsewhere, it is really an account of the properties of things in general so far as they were understood by an educated writer of the Middle Ages. After studying the quaint and pleasant accounts of mediæval science, medicine, geography, and natural history which the book contains, the student will begin to realise that during the Middle Ages science was not stagnant, but, by gradual development, was making possible the rapid growth of scientific knowledge characteristic of the nineteenth century. The reprint deserves to be read widely.

Ergebnisse und Probleme der Zeugungs- und Vererbungs-lehre. By Prof. Oscar Hertwig. Pp. 31. (Jena: G. Fischer, 1905.) Price 1 mark.

PROF. OSCAR HERTWIG is well known as a pioneer in the researches on fertilisation. In 1875 he made the important discovery that the essential fact in the process lay in the fusion of a single male with a female cell, and he also saw and recognised the fusion of the nuclei. It was fitting that at the congress held at St. Louis last year he should choose this subject as the text of his lecture. The reprint forms a clear statement of the chief details of fertilisation, and also indicates some of the theoretical conclusions towards which modern cytology is tending. The sketch of the so-called "reduction divisions" is specially good, and the author shows how clear a light they throw on the modern experimental results obtained from the study of heredity. The lecture will be welcomed by all who are interested in these and kindred questions, and those who know Prof. Hertwig's writings will not be surprised to find that if the treatment is of necessity brief, it is masterly of its kind.

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 Dynamical Theory of Gases.

IN Mr. Jean's valuable work upon this subject he attacks the celebrated difficulty of reconciling the "law of equipartition of energy" with what is known respecting the specific heats of gases. Considering a gas the molecules of which radiate into empty space, he shows that in an approximately steady state the energy of vibrational modes may bear a negligible ratio to that of translational and rotational modes.

I have myself speculated in this direction; but it seems that the difficulty revives when we consider a gas, not radiating into empty space, but bounded by a perfectly reflecting enclosure. There is then nothing of the nature of dissipation; and, indeed, the only effect of the appeal to the æther is to bring in an infinitude of new modes of vibration, each of which, according to the law, should have its full share of the total energy. I cannot give the reference, but I believe that this view of the matter was somewhere expressed, or hinted, by Maxwell.

We know that the energy of ætherial vibrations, corresponding to a given volume and temperature, is not infinite or even proportional to the temperature. For some reason the higher modes fail to assert themselves.[1] A full comprehension here would probably carry with it a solution of the specific heat difficulty. RAYLEIGH.

The Physical Cause of the Earth's Rigidity.

SINCE publishing the paper in the *Astronomische Nachrichten* (No. 3992), the investigations there outlined have been considerably extended, and lead to some remarkable results. My only purpose in this letter is to direct attention more particularly to the physical cause of the earth's rigidity. This seems to have remained rather obscure, and I am not aware that any definite theory has been adopted to account for the remarkable fact established by the researches of Lord Kelvin and Prof. G. H. Darwin.

It was pointed out in the *Astronomische Nachrichten* (3992) that the physical cause of the earth's high effective rigidity is to be found in the great pressure existing throughout the interior of our globe. This may be made somewhat more obvious by remembering that in any concentric spherical surface the resistance of the enclosed nucleus must be just equal to the pressure of the surrounding shells resting upon it, and thus the strain upon the matter of the globe increases towards the centre according to the same law as the curve of pressure given in the *Astronomische Nachrichten* (3992). This pressure is sustained by the increasing density and rising temperature of the matter in the earth's interior, which is thus under an inconceivable strain, far surpassing the strength of any known substance. As the matter is above the critical temperature of every element, it is essentially a gas reduced by pressure to a hardness greater than that of steel, and with an elasticity and rigidity infinitely near to perfection. The result is that the explosive strain upon the matter of our globe from within, which is everywhere just equal to the pressure sustained by the enclosed nucleus, renders the interior matter more rigid than any known substance; and even the outer layers, which are but slightly compressed, yield so little under the action of external forces that the globe as a whole is more rigid than steel, as Lord Kelvin and Prof. G. H. Darwin found from their profound researches on the long-period tides of the ocean.

It was these considerations which led to the conclusion that all the heavenly bodies of considerable mass when condensed to moderate bulk have nuclei of great effective rigidity, and experience no sensible circulation at great depths. T. J. J. SEE.

U.S. Naval Observatory, Mare Island, Cal., March 20.

[1] Compare "Remarks upon the Law of Complete Radiation" (*Phil. Mag.*, xlix. p. 539, 1900).

The Lyrid Meteors.

THOUGH in the present year the light of the full moon will impede observations of these meteors, yet it is not improbable that the shower will be sufficiently strong to manifest its presence, provided that the atmospheric conditions prove favourable for the occasion. In 1905 the calculated maximum will fall on the night of April 19, as was the case last year, when Lyrids were found to be somewhat more numerous at Utrecht on the night of April 19 than on the succeeding night, both nights having been clear; observations at Dublin, made, however, under less favourable conditions, tended also to confirm this result.

On the present occasion the shower will extend throughout the night of April 19, and of its three constituent maxima two at least will be visible to Cisatlantic observers. The calculated time of the first of these maxima is April 19, 11h. 15m. G.M.T., while the second occurs at 15h.; the third may occur shortly after 14h., but owing to an uncertainty respecting some of the data requisite for its calculation, it is liable to arrive two or three hours later, and consequently elude the vigilance of observers of the first two maxima.

The conditions under which the anticipated display will take place indicate that it will be much above the average in brightness, and probably, notwithstanding the presence of the full moon, several brilliant meteors will be observed on April 19, owing to the meteoric concentration that characterises this night. JOHN R. HENRY.

ANTARCTICA.[1]

WE have entered upon a new era of South Polar literature, since each of the recent expeditions bears the promise and the potency of several books. Of these the recent publication of Dr. Otto Nordenskjöld's "Antarctica" is an addition to our knowledge of southern regions.

[1] "Antarctica, or Two Years amongst the Ice of the South Pole." By Dr. N. Otto G. Nordenskjöld and Dr. Joh. Gunnar Andersson. Pp. xviii+608. (London: Hurst and Blackett, Ltd., 1905.) Price 18s. net.

Dr. Nordenskjöld sailed from Buenos Aires on Christmas Eve, 1901, with the Swedish expedition. The object of the expedition was not to make a dash for the Pole, but, in conjunction with the English, Scottish, and German expeditions, to pursue certain scientific studies in the unknown Antarctic, the special sphere of operations being that section known as the Weddell Quadrant. Dr. Nordenskjöld appears to have succeeded in carrying out much of his programme, although he was unable to push far south, indeed, not so far as the Antarctic Circle, and notwithstanding disasters and hardships without a parallel in the history of Antarctic exploration.

The narrative is divided into two parts. The first, by Dr. Nordenskjöld himself, deals with the cruise of the *Antarctic* in the summer of 1901–1902, and with the two consecutive winters spent on shore near Seymour Island. The second part is by Dr. Andersson and Capt. Larsen, and describes the attempt of the *Antarctic* to reach Nordenskjöld's winter quarters in the summer of 1902–1903, and the loss of the ship in the ice-pack off Louis Philipp Land near the entrance of Erebus and Terror Gulf.

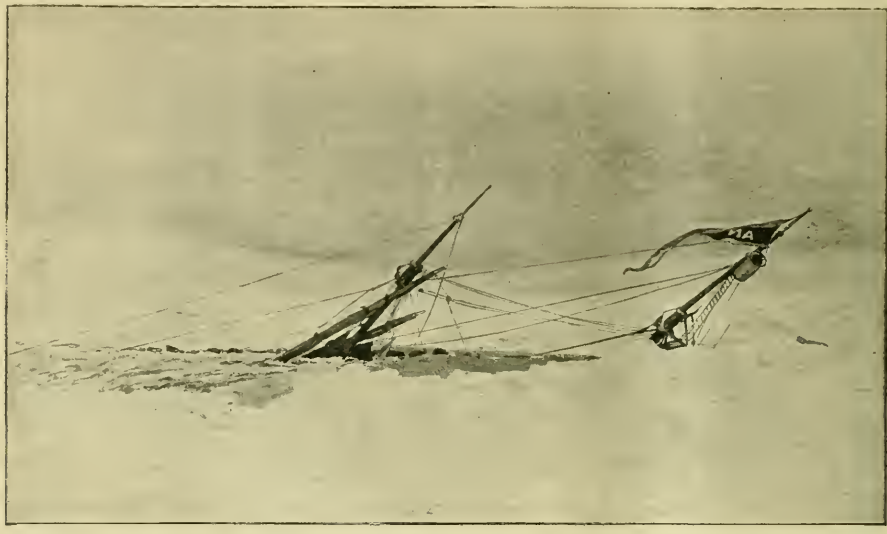

FIG. 1.—The loss of the *Antarctic*. From Nordenskjöld and Andersson's "Antarctica." The original illustration is slightly larger than the above.

Geographically, the summer of 1901–1902 was perhaps the most prolific in discoveries. Louis Philipp Land was found to be continuous with Danco Land, and Gerlache Channel nothing but a continuation of D'Urville's Orleans Channel. Indeed, D'Urville is the real discoverer of the whole island. It appears that the *Belgica* maps of this locality present many difficulties and differences. The illustrations of this land from about lat. 63° S. to 65° S. bear a strong resemblance to Victoria Land, and seem as desolate and as heavily glaciated as land in lat. 75° S. in the Ross Quadrant.

Continuing southwards down the east coast of King Oscar II. Land, the *Antarctic* was at last stopped by a perpendicular wall of ice about 130ft. high. This was in about the 66th degree of latitude south, and it grew clear to Dr. Nordenskjöld "that the chief aim of the expedition to penetrate to unknown regions along the coast of King Oscar's Land was utterly annihilated by powers of nature against which it would be fruitless to combat."

Sailing eastwards along the barrier some trawl hawls were made in deep water, a fairly constant depth of 2000 fathoms found, and indications of a layer of warm water at about 300 fathoms. This layer of warm water at a certain depth is characteristic of a great part of the polar sea.

On February 1, 1902, in lat. $63\frac{1}{2}^\circ$ S. and long. 45° 7′ W., it was decided to return westwards and seek a suitable place for winter quarters. The spot selected was Snow Hill, a little to the south of Seymour Island, where Capt. Larsen first discovered fossils in 1892. A party of six, including Nordenskjöld, was landed, with a strong, comfortable log hut, a few dogs, and provisions and equipment for two years. Before finally leaving the party an attempt was made by Capt. Larsen to establish a depôt farther south, but it was unsuccessful on account of the close conditions of the ice.

The two winters seem to have been passed cheerfully and harmoniously. The party was too far north to feel the terrors of a real polar night, for even at midwinter the sun remained four hours above the horizon, but the weather, common to all parts of Antarctica, was most boisterous; storm followed storm, and made outdoor work only too frequently impossible and the carrying out of scientific observations most arduous. Perhaps we do not thoroughly realise what physical hardships attend the taking of scientific observations in the Antarctic regions.

The magnetic work was undertaken by Dr. J. Bodman. There were no self-recording variometers like those of the *Discovery*, and there is therefore no continuous magnetic record, but the conditions of the International Term Days were fulfilled by means of the ordinary method of eye readings.

Bacteriological investigations were undertaken by Dr. Ekelöf, and chiefly concerned the bacterial flora of the surface soil. The result seems to show that "in these regions the surface soil must almost be considered as the place of origin of bacteria, and the results which were pursued during different seasons and with regard to different kinds of earth have given rise to wholly new ideas concerning the conditions of bacterial life within the polar regions."

The taking of the meteorological observations was shared by all alike. At first readings were taken only at 7 and 8 a.m. and 2 and 9 p.m., but towards the middle of April night observations were also taken.

August 6 was the coldest day, when the thermometer registered $-42^\circ.3$ F. ($-41^\circ.3$ C.). At Cape Adare (lat. 71° S.) the lowest temperature observed was $-43^\circ.5$ F., also in August, and with the *Discovery* in lat. 78° S., $-67^\circ.8$ F.

Dr. Nordenskjöld expresses the opinion that the summer of 1902–3 was exceptionally cold, and points out that the German ship *Gauss* alone succeeded in extricating itself from the ice, but no figures are given to prove the statement. Fewer heavy storms in the summer of 1902–3 were more likely the direct cause of the ice not breaking up.

On October 1, Dr. Nordenskjöld set out with Lieut. Sobral and a sailor on a sledge expedition southwards along the coast of King Oscar II. Land. The one sledge drawn by Nordenskjöld and Sobral weighed in all 200 lb., and the other, drawn by five dogs, 485 lb. The total length of route traversed in thirty-four days was 400 miles. As a result of this journey the chart of this coast has become completely changed.

During the summer of 1902–3, while waiting for the return of the *Antarctic*, important fossil finds were made on Seymour Island. The first were bones belonging to a species of penguin considerably larger than the largest now living—the Emperor penguin. This demonstrates that even at such a distant epoch—probably the beginning of the Tertiary period—the penguin was an inhabitant of the Antarctic regions. The other was that of numerous large and quite distinct leaves in a brown, coarse, hard, tuff-like rock, belonging to different forms of exogenous trees, firs, and ferns. The leaves are small and narrow, and call to mind similar fossils from the Tertiary form-

FIG. 2.—Tertiary plant fossils from Seymour Island (drawings by Prof. A. G. Nathorst). From Nordenskjöld and Andersson's "Antarctica."

ations of Central and Southern Europe, but also certain South American types of leaves.

Dr. Nordenskjöld writes: "If there was one hope whose fulfilment or non-fulfilment was, in my thoughts, almost synonymous with the success or failure of this expedition, it was just that of being able to discover in these regions determinable Tertiary vegetable fossils."

Dr. Andersson also discovered a fossil flora from the Jurassic system in Hope Bay, about a degree farther north, and some very fine illustrations of the

Cladophlebis, Pterophyllum, and Otozamites are given.

Some form of fossil plant was found by the geologist of the *Discovery* as far south as lat. 78°, but it has been found quite impossible to identify it on account of the imperfect nature of the specimen.

The second part of the book makes some thrilling reading, but adds very little to our knowledge. The attempt of Dr. Andersson, Lieut. Duse and seaman Grunden to reach Nordenskjöld across the ice from the *Antarctic* in the summer of 1902–3, their failure either to reach the winter quarters or to regain the ship, and subsequent lonely winter in Hope Bay, is given in detail. The *Antarctic* foundered on February 12, 1903, as the result of a severe ice "nip," and the crew succeeded in reaching Paulet Island across the ice, where they spent the winter under extremely trying conditions. Fortunately, both Dr. Andersson and Captain Larsen and their parties succeeded in reaching Nordenskjöld's winter quarters in the following summer, and, with the exception of a sailor who died on Paulet Island, all were rescued by the Argentine ship *Uruguay* in November, 1903.

The book consists of about 600 pages, and there are a large number of illustrations, some of which are from crude drawings and are indifferently reproduced. The coloured plates might have been advantageously omitted, as they give no idea of the extreme delicacy and beauty of Antarctic colour. Here and there are slight slips, such, for instance, as appears on p. 119, where the velocity of the wind is given as forty-five miles per second! However, there are no serious blemishes. The field of operations was, geographically, a limited one, and well outside the Antarctic Circle. Scientifically we may look forward to more interesting results. No attempt has been made to give an account of the scientific work, and Dr. Nordenskjöld hints that several years must elapse before the results of the voyage of the *Antarctic* can be published in full.

L. C. B.

A NEW BRITISH MARINE EXPEDITION.

THE hydrographical and biological investigation of the central and western parts of the Indian Ocean will this year be the object of a special cruise of H.M.S. *Sealark*, which is fixed to leave Colombo for the purpose about April 20. This yacht, which is the latest addition to the survey vessels of the Navy, is under the command of Captain Boyle Somerville, who will be accompanied by two scientific civilians, Mr. J. Stanley Gardiner and Mr. C. Forster Cooper.

It will be remembered that the Indian Ocean was not visited by the *Challenger* Expedition in the famous cruise around the world, the course then taken lying further to the south, almost within the Antarctic circle. Meantime, however, knowledge of the region has been steadily increased by the exertions of individual explorers and by special Admiralty surveys. To the east there has been continuous progress, culminating in the Dutch *Siboga* Expedition of 1899–1900 through the East Indies, while other explorers have investigated Keeling Atoll, Christmas Island, and parts of Torres Straits and Western Australia. To the north, the Indian survey vessel *Investigator* has been active from the Persian Gulf almost to the Straits of Malacca, while individual explorers have borne their full share. Prof. Ortmann examined the reefs of Ceylon, and Prof. Herdman is now publishing a full account of the marine fauna and flora of that region. In addition, Mr. Stanley Gardiner, with Messrs. Borradaile and Forster Cooper, devoted sixteen months in 1899–1900 to the examination of the Laccadives and Maldives, being followed through the same region in 1901 by Prof. Alexander Agassiz, who devoted himself mainly to the coral reefs, with the surface and the deeper pelagic fauna.

The Red Sea and the coast of East Africa is largely a German zone, but to the south a regular systematic investigation of the hydrography and biology is being undertaken by Cape Colony in connection with its sea fisheries. The French have accumulated much knowledge of Madagascar (mainly of the land), while Rodriguez and Mauritius have become fairly well known, to a large extent owing to the Royal Society Expedition of 1874. Of greater importance, however, were the Admiralty surveys of the numerous islands and banks to the north of and around Madagascar, carried out for the most part by Captain (now Admiral Sir Wm.) Wharton. Lastly, the German *Valdivia* Expedition in 1898–9 ran a rapid traverse from St. Paul to Nicobar, Ceylon, Chagos, Seychelles, and up the East African coast. Its work showed the existence of a pelagic fauna at all depths, and of practically the same deep-sea fauna as exists in other oceans. A relatively shallow bank was found between Chagos and the Seychelles, an important discovery which ought to have been followed up by an extended investigation of the region.

The present expedition, organised by Mr. Stanley Gardiner, is an attempt to correlate in some degree the work of all these different expeditions and explorers by a thorough investigation of the oceanography and biology of the region between India and Madagascar, and is the direct outcome of the Maldive and Laccadive expedition of 1899–1900. As at present proposed, H.M.S. *Sealark*, after leaving Ceylon, will proceed to the Chagos Archipelago, situated to the south of the Maldives in lat. 7° S. This group, for the topography of which we are at present depending almost entirely on a survey made by Captain Moresby in 1837, consists of a series of atolls and submerged banks, of which Great Chagos, an irregular circle upwards of seventy miles in diameter, is the most conspicuous, being the largest existing circular coral reef with a basin in the centre. It is, however, perhaps better known through the atoll of Diego Garcia to the south-east, at one time used as a coaling station by the Orient Line between Aden and Australia. That there will be plenty of hydrographical work in the group is quite clear, for there are at present no bottom soundings between any of the banks, and considerable changes may reasonably be expected to have taken place in the last seventy years owing to the growth of the reefs. The expedition will endeavour to fill in these omissions, and while this work is proceeding a close biological and geological survey of the reefs will be undertaken.

From Chagos the *Sealark* will proceed to Mauritius, which should be reached about August 1. Here fresh stores will be taken in, and the collections so far obtained sent home. No extensive work around the island will be possible, but it is hoped to visit some of the reefs. The *Sealark* will then proceed to Cargados, a surface reef to the south of the submerged Nazareth Bank, and the line will be continued along to the Seychelles group over the likewise submerged Saya da Malha Bank. Both these banks may well lie on a crescent of relatively shallow water (less than 1500 fathoms) connecting the Seychelles with Mauritius, but the actual depths should be settled by the expedition. In any case, the examination of these two great submerged banks should throw much-needed light on the formation of coral reefs. The Agalegas group may also be surveyed, and the nature of its land ascertained. From the Seychelles the *Sealark* will return to Colombo, while the civilian members of the expedition will spend some months in that group and its vicinity, returning home in January, 1906.

The scientific work of the expedition will be of a varied nature. In the first place, the soundings and temperature observations taken by H.M.S. *Sealark* should settle such questions as the existence or non-existence of any relatively shallow banks connecting India and South Africa, and also of any bank from Mauritius to the Seychelles. They should also give an accurate knowledge of the rise and relationships of the various Chagos atolls and banks to one another, and show whether they are really isolated by deep sea or arise on some shallow plateau as do the greater number of the Maldive atolls. Incidentally, also, the soundings may reasonably be expected to indicate what changes, if any, have taken place in the reefs and banks since the last surveys. At the same time it is hoped to examine the currents at various depths, so as to see as far as possible the actual influences at work. In the same connection an investigation has already been commenced on the waters of the Indian Ocean. By the kind assistance of the Meteorological Council, cases of bottles have been sent out to many captains of the British India, P. and O., Orient, Bibby, Clan, and other lines for daily samples of the surface waters, while the expedition itself will obtain samples both from the surface and from various depths during the whole of its sojourn in the Indian Ocean. Mr. D. Matthews, English hydrographer to the North Sea investigation, has undertaken the analyses of these samples, and it is hoped that by continuing the collection for twelve months a more accurate knowledge may be obtained of the movements of the waters of the Indian Ocean. In meteorology a careful log and graphic records will be kept, which, coming from such a little known region, should be useful for comparison with the more regular steamer routes.

In biology, the expedition will everywhere take samples of the bottom and of the pelagic fauna at various depths. The coral reefs will be examined, both surfaces and slopes, while the currents and other factors, possibly influencing the same, will be carefully investigated. The dredges and trawls will be let down as frequently as possible, both to ascertain the general characters of the bottom off the islands and banks, and also to sample the flora and fauna. The deep-sea fauna will not be collected, work being for the most part devoted to intermediate depths (50 to 500 fathoms), within which light tails off into absolute darkness. At the same time, the fauna at lesser depths, both in the Chagos and Seychelles, will be investigated as completely as possible. By these means some clear idea should be obtained of the vertical distributions of both animals and plants, and the comparisons of the marine fauna and flora of the Seychelles and Chagos, together and with those of the surrounding slopes of the Indian Ocean, should at least illuminate the question as to how far the horizontal distribution of such is of value in tracing the former connections of continents and lands. The land flora and fauna can scarcely be expected to be of great interest—it will not at present be attempted in the Seychelles—but it will nevertheless be collected in view of the gradual peopling of oceanic islands.

On the whole, this most recent British exploring expedition may be said to be conceived in the interests, not of one, but of many sciences, and all who sympathise with the advancement of knowledge may be grateful to the Admiralty for detailing a vessel for such work. The hydrographic results alone should more than justify the dispatch of H.M.S. *Sealark*, while any discovery which may be made of the laws which govern the formation and growth of coral and other reefs—and to which we seem to be tending—would make navigation in tropical waters appreciably safer. The scientific members of the expedition have been required to find all the extra gear and instruments necessary for their work. In this they have been materially assisted by grants from the British Association and from the Balfour memorial fund at Cambridge; but the bulk of the expense has been undertaken by the Trust recently founded by Mrs. Percy Sladen in memory of her late husband—to whom, it is felt, the objects of this expedition would have very closely appealed, and whose name will appropriately appear upon the publications issued as a result of the investigation.

THE INDIAN EARTHQUAKE OF APRIL 4.

A LARGE part of north-western India was severely shaken by an earthquake which occurred on April 4, shortly after six o'clock in the morning, causing the destruction of numerous buildings and the loss of many lives—the number being estimated at twenty thousand. The last great earthquake in India, in June, 1897, was one of the most violent of which there is any historical record, but the casualties and damage due to that disturbance were comparatively small, because the earthquake occurred at five o'clock in the afternoon, when many people were out of doors, and there were no large cities within the area of maximum violence. In the case of the earthquake on April 4, most people were indoors at the time of the shock, and the area of greatest disturbance included, unfortunately, several centres where fairly large towns have grown up, chiefly round the official settlements, cantonments, and sanatoria of the British Government. Dharmsala, Dalhousie, Simla with several neighbouring cantonments, Mussoorie, Dehra Dun, Almora, Ranikhet, and Naini Tal are the chief of these; and the many substantial stone buildings in them have naturally suffered much damage from the earthquake shocks.

The reports so far available show that the earthquake, like that of other great disturbances of the same kind, was of Himalayan origin, the centre being about Dharmsala. Its intensity decreased through the Punjab and the United Provinces, while from Rajputana to the north it decreased rapidly. There appears to have been no wide extension of the disturbance towards Assam or Afghanistan, but information from the west is very imperfect.

The whole area where serious damage is known to have been done is included within a line drawn from Shahpur through Kangra to Jawalamukhi, thence east to Sujanpur, and then to Baijnath; but what occurred eastwards of this area is not known.

It is clear from the Viceroy's telegrams that the towns of Dharmsala, Kangra, and Palampur are virtually destroyed, that the loss of life has been very great, and that the full measure of catastrophe, owing to difficulty of communication, cannot be ascertained for some time.

The King has sent to the Viceroy a telegram expressing his "profound concern at the news of the calamity which has befallen Lahore and surrounding district," and a message of sympathy with all who have suffered from the earthquake has been sent by the Prince and Princess of Wales.

No news about the earthquake has been received from the regions north of Kashmir, but two days before the first shock was felt in India the Punjab stations reported the arrival of storms bearing large quantities of dust and ash. Natives arriving at Simla from the interior declare that a volcanic eruption has occurred in the hills in Bashahr State.

The earthquake was clearly registered by the seismograph in the observatory at Göttingen, and a record was also obtained at the Royal Observatory, Edinburgh. The record began with some very minute tremors about 1 a.m., while the larger waves began about eight minutes later. The *maximum* disturbance was recorded about 1.30, and was followed by one of almost equal severity a minute and a half later. From that point the tremors were gradually reduced until 4.43 a.m. The difference of time between Edinburgh and Dharmsala is about five hours. Seismograms recording the earthquake were also obtained by Prof. Milne at Shide, Isle of Wight, and at the hydrographic station at Pola.

A severe earthquake shock, lasting six seconds, was felt at Benevento, Italy, at 8.20 p.m. on April 9, and fresh shocks were experienced at Simla on April 10 and 11.

The following particulars of the effects produced by the earthquake in various parts of India have been extracted from the extensive reports which have appeared in the daily papers.

Dharmsala.—All houses and buildings throughout the entire station, including cantonment and bazaars, totally destroyed, with loss of many lives. About 80 per cent. of the population killed or injured, and from 20 per cent. to 30 per cent. in the neighbouring villages.

Kangra Valley.—Kangra and Jowala Mukhi and other villages in Kangra Valley reported totally destroyed, and many hundred lives lost. Every building, without exception, in Kangra and Bhawan in ruins. Of a total population of nearly 5000 in Kangra town it is believed that only about 500 remain alive. Similar state of affairs in most other villages in the neighbourhood. At Palampur, in the Kangra district, all the houses, including the Government buildings, reported totally destroyed, and many hundred lives lost.

Lahore.—A succession of violent shocks caused a panic. The inhabitants rushed from their houses to seek safety in the open. Almost every house suffered by the earthquake, and much serious damage was done to public and private property, and twenty-five people were killed. The shock created an extraordinary uproar at the zoological gardens. The shrieks of the pea-fowls were heard all over the station, while crows and other birds flew in alarm from the swaying trees.

Mussooree suffered severely. Two slight shocks were felt during the night of April 3. A succession of shocks began at 6.10 a.m. on April 4, the first, which lasted three minutes, being the severest. In all eleven shocks were felt. Every house in the city more or less injured. Several small landslips occurred, and many casualties reported. This is the fourth severe earthquake that has happened at Mussooree, and the second worst as regards its effects. Four or five slight shocks were felt during the night of April 4–5.

Simla.—Much damage done to buildings. The Viceregal Lodge is so badly damaged that the re-building will occupy several months. Other estate houses have been seriously damaged. *Delhi.*—The shock was severely felt, and damage was done to buildings, but no reports of injury to monuments. A further shock occurred at midnight on April 4–5. *Agra.*—A violent shock lasting several minutes, and travelling from west to east, was experienced at 6.10 a.m. No reports of injury to architectural monuments.

Jalandhar.—Much damage done. *Amritsar.*—Extensive damage, and several lives lost. *Ambala.*—A large number of houses thrown down. *Srinager.*—Much damage, and several lives lost. *Mudki.* Serious damage. *Sialkot.*—Not a house escaped damage of some sort, but no lives lost. *Dalhousie.*—Property damaged, but no deaths.

Kashmir.—Communication interrupted by landslips and accidents to telegraph lines.

Slight tremors appear to have been recorded at Calcutta and Bombay, but no decided disturbance was felt.

PROF. PIETRO TACCHINI.

THE death of Prof. P. Tacchini on March 24, at the age of sixty-seven years, has caused much regret among men of science interested in celestial and terrestrial physics. Italy has thus lost a representative man of science who especially devoted himself to the cause of astronomy with zeal and patience. For many years, as director of the Observatory of the Collegio Romano, he proved himself an indefatigable observer of planets and comets; but recently this position has been filled by Prof. Millosevich, and Prof. Tacchini had been known as the director of the Central Office of Meteorology and Geodynamics. But the especial work with which his name will ever be connected has been upon lines that have long commended themselves to Italian observers. Secchi made his reputation in the domain of spectroscopy and solar observation, and the example he set has been followed with no less eagerness and success by the distinguished astronomer whose death we have now to regret. All that related to sun-spots, faculæ, or protuberances had a fascination for Tacchini, and for years past our columns have borne witness to his continuous devotion to this subject. He was particularly interested in the heliographical distribution of solar phenomena, and every three months, in the pages of the *Mem. degli Spettroscopisti Italiani* or the *Comptes rendus*, he recorded the variations and gave comparative tables showing the growth or decline of solar activity as testified by these outbursts. Researches carried on so long and so industriously cannot but prove of eminent service, and we may well hope that the work he inaugurated will be carried on with equal zeal by his successors. Prof. Tacchini's work in this direction well deserved the Janssen prize which was awarded him by the Paris Academy of Sciences in 1892.

To a solar observer of such ardour, eclipses of the sun especially appealed, and he took part in several expeditions to observe these phenomena. He was present on the Caroline Island reef, where he associated himself with the French party organised by Janssen. Again in Egypt, and later on in 1886, he visited the American continent for the purpose of observing the great eclipse in that year. On this occasion he showed, by comparing the forms and appearances of the prominences seen during the eclipse with the images ordinarily seen in the spectroscope, that it is only the vaporous cores of these objects which are rendered visible by the usual methods of observation. In many other ways he showed not only his skill as a spectroscopist, but his anxiety to promote astronomical knowledge. He laboured long and diligently in the cause of science, and left a reputation that his countrymen will cherish; while his memory will be held in esteem by the astronomers of many nations. He was elected a foreign member of the Royal Society in 1891, and was awarded the Rumford medal of the society. He was also a foreign associate of the Royal Astronomical Society in 1883, and many other societies have been proud to enrol his name among those of their honoured fellows.

The progress of solar physics is largely due to Prof. Tacchini's unremitting labours; and the numerous papers published by him on solar phenomena stand as an enduring monument of work done by a pioneer in a fruitful field of scientific inquiry.

NOTES.

WE are glad to see the report that Lord Kelvin's condition continues to improve. It was stated on Monday that he now takes nourishment fairly well, and that his medical advisers are well satisfied with the progress he is making. It is expected that he will be able to leave his bed in about a fortnight's time.

THE Irish branch of the Geological Survey has been transferred from the Board of Education to the Department of Agriculture and Technical Instruction for Ireland. The work will be carried on under the immediate direction of Prof. G. A. J. Cole.

WE regret to learn that Mr. H. B. Medlicott, F.R.S., formerly director of the Geological Survey of India, 1876–1887, died on April 6, at seventy-six years of age.

AMONG the portraits recently added to the National Portrait Gallery are those of Sir Charles Lyell, painted by Lowes Dickinson, Charles Darwin, and Prof. W. Whewell.

REUTER'S Agency is informed that the Duc d'Orléans has organised a North Polar expedition, which will leave for the Arctic under the Duc's personal leadership next month. For the purposes of the expedition the *Belgica*, the vessel of the recent Belgian Antarctic Expedition, has been secured, together with the services of Lieut. Gerlache, who will again command the ship on the present occasion. The object of the expedition is not to reach the North Pole, and, according to present arrangements, the Duc will not winter in the Arctic, although the *Belgica* will be provisioned for the event of her being closed in by the ice. The expedition will leave Norway probably on May 1 and proceed direct to Franz Josef Land, where it is believed that an attempt will be made to push northwards by way of a new channel. The Duc's staff will include some French men of science and a number of Norwegian sailors.

AT the annual meeting of the Australasian Ornithologists' Union, held at the end of last year, Captain F. W. Hutton, F.R.S., submitted a presidential address dealing with some interesting problems in connection with New Zealand's avifauna. The evidence he has obtained during his years of research leads him to think that the ancestors of many New Zealand birds went south along a land ridge which connected New Zealand with New Caledonia and New Guinea, probably in the early Eocene period. New Zealand ornithologists, Captain Hutton pointed out, have special advantages for studying the effects of the absence of enemies on development, and New Zealand itself offers more examples of degeneration in the wings of birds than does any other country in the world.

PROF. J. MACMILLAN BROWN, of Christchurch, New Zealand, recently paid a visit to the Maoris who live in the fastnesses of the great King country and Urewera country, in the heart of the North Island of New Zealand. He went specially to visit the "Uru-kehu," or red-headed Maoris, who are often seen in those districts. He had previously come to the conclusion that the Maoris' ancestors, in their migrations, crossed with a white race, and he informed a representative of the *Lyttelton Times* that his visit has strengthened his opinion. He states that in one assembly at which he was present at least 25 per cent. of the children had brown, or even flaxen, hair, a complexion which resembled that of the Italians, and fine European features.

DR. W. J. HOLLAND, director of the Carnegie Museum, Pittsburg, has arrived in London for the purpose of superintending the setting-up of the plaster model of the skeleton of the gigantic herbivorous dinosaur *Diplodocus carnegii*, presented by Mr. Andrew Carnegie to the British (Natural History) Museum. The restoration, which is described by the late Mr. J. B. Hatcher in No. 1 of the *Memoirs* of the Carnegie Museum, is mainly based upon two incomplete skeletons discovered respectively in 1899 and 1900 in the Upper Jurassic beds of Sheep Creek, Albany County, Wyoming. As restored, the skeleton is nearly 80 feet in length. Whether this dinosaur is really specifically distinct from the typical *Diplodocus longus* may be a question.

DURING a violent thunderstorm on March 31 the second pyramid of Ghizeh was struck by lightning slightly below the apex of the monument. Several of the immense stones of which the pyramid is built were dislodged and rolled down the sides to the sands below. The storm was the most violent experienced in Egypt for the past fifteen years. This is the first recorded instance of any of the pyramids having been struck by lightning.

IT is announced in *Science* that the first John Fritz gold medal will be conferred upon Lord Kelvin. This medal is awarded by a joint committee of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Society of Civil Engineers, and the American Institute of Mining Engineers to the man most representative of, and eminent in, scientific advance in the engineering field.

THE following are the lecture arrangements at the Royal Institution after Easter:—Prof. L. C. Miall, three lectures on the study of extinct animals; Sir James Dewar, three lectures on flame; Prof. J. A. Fleming, three lectures on electromagnetic waves (the Tyndall lectures); Prof. H. Marshall Ward, two lectures on moulds and mouldiness; Dr. J. G. Frazer, two lectures on the evolution of the kingship in early society; and Mr. A. H. Savage Landor, two lectures on exploration in the Philippines. The Friday evening meetings will be resumed on May 5, when a discourse will be delivered by Prof. H. E. Armstrong on problems underlying nutrition.

A BRANCH of L'Alliance Française, an association for the spread of the French language, is to be established in London and Paris under the title of "Alliance littéraire, scientifique et artistique Franco-Anglaise." Information as to membership of the new association can be obtained from 186 Boulevard Saint-Germain, Paris. The first *soirée* will take place in London in the course of the present month. The presidents of the association are M. Paul Delombre, previously Minister for Commerce, and M. Pierre Foucin, Inspecteur-Général de l'Instruction publique. Among those who have promised their support to the new society are Lord Avebury, Sir William Crookes, Sir Archibald Geikie, Sir Oliver Lodge, Prof. Meldola, Sir William Ramsay, Sir Henry Roscoe, and Sir William White.

THE *Times* correspondent at Athens reports that the proceedings in connection with the Archaeological Congress began on April 7 with a reception at the university, at which the King and the Crown Prince were present. The opening ceremony took place at the Parthenon under the presidency of the Crown Prince, the King and Queen being also present. On April 8 Prof. Lambros delivered an address of welcome, recapitulating the achievements of foreign and Greek research in recent years. The ceremony of inauguration of the Penrose Memorial Library took place on April 8 in the British School. The King and Queen and all the members of the Royal family were present. After Mr. George Macmillan had given an account of the past history of the school, a marble tablet to the memory of Penrose was unveiled by the Crown Prince, who delivered an address in English. Speeches were then delivered by Mr. Cecil Smith, a former director of the school, M. Homolle, secretary to the congress, who paid an eloquent tribute to the amiable and noble character of Penrose, as well as to his great scientific attainments, and by Profs. Conze, Wheeler, Waldstein, and Bosanquet (director of the school). The various sections of the congress met for the reception and discussion of papers on April 9 and 10.

A meeting of the Association of Economic Entomologists will be held at Birmingham on April 19 and 20, in the large medical theatre of the university. The president of the association is Mr. F. V. Theobald, and the secretary Mr. W. E. Collinge, University of Birmingham.

The London Geological Field Class, conducted by Prof. H. G. Seeley, F.R.S., will begin its twentieth year's season on Saturday, April 29, with a visit to the north downs at Betchworth. The field class, which is carried on continuously on the Saturday afternoons in May, June and July, affords practical teaching in geology by studying direct from nature the structure and modes of occurrence of the rocks in the basin of the Thames and adjacent country. Further particulars may be obtained from the secretary, Mr. J. W. Jarvis, St. Mark's College, Chelsea, S.W.

At the annual meeting of the Iron and Steel Institute, to be held on May 11 and 12, the Bessemer gold medal for 1905 will be presented to Prof. J. O. Arnold. The awards of the Andrew Carnegie gold medal and research scholarships will be announced; and the president, Mr. R. A. Hadfield, will deliver his inaugural address. The following is a list of papers that are expected to be submitted:—experiments on the fusibility of blast furnace slags, Dr. O. Boudouard; recent developments of the Bertrand-Thiel process, Mr. J. H. Darby and Mr. G. Hatton; the application of dry-air blast to the manufacture of iron, Mr. James Gayley; the effect produced by liquid air temperature on the mechanical and other properties of iron, Mr. R. A. Hadfield; the cleaning of blast furnace gas, Mr. Axel Sahlin; the failure of an iron plate through fatigue, Mr. S. A. Houghton; the continuous steel-making process in fixed open-hearth furnaces, Mr. S. Surzycki; accidents due to the asphyxiation of blast furnace workmen, Mr. B. H. Thwaite; and the behaviour of the sulphur in coke in the blast furnace, Prof. F. Wüst and Mr. P. Wolff.

Reuter's correspondent at Rome reports that the draft scheme for the organisation of the International Agricultural Institute, which will be considered by the conference to be held in May, is as follows:—(1) The constitution and organisation of the institute. (2) Functions of the institute: (a) To report periodically information concerning agricultural production, the conditions of labour in rural districts, and the diseases of plants and live stock. (b) To facilitate the organisation and working of cooperation between the rural communities of different countries, and to provide insurance and banking facilities for the benefit of agriculture. (c) To propose on its own initiative or at the invitation of Governments interested, international measures and institutions for the protection of the common interests of the agriculturists of all countries, and at the same time to consider the resolutions passed by international congresses on agriculture. (d) To exercise other functions which are already exercised by the great agricultural associations, which the institute could discharge independently of the action of the different Governments. (3) The financial resources of the institute.

In the House of Commons on April 5 Sir W. Palmer asked the President of the Board of Agriculture whether his attention has been directed to experiments which have been carried on in America with a view to the propagation and use upon the land of nitrogen-producing bacteria, whether he is aware that certain rights relating to the method of preparation of these bacteria are the property of the United States Government, and that that Government is distributing packets of these bacteria free of charge to any farmers who apply for them, and that the result of such distribution has been beneficial for farming; and, if so, could he say whether any rights relating to the preparation of these nitrogen-producing bacteria prevent His Majesty's Government from adopting a similar course; and, if not, whether he is prepared to recommend that a similar free distribution be adopted in this country. In reply, Mr. Fellowes remarked that some articles on the subject have appeared in the Board's monthly journal. Experiments as to the value of nitrogen-producing bacteria are now being carried out under the auspices of the Board by several of the agricultural colleges in this country, and so soon as the results are known the Board will consider what further action in the matter can be taken in the interest of British agriculturists. The process of producing and cultivating the bacteria has been patented by the United States Department of Agriculture, but it appears that the department does not propose indefinitely to continue its gratuitous distribution. There appears to be nothing to prevent the manufacture and sale of the material in this country.

According to the report of the Australian Museum, Sydney, for 1903-4, remarkable fluctuations occur in the annual number of visitors. In 1900, for instance, the total was 85,474, in 1901 123,326, in 1902 106,704, and in 1903 118,372. The general condition and progress of the museum appear to be satisfactory

No. 3 of the Johns Hopkins University *Circular* for the current year contains an account of observations and experiments with regard to the abnormally elongated form assumed by a considerable percentage of American oysters during the early stages of growth. The author, Mr. O. C. Glaser, concludes that this is due to crowding, and that it is a premature assumption of the normal adult condition. The crowded condition of these prematurely old oysters makes it impossible for them to expand and grow to the normal width, but if removed to a more favourable situation they quickly assume the ordinary shape.

The second portion of the article by Mr. F. Voss in part iii. of vol. lxxviii. of the *Zeitschrift fur wissenschaftliche Zoologie*, on the thorax of the house-cricket, with especial reference to the articulation of the wings and their movements, and thus to the mechanics of insect flight in general, is devoted to the musculature, and is illustrated with several diagrams and text figures. The other article in the same issue, by Mr. F. Fuhrmann, of Gratz, is devoted to the history of the adrenal bodies of the guinea-pig. The internal tissue of these organs is subject to very rapid *post-mortem* degeneration, so that the investigation is one of considerable difficulty.

According to its report for the past year, the Rugby School Natural History Society continues to do steady work, and its permanent collections are making satisfactory progress. During the year two important additions have been made by gifts to the museum, namely, a collection of British butterflies and one of birds' eggs, the latter including many rare specimens. The conservatory, containing the greater part of the vivarium, has been rebuilt, and a new case is in course of construction for the geological collection. On the other hand, the secretary deplores the lack of interest in microscopy, and also the few competitors for prizes.

In the report of the Northumberland Sea Fisheries on the scientific investigations conducted in 1904, it is stated that there has been a decided decrease in the number of flat fish, especially plaice, in Cambois Bay, although in this respect the other stations do not depart materially from the satisfactory results of the last few years. A number of flat fish, chiefly dabs, were marked and returned to the sea. Those re-captured apparently indicate that plaice do not usually leave the inshore waters until they are approaching maturity (four or five years old), but that dabs show a separation of the sexes, the females remaining near the shore while the males migrate to deeper water twenty or thirty miles to the south. Legislation for the protection of lobsters does not work well, as the fishermen are in the habit of stripping and selling the "berried" females instead of returning them to the sea.

In the first part of vol. xxxiii. of Gegenbaur's *Morphologisches Jahrbuch* is continued Dr. A. Fleischmann's article on the skull of the Amniota, Dr. O. Hofmann contributing a section on the structure of the roof of the mouth-cavity in lizards. The second article, by Dr. H. Adolphe, is devoted to a discussion of the variation in the human sternum and vertebral column, more especially as regards the number of vertebræ which may bear ribs and which may enter into the composition of the sacrum. After referring to analogous variations in apes and monkeys, the author considers that there is no evidence that any of the earlier mammals had eight cervical vertebræ. In the third article Mr. W. M. Smallwood records some observations on the chromosome vesicles developed in the earlier stages of nudibranch molluscs.

The two original articles in *Biologisches Centralblatt* of March 15 are devoted to the subject of ants, Mr. E. Wasmann continuing his account of the origin of slavery among these insects, while Prof. D. H. Forel figures and describes the nests and "fungus-gardens" of certain South American ants. The photographs and notes on which the latter account is based were communicated to the author by Dr. E. Goeldi, director of the museum at Pará. In the case of *Atta sexdens*, it appears that the female has a fungus-garden to herself, in which the eggs are laid; and while this and other large species of the same genus, together with certain kinds of Acromyrmex, make their fungus-gardens in holes in the ground, the smaller *Atta moelleri* constructs them in hollow trees, under leaves, and in such-like situations.

A further instalment of the account by Mr. B. Fedtschenko of his journey in Central Asia is given in vol. iv., parts vi. and vii., of the *Bulletin du Jardin Impérial Botanique*, St. Petersburg. These letters relate to his wanderings across the Pamir plateau, and he describes the vertical sequence of plant formations observed in the unexplored valley of the Mouskol River.

The present time, when changes are pending in India in connection with the formation of a department of commerce and industry, is opportune for considering the possibility of changes in allied departments. A pertinent article advocating the establishment of a bureau of forestry as a complement to the Indian Forest Department appears in the *Indian Forester* (January). The duties of the staff would include the preparation of working plans, the institution and supervision of experimental investigations, and the responsibility of regulating the cultivation and supply of forest products.

A *Circular* (vol. ii., No. 24) of the Royal Botanic Gardens, Ceylon, by Mr. R. H. Lock, deals with the varieties of cacao trees existing in the gardens and the experiment station, Peradeniya, and incidentally supplies some interesting information on the colour of the seeds. As a primary division, Criollo varieties having seeds with a thin shell are distinguished from the Forastero varieties with a hard shell. Fruits of the old red type of Criollo were found to contain about 14 per cent. of purple and 80 per cent. of white seeds. Forastero varieties pass from forms of good quality, having well rounded beans of a light colour, to those of a poor quality, in which the beans are flat, purple, and bitter. The proportion of white to purple seeds in a number of pods of one of the best Forastero varieties was 35 per cent. to 63 per cent.

Nos. 1 and 2 of the *Zeitschrift* of the Berlin Gesellschaft für Erdkunde contain a valuable paper by Dr. S. Passarge on the Kalahari region and its significance as a factor in the ethnography of South Africa. The paper discusses the physical and biological conditions of the region, and the distribution of the races of mankind. It is illustrated by a number of excellent maps.

The most recent addition to the *Abhandlungen* of the Vienna Geographical Society is a paper by Dr. Artur Gavazzi, forming the first or "morphological" part of a monograph on the lakes of the Karst region. The work includes measurements of permanent lakes, fresh-water, brackish, and salt, "periodic lakes," and periodically inundated "poljen." Observations of the micro-plankton and diatoms have been made by Drs. L. Car, A. Forti, and V. Lurgaiolli. Dr. Gavazzi's paper forms an important contribution to our knowledge of an extremely interesting region.

We have received the report of the Danish Meteorological Institute on the state of the ice in the Arctic seas during 1904. The statistics go to show that the winter of 1903–4 was comparatively mild in that part of the Arctic regions which lies north of the Atlantic Ocean, that during 1904 the East Greenland current supplied the temperate seas with a smaller quantity of polar ice than in a normal year, and that the Labrador current carried more than the average number of icebergs past Newfoundland. It is expected that during 1905 there will be more ice along the coast of East Greenland and in Davis Strait than in 1904, and less off Labrador and Newfoundland.

The Meteorological Institute of the Netherlands has issued a paper, by M. J. P. van der Stok, continuing and extending M. Phaff's discussion of tidal observations made on board the light-ships on the Netherland coasts. The periodic movements in horizontal and vertical planes, and the progressive movements of the waters, are dealt with separately, and the general result is to support the view set forth by Lord Kelvin in 1878, that the tides of the North Sea would not be materially affected if the Straits of Dover were closed. Further observations, especially off the English coasts and in the centre of the North Sea, are necessary for the complete investigation of the complex conditions which occur.

AN interesting address was recently delivered to the Royal Meteorological Society (published in its *Journal* for January last) by Mr. C. W. R. Royds, first lieutenant of the National Antarctic vessel *Discovery*. As the observations are now under discussion, he was only able to give a general account of the meteorological conditions of the Antarctic, but entered fully into the arduous labours which were zealously carried out by the whole of the observing staff. The meteorological instruments were set up on the ice on April 17, 1902, in lat. 77° 50′ S., and eye observations were continued until February 15, 1904, at intervals of two hours; between 8h. a.m. and 10h. p.m. they were taken under the superintendence of Mr. Royds, and the night observations were divided between the eleven officers, each taking one night. In addition there were the self-recording instruments; these were managed under great difficulties, and their continuous registration was entirely due to the mechanical skill of Mr. Skelton, as they were frequently choked by blizzards. On these occasions the rain gauge would be buried under three or four feet of snow. The lowest screen temperature recorded in the winter quarters was $-59°.5$; on the same day at Cape Armitage ($1\frac{1}{2}$ miles distant) it was $-64°.6$; the coldest day at the latter station was $-67°.7$ (or nearly 100° of frost) on May 16, 1903. The highest black-bulb reading in the sun was 154°, on December 21, 1902. The heaviest gale recorded was 85 miles per hour, by the Robinson anemometer. Throughout the stay in the Antarctic Circle no *rain* was recorded, and fogs were not nearly so prevalent as is generally supposed; day after day clear skies and continuous 24 hours' sunshine were recorded. Speaking of the barometer as an instrument of warning of gales, Mr. Royds states that all faith was lost in it, as they came on without any appreciable sudden change in the motion of the mercury.

THE final report of the Royal Commission on Coal Supplies was recently reviewed at some length in NATURE (February 2, p. 324). The minutes of evidence, the reports on the various districts, and the appendices, on which the commissioners' conclusions were based have now been issued. The district reports contain much information of great value, and it is satisfactory to find that, in order to render them generally accessible, they are issued separately at moderate prices. The contents of the various parts are as follows:—part ii., report of Sir W. T. Lewis on the available coal resources of South Wales and the south of England; part iii., report of Prof. Lapworth and Mr. A. Sopwith on the coal resources of the midlands; part iv., report of Prof. E. Hull, Sir G. J. Armytage, and Mr. A. Strahan on the coal resources of North Wales, Lancashire, and Cheshire; part v., report of Mr. A. Currer Briggs on the coal resources of Yorkshire, Derbyshire, and Nottinghamshire; part vi., report of Sir Lindsay Wood on the coal resources of Northumberland, Durham, and Cumberland; part vii., report of Mr. J. S. Dixon on the coal resources of Scotland; part viii., report of Prof. E. Hull on the coal resources of Ireland; and part ix., report of the geological committee, consisting of Prof. E. Hull, Prof. C. Lapworth, Mr. J. J. H. Teall, and Mr. A. Strahan, on the resources of the concealed and unproved coalfields of the United Kingdom. Part x., which covers 400 pages, contains the minutes of evidence, and part xi. includes a series of appendices of great interest. Among these are an estimate of the future coal output of the United Kingdom, calculated at its average decreasing rate of increase during the last thirty years, by Mr. R. Price-Williams, a report on the colonial and foreign coal resources by Mr. Bennett H. Brough, and a report on deep borings through Secondary rocks by Mr. W. Whitaker. Lastly, part xii. is a supplement containing the plans and diagrams referred to in the evidence. The report on the coal available in concealed unproved areas at depths less than 4000 feet is certainly the most important of this valuable series of documents. Without being over-sanguine, the committee has added 40,000 million tons to the probable coal resources of the kingdom. The coloured geological map of the United Kingdom, on the scale of 25 miles to the inch, accompanying this report, is of particular interest.

THE well known firm of Bausch and Lomb (London agents, Messrs. A. E. Staley and Co.) has brought out an admirable instrument in their "B.B.P. portable microscope." The workmanship is excellent, and in spite of the fact that the stand and accessories are packed away into a case measuring $11.4 \times 7.8 \times 4.6$ inches, the instrument is thoroughly serviceable and convenient for use. The base of the stand is made of two diverging bars, which move on the upright column so as to assume a parallel position when ready for packing; but they are well and heavily constructed, and are perfectly rigid when open. The stage is large, and is ingeniously contrived to turn into the plane of the stand when in the case, and when open it is firmly held in its place. The objectives are of the quality which would be expected from a firm with so high a reputation, and the cedar oil for the immersion lens is contained in a metal box, so that there is no danger of breakage or leakage. We think the instrument quite justifies the description given of it as a microscope "capable of being taken out and set up in a few seconds ready for use, giving all the desirable features of the highest grade bacteriological laboratory instrument."

IN the classical researches of Sainte-Claire Deville on dissociation much use was made of the "hot and cold tube" in proving the existence of chemical reactions at high temperatures, the idea being that by suddenly cooling a gaseous system there would not be time for the recombination of the gases, and hence that some clue could be obtained as to the actual composition of the gaseous mixture at the high temperature. The properties of fused quartz have led M. Berthelot to repeat these experiments under different conditions, and an account of the results is given in the *Comptes rendus* for April 3. The substances under examination were enclosed in hermetically sealed quartz tubes, heated for about an hour at 1300° C. to 1400° C., and then suddenly cooled by dropping the tubes into cold water. The cooling in this way was at least as sudden as in Sainte-Claire Deville's experiments, and the whole contents of the tubes could then be examined. The observations were too numerous to be given in detail here, but the whole trend of the results was to show that no dissociation could be detected in cases where from the earlier experiments a positive result would be expected. Oxygen furnished no trace of ozone, and no trace of hydrocarbon could be formed from carbon, in any of its states, with hydrogen. The dissociation of carbon monoxide was practically inappreciable, and in a case of special practical importance, the dissociation of carbon dioxide, and in which two experiments were made, one with slow and the other with instantaneous cooling, no trace of dissociation could be detected.

A booklet on "Pattern Making," by Mr. J. E. Dangerfield, has been added by Messrs. Dawbarn and Ward, Ltd., to their "Home Workers' Series of Practical Handbooks."

A new edition of Mr. W. Woods Smyth's "Divine Dual Government" has been published by Messrs. Horace Marshall and Son. The present issue has been revised and illustrated with new matter, some of which has already appeared in earlier books, now out of print, by the same author.

Messrs. Longmans, Green and Co. have published a new edition of "Telegraphy," by Sir W. H. Preece, K.C.B., F.R.S., and Sir J. Sivewright, K.C.M.G. The book has been revised and enlarged, and now includes descriptions of recent devices used in telegraphy, in relation to fast-speed recorders, to automatic and translating apparatus for submarine circuits, to Murray's improvements in the Wheatstone automatic apparatus, and to the new telegraph switching system. A chapter on wireless telegraphy considered theoretically and in its most recent application has been added.

Mr. Henry Frowde has sent us two pages of the "New English Dictionary on Historical Principles," edited by Dr. J. A. H. Murray, to show how the word refraction and its congeners are defined and traced. The number of references to uses of these words is astonishing; and a vast amount of research must have been necessary to bring so much material together. We extract a few early references of historical interest:—Refracting, causing refraction, refractive; 1704, Newton, "Optics" (1721), 4 def. iv., "the perpendicular to the reflecting or refracting surface at the point of incidence"; 1764, Hornsby, in *Phil. Trans.*, liv., 145, "an excellent refracting telescope of 12 feet focus." Refraction; 1603, Holland, "Plutarch's Mor.," 1295, "the rainbow is . . . distinguished by sundry colours, by the refraction of our eie-sight against a cloud"; 1646, Sir T. Browne, "Pseud. Ep.," 347, "the colours are made by refraction of light, and the shadows that limit that light"; *Astron.*: 1603, Heydon, "Jud. Astrol.," 137, "there lieth a deceipt or fallacie in the refraction of beams, which cheifly happeneth about the horizon, where the aire is alwaies thickest"; 1669, Sturmy, *Mariner's Mag.*, ii., 118, "the refraction of the sun, moon and stars, causeth them to appear higher above the horizon than they are." Refractive; 1673, Flamsteed, in Rigaud's "Corr. Sci. Men" (1841), ii., 168, "the refractive air reaches some height above our heads"; *a* 1691, Boyle, "Hist. Air" (1692), 190, "the air . . . was filled with vapours and exhalations, that made it much more refractive than formerly."

OUR ASTRONOMICAL COLUMN.

Comet 1905 *a* (Giacobini).—A further extract from Dr. Strömgren's daily ephemeris for comet 1905 *a*, as published in No. 4009 of the *Astronomische Nachrichten*, is given below. A set of elements and an ephemeris similar to those obtained by Dr. Strömgren have been computed at the U.S. Naval Observatory, from observations made on March 26, 27, and 28, and are published in the same journal.

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

1905	α (h. m. s.)	δ (° ′)	log r	log Δ	Brightness
April 15	7 8 22	+33 47·9	0·0590	9·8855	0·87
17	7 18 24	+35 38·6			
19	7 28 42	+37 22·7	0·0638	9·8988	0·80
21	7 39 16	+35 59·8			
23	7 50 6	+40 29·8	0·0699	9·9139	0·73

Brightness at time of discovery (March 26) = 1·0.

The following magnitudes have been estimated by various observers at the times named:—

	h. m.		mag.
March 28	7 59·6	(Geneva M.T.)	11·5
29	8 28·2	(Vienna ,,)	13·0
April 1	9 6·3	(Bamberg ,,)	11·0

On the last mentioned date Prof. Hartwig found that the comet was circular, about 3′ in diameter, and had a scattered nucleus.

Variability of a Minor Planet.—A telegram from Prof. Pickering, published in No. 4009 of the *Astronomische Nachrichten*, announces that Prof. Wendell has discovered a variation of 0·5 magnitude in the brightness of the minor planet (15) Eunomia.

This is one of the asteroids situated at an intermediate distance from the sun, and having a revolution period of 1570 days.

Visual Observation of Jupiter's Sixth Satellite.—A further visual observation of Jupiter's sixth satellite has been made at the U.S. Naval Observatory with the 26-inch refractor.

Observing on January 8, Mr. Hammond made a search for the recently discovered satellite in the position computed from the Lick photographs, and there found a very faint object, which, from its movement in relation to a neighbouring star, proved to be the object sought.

Real Path of a Bright Meteor.—From a large number of observations made in south-west Germany, Herr H. Rosenberg has calculated the real path of an exceptionally bright meteor which was seen at 8h. 22m. (central European time) on March 21, 1904, and emitted about one-quarter of the light given by the moon at full.

After giving the details of the times and places of the various observations, he deduces the following values for the actual path of the object. Length of path 385 km., duration of flight about 9 seconds, mean velocity 42·8 km. per second, mean velocity relative to the earth 41·4 km. per second. The average absolute height of the path above the earth's surface was about 30 km. Other deductions are made concerning the actual size, brightness, parabolic velocity in space and actual path, and the following value is obtained for the radiant point:—long. = 23° 8′, lat. = +9° 10′ (*Astronomische Nachrichten*, No. 4008).

A New 24-inch Reflector at Harvard.—In No. 93 of the Harvard College Observatory *Circulars* Prof. E. C. Pickering announces that the construction of the new 24-inch reflector—one of the chief acquisitions with the Anonymous Fund of 1902—is now so far advanced that the instrument may be used for visual observations. The mirror was made by Messrs. Alvan Clark and Sons, and the mounting has been designed and constructed in the observatory workshop.

Magnitude observations of three of the variable stars discovered by Miss Leavitt near the Orion nebula have been made with this instrument, and their variability confirmed, by Mr. L. Campbell, and the results are set out in detail in the *Circular*.

Stars with Variable Radial Velocities.—A list of nine spectroscopic binaries discovered with the Mills spectrograph, in addition to the forty-eight previously announced, is given in No. 70 of the Lick Observatory *Bulletins*. Amongst them we find α Andromedæ, which was announced as a binary by Mr. Slipher in 1904, and which the Lick spectrograms show to have a negative radial velocity varying from 2 km. (October 5, 1903) to 36 km. (November 30, 1903). ζ Ceti has a small but undoubtedly real variation, whilst γ Geminorum shows a variation from −17 km. (on October 24, 1899) to −4·7 km. (on January 27, 1904). Twenty-five spectrograms of the brighter component of Castor, α^2 Geminorum, indicate a variation of about 26 km. in the radial velocity. Applying the values determined to Prof. Doberck's orbit of Castor, a preliminary value of 0″·05 is found for the parallax of this star; but this has not very great weight, owing to the uncertainty in the elements of the visual system. η Böotis with a period of several years, ξ Serpentis with a probably short period, ζ Lyræ, τ Sagittarii, and 71 Aquilæ are the other stars for which variable radial velocities have been discovered.

NORTH AFRICAN PETROGLYPHS.

M. E. F. GAUTIER has published in *l'Anthropologie* (xv., 1904, p. 497) an illustrated account of a recent find of rock carvings in the ravine of Zenaga, between

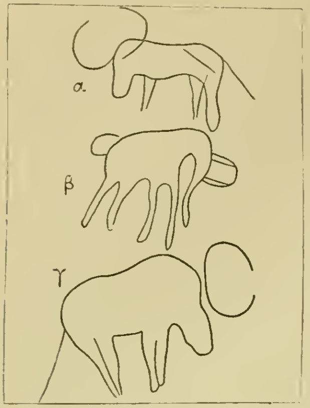

FIG. 1.—Rock carvings from Zenaga. Dimensions from the furthest point of the horns to the end of the body. α, 43 cm.; β, 39 cm.; γ, 53 cm.

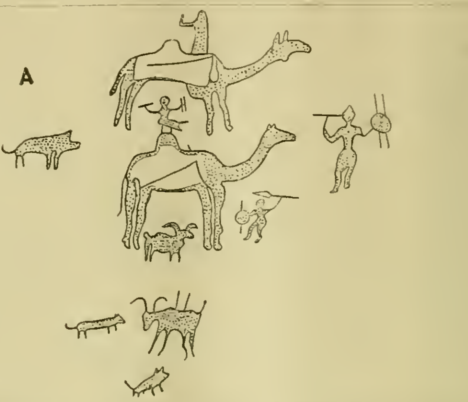

FIG. 3.—Touareg rock carving. Total height of the space occupied by the people.

Figuig and Beni-Ounif, in Sahara. The drawings are in deep outline and of large size, sometimes life-size, and their antiquity is established by the patina in the cuts being as pronounced as that on the surface, and by the fact that

FIG. 2. Rock carving from Zenaga. Dimension, 1 metre from the head to the tail. All the part of the design left white is carefully polished in the original.

some of the animals represented, such as the elephant, no longer exist there, while others, like the buffalo, are now extinct. In Fig. 1 we have two recognisable portraits of *Bubalus antiquus* and one of an elephant. Several South Oranais petroglyphs represent a ram or goat with a spheroid on its head, provided with projecting appendages (Fig. 2). It is suggested that the spheroid is a solar disc flanked on each side by a snake (*uraeus*), and this would be a representation of the great god Ammon, of Thebes. If this be so, the question arises, did the inspiration of the South Oranais engraving come from Egypt, or had the god Ammon a Libyan origin? The goat (*Ovis longipes*) of Zenaga differs in some details from those of Bou-Alem, and the "solar disc" is provided with rays. The other drawings of this problematic design were exhibited at the International Congress of Anthropology of 1900, and gave rise to a long discussion.

Rock carvings of a very different character were discovered by the author in the Touareg (Tawarek) country on the first slopes of the Hoggar (Ahaggar) massif, 200–300 kilometres south of In Salah. Some are scribblings in which animals and men are represented diagrammatically, and with these inscriptions are associated. M. Flamand some time ago described entirely similar graffiti in South Oranais which he identified as "Libyco-berbères." The greater part of the figures in this paper illustrate engravings of a very different character, and are far less ancient than those just referred to, for the animals represented are forms that still exist there. The presence of the camel is very significant, since it is generally admitted that it was only introduced, or re-introduced, into north-west Africa in the first centuries of our era, and appears to have been abundant there about the period of Justinian. Other animals represented are the horse, ass, cattle, goat, moufflon, gazelle, dog, ostrich, &c. The engraved portions differ in their colour markedly from the rest of the rock, and lack patina. From their appearance, these petroglyphs may be recent, but it has been denied that they have any relation with the Touaregs. Direct evidence is afforded by the representations of men instead of the square shield, very long spear, and sword of the present inhabitants. These men are provided (Fig. 3) with a small round shield and three javelins, thus proving that they are "Libyco-berber" productions.

A. C. H.

THE MINERAL RESOURCES OF CANADA.

THE publications of the Geological Survey of Canada have long been characterised by the want of promptness of publication. This defect is, however, to a large extent removed by the new departure made by the section of mines under the direction of Mr. E. D. Ingall. It consists in issuing a series of bulletins, giving in condensed and popular form information regarding the mineral resources of the Dominion, together with particulars of similar occurrences in other countries, which may be of use to mining engineers in Canada. We have received thirteen of these bulletins, and from the information given it is evident that the mineral resources of the Dominion are of a most varied character, and that the mineral industry is in a healthy condition. The subjects dealt with are platinum, coal, asbestos, infusorial earth, manganese, salt, zinc, mica, molybdenum and tungsten, graphite, peat, apatite, and copper.

So far the production of platinum has been obtained from placer workings on the Similkameen river in British Columbia. At Sudbury, Ontario, it is found *in situ* in combination with arsenic and associated with the nickeliferous pyrrhotite deposits. The yield of platinum in Canada has been falling off for some years past and is now insignificant.

The bulletin on coal covers sixty-four pages, and contains a collection of analyses of typical coals and a valuable bibliography of the subject. In 1902 the output of coal in Canada exceeded seven million tons. The principal areas at present worked are the Nova Scotia coalfields with rocks of Carboniferous age, and the Cretaceous coalfields of Vancouver island, and of the Crow's Nest Pass, British Columbia. Anthracite is mined in Alberta, and lignite is mined in the Souris river district, Assiniboia, and in the Yukon district.

The asbestos industry of Canada is of considerable importance, the production having increased from 380 tons in 1880 to 40,000 tons in 1902. Canada now furnishes about 88 per cent. of the world's supply. The deposits are found in serpentine. In 1896 the manufacture of asbestic was begun. This is a finely-ground serpentine in which there is a small amount of very fine fibre disseminated, and the resulting product is specially adapted for fine plaster for walls and interior decoration. Its value per ton is low, but as its preparation involves little extra expense, it is claimed that a profit results from its manufacture.

Infusorial earth was produced in Canada in 1902 to the amount of 1000 tons, valued at 3300*l*. It is mined at Bass river lake, and St. Ann's, Nova Scotia, and is sold chiefly in the United States. The uses to which it is put are varied. Formerly it was largely used in the manufacture of dynamite, but it has now been replaced by cheaper absorbents, such as wood pulp. It is now chiefly used as a polishing material and as a boiler covering. It can also be used in the manufacture of bricks when great lightness is required.

Although Canada has not yet taken a prominent place among the manganese-producing countries of the world, this is not due to lack of deposits of the ore. The extent of the production depends on the development of steel manufacture, and, as Canada is now making great strides in this direction, its deposits will probably soon assume greater importance. The ores represented comprise pyrolusite, manganite, psilomelane, and wad, and as some of the Canadian deposits contain a large proportion of the first-named mineral, the ore is specially adapted for chemical manufacture.

At present Ontario is the only province producing salt, the output in 1902 having been 64,000 tons. The country's chief resources consist of the rock salt beds underlying some 2500 square miles on the eastern shores of Lake Huron. The amount of salt imported into Canada is at present double the amount produced in the country, owing to the fact that salt is produced more cheaply in England, whence the bulk of the imports come.

In eastern Canada mica occurs in large and important deposits, the mining industry being chiefly confined to the provinces of Ontario and Quebec. The merchantable mica is always associated with intrusive masses and dykes of pegmatite-granite and pyroxene, which cut the gneiss and crystalline limestone. The mica produced is chiefly used for electrical purposes.

Apatite is widely distributed in Canada in deposits in the crystalline rocks, and in fossiliferous strata of Cambrian age. In 1889 the province of Ontario produced as much as 3547 tons, but since then, owing to the competition of the cheaply mined phosphates of Carolina, the output has rapidly decreased. Graphite is widely distributed in the gneiss and crystalline limestones of Canada, the output in 1901 having been 2210 tons. Zinc ore is produced at one mine in Olden township, Ontario. The ores of molybdenum and tungsten are of frequent occurrence in Canada. Copper ores have been known in eastern Canada for nearly a century, and large amounts of capital have been expended in developing what appeared to be promising localities, but little economic success has as yet resulted.

The Canadian peat resources are dealt with by Dr. R. Chalmers in a bulletin of forty pages. The peat bogs in the eastern provinces are attracting attention in view of the depletion of the forests and the increasing prices of coal, and attempts are being made, in many cases with poor success, to utilise them in the production of fuel, coke, and moss-litter.

In connection with this valuable series of bulletins of the Geological Survey, reference may be made to a memoir in the *Ottawa Naturalist* on the marl deposits in Ontario, Quebec, New Brunswick, and Nova Scotia, by Dr. R. W. Ells, the author of most of the bulletins mentioned. The chief value attributed to this shell-marl was supposed to be confined to its use as a fertiliser for soils deficient in calcareous matter. Recently it has been found to be specially adapted for the manufacture of the best grades of Portland cement, when mixed with a proper proportion of clay; and large manufacturing establishments have been established at several points, more especially in the province of Ontario.

The latest publication of the Geological Survey of Canada is an exhaustive report by Dr. A. E. Barlow on the origin, geological relations, and composition of the immense nickel and copper ore deposits of Sudbury, Ontario. Details of the mining, smelting, and refining methods are given, and reference is made to the character and extent of all the more important nickel ore deposits in other countries. With a production of 6253 tons of metallic nickel in 1903, valued at 5,002,204 dollars, Sudbury is the largest producer of nickel in the world; and this monograph of 236 pages, with numerous plates and maps, summarises all the previous original investigations and supplies the most detailed and accurate information regarding these important deposits yet available.

THE ROYAL HORTICULTURAL SOCIETY.[1]

THE history of the Royal Horticultural Society has been chequered to an extent probably exceeding that of any other society. At one time fashionable, it enjoyed a fictitious prosperity. We say fictitious, for horticulture, especially scientific horticulture, was neglected, and, as a consequence, the wave or waves—for there were several—of prosperity broke on the shores of adversity, with the result that the gardens were curtailed, the expenditure was reduced in all directions, the valuable collections were sold or destroyed, the herbarium and the library were dispersed.

It is, however, not our purpose now to dwell on ancient history, but rather to point out the satisfactory progress in recent years of which the journal before us affords evidence. Some foreshadowings of that progress date back to the year 1866, when an international horticultural exhibition on a very large scale was held on the ground where the Natural History Museum now stands. The exhibition itself differed from others mainly in its extent and in the larger participation of foreign exhibitors. It was organised and managed, not by the society, the financial position of which at that time precluded it from embarking on such an enterprise, but by a special committee presided over by the late Sir Wentworth Dilke, to whose organising faculty and strenuous labour the success obtained was largely due.

[1] The *Journal* of the Royal Horticultural Society, vol. xxix., parts i., ii., and iii.

If this exhibition had been merely a flower-show on a gigantic scale there would have been little or no need to advert to it in these columns. But associated with it was a botanical congress attended by many of the chief European notabilities, and presided over by the late Alphonse de Candolle. The results of their discussions were recorded in a report of proceedings which still forms a most valuable document. Copies are now rarely met with, although they were distributed widely among foreign and British botanical libraries.

We have a special reason for alluding to this nearly forgotten congress, because it may be looked on as the progenitor of two important events in the modern history of the Royal Horticultural Society. A large surplus was eventually derived from the exhibition, and this surplus was devoted to the publication of the proceedings before mentioned, to charitable purposes, and to the purchase of the valuable library of the late Dr. Lindley. This library was placed in the hands of trustees for the benefit, primarily, of the fellows of the Royal Horticultural Society, and, under certain regulations, of the general public also. In this way the society once more became possessed of an extensive library, which cannot be alienated if evil days should again arise. It is now, after various vicissitudes, fittingly installed, at the expense of Baron Sir Henry Schröder, in the new building erected for the society in Vincent Square, Westminster.

Thus has been accomplished one result of the congress of 1866. Another consequence of that meeting was the formation of a scientific committee under the presidency of Sir Joseph Hooker, which has endeavoured so far as circumstances permitted to carry out the objects formulated in M. de Candolle's presidential address. The early days of the committee, when such men as Sir Joseph Hooker, Mr. Berkeley, Prof. Westwood, Mr. Wilson Saunders, Colonel Clarke, Mr. Andrew Murray, Sir William, then Mr., Thiselton-Dyer, and other naturalists took part in the discussions, remain as a pleasant memory. The Rev. Prof. Henslow, who acted as secretary for the last quarter of a century, has only lately relinquished his office. The committee still includes a body of experts in many departments of horticulture and natural history generally.

We have alluded to the new building, to the erection of which Baron Schröder has magnificently contributed, whilst others have not been backward. Much, however, remains to be done, and until the existing debt is cancelled not much in the way of scientific experiment or research can be effected. The society has been exceptionally fortunate in its centenary year. Not only has it secured a fine hall for exhibition purposes, together with commodious offices and accommodation for the library, but through the generosity of Sir Thomas Hanbury it has come into possession of the late Mr. G. F. Wilson's interesting garden at Wisley, near Weybridge.

The old garden at Chiswick, the value of the services of which in the past is beyond compute, has been abandoned, soil and climate no longer being propitious for gardening operations. The cultural trials hitherto carried out at Chiswick will henceforth be conducted at Wisley, and there is every reason to hope that in a short time a research station under a competent director may be established, and thus a great and pressing need may be supplied.

This is rather a long preface to the notice of the *Journal*, but we hope it will not be thought irrelevant. The necessity for a journal to link together all the otherwise separate departments of the society has always been recognised, but in the evil days aforementioned the publication was often spasmodic and irregular. Since the appointment of the Rev. W. Wilks as secretary, and under the steady impulse of the president, Sir Trevor Lawrence, a great improvement all round has been manifested, and in no way more remarkably then in the contents and regularity of issue of the journal. So marked is the improvement that it has become too much for the digestion of some people, and some of the fellows are crying out, not for more, but for a more limited supply.

Our notice has extended to such a length that we can only indicate some of the contents other than those relating merely to practical cultivation; such are Dr. Cooke's article on the fungous pests of the shrubbery, with coloured illustrations; on the heredity of acquired characters, by Prof. Henslow; gooseberry mildew, by Mr. Salmon; diseases of Calanthes, by Mr. Bidgood; note on electric heating, by Mr. Rogers; diseases of the potato, by Mr. Massee; Indian primulas, by Sir George Watt; and a large number of other communications which tend to show that the scientific side of horticulture is not neglected. The abstracts from botanical and horticultural literature which have of late formed so important a feature of the *Journal* are omitted from the present part, possibly because so much space has, not unnaturally, been devoted to the proceedings in connection with the centenary celebration and the formal opening of the new hall by H.M. the King.

The interests of the commercial side of horticulture, however great their importance, can very well be left to take care of themselves. Nevertheless, the cultivators may well look to the society for light and guidance in such matters as cucumber spot, and the many diseases which so very seriously affect their business prosperity. Progressive horticulture looks to the society to investigate outstanding problems, open out new paths, and generally to acquire and diffuse useful knowledge. Even if not immediately useful, such knowledge is sure eventually to be of advantage even to the "practical man." With a research station at Wisley, a competent director, a sympathetic scientific committee to direct and advise, and an energetic secretary, the society may on entering its second centenary look forward to being able to advance scientific horticulture in a more thorough manner than it has ever done before.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

The *Pioneer Mail* states that a gentleman of Nagpur has bequeathed a sum of fifty thousand rupees to the Central Hindu College, Benares.

At the spring graduation ceremony of the University of Edinburgh on April 7 the honorary degree of LL.D. was conferred upon Prof. W. W. Cheyne, C.B., F.R.S., Dr. J. H. Jackson, F.R.S., Dr. A. D. Waller, F.R.S., Sir Frank E. Younghusband, and Prof. G. A. Gibson.

The Catholic University of America will receive, says *Science*, a bequest of 20,000*l*. from Miss Helen Tyler Gardiner. We learn from the same source that Mr. Andrew Carnegie has agreed to give a 10,000*l*. library to the Washington and Lee University on condition that the university raises an endowment of 10,000*l*. for maintaining it.

The *Glasgow Herald* announces that by the will of the late Mr. Donald the sum of 20,000*l*. is bequeathed to the Glasgow and West of Scotland Technical College, to be paid on the death of Mrs. Donald. After various other bequests have been made, the residue of the estate is to go to the governors of the Glasgow and West of Scotland Technical College for purposes specified in the trust disposition and settlement.

The committee of the Privy Council has decided to recommend the King to grant a Charter incorporating a university in Sheffield. A large sum of money has already been given or promised for the endowment of the university, and, in addition, the city council has pledged the city to the gift annually of a sum equal to the proceeds of a rate of 1*d*. in the pound (the capitalised value of which gift is 200,000*l*.). The draft Charter of the proposed university provides for the establishment of a teaching university with powers to grant degrees in the faculties of arts, science, technology, and medicine.

The articles of agreement under which it is proposed to combine the Massachusetts Institute of Technology and Harvard University have been made public. Provision is made for a joint school of industrial science, to be known under the present name of the Institute of Technology, to be governed by an executive board of nine members, of which three shall represent Harvard, and to be maintained by present institute funds, augmented by the income of all funds of the Lawrence Scientific School, by three-fifths of the net income which may accrue from the Gordon McKay bequest, amounting to several millions, and by the income of all property which Harvard may hereafter acquire for the promotion of instruction in industrial science.

THE new regulations recently issued by the War Office, under which commissions in the Army may be obtained by university candidates, provide that commissions shall be allotted each half-year to the University of London. To satisfy the requirements of the regulations, the Senate has appointed a nomination board for military commissions which will nominate qualified students for commissions, and arrangements have been made for the instruction of candidates in military subjects. To be eligible for a commission, a candidate must have graduated as an internal student, and this involves three years' study at one or more of the schools of the university. Before a student can be nominated for a commission he must, as a rule, have attended the various courses of instruction in military subjects in the university, and he must have been attached for two periods of six weeks, or for one period of twelve weeks, to a regular unit. Courses of lectures in military subjects are being given at the University of London by Colonel H. A. Sawyer, P.S.C., and Lieut.-Colonel F. N. Maude, P.S.C., late R.E.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 23.—"Two Cases of Trichromic Vision." By Dr. F. W. **Edridge-Green.** Communicated by Dr. F. W. Mott, F.R.S.

One case (Prof. J. J. Thomson) sees only three colours in the bright spectrum—red, green, and violet. He can distinguish nothing of the nature of pure yellow, like the sensation given him by the sodium flame, in the spectrum. There is no definite colour to him at the portion of the spectrum where the normal sighted see pure blue. Reddish-green would describe the orange and yellow regions and greenish-violet the blue. λ 5950 (orange-yellow) is the point which differs most from red and green. There was no shortening of either end of the spectrum.

Difference of Hue Perception.—The author then tested him with his apparatus for ascertaining the size of different parts of the spectrum which appear monochromatic, and found him defective in distinguishing differences of hue.

Colour Mixtures.—Tested with Rayleigh's apparatus for matching spectral yellow by a mixture of red and green, the mixed colour of his match always appeared green to the author.

Classification Test.—Only a few colours were selected in each case. On being asked to pick out all the yellows he chose those with orange in them. He had considerable difficulty in matching the colours. In common with the cases previously observed, the effects of simultaneous contrast were much more marked than in the normal sighted. Two wools changed colour to him on being contrasted, when no change was evident to the author.

Lantern Test.—He correctly named the red, green, and violet with and without the neutral glasses, and saw them at the normal distance. He had difficulty with yellow and blue. He called pure yellow "greenish yellow."

The other case is that of Mr. P. S. Barlow, a research student in the Cavendish Laboratory, and was similar in most respects to the above.

The author uses the term trichromic as a statement of the fact that persons having this vision see only three colours in the bright spectrum, whilst the normal sighted see six, and may, therefore, be designated hexachromic. It is probable that the appearance of the bright spectrum to the trichromic is very similar to that of a spectrum of feeble luminosity to the normal sighted, in which only three colours—red, green, and violet—are seen. The defective difference perception which is found in these cases accounts for most of the facts. Both these cases are bordering on the tetrachromic, as the sodium flame appears to give rise to a distinct sensation.

March 2.—"Atmospheric Electricity in High Latitudes." By George C. **Simpson,** B.Sc. Communicated by Arthur Schuster, F.R.S.

This paper is an account of a year's work on atmospheric electricity undertaken at Karasjok, Norway, from October, 1903, to October, 1904, with the results of a month's observations on atmospheric radio-activity made at Hammerfest.

Karasjok is situated well within the Arctic Circle (69° 17′ N.), and during the winter has a severe Arctic climate, so that it is well situated for finding the influence of meteorological elements and the presence or absence of direct sunlight on the electrical conditions of the atmosphere.

The observations were limited to determinations of the potential gradient, electrical dissipation, atmospheric ionisation, and atmospheric radio-activity. A continuous record of the potential gradient was obtained by means of a Benndorf self-registering electrometer, and measurements of the dissipation and ionisation were made three times each day unless the weather made it impossible to use the instruments. Measurements of the radio-activity were made between the hours of 10 to 12 a.m., 3 to 5 p.m., and 8.30 to 10.30 p.m. on 253 days, and in addition 42 measurements were made between 3 and 5 a.m. The results of the work are shortly as follows:—

YEARLY VARIATION.—*Potential Gradient.*—The yearly course was found to be in accordance with the general rule for the northern hemisphere—rising rapidly from October to February, when it reaches a maximum, then falling more rapidly until the end of May, after which it remains constant until the winter sets in again during October. *Dissipation.*—The yearly course is exactly opposite to that of the potential gradient, the curves representing the two being almost mirror images of one another. *Ionisation.*—The course of the ionisation consists of a nearly linear six months' fall from the beginning of September to the end of February, followed by a similar six months' rise from March to the end of August.

DAILY VARIATION.—*Potential Gradient.*—The daily course for the whole year consists of a single period having a minimum about 5 a.m. and a maximum about 9 p.m. *Dissipation.*—For the whole year the dissipation is slightly higher at midday than earlier in the morning, while the evening observations show the lowest dissipation of the three. *Ionisation.*—The daily period of the ionisation is not so pronounced as that of the dissipation, but the ionisation is slightly lower in the evening than in the morning or at midday during the whole year.

RELATION BETWEEN THE METEOROLOGICAL AND ELECTRICAL CONDITIONS OF THE ATMOSPHERE.—*Wind.*—As is to be expected, the dissipation increases greatly with the wind strength. *Temperature.*—Both the ionisation and dissipation become much less as the temperature goes down. With temperatures between 10° C. and 15° C. the dissipation is 4·95 per cent. and the ionisation 0·44 per cent., while with temperatures below −20° C. these become 0·83 per cent. and 0·17 per cent. respectively. The potential gradient increases as the temperature falls. *Relotive Humidity.*—With rising relative humidity the dissipation falls rapidly, and the ratio of negative to positive dissipation increases. When the whole year is taken into account, the same result is found for the ionisation; but for the winter and summer six months, taken separately, the effect of the humidity of the air on the ionisation is not apparent.

INTERRELATION OF ELECTRICAL FACTORS.—Both the dissipation and ionisation greatly influence the potential gradient. Low values of ionisation and dissipation are accompanied by high values of the potential gradient, and *vice versâ*. The dissipation increases with the ionisation.

THE AURORA AND THE ELECTRICAL CONDITION OF THE ATMOSPHERE.—No relation whatever could be detected between the aurora and the electrical conditions of the atmosphere. The most careful watching of the electrometer needle revealed no variation of the potential gradient with variations of the aurora.

RADIO-ACTIVITY.—Measurements of the radio-activity were made by Elster and Geitel's method, and their arbitrary unit was used in expressing the results. A most distinct yearly course of the radio-activity was found, the maximum, 129 (mean for month), falling in December, and the minimum, 47, in June. The radio-activity has also a very pronounced daily course, the maximum, 162 (mean for year), falling in the early hours of the morning, and the minimum, 58, about midday.

There is a distinct connection between the radio-activity and the meteorological conditions of the atmosphere; the radio-activity increases as the temperature falls, rises as the relative humidity rises, decreases with increasing wind strength, and is greater with a falling than with a rising barometer. All these facts support Elster and Geitel's theory that the source of the emanation in the atmosphere is the soil of the ground. Those meteorological conditions which prevent the air immediately above the ground from ascending tend to increase the radio-activity; on the contrary, all those conditions which cause a rapid circulation of the air greatly reduce the radio-activity when measured in the lower atmosphere.

OBSERVATIONS AT HAMMERFEST.—The mean values of the radio-activity were found to be lower at Hammerfest on the coast than at Karasjok inland. The most important result of the Hammerfest measurements was the great difference between the radio-activity of the air from the sea and that from the land. The mean radio-activity with a wind from the sea was only 6, while with a land breeze the mean was 72.

March 16.—"A New Radio-active Element, which Evolves Thorium Emanation." Preliminary Communication. By Dr. O. **Hahn.** Communicated by Sir William Ramsay, K.C.B., F.R.S.

The radio-active preparation was gained from barium radium bromide, obtained from thorianite from Ceylon, while fractionating it in order to separate the radium. It collected along with small traces of iron and other impurities in the more soluble portions, and was precipitated by ammonia. From this preparation a quantity of about 10 mg. of a strongly radio-active oxalate was obtained, giving off a strong emanation and imparting bright luminosity to sensitive screens. The emanation was found to be identical with that of thorium; different samples gave for the half-period of decay from 52 to 55 seconds. For the half-period of the induced activity somewhat more than $11\frac{1}{2}$ hours was found. The emanation given off by the 10 mg. of the oxalate, dissolved in hydrochloric acid, corresponds in intensity to more than that of a kilogram of thorium in solution; consequently it was more than 100,000 times stronger than the common thorium emanation when compared weight for weight. Further work led to the separation of about 20 mg. of a substance giving nearly 250,000 times more emanation than thorium.

Whether this active substance is the constant radio-active constituent of thorium preparations, or whether it is another new radio-active element, remains still undecided. It is hoped that an even more strongly radio-active product may be obtained, and that it may be possible to describe more in detail the properties of the substance.

Recent researches would appear to show that the amount of this substance in soil is comparable with, but still considerably smaller than, radium.

March 30.—"The *Rôle* of Diffusion in the Catalysis of Hydrogen Peroxide by Colloidal Platinum." By Dr. George **Senter.** Communicated by Sir William Ramsay, K.C.B., F.R.S.

The deviations from the simple logarithmic formula in the catalytic decomposition of hydrogen peroxide by colloidal platinum are probably due to disturbances caused by convection currents. When the velocity-constant calculated on Nernst's diffusion hypothesis is great compared with the chemical velocity-constant, increased convection can produce no appreciable effect on the observed reaction-velocity.

In the case under consideration, therefore, since increased convection modifies the observed reaction-velocity, there must be some error in the assumptions which lead to the conclusion that the diffusion velocity-constant is great in comparison with the chemical velocity-constant. This error is probably to be found in the assumption that the whole surface of the platinum is, under ordinary conditions, active towards hydrogen peroxide.

It cannot be claimed, from the above considerations, that Nernst's hypothesis is true for the platinum catalysis, but only that the diffusion-velocity is not great in comparison with the chemical velocity. Other considerations, however, such as the small value of the temperature coefficient, make it probable that the above hypothesis does apply to this particular action. Further support for this view may, perhaps, be found in the fact that the deviations from the simple logarithmic law in catalysis by platinum have their exact analogy in the hæmase catalysis. On the "chemical" velocity hypothesis it would seem rather remarkable that two catalysers of so different origin should show exactly similar behaviour, but this becomes at once intelligible on Nernst's hypothesis, according to which the chemical action plays quite a secondary part in the reaction-velocities in question.

Mineralogical Society, March 15.—Prof. H. A. Miers, F.R.S., president, in the chair.—Description of the big diamond recently found at the Premier Mine, Transvaal: Dr. F. H. **Hatch** and Dr. G. S. **Corstorphine.** The stone weighed more than $1\frac{1}{4}$ lb., and its greatest linear dimension was 4 inches. It was part (probably less than half) of a distorted octahedral crystal.—On some new mineral localities in Cornwall and Devon: A. E. I. M. **Russell.** An account was given of various new finds of the minerals anatase, scheelite, wolframite, childrenite, apatite, and connellite.—On a crystal of phenakite from Africa: L. J. **Spencer.** This crystal, which was transparent and rich in faces, was brought back together with crystals of tourmaline, corundum, and amethyst, by the Rev. A. North Wood from the Usagara country in German East Africa.—Notes on various minerals from the Binnenthal, Switzerland: G. T. **Prior** and G. F. Herbert **Smith.** Further crystallographic and chemical details were given of the three new red minerals from the Binnenthal originally described by R. H. Solly, and named by him Smithite (after G. F. Herbert Smith), Hutchinsonite (after A. Hutchinson), and Trechmannite (after C. O. Trechmann). Smithite is a sulpharsenite of silver having the composition represented by the formula $AgAsS_2$; it is monoclinic with $a:b:c=2.2205:1:1.9570$, β 78° 40′. A perfect cleavage parallel to 100 distinguishes it from the other two red minerals. Hutchinsonite is rhombic with $a:b:c=1.6356:1:0.7540$. A prominent form is 140. Trechmannite is rhombohedral with $c=0.7265$. The symmetry is the same as that of quartz.—On a new oxychloride of copper from Sierra Gorda, Chili: G. T. **Prior** and G. F. Herbert **Smith.** This new mineral, to which the name paratacamite was given, has the same chemical composition as atacamite, but begins to lose its water at a higher temperature than that mineral. It is pseudorhombohedral with $rr'=83°$ nearly. Twins about r are common. It displays optical anomalies, for minute fragments under the microscope are found to be biaxial.—On Dundasite from North Wales: G. T. **Prior.** The mineral was found by Mr. H. F. Collins in the Welsh Foxsdale Mine, Trefriw, Caernarvonshire; it occurs in white silky radiating tufts on cerussite with allophane; analysis showed it to be identical with Dundasite, hitherto known only from Dundas, Tasmania. A probable formula is $PbO.Al_2O_3.2CO_2.4H_2O$ or $PbH_2(CO_3)_2.Al_2.OH_6$.

Zoological Society, March 21. Mr G. A. Boulenger, F.R.S., vice-president, in the chair.—*Exhibits.*—Photograph of a wounded Oryx (*Oryx beisa*) hiding in undergrowth of wood in its native haunts, in order to show the protective nature of the coloration of the animal: F. **Gillett.**—A series of pencil sketches of fishes of the Rio Negro and its tributaries made by Dr. A. R. Wallace about fifty years ago: C. Tate **Regan.**—Radiograph of a living snake showing the skeletons of two frogs it had swallowed some hours previously: M. **Yearsley.**—Skulls of the fallow deer (*Dama vulgaris*) and the red deer (*Cervus elaphus*) showing arrest of the growth of the antlers due to complete or partial castration: R. E. **Holding.**—*Papers.* Effects of castration upon the horns of the prongbuck (*Antilocapra americana*): R. I. **Pocock.** The effects of the operation were curvature in growth, prevention of exuviation, and practical suppression of the anterior tyne.—The mammals and birds of Liberia: Sir Harry **Johnston,** G.C.M.G., K.C.B. Although Liberia was not marked off clearly by any natural features from either Sierra Leone on the one hand or the Ivory Coast on the other, it possessed a certain distinctness and a slight degree of peculiarity as regards its flora and fauna. As regards mammals and birds, Liberia was, to a great extent, a meeting-place for the forms of northern Guinea (Sierra Leone to the Gambia) and those of the Gold Coast, the Niger Delta, and the Cameroons. The species of mammals peculiar to it included the dwarf hippopotamus, the zebra antelope, Jentink's duiker, and Büttikofer's monkey. The author enumerated eighteen species of mammals and twenty of birds, specimens of which had been obtained by various collectors in Liberia.—Abnormal remains of the red deer (*Cervus elaphus*): M. A. C. **Hinton.** The remains consisted of three antlers which were obtained from different post-Pliocene deposits in the south of England. They agreed in having all the tynes suppressed and in being supported upon very long pedicles, thus resembling in form, though much exceeding in size, those of the pricket. Rudimentary offsets were seen on the most perfect example, which proved the antler to be the third in the series. These antlers belonged to individuals who had suffered testicular injury at an early period of life, by which the characters of youth were retained for a longer period than was usual.—On the affinities of Procolophon: Dr. R. **Broom.** The author believed that reptiles in Permian times became specialised along two distinct lines, the one represented by the pareiasaurians, anomodonts, therocephalians, and theriodonts, and terminating in the mammals, the second giving rise to all the other reptilian orders. The common ancestor was believed to have been a true reptile probably belonging to the order Cotylosauria. Procolophon was held to be an early member of the branch which led to the rhynchocephalians, and possibly fairly closely allied to the land ancestor of Mesosaurus.—Skulls of the fossil reptile Procolophon from Donnybrook and Fernrocks: Prof. H. G. **Seeley.** The author concluded that the main affinities were with the Anomodontia, chiefly with the Pareiasauria, and in the teeth with the Theriodontia; but that in a less degree there were indications of affinity with reptiles classed as labyrinthodonts. All parts of the skeleton supported the separation of the Procolophonia as an order of extinct Reptilia.

Geological Society, March 22.—Dr. J. E. Marr, F.R.S., president, in the chair.—An experiment in mountain-building, part ii.: Lord **Avebury**, P.C., F.R.S. In this paper some experiments are described, which were conducted by an apparatus by means of which pressures could be applied in two directions at right angles to one another, a space of 2 feet square being reduced to one 22 inches square. In the first series, plastic materials, such as cloth and thin oilcloth, were used, with layers of sand between them. Two main folds crossing at right angles were formed, the upper one shifted over the lower. The use of two layers of linoleum produced a different type of folding, and the lower layers of the linoleum were broken along the principal ridges. In the second series, a layer of plaster was introduced; this was found to be fractured, tilted up into a "writing-desk" form, and forced irregularly into the sandy layers. Overthrusts were thus produced, so that in some cases a boring would have passed through two or even four layers of the rigid substance. In other cases, the edges of the primary fracture broke off more or less regularly, and the detached pieces were pushed up, assuming gradually a very steep angle. The remainder of the edges of the plate of plaster, having now room, were able to approach each other. Pliable material above the plaster was thrown into one or a few extensive folds, while that beneath assumed a greater number of small folds.—The Rhætic rocks of Monmouthshire: L. **Richardson.** The Rhætic rocks occur only in the neighbourhood of Newport, and the present paper describes three new sections and four new exposures.

Manchester.

Literary and Philosophical Society, February 21.—Prof. H. B. Dixon, F.R.S., vice-president, in the chair.—Electrically-heated carbon tube furnaces: R. S. **Hutton** and W. H. **Patterson.** These furnaces are intended for experimental work, and not only enable extremely high temperatures to be attained, but with them the temperature, being under perfect control, can be kept steady at any value up to the maximum.

February 28.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—The early history of seed-bearing plants, as recorded in the Carboniferous flora (Wilde lecture): Dr. D. H. **Scott**, F.R.S. (see p. 426).

March 7.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—Two new aldehyde reactions: W. B. **Ramsden.**

March 21.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—A new genus Nevillina, of the subfamily Miliolininæ, of the Foraminifera: H. **Sidebottom.**—On the temperature coefficient of electrical resistivity of carbon at low temperatures: H. **Morris-Airey** and E. D. **Spencer.** The method of taking observations at temperatures between the normal temperature and that of boiling oxygen was described, and the results plotted in the form of curves. The shape of the curves was discussed in connection with the theory that carbon conductors behave like loose powders.

Paris.

Academy of Sciences, April 3.—M. Troost in the chair.—On the use of the hot and cold tube in the study of chemical reactions: M. **Berthelot** (see p. 568).—Observations on the new Giacobini comet made at the Observatory of Paris: G. **Bigourdan.** The observations were made on March 28 and 31; the positions of the comparison stars and apparent positions of the comet are given. On March 28 the comet appeared as a nebulosity of about the thirteenth magnitude, with a nucleus sensibly brighter than the rest. On March 31 the size had diminished, and the apparent brightness increased.—On the relation between the integrals of the total differentials of the first and second species of an algebraic surface: Emile **Picard.**—The variation of the band spectra of carbon with the pressure and some new band spectra of carbon: H. **Deslandres** and M. **d'Azambuja.** The kathode spectrum in air having shown peculiar variations with the pressure, it was thought desirable to study the effect of pressure upon the carbon spectrum. The negative spectrum of carbon is a band spectrum which appears at the kathode in the oxygen and hydrogen compounds of carbon, and is especially intense in the case of carbon monoxide and dioxide. Two spectra were photographed simultaneously on the same plate, one from a Geissler tube containing the gas at a pressure of about 0·2 mm., and the other from the kathode of a tube in which the pressure was capable of being varied up to nearly atmospheric. The variations noted strongly resemble those already studied for the negative spectrum of air. Details of a new spectrum of carbon dioxide, given by the kathode at a pressure of 30 cm. of mercury, are given.—On the grains found attached to *Pecopteris Pluckeneti*: M. **Grand'Eury.** In the search for fronds giving rise to fossil seeds, the author has found fronds of the above species to which are fixed, not one or two, but many hundreds of grains, proving that the fossil ferns of the Coal-measures, other than the Neuropterideæ, are gymnosperms, and must be placed among the Cycadeæ. Two reproductions of photographs of the fossils are given.—On the new Giacobini comet: M. **Giacobini.** The elements of the comet are given, calculated from observations made at Nice on March 26, 28, and 30.—The provisional elements of the Giacobini comet (1905, March 26): E. **Maubant.** The elements are calculated from observations made at Nice on March 26, and by M. Bigourdan at Paris on March 28 and 31.—Abel's theorem on algebraic surfaces: Francesco **Severi.**—On linear differential equations of the second order with a periodic solution: Maxime **Bôcher.**—On a hyperelliptic surface: E. **Traynard.**—On the dynamics of the point and the invariable body in an energy system: Eugène and François **Cosserat.**—On the properties of tungstic anhydride as a colouring material for porcelain: Albert **Granger.** The yellow enamel was obtained by heating with tungstic anhydride at 800° C., using lead monosilicate as a flux. With the addition of bismuth oxide this colour withstood firing well. The conditions under which these colours tend to become opaque have not been fully worked out, and work is being continued by the author in this direction. On the production of the hyposulphites: M. **Billy.** The production of sodium hyposulphites by the action of sulphur dioxide on sodium in presence of a neutral solvent has been claimed by a German patent, but the author's experiments have led invariably to a negative result. In presence of alcohol the reaction would appear to take place. By the introduction of sulphur dioxide into magnesium powder in suspension in absolute alcohol, the metal dissolves, possibly as an acid hyposulphite. This solution, left in a vacuum, deposits magnesium hyposulphite.—On acetyl-lactic acid: V. **Auger.** Previous accounts of this substance being contradictory, the author has attempted to procure it in a pure state. It can be obtained either by the action of acetyl chloride on calcium lactate or on lactic acid, or by using acetic anhydride in the place of the acetyl chloride. The substance was obtained in a crystalline form in all three preparations, and its physical and chemical properties are given.—On the compounds of aluminium chloride with hydrocarbons and hydrogen chloride: G. **Gustavson.** By the interaction of benzene, isopropyl chloride, and aluminium chloride, the author has isolated a definite compound, the action of which, in the Friedel and Crafts reaction, may be compared to that of a ferment. This substance can unite both with hydrocarbons and hydrogen chloride.—On the hydrides of phenanthrene: Pierre **Breteau.** Previous work on the hydrogen addition compounds of phenanthrene has been carried out with the aid of hydriodic acid. The author has applied the Sabatier and Senderens reaction with reduced nickel, and in the present communication gives the results obtained with the hexahydride and octahydride of phenanthrene.—On the retrogradation of artificial starch: E. **Roux.**—The influence of the ethylene function in an active molecule: J. **Minguin.** With the view of throwing further light on the effect of the ethylene linkage on the rotation, the author has prepared amyl succinate, maleate, and fumarate, as well as the corresponding esters of bornyl alcohol, and has measured the rotatory power.—The constitution of the ligamentary ridge and the evolution of the ligament in existing Acephalæ analogous to the Rudistæ: R. **Anthony.**—Diagrams showing the ligament in section are given for *Unio Pictorum* and *Aetheria Caillaudi* at two ages.—Heterotypical mitosis in the Ascomycetes: René **Maire.**—On the possible *rôle* of slipping in metallogeny: L. **De Launay.** An application of the idea of *charriage* to a study of the continuity of metallic lodes.—On the existence of schists with graptoliths at Haci-El-Khenig, Central Sahara: G. B. M. **Flamand.** Specimens of schists bearing fossils, collected by Captain Cottenest, prove to be characteristically Silurian, and form the first definite proof of this system in the Central Sahara.—On the presence of the Middle and Upper Carboniferous in the Sahara: Émile **Haug.**—On an extraordinary halo observed at Paris: Louis **Besson.** This halo, which was observed at the Montsouris Observatory on March 26, besides the ordinary circle and parhelia of 22°, presented two abnormal coloured arcs, the angular measurements of which are given.

DIARY OF SOCIETIES.

THURSDAY, APRIL 13.

ROYAL SOCIETY, at 4.30.—On a New Type of Electric Furnace; with a Redetermination of the Melting Point of Platinum: Dr. J. A. Harker.—On Colour Vision by Very Weak Light: Dr. G. J. Burch, F.R.S.—(1) The Improved Electric Micrometer; (2) The Amplitude of the Minimum Audible Impulsive Sound: Dr. P. E. Shaw.—The Refractive Indices of Sulphuric Acid: Dr. V. H. Veley, F.R.S., and J. J. Manley.—On the Intensity and Direction of the Force of Gravity in India: Lieut.-Colonel S. G. Burrard, F.R.S.—A Quantitative Study of Carbon Dioxide Assimilation and Leaf-Temperature in Natural Illumination: F. F. Blackman and Miss G. Matthaei.

ROYAL INSTITUTION, at 5.—Synthetic Chemistry: Prof. R. Meldola, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Alternating Current Series Motor: F. Creedy.—Discussion of Mr. Bion J. Arnold's address to the joint meeting at St. Louis.

INSTITUTION OF MINING AND METALLURGY, at 8.—The Kedabeg Copper Mines: Gustav Köller.—Refining Gold Bullion and Cyanide Precipitates with Oxygen Gas: T. Kirke Rose.—Wood Gas for Power Purposes and Gas Generator: G. M. Douglas.—Notes on the Prestea District, Gold Coast Colony: P. Poore.—Notes on the New Dharwar Gold Field of India: R. O. Ahlers.—The Cause of Border Segregation in some Igneous Magmas: J. Park.

MATHEMATICAL SOCIETY, at 5.30.—On Irreducible Jacobians of Degree Six: P. W. Wood.—On Fermat's Numbers and the Converse of Fermat's Theorem: A. E. Western.—On the Strains that accompany Bending: Prof. A. E. H. Love.—Ordinary Inner Limiting Sets in the Plane or Higher Space: Dr. W. H. Young.

FRIDAY, APRIL 14.

ROYAL INSTITUTION, at 9.—The Law of Pressure of Gases below Atmosphere: Lord Rayleigh.

PHYSICAL SOCIETY, at 8.—On Ellipsoidal Lenses: R. J. Sowter.—(1) The Determination of the Moment of Inertia of the Magnets used in the Measurement of the Horizontal Component of the Earth's Field: (2) Exhibition of a Series of Lecture Experiments illustrating the Properties of the Gaseous Ions produced by Radium and other Sources: Dr. W. Watson, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Value of Meteoric Radiants Based on Three Paths: W. F. Denning.—Determination of Longitude on the Planet Jupiter: G. W. Hough.—(1) Revised Elements of UY Cygni; (2) Revised Elements of Y Lyræ: A. Stanley Williams.—Further Note on Instrumental Errors affecting Observations of the Moon; in reply to Mr. Cowell's paper of June, 1904: H. H. Turner.—Reply to Prof. Turner's paper: P. H. Cowell.—Note on the Point Distributions on a Sphere; with Remarks on the Determination of the Apex of the Sun's Motion: H. C. Plummer.

MALACOLOGICAL SOCIETY, at 8.—Anatomical and Systematic Notes on Dorcasia, Trigonephrus, Corilla, Thersites, and Chloritis: Henry A. Pilsbry.—Some Account of the Anatomy of *Cassidaria rugosa*, L.: Alexander Reynell.—Notes on a small Collection of Shells from the Victoria Falls, Zambesi River: H. B. Preston.—Descriptions of Six New Species of Land Shells from South Africa: H. Burnup.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—President's Address. Conclusion of discussion on Steam-engine Research Report and Prof. Capper's reply.

SATURDAY, APRIL 15.

ROYAL INSTITUTION, at 3.—Some Controverted Questions of Optics: Lord Rayleigh.

MONDAY, APRIL 17.

INSTITUTE OF ACTUARIES, at 5.—On the Importance and Practicability of a Standard Classification of Impaired Lives: Dr. S. W. Carruthers.—Social Conditions as affecting Widows' and Orphans' Pension Funds: S. J. H. W. Allin.

TUESDAY, APRIL 18.

ROYAL STATISTICAL SOCIETY, at 5.

ZOOLOGICAL SOCIETY, at 8.30.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Annual General Meeting.

WEDNESDAY, APRIL 19.

GEOLOGICAL SOCIETY, at 8.—The Blea Wyke Rocks and the Dogger in North-East Yorkshire: R. H. Rastall.—Notes on the Geological Aspect of Some of the North-Eastern Territories of the Congo Independent State: G. F. J. Preumont; with Petrographical Notes: J. A. Howe.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On the Application of the Undulatory Theory to Optical Problems: A. E. Conrady.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—An Account of the Observations at Crinan in 1904, and Description of a new Meteorograph for use with Kites: W. H. Dines.—Rate of Fall of Rain at Seathwaite: Dr. H. R. Mill.

CHEMICAL SOCIETY, at 5.30.—Complex Nitrites of Bismuth: W. C. Ball.

CONTENTS.

THURSDAY, APRIL 20, 1905.

MAN AND SCENERY.

Landscape in History and Other Essays. By Sir Archibald Geikie, F.R.S. Pp. viii + 352. (London: Macmillan and Co., Ltd., 1905.) Price 8s. 6d. net.

IN this collection of essays Sir Archibald Geikie has given us in a connected form some of his contributions to the study of the effect of geographical environment and geological changes, not only in determining the distribution of population and of the centres of rule and of commerce, but also in influencing literature and the interpretation of history. In some of them he treats of the part man has played in controlling and directing those forces of nature which tend to produce change on the surface of the earth, and he has added a few essays dealing with subjects which arise naturally out of such inquiries. In this way he has produced a most readable book, the several parts of which hang well together.

When we have exhausted all the available documents, sought out the meaning of all the descriptive place-names and gathered the local traditions, there remains the most trustworthy evidence of all, namely, the examination of the ground to see whether the events recorded can have occurred on the area to which they have been assigned, either under present conditions or other conditions the former existence of which we can learn from what we see. Our author gives as an example the story of the Battle of Bannockburn, where the army of Edward was compelled to crowd its attack into a narrow space because Bruce had rested his left flank on what the trained eye can see must at that time have been a morass with impassable bogs and sheets of water, though it is now dry and richly cultivated.

Estuaries and the rivers which run into them provided landing places and opened up the inland regions to the vessels of primæval man, and on their banks were sites for the settlements of the first comers and the cities of later more civilised times; while, on the other hand, mountain ranges and tangled forests separated tribes and offered an insurmountable barrier to expansion and intercourse.

Man, by cutting down or burning forests, and by draining lakes and swamps, has altered the conditions of many extensive tracts of country, changing the climate, the amount of rainfall, and the rate of waste of the hill-slopes and valleys.

The south of Scotland and parts of the north of England were once covered with small shallow pans of water like Finland, "the land of a thousand lakes." Most of these have got filled up in the British Isles, and the process of reclaiming and cultivating the areas once covered with water has been hurried on by the advance of agriculture; but history tells us how the early dwellers in these broken grounds took advantage of them in their struggles against the powerful races that from age to age invaded them. The Caledonians met the Romans on such ground, and the Scotch the English in later times; and, further south, the Saxons long held their own in the flooded fenlands against William and his Norman followers.

The mythology of Greece and of northern Europe is largely influenced by the character of the scenery in which it took shape. It was recognised that the plain of Thessaly had once been covered with a sheet of water, of which the remaining portions formed two considerable lakes. The opening of the gorge by which it was drained was attributed to Poseidon, the God of the Sea, or in later times to Hercules. Here we seem to have the tradition of an old controversy as to whether the sea, the natural operation of water running out of a lake or connected with inroads of the sea, or even artificial operations, had contributed most to bring about the draining of the area.

The snowy summits of Olympus, rising serenely above the shifting clouds into the calm, clear, blue heaven, naturally came to be regarded as the fit abode of the gods who ruled the world, and soon Olympus came to be synonymous with heaven itself.

So, also, in the countries of western and northern Europe the grandeur and ruggedness of the scenery and the "mountain gloom" are faithfully reflected in the Teutonic myths and superstitions.

Our author gives three examples of typical districts to show how a knowledge of the causes which have brought about the varied scenery of each, far from checking the free play of fancy, enhances the pleasure derived from their contemplation.

He takes first the little cake of rock which caps Slieve League in Ireland, and leads the imagination to recall the time when it extended over all the surrounding area; but it has been removed over most of the district, a patch being left here and there to indicate the wide area over which it once extended.

Then our author takes us to the Isle of Wight, and showing us the "long backs of the bushless downs," explains how they come to rise as they do from the waves and run across the island from side to side. The long story that they tell is a stimulus to the imagination that greatly heightens the pleasure derived from the scene.

Again he carries us to the flanks of Slioch and the shores of Loch Maree, and makes them tell their tale.

He then goes on to describe the influence of scenery upon our literature. Here he is, of course, dealing with a later stage of mental development, and what he gives us is chiefly a sketch of the distinguishing physical features which inspired the descriptive passages in the poets of nature.

He tells us of the simple, child-like delight in nature which was so characteristic of Chaucer. He points out the placid rural quiet of the Colne Valley, where Milton dwelt, and which inspired the two finest lyrics in the English tongue. He describes the scenery of the Ouse near Olney and Weston, so thoroughly characteristic of the southern lowlands which filled Cowper with images of rural peacefulness and gentle beauty.

He points out how the poetry of Thomson ever showed the impress of his early life in the Scottish lowlands within sight of the Cheviot and Lammermuir Hills.

Our author is at his best when he comes to deal with the genius of Burns, to whom the hills and woods were not merely enjoyable scenes to be visited and described, but became part of his very being; who found in their changeful aspects the counterpart of his own variable moods, and whose feelings found vent in an exuberance of appreciation which had never before been heard in verse.

He touches lightly the descriptive passages in Scott and Wordsworth, and the ballad singers of the border, who, though mostly inspired by war-like achievements, often wove into their tales a thread of tender affection and romance. In the poems attributed to Ossian, although Highland scenery is not specially described, it forms a visible and changing background.

Our author turns from the consideration of the influence exerted by the geographical features of a country upon the development and habits of thought of its inhabitants to the discussion of the origin of those features themselves. This is a subject which has of recent years received much attention both in this country and in America. Our author describes the scenic features under several heads. Mountains and valleys may be considered as correlatives, the mountains being there because the valleys have been scooped out between them. Under lakes, we turn with interest to his views on the glacial erosion of rock basins, which he holds could be effected by land ice only. He makes, however, the qualifying remark that a terrestrial surface of crystalline rock, long exposed to the atmosphere or covered with vegetation and humus, may be so deeply corroded as for two or three hundred feet downward to be converted into loose detritus, and the ice may thus have had much of its work done for it, and would be mainly employed in clearing out the corroded débris. Whether, however, this will explain many of the rock basins of the British Isles is not very clear.

In another essay he shows what Hutton did by his theory of the earth to pave the way for the accurate scientific treatment of all those questions of the changes which the earth has undergone in attaining its present configuration. Playfair, Hall, and others helped on the work. The obvious question arising out of such speculations is, how long must it have taken to bring about such great results? and thus we are taken through the controversies as to whether uniform change, which we observe, or local and intermittent catastrophic action, of which we see proofs everywhere, have done most to bring about the results in every individual case. The physicists tell us that from a consideration of the rate at which the earth parts with its heat, of the limitation of the age of the sun, of the retardation of the earth's angular velocity by tidal friction, they are not prepared to allow such a vast age as geologists have claimed for the earth. The geologists, on the other hand, having regard to the rate at which changes on its surface are observed to be brought about by existing agents, and the time demanded for the evolution of living things, insist upon a much larger estimate of time than the physicists are prepared to allow. The confidence reposed in the accuracy of such inferences must depend upon the probability or improbability that the observer has seen enough to justify his generalisations, and that no contradictory evidence can be forthcoming.

The geologist and physicist will probably arrive at a compromise when the one admits that his calculations, based on the rate of waste, may be entirely vitiated by earth movements, which will either hurry on or retard such waste, and that life will change more rapidly with the changes of environment produced by earth movements, and when, on the other hand, the physicist has corrected his estimate of the rate at which the earth is cooling by taking more careful account of the variety of conducting material of which the earth is composed, has estimated the planetary fuel for ever being thrown into the sun from space, to say nothing of the new views of radioactivity, and has re-considered his inferences from tidal friction, which some of our highest mathematicians admit is still open to doubt.

Such speculations suggest the name of the great apostle of evolution, and an essay on the life and work of Charles Darwin follows, while a biographical sketch of Hugh Miller is fitly introduced among essays which so largely deal with the influence of a man's environment upon his imagination and writings.

In an age like this, when the relative place and value of technical and literary training are so strongly forced upon the attention of the country, an essay on science in education by one whose experience and outlook are so wide will be welcomed. Then, to bring us back to the main subject with which he commenced, he gives an interesting sketch of the building up and moulding of the Campagna and the surrounding country, fitting it for the site of many an ancient city, and at last for the eternal city so long the centre of the world.

A MAGNETIC SURVEY OF JAPAN.

A Magnetic Survey of Japan reduced to the Epoch 1895·0 *and the Sea Level.* Carried out by order of the Earthquake Investigation Committee, reported by A. Tanakadate. Pp. xii + 347 and plates. (Published by the University, Tokyo, Japan, 1904.)

THE completion of the detailed magnetic survey of a country is a task requiring great skill and industry. We congratulate Prof. A. Tanakadate and his colleagues on the successful accomplishment of a heavy piece of work, which will be welcomed by all who are interested in the science of terrestrial magnetism. The work is the result of the voluntary cooperation of sixteen observers, of whom seven are professors or assistant professors of the Imperial University, Tokyo, the others also occupying responsible positions. Prof. Tanakadate modestly only claims for himself the position of a "reporter" who has collected the work of the different parties, but we imagine that we owe to him also the detailed discussion of the results which forms an essential portion of the volume before us.

A clear account is given in the initial paragraphs of the method of observations and the instruments used, but not too much space is devoted to these details, so that the reader is soon brought to the first difficulty which occurred in the working out of the observations. It was necessary, in order to reduce them to a common epoch, to take account of secular variations. This might most easily have been done by choosing as observing stations the same places at which the magnetic elements had been determined in a previous survey, but in attempting to carry this out it was found that the changes which had taken place in their surroundings made it impracticable to observe at most of the old stations. Some other method of reduction had therefore to be adopted. Empirical expressions were found for the magnetic elements in terms of longitude and latitude similar to those deduced by Prof. Knott for the previous survey. A comparison of the two expressions gave the secular variation. The results of all the observations for each station are given in the report. The reduction of the observations to sea level is always to some extent arbitrary. The process employed in the present case, where use is made of relations given by the theory of the potential between the radial variation of the horizontal components and the horizontal variation of vertical force, is an improvement on the more empirical methods which have sometimes been adopted.

A further application of the potential theory may serve as an important check on the accuracy of the observations. If a potential exists, the rate of variation of the northerly force towards the west must be equal to the rate of variation of the westerly force towards the north. If this relation does not hold, the earth's magnetism cannot be completely represented by a potential, and this would mean that vertical electric currents traverse the earth's surface. The authors of the present survey calculate the intensities of these vertical currents, but rightly do not attach much importance to them. They are much greater than observations on atmospheric electricity allow us to contemplate as possible. We may therefore take the calculated values of these currents to be indications of the extent of uncertainty in the observations.

We must refer the reader to the original for the discussion of local disturbances, but cannot avoid directing attention to one passage, which seems to indicate some kind of misapprehension on the part of the author.

"It is often erroneously believed," he says, "that the expansibility of the earth's magnetic potential in negative powers of the radius vector is a proof that the source of action is inside the earth."

In a preceding sentence the writer connects his supposed error with the fact that "inasmuch as the surface integral of the force over the earth vanishes, the so-called seat of action may be placed either inside or outside."

In this passage the author seems to doubt a well-established theorem which is quite independent of the question whether the surface integral of normal force when taken over the whole surface of the earth has a finite value or not.

To put the matter plainly: If the magnetic forces at all points of the surface of a sphere can be represented in terms of a potential which is expressed as a series of spherical harmonics proceeding by negative powers of the radius vector, then there are no magnets or electric currents outside the sphere. If the passage quoted is intended to deny the truth of this proposition, the author is guilty of a heresy which he does not justify either by his hydrokinetic analogy or by his reference to one of Lord Kelvin's papers. It should be said, however, that in other parts of his volume the author seems to adopt Gauss's reasoning as to the discrimination between outside and inside effects by spherical harmonic analysis. It may be, therefore, that the apparent meaning of the passage is not the one which it was intended to convey. It is of some importance to avoid misunderstanding on so important a matter, and it is for this reason that I feel compelled to direct attention to the only criticism which can fairly be raised with regard to a very meritorious and heavy piece of work.

May other countries follow this example of Japanese enterprise, and may, especially in English colonies, scientific men receive such help from their Governments as will enable them to keep pace with foreign nations in the successful prosecution of similar work. It is not the enterprise or the knowledge which is wanting, but the material assistance and the official recognition that a certain duty is imposed on each country to take its share in the working out of geophysical problems. ARTHUR SCHUSTER.

THE TECHNOLOGY OF THE VEGETABLE FIBRES.

The Spinning and Twisting of Long Vegetable Fibres (Flax, Hemp, Jute, Tow, and Ramie). By Herbert R. Carter. Pp. xvi+360. (London: Chas. Griffin and Co., Ltd., 1904.) Price 10s. net.

WORKS written for the textile industries may be divided into three classes, viz. descriptive works of a more or less technical and practical character, educational works leading students up to an appreciation of the difficulties to be faced, and works which combine the descriptive and educational but which too frequently meet the requirements of neither manager nor student. The work under consideration meets the requirements of the mill manager or advanced student in a manner perhaps more than satisfactory. On the other hand, to place such a work as this in the hands of the elementary student would be anything but satisfactory, rather suppressing than developing that genuine interest without which it is impossible for the student to make true progress in his studies. In its particular line, however, we must highly commend the work as representing up-to-date practice in most of the sections of the textile industries of which it treats.

The work is really arranged in four sections, the first three chapters being devoted to general particulars respecting the fibres in question, chapters iv. to xv. dealing with the mechanical processes necessary for the formation of the said materials into satisfactory yarns, chapters xvi. and xvii. referring to miscellaneous processes, such as the manufacture of threads, twines, cords, and ropes, while chapters xviii. to xxi. treat on general mill management, arrangement, and engineering.

In the first section, very interesting and useful particulars are supplied respecting the fibres and their marketing, the only difficulty being the grasping of the multitude of details here given. Had these details been represented by maps illustrating (*a*) area of growth, (*b*) area of manufacture, (*c*) area of distribution and use of the fibres in question, with graphical illustrations of quantities, &c., the facts presented would have been vastly more interesting and useful. This method, we believe, is employed in the textile museums of certain of our northern technical colleges.

The author wisely remarks in his preface that were it not for the similarity in the processes necessary for the preparation and spinning of many of the fibres here treated, it would be impossible to bring the work within reasonable limits. The similarity in treatment is certainly marked, and practically leads the author throughout to the employment of the "comparative method." Thus, in the first preparation of ramie, the hand and the chemical or mechanical methods are naturally compared with reference to quality of result and price, this latter necessarily involving the question of native hand-labour *versus* European machine-labour. Then the difference between ramie and flax is naturally noted, and so on.

The comparative method would naturally arrange itself under some six heads:—(1) methods of dealing with the fibres in the raw state commercially; (2) methods of preparing, that is, of cleaning for the subsequent mechanical operations; (3) ultimate length, diameter, colour, &c., of the fibres; (4) the conditions for preparation of the fibres as necessarily deciding the types of machines required; (5) the types of machines for each quality of fibre; (6) value of resultant thread or fabric as revealed by scientific and "use" tests.

This is approximately the grouping employed. The greater proportion of the book is devoted to the mechanical side, and it must be recognised that this is just, as in many cases not only has the machine taken the place of the hand method, but actually does what would be impossible without mechanical aid. Perhaps one of the most interesting comparisons in the book is that afforded by chapters xii. and xiii., in which dry, semi-dry, and wet methods of spinning are successively dealt with.

The section dealing with threads, twines, ropes, &c., is chiefly interesting as introducing machines which are practically unknown in the ordinary textile industries. It very often happens that principles developed in one industry would be of great value in another were they known; in this way the present work may indirectly be of considerable use to industries other than those specially dealt with.

Chapter xviii. deals in an interesting manner with the mechanical department, including the hackle setting, wood turning, fluting, oils, and oiling; this is certainly a useful chapter for the ordinary mill manager. Chapters xix., xx., and xxi., however, in our opinion, are somewhat out of place, it being impossible satisfactorily to consider modern mill construction, boilers and engines, steam and water power, and electric power transmission in the fifty-six pages devoted to this subject. Mere statement, usually very excellent, is all that is possible. We would, however, question the advice given respecting electric lighting in factories. There is a marked tendency to revert to incandescent gas lighting, not only on account of the expense, but also on account of the light value.

The work is not only to be commended to those engaged in the particular trades in question, but also to those engaged in the allied textile industries, as such questions as the position of the nip of the rollers in relation to the spindle and with reference to length of fibre, the varieties of gills employed, Combe's expansion pulley and quick change motion in place of the cones in cone drawing frames, &c., constitute interesting mechanical arrangements which may be of marked value in these allied industries.

The work is illustrated by 161 figures, usually of a most interesting type. The general arrangement is certainly such as will commend itself to the mill manager, who will naturally wish to refer to the work under conditions requiring speed and accuracy.

ALDRED F. BARKER.

ENGLISH ESTATE FORESTRY.

English Estate Forestry. By A. C. Forbes. Pp. xi+332. (London: Edward Arnold, 1904.) Price 12*s.* 6*d.* net.

AS the title suggests, the book is intended for the instruction of English foresters. In the preface, the author states that he feels,

"probably in common with many practical foresters, that English forestry is sufficiently distinct from Continental, or even Scotch forestry to entitle it to be regarded as a separate subject."

The author further emphasises this point in his chapter on thinning and pruning, where he seems to hint that all the mistakes and failures in English sylviculture, about the middle of the nineteenth century, were due to the bad influence of Scotch forestry and Scotch foresters, who, according to Mr. Forbes, were imported into England about that time, bringing with them their mistaken ideas of thinning and pruning, to the detriment of English forestry.

The following extract from the preface gives the author's own views regarding the book:—

"This book is intended to be suggestive rather than instructive to the practical forester. There is little in its pages but what he already knows, and possibly a great deal with which he will not agree. But as a more or less faithful record of individual experience it is offered as a small contribution to forestry literature, which, if it does not enrich, it will not, it is hoped, disgrace."

The concluding paragraph of the preface states

"that this book is not, nor does it make a pretence of being, a text-book. The intelligent reader, therefore, who discovers that it does not contain a planter's guide, nor a reference to more than *one* work on German forestry, is requested not to despise it on that account, nor to conclude prematurely that the author has written on a subject he knows nothing about."

The book is a fairly bulky one, and consists of thirteen chapters and twenty-three illustrations, representing different woodland scenes. The opening chapter gives an interesting historical account of English forests and the origin of forestry. The present conditions, the future prospects and possibilities of extended afforestation are next dealt with. The sylvicultural treatment of the commoner coniferous and deciduous trees, and the financial results to be derived therefrom, is a chapter which will be read with interest by proprietor and forester alike. Planting and natural regeneration are dealt with in a satisfactory manner. A chapter on the measurement of timber and its selling value contains much information, which will be of the greatest use to the English estate forester. The home nursery and forest management receive their due share of attention. The author has not forgotten the arboricultural aspect of the forester's profession. His chapters on landscape forestry and park and avenue trees are written with much artistic feeling, and contain many valuable suggestions. The more important injurious fungi and animals, including insects, are dealt with in a chapter under the heading "Enemies of English Woodlands." It deals with only a few of the outstanding pests which are of practical importance. There is probably no pest about which more has been said or written than the larch canker disease, and we find the author is no exception to the rule. A great many pages are devoted to this disease alone. It consists essentially of a criticism of all the theories that have been advanced regarding the disease since the introduction of the larch. Much of what he says is undoubtedly true, but we must confess we find great difficulty in following the author through many of his arguments, especially those which are based upon purely suppositional grounds.

Regarding the book as a whole, we find a great deal of historical detail in its pages. Past and present methods are criticised without reserve. It will not replace any of the already existing text-books intended for the instruction of the young forester, but as an addition to our existing literature on forestry we may recommend its perusal to those interested in the subject.

OUR BOOK SHELF.

Index Kewensis Plantarum Phanerogamarum. Supplementum secundum, nomina et synonyma omnium generum et specierum ab initio anni MDCCCXCVI usque ad finem anni MDCCCC complectens. Ductu et consilio W. T. Thiselton-Dyer confecerunt herbarii horti regii botanici Kewensis curatores. Abama-Leucocoryne. Pp. 103. (Oxford: Clarendon Press, 1904.) Price 12*s*. net.

Workers at the systematic botany of seed-plants, and all who are concerned that plants should have their right names, will welcome the appearance of this latest instalment of a well-known work of reference. The original "Index Kewensis," the monumental work owed to Sir Joseph Hooker and Mr. Daydon Jackson, gives the reference for generic and specific names published up to 1885. For names published during the next ten years we have the first supplement, the work of M. Durand, of Brussels, and Mr. Jackson. This makes but slow progress, and has now reached Ph; the last number appeared at the end of November, 1903. Hence, while the present instalment carries us, for the first half of the alphabet, to the end of last century, as regards the last ten letters we are twenty years behind time!

As implied in the heading, the supplement includes not only new names, but also synonyms, that is, those names which, in works published in the interval in question, have been transferred to other genera or regarded as identical with names previously published. Thus the eight names under Eriachne represent old species, chiefly of Nees, which more recent workers have transferred to Achneria. The inclusion of synonymy, while undoubtedly of value, must add considerably to the labour of preparation. Moreover, while in some cases the citation of a name as a synonym is amply justified, it is in others merely the expression of the opinion of one school of botanists, or perhaps only of an individual worker, on a matter about which perhaps much may be said on both sides. In our opinion the great use of the "Index" is that implied in its title; the working botanist wants a list containing every published name, he wants it as soon as possible after publication, and to get an exhaustive and up-to-date index he will sacrifice much in the way of botanical comment, however valuable. Refer him to the place and date of publication, and you will earn his lasting gratitude. He should be able to draw his own conclusions as to the relative value of the names.

The omission of the date from the references is, we think, matter for regret; it would have involved but very little additional labour at the time; moreover, it is given in the first supplement, an improvement instituted by Messrs. Durand and Jackson. There are also other omissions which we shall hope to see rectified in an appendix or addendum. A. B. R.

Birds I have Known. By Arthur H. Beavan. Pp. 256. (London: T. Fisher Unwin, 1905.) Price 5*s*.

This little book records the author's "experience of birds during many years in many lands and on many seas . . . its sole purpose being to bring to its readers' notice the ways and habits of these beautiful creatures of the Almighty."

With such a preface, and after the author's assurance that he prefers the unquestioning belief of his little son in the Bible story of Creation to the Darwinian theory of evolution, we are a little taken aback at the author's treatment of the Creator's handiwork.

"I have always loved the birds," he protests. Unfortunate birds! His earliest manifestation of this love was, on his own confession, to endeavour to catch them with the proverbial pinch of salt! Age brought wisdom, however, and with the judgment of mature years a piece of pork concealing a fish-hook was found more efficacious!

In other places he naïvely describes the patience he displayed in waylaying with a gun such rare birds as he happened to discover. Descanting upon the glories of Cornwall as a happy hunting-ground, he gives a list of the rarities that may turn up here during gales, enumerating such species as the golden oriole, Bohemian waxwing, hoopoe, and spoonbill—just those, in short, which the true bird-lover is most anxious to protect. The chance of killing such prizes, he assures us, makes the ornithologist "despise common bird-life," and look only for rarities!

Concerning the toucan and hornbill, he writes:—"The Almighty—speaking reverently—seems to have made certain animals and birds (*sic*) in a spirit of fun, or at least in a sportive mood"!! And this, too, in spite of a statement on a previous page to the effect that with "an ordinary beak" the toucan would be unable to procure the fruit on which it feeds, and that, in consequence, "the Almighty, in His wisdom, has provided it with a 'beak-hand'. . . ."!

We confess we do not like this book; where it is not mischievous it is puerile. The illustrations could not possibly be worse. W. P. P.

The Elements of Chemistry. By M. M. Pattison Muir. Pp. xiv+554. (London: J. and A. Churchill, 1904.) Price 10*s.* 6*d.* net.

It is somewhat difficult to understand for what class of reader this book is intended. In style and treatment it is not well adapted to beginners, yet in its descriptive matter it is quite elementary. Probably it will prove of greatest service to mature students of other subjects who wish to gain some acquaintance with the principles of chemistry without intending to study the science practically. The author tells us in his preface that his object has been "to present some of the fundamental facts, generalisations, principles and theories of chemistry, lucidly, methodically, and suggestively." In this he has had a certain measure of success, but the general impression left by the book is that in its construction substance has been sacrificed to form. When, for example, the author tells us (p. 89) that weighed quantities of the basic oxides BaO, CaO, K_2O, Na_2O, have been combined with weighed quantities of the acidic oxides I_2O_5, N_2O_5, P_2O_5, P_2O_5 respectively, and that analysis showed the resulting products to be BaI_2O_6, CaN_2O_6, K_3PO_4, and Na_3PO_4, we are inclined to doubt the statement, and also to doubt the wisdom of adducing imaginary experiments in confirmation of a formal rule. On p. 252 we find the equation

$$\text{"}Na_2O+N_2O_5 \text{ (heated)}=2NaNO_3.\text{"}$$

We wonder if the author tried the experiment; the practical instruction to heat would almost indicate that he had.

Richard Jefferies: his Life and Ideals. By H. S. Salt. New edition. Pp. vii+119. (London: A. C. Fifield, 1905.) Price 1*s.* 6*d.* net.

The fact of a new (and cheaper) edition of this work being called for may be taken as an indication of the hold the writings of the great pioneer of the true type of nature-study have taken on the popular mind. In the preface, the author emphasises his opinion that the real claims of Jefferies to literary immortality are based on his later works of the type of "The Story of My Heart"; but there can be no doubt, as the author himself is fain to admit, that "The Gamekeeper at Home" and "Round about a Great Estate" are the volumes which have made the name of Jefferies a household word. Biographers and eulogists may make what efforts they please to alter the verdict of the public; but in such cases the old maxim that the *vox populi* is *vox dei* still holds good. To the great majority of readers Jefferies will continue to be known solely by his inimitable (if sometimes too realistic) descriptions of rural life and character. Although in small type, the new edition of his life is well printed on good paper. 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.*]

Historical Note on Dust, Electrification, and Heat.

Your readers may remember that in July, 1883, I penned a letter to your columns (vol. xxviii. p. 297) describing some observations which the late J. W. Clark and myself had recently made; among others, one to the effect that a small electrical discharge into a smoke-laden atmosphere rapidly dissipated the smoke by coagulating the particles. Some time afterwards we found that the observation had previously been made by a Mr. Guitard, and printed in the *Mechanic's Magazine* for 1850—a reference to this fact being actually contained in that great compendium of electrical information, Wiedemann's "*Galvanismus u.s.w.*," so that it must be regarded as fully "published."

I now write to say that during the labour of indexing, at the Royal Society, Prof. McLeod has come across a much earlier instance of the same observation, showing that the phenomenon was really discovered in 1824. An extract from Prof. McLeod's letter runs as follows:—

"In the course of our indexing we have come across a paper that may interest you, if you do not already know of it. It is by Hohlfeld, "Das Niederschlagen des Rauchs durch Elektricität," Kastner, *Archiv Naturl.*, ii., 1824, 205–206. It is very short; he refers to the increase of the fall of rain and hail after a flash of lightning, and describes how he filled a globe with smoke and led into it a pointed wire connected to an electric machine which caused the smoke to settle."

If any importance attaches to the subject, it must depend upon the successful application, in future practice, of so conspicuous a result. Hitherto the only practical application of the same sort of principle has been the "coherer" used in some systems of wireless telegraphy, of which Prof. Branly's porphyrised-copper powder-smears and iron filings-tubes may be regarded as the earliest examples.

Perhaps, however, I may direct attention to my paper to the British Association (Report for 1885, pp. 743 *et seq.*), in which this electrical action on visible particles is likened to chemical agglomeration into molecular aggregates, leading to an electrostatic theory of chemistry, a matter worthy of, and now receiving, sustained attention.

May I further take the opportunity of amending an oversight? Mr. Clark and I came across the fact of the electrical deposition of smoke while we were experimenting on Tyndall's dark plane or dust-free space seen near hot bodies in illuminated air, a matter to which attention had been directed by a notable investigation of Lord Rayleigh's (see Nature for 1882, vol. xxviii. p. 139). It turned out afterwards that we were not the only experimenters on this subject, Lord Rayleigh's letter having also roused the attention of that eminent specialist in dust researches, Mr. John Aitken, of Edinburgh; and though we published our account of dust-free spaces due to heat in the *Philosophical Magazine* for March, 1884, his corresponding investigations and explanations were published a month or so earlier in the *Transactions* of the Royal Society of Edinburgh, vol. xxxii. p. 239; and to him accordingly belongs priority in such parts of this matter as are not covered by my preliminary letter to Nature of the July previous, which doubtless includes many things that were practically anticipated by Lord Rayleigh himself.

I mention this now because I have been rather too apt to forget it, and have omitted to mention Mr. Aitken's name when, if I had had all the circumstances consciously before me, I should certainly have mentioned it. In particular, in a history of the coherer principle contained in my little book on "Wireless Signalling," third edition, p. 75, I speak of the explanation of the dust-free space round a hot body, due to a molecular bombardment, as having been first published by ourselves, instead of by Mr. Aitken, whose name, I regret to say, does not appear; this is the oversight I wish to amend.

April 12. Oliver Lodge.

The late Prof. Tacchini.

As a tribute to the memory of the late distinguished Italian astronomer, of whom an obituary notice appeared in the columns of Nature last week, may I be permitted to add a few personal reminiscences? Prof. Tacchini took part in the eclipse expedition of 1875 to the Nicobar Islands. He joined our party from India, where he had been staying from the previous year, having been commissioned by his Government to make observations on the transit of Venus of 1874. The Italian Government sanctioned his remaining in India until the following year in order that he might make use of the opportunity with the instruments in his charge for the observation of the forthcoming total solar eclipse. Of the little band of observers who assembled on the Island of Camorta in April, 1875, most are happily still with us. Vogel, the introducer of "orthochromatic" photography, has passed away, but Pedler, Waterhouse, and others will remember the pleasant *camaraderie* which existed between ourselves and our Italian colleague. The expedition failed in its object through a cloudy sky, and we were all more or less the victims of intermittent malarial fever; but we made the best of adverse circumstances, and under conditions which, to many a party of observers similarly placed, would have been extremely trying, the good understanding which the members had arrived at among themselves helped to lighten the burden of our disappointment. Not the least weighty factor in the formation of this good fellowship among the representatives of different nations was the geniality of Tacchini, with whom we parted on the P. and O. steamer *Baroda* on the homeward voyage with every regret.

April 15. R. Meldola.

Propagation of Earthquake Waves.

Mr. Rudzki, in his letter to Nature of April 6, observes that "it is only for perfectly elastic and isotropic bodies that the separation of the dilatational (normal) from the tortional (transverse) wave takes place with certainty"; and his conclusion is that "it is more than highly improbable that the effect of internal friction would neutralise the effect of æolotropism." If the term "internal friction" is intended to refer to the effect of pressure, this objection was forestalled by Major Dutton by the remark that "towards this more compact and continuous condition (of a compact mineral substance with a feeble pronounced cleavage), the pressure of great depths in the earth should, it may seem, tend to bring the material subject to it."

To me it is refreshing to learn that any objection can be raised to the view that the two speeds of earthquake waves are respectively condensational and tortional, the latter being held to prove a high degree of rigidity for the interior of the earth.

To examine the question whether the interior is to a considerable depth liquid or solid formed one subject of my "Physics of the Earth's Crust," and I came to the conclusion that it is liquid; and, so far as I am aware, my arguments have never been refuted. On this question Sir A. Geikie writes (Nature, February 9), "the geological belief rests upon a large body of evidence from the structure of the terrestrial crust, which it is difficult or impossible to explain except on the supposition of an internal mass which, at least in its outer parts, is sufficiently liquid to emerge at the surface as molten lava."

To produce arguments on the opposite side of the question is another matter, and that derived from the two speeds of earthquake propagation is perhaps the strongest. I was consequently led to inquire whether the same result could not be obtained on the hypothesis of a liquid magma holding water gas in solution, subject to Henry's law that the same volume of gas can be absorbed by a given volume of the liquid at all pressures. The result which I obtained was that two waves would be propagated with different velocities, the one a condensational wave depending on the elasticity of the liquid, and the other a wave depending upon the pressure and the volume of the gas which could be held in solution by a given volume of the liquid.

If e be the elasticity of the liquid and D its density, then $\sqrt{e/D}$ will be the velocity of the condensational wave. And if P be the pressure and rV the volume of gas which can be held in solution by the volume V of the liquid, then $\sqrt{P/rD}$ will be the velocity of the gaseous wave. If we accept Laplace's law of density, P/D will increase with the depth, and r will probably decrease, hence the velocity of the gaseous wave will increase (*Proc.* Cambridge Phil. Soc., vol. xii., part v., 1903).

Harlton, Cambridge, April 10. O. Fisher.

The Ancient Races of the Thebaid.

On my return to Oxford I saw Prof. Pearson's letter in your issue of March 30.

Since Prof. Pearson admits that he is not an anatomist, it would serve no useful purpose to discuss with him the anatomical value of the criteria which Mr. MacIver and I employed in our analysis of the skulls of the ancient inhabitants of the Theban province of Egypt.

The letter may be regarded as an interesting record of a method of interpreting percentage values adopted by a professed statistician. Arthur Thomson.

Oxford, April 8.

There is an old saying that all good science is shorthand common sense. I am sorry that Prof. Arthur Thomson does not think it worth his while in the case of his just published far-reaching negroid cranial criterion to convert the esoteric methods of the anatomist into simple language for the benefit of other readers of Nature, if not for that of the "professed statistician." I hope he will meet me later when I ask him to discuss, as I propose shortly to do, the mathematico-statistical treatment of his volume, which is of a somewhat remarkable character. Meanwhile, in order to expedite those further investigations by professed craniologists which his discovery is exciting, it would be of great value if he would tell us to what negro series he, *a priori*, applied his criteria, and what percentages of pure negroid, non-negroid, and intermediate crania he found in that series. Karl Pearson.

Inversions of Temperature on Ben Nevis.

The recent letters of Mr. Dines and Mr. Rotch (Nature, February 16 and March 30) have suggested that a note as to the occurrence of temperature inversions on Ben Nevis may be of interest.

During the thirteen years 1891–1903, occasions were not infrequent when the temperature at the top of the mountain (4406 feet) was higher than that at the base. These inversions have been grouped according as the summit temperature was the higher, (1) at one hour at least of the day; (2) at each of the twenty-four hours of the day; (3) on the mean of the twenty-four hours of the day.

The total number of cases in the thirteen years was as follows:—

	Class I.	Class II.	Class III.
January	7	—	3
February	18	1	5
March	11	—	1
April	9	—	—
May	7	—	—
June	8	—	—
July	4	—	—
August	4	—	—
September	22	—	3
October	15	—	5
November	29	3	8
December	24	5	8
Year	158	9	33

Thus inversions occurred at all seasons, but inversions continued throughout the twenty-four hours of the civil day only in February, November, and December, and those of Class III. only between September and March. The average difference of temperature between Ben Nevis and Fort William ranged from 16°·8 F. in April to 14°·4 in December, the mean for the whole year being 15°·4. Hence inversions were at all seasons large departures from the usual conditions.

The greatest inversion was recorded during the great frost of February, 1895, when at 9 a.m. on February 19 the summit was 17°·6 warmer than the base (Ben Nevis 33°·6, Fort William 16°·0). The longest continued inversion occurred during November 2–5, 1897, when the summit temperature was the higher for fifty-eight consecutive hours, the mean daily temperature on November 4 being 9°·7 higher on Ben Nevis than at Fort William.

The Ben Nevis observations, of course, afford a comparison only between the conditions at the summit and those at the base of the mountain. It is more than probable that on many occasions when the summit temperature becomes nearly, though not quite, as high as that at the base, there is an inversion of temperature in part of the air-column between the summit and sea-level.

Andrew Watt.

Scottish Meteorological Society, Edinburgh, April 12.

Stanton Drew.

The mysteries of this group of circles—the next in importance to those of Avebury and Stonehenge—are not yet fully unveiled, even by the very remarkable astronomical discoveries made in them by Sir Norman Lockyer or by his interesting description of them.

The diameter of the north-east circle is 97 English feet, or 100 of an old Mediterranean foot of 11·64 inches. This is within an inch or two of the diameter of the outer sarsen ring at Stonehenge, which is in itself a very significant fact. The diameters of the south-western and central circles are respectively 150 and 380 of this old foot, so that the diameters of the circles (within a very slight working error) are in proportion one to the other of 5, $7\frac{1}{2}$, and 19, the latter being the Metonic cycle number.

The distances between the various parts of the group, subject to a working error of from $\frac{1}{2}$ to $\frac{3}{4}$ of 1 per cent. only, are:—

Centre of cove through great circle to centre of north-east circle = 14 diameters of north-east circle.

Centre of great circle to Hauteville's Quoit = 5 diameters of the great circle, or 19 diameters of the north-east circle, the latter being the Metonic cycle number.

Centre of south-west circle through great circle to Hauteville's Quoit = 7 diameters of the great circle.

Centre of great circle to two stones too far to the west to be shown on the plan in Nature = 9 diameters of the great circle.

With the exception of the last, anyone can test these proportionate distances by the plan given in Nature, but who will tell us what was the meaning or object of them?

A. L. Lewis.

ALCOHOL IN INDUSTRY.

The committee, consisting of Sir Henry Primrose, K.C.B. (chairman), Sir W. Holland, M.P., Mr. J. Scott-Montagu, M.P., Sir William Crookes, Mr. Lothian Nicholson, Dr. Somerville, of the Board of Agriculture, Dr. Thorpe, the director of the Government Laboratories, and Mr. Thomas Tyrer, appointed last autumn by the Chancellor of the Exchequer to inquire into the use of duty-free alcohol in the arts and manufactures have got together their evidence and published their report with commendable promptitude. The report, we are glad to find, is unanimous, and this unanimity has doubtless not been without its influence in accelerating the business of the committee and the appearance of their report.

The subject, as was to be anticipated, has not been without its difficulties, for, as the committee state, a duty that yields more than twenty millions a year is a public interest that cannot be trifled with; but, as usual when men are determined to find a solution, it is remarkable how purely academic difficulties tend to disappear. Now that the suggestions of the committee are before us, the wonder is that they should not have been given effect to a quarter of a century ago. We are afraid the delay does not reflect creditably upon the enterprise, energy, or constructive ability of the numerous groups of manufacturers who are interested in obtaining the greatest possible facilities in the use of duty-free alcohol in the arts. This attitude of *laissez-faire* is seen, and commented upon by the committee, in connection with the apathy and general ignorance of manufacturers with respect to the provisions of Section 8 of the Finance Act of 1902, which gave the commissioners of Inland Revenue large discretionary powers as regards the use of spirit for industrial purposes. The committee point out that advantage has not been taken of the Act to the extent that might have been anticipated, and they have been surprised to find in examining the witnesses sent by the various Chambers of Commerce, who certainly ought to have had official knowledge of its existence, how very inadequate has been their acquaintance with its provisions.

In view of this general indifference one is tempted to inquire whether the manufacturers have had any real grievance, since they have made so little individual or collective effort to remove it. There is certainly no evidence that any collective effort has been made in the past, or, if it had been made, that the Treasury or the Revenue authorities would not have sympathised with it. The Exchequer, at all events since 1855, when the present system of denaturing spirit came into existence, may be said to have disclaimed any idea of collecting a revenue on alcohol used solely as a raw material and for purely industrial purposes. If the hitherto existing system of denaturing and control had proved so irksome that the development of chemical industry was impossible, it might have been supposed that Parliament would have been troubled with the question long ago. But as an actual fact the languid interest of the chemical manufacturers needed, apparently, to be supplemented by the quickening influence of the internal-combustion engine, and the possible applications of spirit as a motor-fuel supplied to a jaded House of Commons engaged in the discussion of a Finance Bill that stimulus which was necessary to secure from the Chancellor the promise of the departmental inquiry, which it would seem the great body of manufacturing chemists was too lukewarm to ask for.

Great cry has been made in the past that the hindrances to a free and untrammelled supply of alcohol have cost us the coal-tar dye industry, which originated in this country, and at one time flourished here; but the committee apparently have had little difficulty in ascertaining how "little wool" there is in this cry. They say they are satisfied that the assertion, as a statement of historical fact, is destitute of substantial foundation. In their opinion the main cause which led to the decadence of the industry in this country is that which we have repeatedly insisted on in these columns, viz. the failure of those responsible for the management and for the finance of the industry here during the years 1860–1880 to realise the vital importance of its scientific side, and their consequent omission to provide adequately for its development on that side.

It is true, however, that after signing the report, the two Members of Parliament named were induced to modify their assent to the unanimous finding of the committee as to the real cause of the decline of the coal-tar dye industry in this country. It will be interesting to see from the evidence, when this is published, what support Sir William Holland and Mr. John Scott-Montagu are able to find for the view they express in their letter to the Chancellor.

In reality, "alcohol" plays a very small part in that industry, and of this "alcohol" methyl alcohol is the most important variety. Large classes of the coal-tar colours—alizarin, indigo, and by far the greater number of the azo dyes—require no spirit at all in their manufacture either directly or indirectly, and these represent the larger proportion of all the colours produced. It is perfectly certain that for at least 75 per cent. of the whole output of coal-tar dyes alcohol does not enter into account even now, and therefore whatever causes may have hindered the prosecution of the industry in this country, the question of "alcohol" is not one of them.

Although it has destroyed some illusions, corrected many misstatements, and, as in this example of the coal-tar colour industry, set many matters in their true perspective, the report is eminently constructive in character. To what extent the representations of manufacturers have actually aided the committee in formulating their main suggestions remains to be seen, as the evidence has not yet been published.

These recommendations are as follows:—

(1) That an allowance be granted to all industrial spirit, whether of British or foreign origin, at the rate from time to time prevailing for the allowance to British plain spirits on exportation.

(2) That imported methylic alcohol be relieved from the obligation to pay the surtax imposed by the proviso to Section 8 of the Finance Act, 1902, and that methylic alcohol be accorded favourable treatment in the matter of denaturing.

(3) That "ordinary," *i.e.* unmineralised, methylated spirit should contain only 5 per cent. of wood-naphtha instead of 10 per cent. as now.

(4) That no charge should be made on manufacturers for the regular attendance of Excise officers to supervise denaturing operations or the use of denatured spirit, in factories taking the benefit of Section 8 of the Finance Act, 1902.

(5) That where spirit is allowed to be denatured with special agents, such agents should be subject to official test and approved, and that accounts should be kept by the user showing receipts of spirit into store, the issues thereof from store in detail, and the quantities of the goods produced.

(6) That in the manufacture of fine chemicals and pharmaceutical products, spirit specially denatured should be allowed only where the manufacture is kept entirely separate from the manufacture of tinctures and other preparations in which spirit remains as spirit in the finished product.

(7) That the regulations governing the sale by retail of "mineralised" methylated spirit should be made less stringent and more elastic.

The committee are of opinion that any special cases not touched by the above recommendations can always be met under the powers conferred by Section 8 of the Act of 1902. This Act provides adequate and entirely satisfactory machinery for securing that the spirit may be used in a condition that is suitable and appropriate to each particular purpose of manufacture. The machinery is elastic—much more so than is the corresponding machinery in Germany—and it permits of every reasonable process of denaturing, or even in the last resort of the use of spirit in a pure state. For more than this it would be impossible to ask.

The committee believe that their recommendations, if adopted, will place the manufacturers of this country in respect of the use of alcohol in industry on a footing of equality, in some respects of advantage, as compared with their competitors abroad. Amongst the witnesses who appeared before them they found a very general impression that in Germany, at any rate—and Germany is always alleged to be our most formidable competitor—spirit could be used in manufacture duty-free and pure with scarcely any restraint. This, too, is one of the illusions which the inquiry may serve to dispel. As an actual fact, in practically all cases, with the exception of that of smokeless powder, in Germany duty-paid spirit must be used unless the spirit be subjected to some authorised process of denaturing prior to use. As regards price, and that is the principal factor, the committee think that the grant of the export allowance would make the average price of industrial spirit in the United Kingdom even lower than the average price in Germany. The price here, exclusive of the cost of any denaturing, and this denaturing may be what is called *ad hoc*—that is, dependent upon the use of something which is necessary to the manufacture—would be about $7d.$ the *proof* gallon, or about $11\frac{1}{2}d.$ the bulk gallon at 64 over proof—the strength common in industrial spirit. That is as low as the minimum price paid by users in Germany in 1902, when spirit was abnormally cheap, and is much below the figures of $15\frac{1}{2}d.$ per proof gallon, or $25\frac{1}{2}d.$ per bulk gallon, prevailing in Germany at the present time. Further, it is important to remember that the price of spirit in this country, where all materials may be freely used, and where none of general use is subject to taxation, is a stable price. In Germany the conditions of production are largely artificial and of very doubtful economic soundness, and they tend to wide and rapid fluctuations in price.

The main report is supplemented by a valuable report by the chairman, Sir Henry Primrose, and Dr. Thorpe, the principal of the Government Laboratories, on the working of the spirit regulations in Germany, based upon personal inquiry and observation in that country. So much stress was laid by certain witnesses upon the system and regulations established in Germany in connection with the industrial use of alcohol that it was thought very desirable to procure information at first hand upon that subject. This report may, it is hoped, serve to correct much misapprehension which appears to exist upon the benefits of State-aided alcohol in Germany. There is ample proof that the German user of spirit is not greatly benefited by the policy which the agrarian party has succeeded in fixing upon him, and is, indeed, at times greatly injured by it.

In reply to a question asked in the House of Commons on Tuesday, the Chancellor of the Exchequer announced that he has decided to deal with the subject of the committee's report in an omnibus Bill which he will introduce to the House, and not in the Budget and Finance Bill as originally proposed.

THE CAPITAL OF TIBET.[1]

ALL who have read in the columns of the *Times* about the mission to Lhasa will welcome in a more concrete form the story as re-told by Mr. Landon in the two handsome volumes now given to the public. In an expedition carried out under such conditions as those which governed Colonel Younghusband's mission, the special correspondent becomes a distinct factor in its success. The working men of the party, even if they have eyes to see and the rare gift of recording their impressions faithfully, can but present such generalisations as may be gathered during the few intervals hastily snatched from the worries and anxieties incidental to the routine of an abnormal state of existence. Usually they see but little, and that little from the restricted standpoint of their own idiosyncrasies.

[1] "Lhasa; an Account of the Country and People of Central Tibet, &c." By Perceval Landon. Vol. i. Pp. xix+414. Vol. ii. Pp. xi+426. (London: Hurst and Blackett, 1905.) Price 42s. net.

There is no lack of literature dealing with Tibet, literature dating from the early Jesuit and Capuchin friars of the seventeenth and eighteenth centuries to the latter-day expeditions of the native explorers of the Indian Survey, to whose marvellous performances in the field Mr. Landon is about the first writer to do passing justice; but we have never yet had an intelligent and accurate representation of the social existence of the people, nor a careful exposition of the weird eccentricities of that extraordinary anachronism, the Government of Tibet, at all comparable to that which Mr. Landon now gives us. Nor is this all. The enthusiasm of the true explorer pervades the book; that nameless joy in treading new and untouched fields; that absorbing interest in the aspects of nature, in its lights and shadows, fields and flowers, outline and colour; aspects which enchain the imagination everywhere, but acquire fresher value and larger interest the farther they are removed from the area of the well trodden world. Certainly there must be many more beautiful landscapes than those of the southern valleys of Tibet, the beauty of which exists, so to speak, in scraps large scraps, perhaps, but scraps that are separated by wide intervening spaces of stony desolation and dreary outlook. Yet many of the best pages of the book are full to the brim with vivid descriptions of the beauty of Tibetan scenery as Mr. Landon saw it in the basin of the Brahmaputra River.

The illustrations are excellent, and there is an added value to them in the notes which are appended indicating the general tones and local colour of each view. If Mr. Landon has invented this method of recording the principal charm of Tibetan scenery for the benefit of those who know not Tibet, he is much to be congratulated thereon. All who know and love the Himalayas can fill up the pictures with the grace of nature's colouring from Mr. Landon's description alone, although here and there his colour notes are perhaps a little indefinite. What, for instance, are "lightning greys"? But where colour reproduction has not been left to the reader's imagination, and has been attempted by some process of block printing, the results are not so satisfactory. The distances are hard and obtrusive, and atmosphere has vanished from the view. Even in Tibetan highlands there is a certain amount of atmospheric influence, however thin it may be, which affects one's appreciation of distance.

FIG. 1.—Part of the Potala Palace from the buildings at its base. It is built of granite and whitewashed once a year. The dark central portion is crimson. From Landon's "Lhasa."

To the great majority of readers Mr. Landon's descriptions of the beauty of the Brahmaputra valley to the south of Lhasa, of the glory of Tibetan sunsets, of the splendour of the Turquoise Lake set in the midst of the flower-strewn plain, of the vast impressiveness of the isolated city of mystery itself as it bursts on the view from a mountain-ringed depression beyond the Potala—the guardian sanctuary of its western gates—all these things will be just as new and as surprising as are the kindly amiability of its half barbarous people and the friendliness of disposition which they evinced towards the foreigner. Not that Mr. Landon is unduly optimistic. The extraordinary contrasts between barbarous magnificence and indescribable filth and squalor are not missed. Where the sweet scent and brightness of English flowers is noted as a passing incident there is no lack of intimation as to the nature of the rotting filth from which they spring. The interior of temples and dwelling houses, described as often impressive in its magnificence, and always surprising in the character of its artistic decoration, involves an approach through knee-deep slush and mud, terminating in the ascent of a greasy stairway foul with the accumulation of rancid butter and poisonous forms of putrid filth.

Animate nature in Tibet is no better than inanimate. We will pass by the pigs and the dogs, and refer only to the people. It was discovered by the medical staff of the mission who attended to the wounded warriors of Guru that the natural complexion of the Tibetan was quite fair—as fair as that of any European, in spite of the fact that no soap is ever used. But to judge from the aspect of the Tibetan as he (or she) appears in the ordinary unclean garb of daily life, the general tint of the skin appears to be that of a well baked potato picked out from amongst the charred sticks of a burn-out bonfire. The children are pretty and remarkably affable, and the general unloveliness of their parents is due quite as much to dirt as to exposure to the rigorous climate.

The story of the advance of the mission through the tangled forests and over the bleak passes of Sikkim is well told. There is none of the reiteration of the guide book or of the monotony of the intelligence report in Mr. Landon's tale. He takes the reader with him through the narrow and slippery ways of Chumbi, over the Himalayan backbone (not so formidable as the Sikkim-Chumbi passes), down the gentle slope to Gyantse, with an ever-varied interest gathered from what is to be seen around him as he rides. Mountains and stone-strewn slopes, trees (where there are any), flowers, and the small things that become great in a land where vegetation barely exists, all are noted in their turn, whilst we happily miss the daily routine of military movement and the everlasting repetition of marching experiences. Only when we get to the fighting stage do we hear much about the little army which formed the escort; and then there is enough of incident to make a fascinating and lasting record of really great achievement.

Not the least interesting chapters of Mr. Landon's book are those which deal with the superficial aspects of lamaism, and the relation between the Tibetan hierarchy and our frontier politics. Tibet affords a notable example (if one were needed) of the degrading, stifling, destroying effects of a dominant priesthood on a country's developments. Between the lamaism of Tibet and the pure faith of early Buddhism there is indeed a great gulf fixed, and Mr. Landon is well within the mark when he describes modern lamaism as "sheer animistic devil worship." Yet he is quite ready to recognise the power and the strength which are gained by the lofty isolation—the stern aloofness of the head of the Tibetan Church; and he is probably correct in estimating the Dalai lama as being still the recognised head of the Tibetan Church and State wherever he may be, at Urga or at Lhasa. Nor does he fail to reckon up the impressive effect of certain ceremonials, and the really awe-inspiring aspects of the temple interiors hallowed by the ever-dominating figures of the great "Master." Here we cannot quite follow him, for if his sketch of the head of the Great "Jo" in the holy of holies at Lhasa is realistic, the original can hardly be impressive.

FIG. 2.—Nichi-kang-sang (24,000 feet). This peak guards the road to Lhasa over the Karo la. The track passes suddenly through the mountain barrier between the darker hill and the icefields of Nichi-kang-sang. From Landon's "Lhasa."

It will be news to most people that our Queen Victoria of blessed memory was, and is, a Tibetan incarnation, and is represented by a bloodthirsty blue goddess who revels in horrors such as would astonish even the gifted Kali of the Hindus. Yet she is regarded rather as a beneficent and protective goddess than a malignant one. This is encouraging, for it shows that something at least of the world-wide veneration that surrounded our ever-loved Queen had filtered through the almost impenetrable armour of lamaistic isolation. The Tsar has only recently been canonised, so to speak, on Dorjieff's recommendation.

As a recent incarnation, or "last-joined" saint, he invested the Dalai lama with a complete suit of bishop's canonicals. Perhaps this recognition of a certain analogy between the two Governments is not quite so inappropriate as it at first appears.

Mr. Landon concludes his delightful book with an expression of his opinion that the doors of Lhasa are once again closed to the European. Not again (according to our author) for many a long year will any Englishman watch for the flashing cupolas of the Potala from the banks of the Kyi Chu, or penetrate into the inner sanctuary of the everlasting Jo. With this view of the future of Tibet we can hardly agree. By his own showing there is quite enough of uncertainty, even in the present political situation, to warrant the making of a straight road over the Himalayan passes with as little delay as possible; and it should not be forgotten that the right of way to Gyantse is already secured. T. H. H.

THE TREATMENT OF CANCER WITH RADIUM.

THE discovery of radium was speedily followed by its use in the treatment of cancer, and it was hoped that at last a remedy had been found for this terrible disease. Great interest has been aroused by a recent report in a contemporary of a case of cancer which has been successfully treated by this agent. The case appears to be undoubtedly one of cancer, as the patient was carefully examined before, during, and after treatment by competent authorities; but the report of cure must be accepted with caution. We are informed that the treatment began in March, 1904, and although the disease has now disappeared, it is still possible that it may recur.

A very large number of cases of cancer have been treated by radium in this country, on the Continent, and in America. Some have improved remarkably, but in most instances there has been no apparent benefit, and in no case has sufficient time elapsed to speak with certainty of cure. No surgeon would feel justified in reporting a cure of cancer until at least two years had passed without recurrence, and there are many instances on record where a longer period of apparent immunity has been followed by a reappearance of the disease.

It must be remembered that the effect of radium upon a cancerous growth is, so far as we are at present aware, purely local. The terrible feature of cancer is the early involvement of the lymphatic glands, followed by the formation of secondary tumours in the internal organs. It is impossible to follow these internal developments by such a remedy as radium. Only too often a patient is found, on first seeking medical advice, to have already these secondary deposits, and treatment by local measures is purely palliative. That relief may be afforded in some cases which are beyond operation is recognised, but nothing has yet been reported which will warrant a surgeon using radium in a case of cancer where there is a possibility of complete removal by the knife.

Radium is applied in small tubes to the surface of a tumour, and in some cases it has been found possible to place it in the interior of a growth through a small incision. The quantities available are so minute that only a small area can be treated at one time. In the case of cancer mentioned above, the quantity which was used was ten milligrams. Fortunately the radium can be used again and again, for its energy appears practically to be inexhaustible.

NOTES.

Since the appearance in Nature of April 6 of an article on the proposed amalgamation of the Society of Arts and the London Institution, a meeting of the proprietors of the London Institution has been held to consider the managers' proposals in connection with the amalgamation. The proposals met with a determined opposition from some proprietors; and after a somewhat noisy and undignified discussion, it was resolved to defer the further consideration of the scheme of amalgamation until after the annual meeting of the London Institution on April 28. The result of this meeting is to be regretted, since it implies the loss for the present of an excellent opportunity to accomplish the establishment of an important and powerful institute designed to develop a popular interest and regard for scientific work and results. It is to be hoped that it may prove possible to arrive at some agreement which will lead to the formation of a vigorous scientific organisation, in which the privileges offered by the Society of Arts and the London Institution will be combined.

The Paris Geographical Society has awarded its gold medal to M. Paul Doumer.

It is intended, if found practicable, says the *Pioneer Mail*, to arrange for daily weather reports from the Andamans by wireless telegraphy.

The death is announced of Prof. A. Piccini, professor of chemistry at the R. Istituto di Studi superiori, Florence, and author of several works on chemistry.

The President of the Board of Agriculture and Fisheries has appointed a committee to inquire into the nature and causes of grouse disease, and to report whether any, and, if so, what, preventive or remedial measures can with advantage be taken with respect to it.

The Paris correspondent of the *Times* announces the death of Colonel Renard, the director of the National Aërostatic Park at Meudon. The investigations and experiments of the Renard brothers have done much to promote the progress of aërial navigation.

It is announced that the Liége International Exhibition will be opened on Saturday, April 22, and that, unlike most exhibitions, the buildings will be complete. The exhibition will be of a very attractive and picturesque character, and the buildings cover a greater area than at any previous exhibition, except those of Paris in 1900 and of St. Louis. During the period of the exhibition several congresses will be held in Liége, that of mining and metallurgy, from June 26 to July 1, promising to be the most largely attended.

The *Times* correspondent at Athens states that at the last meeting of the Archæological Congress, on April 13, it was decided that the present executive committee should continue to exist until the next meeting of the congress, which was fixed to take place at Cairo after a *minimum* interval of two years, the Egyptian Government having signified its willingness to accept this arrangement.

Press telegrams from Martinique report that Mont Pelée is again showing volcanic activity. On April 9–10 the escape of vapour was fairly abundant. On April 10–11 a marked recrudescence manifested itself; numerous small clouds issued from the vent, and there was a small flow of lava into the valley of the White River. On April 13–14 frequent rumblings were heard, and it was noticed that blocks of rock, accompanied by white clouds, were expelled from the south side of the crater.

Mr. C. H. Hamilton records in *Science* that the world-renowned volcano Kilauea, in the Hawaiian Islands, has again become active, after a rest of thirteen years. Fresh lava appeared the last week of February, heralded by a slight earthquake. On March 10 the Volcano House reported the existence of a large lake of lava. "Heavy rumblings and explosions indicate that another outbreak is imminent." Thus there seems to be a restoration of the old-time activity—such as will cause a large increase in the number of visitors.

Dr. Davison states in a letter to the *Times* that a detailed record of the Indian earthquake was given by a horizontal pendulum at Birmingham. The first tremors were registered at 1h. 6m. 18s. a.m., and were succeeded at 1h. 29m. 2s. by long-period undulations lasting for more than an hour and a half. The more prominent of these undulations were in two series, separated by a few minutes, and little more than two hours later the diagram showed another double group of waves. The early tremors took a direct course through the body of the earth; the first double series travelled along the surface by the shortest way to Birmingham, while the second double series followed the longest possible route, through the antipodes, and back again to Birmingham.

It is announced in *Science* that Dr. Frank Schlesinger has been elected director of the New Allegheny Observatory. The observatory has an endowment fund, and a regular income from the time service, besides owning a large and valuable property in the City of Allegheny, which will become a source of income in the near future. Work has not been suspended on account of lack of funds, and much has been accomplished toward the instrumental equipment during the past year. The Keeler memorial telescope of 30-inch aperture is now ready to be set up, and the large (Porter) spectroheliograph is almost completed. The 30-inch objective is well under way, and other instruments will be installed during the year under the directorate of Dr. Schlesinger.

At the meeting of the Royal Colonial Institute, held on April 11, Sir Frederick Pollock read a paper on Imperial Organisation. He deprecated the national faculty of compromise, and asked, could we go on trusting to compromises and accidents? It is necessary to look, he continued, for some plan which will avoid elaborate legislature and formal change in the Constitution. We must be content for the present with a council of advice which will have only "persuasive authority." A permanent secretary's office is required, independent of any existing department, but immediately under the president of the Imperial council. The best living information ought to be at the service of this Imperial council through its secretariat; and this can be most effectively done, without ostentation and with very little expense, by the constitution of a permanent Imperial commission the members of which will represent all branches of knowledge and research, outside the art of war, most likely to be profitable in Imperial affairs. Not only learned and official persons would be included in such a body, but men of widespread business, travellers, ethnologists, comparative students of politics might all find scope for excellent work. It need not be paid work. It would be as willingly done without pecuniary reward as the more formal and laborious work of Royal Commissions, as to which there has never been any difficulty. Of the need for some such advisory council to secure national efficiency there can be no doubt, and it is earnestly to be desired that hopes and schemes, like that of Sir F. Pollock, will soon fructify in accomplished fact. A select advisory council on which men of science familiar with the scientific advances of recent years took a prominent place would assist statesmen to secure national efficiency more than any other expedient.

Reports of the annual general meeting of the Chemical Society and of the anniversary dinner are given in the *Proceedings* of the society, just issued. The following extracts from the official account of remarks made at the dinner by Mr. R. B. Haldane, as to the neglect of science by the British nation in the past, and the promise of an improved position in the future, are of interest:—The problem which lay in front of the British nation was how to develop what he might call the grey matter of the executive brain. All the things spoken of that night represented something new in the nation, and not only something new, but something of which they would have to see a great deal more if the nation was to hold its own in these days. Science counted for more than ever it did. The West had had a rude awakening at the hands of the East. The controversies which agitated the minds of politicians were of less importance than the great question of how to make the permanent element in politics more powerful and better than it was. There was too little science in the present day, although one or two things had been done for which they were very grateful, in connection with the Navy and the Army and the Defence Committee. If they turned to the different departments of the Government there was hardly one which did not require science, if its policy was to be an effective policy. Wherever they turned science was needed, and yet there was not sufficient attraction to a man of high attainments to put himself at the disposition of the State. Foreign Governments held out careers far in excess of any rewards and honours which the British Government could afford. Was it impossible to see an era in which the head of the Government could have at his disposition the first intelligence and the best brains which the nation could command? If we were to hold our own we must not be behind Berlin, the United States, or the French nation. Science never stands still, and if science does not stand still, Governments cannot afford to stand still in their use of science. These were speculations which, perhaps, went beyond the moment, but he had a strong feeling that the time was very nearly, if not quite, ripe for them. They would see what was the mind of the nation on this point, and doubtless they would be subjected to the acute disappointment to which all were usually subjected when they formed great expectations. He hoped to see the position of science raised in the next few years, and he looked to the time when brute force would count for little, and knowledge for more.

We have received from Messrs. R. Friedländer and Sons, of Berlin, a priced catalogue of books and papers dealing with vertebrate anatomy and physiology.

Part xxxi. of the *Transactions* of the Yorkshire Naturalists' Union contains the reports of that body for the years 1903 and 1904, and also a reprint of the excursion circulars for the same period. A satisfactory feature in the work of the union is the care devoted to the collection of photographs of important geological sections within its sphere of influence.

Prof. J. S. Kingsley discusses in the February number of the *American Naturalist* the current nomenclature and homology of the component bones of the lower jaw of reptiles, pointing out that there is still some uncertainty with regard to the proper determination of one of these elements in crocodiles. The other articles are on natural and artificial parthenogenesis, by Dr. A. Petrunkevitch; on the angle of deviation from the vertical at which stems show the strongest geotropical response, by Miss Haynes; and on the variation in the ray-flowers of Rudbeckia, by Dr. R. Pearl.

In the April number of *Bird Notes and News* reference is made to certain common misapprehensions in regard to the authorities responsible for protective regulations, and it is pointed out that many of these emanate from county councils. To the agriculturist and the horticulturist it is, however, of little consequence whether the alleged over-protection of birds in his particular district is the work of the local or of the Imperial Parliament, for the difficulty of getting ordinances repealed appears as difficult in the one case as in the other. In the statement on p. 61 as to the sale of skins of "Argus pheasants from the Himalayas," it should have been pointed out that "Argus pheasant" is the trade name for the peacock pheasants (Euplocamus) of the Himalaya, the true Argus having a very different habitat.

The following quotation in the February issue of the *American Naturalist* from a work by Messrs. Gilbert and Starks on the fishes of the two sides of the Isthmus of Panama has a very great interest from the point of view of distribution in general:—"The ichthyological evidence is overwhelmingly in favour of the existence of a former open communication between the two oceans, which must have become closed at a period sufficiently remote from the present to have permitted the specific differentiation of a very large majority of the forms involved. . . . All evidence concurs in fixing the date of that connection at some time prior to the Pleistocene, probably in the early Miocene." This agrees precisely with the conclusions drawn from the study of the fossil mammalian faunas of North and South America, which indicate that land communication between those two continents was interrupted during a considerable portion of the Tertiary epoch, and only re-established about the close of the Miocene or early part of the Pliocene epoch.

The existence of an entirely distinct second family type of lancelets (Cephalochordata) is demonstrated by Dr. R. Goldschmidt in *Biol. Centralblatt* of April 1. It appears that in 1889 Dr. A. Günther described a lancelet obtained during the *Challenger* Expedition as a new species, under the name of *Branchiostoma pelagicum*, its special characteristic being the absence of a tentacle-apparatus. Although on this ground Gill proposed the new generic name Amphioxides in 1895, while Delage and Hérouard pointed out that if the character in question was not due to imperfection the creature indicated a distinct ordinal type, yet it has generally been allowed to remain in the type genus, as in Prof. Herdman's account of the group in the "Cambridge Natural History." The examination of twenty-six entire specimens obtained during the recent German deep-sea expedition enables Dr. Goldschmidt to state that *A. pelagicus*, together with two closely allied species, represents a distinct family of Cephalochordata, which may be distinguished from the typical family as follows:—Family Branchiostomatidæ.—A peribranchial space; the ventrally-opening mouth surrounded by tentacles; gill-canal furnished throughout its diameter with lateral gill-slits. Family Amphioxididæ.—No peribranchial space; the slit-like mouth opening on the left side; gill-slits situated in the ventral median line; gill-canal divided into a dorsal nutritive and a ventral respiratory half.

Indian Public Health for March (vol. i. No. 8) contains articles on septic tank installations in Bengal, sewage disposal in India, Hankin's views on plague epidemiology, the Finsen method, &c.

In the *Revue scientifique* (April 8) M. Calmette, the director of the Pasteur Institute, Lille, writes on the important *rôle* played by medical science in the successful colonisation of tropical countries, instancing such diseases as cholera, leprosy, plague, and malaria, which can be robbed of their terrors only by the institution of efficient sanitary control in the districts in which they occur.

Major Ronald Ross, F.R.S., in a letter to the *Times* (April 7) directs attention to the remarkable diminution in malarial disease which has accompanied the institution of anti-mosquito measures at Klang and Port Swettenham in the Federated Malay States. The former, with a population of 3576, and the latter of about 700, were both perfect hotbeds of malaria, and in 1901, for the two towns, 236 sick certificates and 1026 days of leave were granted. In 1902, after anti-mosquito measures had been energetically pursued, the figures were 40 and 198, and in 1904 these had further fallen to 14 and 71 respectively. Dr. Malcolm Watson, district surgeon, from whose report these statistics are taken, sums up by saying:—"In whatever direction one turns, it is plain that the two areas which were so malarious in 1901 are now practically, if not absolutely, free from the disease, and that the district surrounding these two areas remains much as it was." These anti-mosquito measures were initiated by the Department for Medical Research, Federated Malay States (which is affiliated with the London School of Tropical Medicine), under the direction of Dr. Hamilton Wright.

In a short paper which appeared in the *Botanical Gazette* (February) Mr. C. H. Chamberlain advances the opinion that an alternation of generations as understood by botanists for plants can be recognised in animals. The egg with the three polar bodies constitutes a generation comparable with the female gametophyte in plants; similarly, the primary spermatocyte with the four spermatozoa constitute a generation comparable with the male gametophyte in plants. All other cells of the animal constitute a generation comparable with the sporophytic generation in plants.

Two debated points connected with the problems of geotropism in plants, *i.e.* the seat of geotropic sensibility, and the statolith theory simultaneously advanced by Haberlandt and Němec, form the subject of a critical review by Dr. Linsbauer, who writes in *Naturwissenschaftliche Wochenschrift* (March, No. 11). The reviewer may be regarded as an adherent to the statolith theory, and notes that although the *rôle* of statoliths is generally attributed to starch grains, in their absence other bodies, such as crystals of calcium oxalate, or certain bright bodies found in the rhizoids of Chara, may function similarly.

The *Bulletin* of the American Geographical Society contains an article on the work of the Reclamation Service of the United States, by Mr. C. J. Blanchard. During the last three and a half years a sum of nearly twenty-five million dollars has been realised from the sale of public lands, and work has been begun on eight irrigation projects which will make an area of about one million acres productive. The *National Geographic Magazine* for March has a short article, with excellent illustrations, on the same subject.

MESSRS. W. STANFORD AND CO., of Oxford, have sent us specimens of a number of outline maps of the world, on Mollweide's equal-area projection; also a map of the Atlantic Ocean, on the same projection. The maps are well drawn and clearly printed; the larger scale maps should be extremely useful for purposes of research and teaching, while the smaller maps are well adapted for museum use. The employment of equal-area maps in representing distribution cannot be too strongly recommended, and in providing such maps at very moderate prices Messrs. Stanford have done good service.

IN ore-dressing operations and in laboratory work much confusion is caused by the practice of describing the sieve or screen employed by the number of the mesh. A sieve of 30 mesh, for example, does not possess an aperture of one-thirtieth of an inch, nor does it yield a product of which the largest particles will be one-thirtieth of an inch in diameter. With coarse sieves the error is not of great moment, but with fine sieves the wire itself occupies so much space that the size of the particle passed by the sieve may vary from a quarter to two-thirds of the size indicated by the word "mesh." Consequently, in ordering wire screens or in recording results it is desirable to specify the size of aperture rather than the number of the mesh. In order to enable this to be done, Mr. G. T. Holloway has drawn up a valuable series of tables, calculated on the British Imperial Standard wire gauge, showing the size of aperture in screen wire cloth of all the principal sizes in use down to the very finest. The tables have been duplicated, one series showing the figures in decimals of an inch, and the other, for the use of those who still prefer to employ vulgar fractions, in both decimals and vulgar fractions. The tables, which have been published in pamphlet form (*Bulletin* No. 5 of the Institution of Mining and Metallurgy), have been calculated with great care, and should do much towards effecting uniformity in the nomenclature of sieve-mesh.

THE Geological Survey of Western Australia is publishing, in handy octavo form, a valuable series of bulletins, of which we have received three. One of them, dealing with the mineral production of the colony up to the end of 1903, is written by Mr. A. Gibb Maitland and Mr. C. F. V. Jackson. It shows that the total value of the mineral products was 47,779,000*l.*, gold alone representing a value of 46,441,000*l.* Other minerals mined include copper, tin, lead, silver, iron, antimony and cobalt ores, coal, graphite, limestone, precious stone, mica, asbestos, and salt. In the other bulletins Mr. C. G. Gibson deals with the mineral resources of the Murchison goldfield and of Southern Cross, Yilgarn goldfield. The reports and the accompanying coloured maps throw much light on the geology of the districts, and indicate that the areas described deserve more attention from the mining prospector than they have hitherto received. The Murchison goldfield is of some historical interest in that in 1855, when its economic value was purely prospective, it was officially stated to have the appearance of being one of the finest goldfields in the world. Although it has not come up to these high expectations, it is one of the most important goldfields in the colony, and contains not only one of the largest quartz veins mined anywhere, but also the iron ore deposits of the Weld range, which, though practically valueless owing to their inaccessibility, are among the richest in the world.

MR. V. KOUSNETZOFF communicated to the *Bulletin* of the St. Petersburg Academy of Sciences of September last some useful formulæ for the determination of the height of aurora borealis. He also gave tabular and graphical results of its occurrence at Pavlovsk from January 1, 1878, to the end of 1903. The tables show, generally, an eleven years' period, as in the case of sun-spots, but the details of the two curves do not correspond. The maxima of the auroræ occurred in 1887 and 1896, and the minima in 1884 and 1894, but this divergence may be due to the occurrence of cloud. The annual period is well marked, the maxima being in March and October, and the minima in January and July.

IN the *Archives des Sciences physiques et naturelles* of March last M. F. A. Forel summarises his own observations and those made by others on the occurrence of Bishop's Ring, following the great volcanic eruption of Mont Pelée (Martinique) on May 8, 1902. Bishop's Ring, as most of our readers are aware, consists of a solar corona of great diameter; it appears to be formed of two parts, a limb of a dazzling silvery hue being immediately round the sun, and, beyond this, a coppery red ring of some 20°–25° exterior radius. The ring appears to have been first observed in the winter of 1902–3, but only became general towards the end of July, 1903, and was constantly seen until November of that year. After that time it became less frequent, and ceased altogether in July, 1904. The phenomenon is best seen from an elevated station, and when the sun is high above the horizon. The intensity of the colours of the ring was less than in that which followed the Krakatoa eruption in 1883.

Bulletin No. 35 of the United States Department of Agriculture, Weather Bureau, will be found of great interest to those who wish to know something about the present stage of long-range weather forecasting. The first chapter is written by Prof. Garriott, and presents a verification of the work of the most prominent of the so-called long-range weather forecasters in the United States. Prof. Garriott considers chapter and verse of the forecast with the actual facts, and shows conclusively the fallacy of these predictions. Prof. Woodward, in the second chapter, devotes his attention to the impossibility of basing weather predictions on planetary influences, and at the same time criticises the work of Mr. Tice embodied in a book on the elements of meteorology. Perhaps the most interesting portions of this *Bulletin* are the pages devoted to a discussion by Prof. Garriott of the subject of long-range forecasting by many of the leading meteorologists of the world. It may be said to be a brief review of the literature on the subject, and gives quotations of their opinions regarding the practicability of long-range work. At the end is given a summary of the remarks and opinions expressed and a series of conclusions based on them, and we refer the reader to the *Bulletin* for these conclusions. There is one which may be mentioned here, since by recent work in this country it has been brought prominently forward. "Advances in the period and accuracy of weather forecasts depend upon a more exact study and understanding of atmospheric pressure over great areas and a determination of the influences, probably solar, that are responsible for normal and abnormal distributions of atmospheric pressure over the earth's surface."

NO. 3 of vol. ii. of *Le Radium* contains useful articles on uraniferous minerals and their deposits, and on the methods used in the measurement of the quantity of heat evolved by radio-active substances.

PROF. MCCLELLAND has recently shown that the emanation of radio-active substances does not carry an electrical charge, and the same conclusion is arrived at by means of a different form of apparatus by Prof. Battelli and F. Maccarrone (*Physikalische Zeitschrift*, No. 6). It must be concluded, therefore, contrary to M. Becquerel's views, that such emanations consist neither of fragments of atoms which have lost positive ions nor of the positive ions themselves.

A new method for the preparation of paraffins from their monohalogen derivatives which is described by M. Paul Lebeau in the current number of the *Comptes rendus* (April 10), is noteworthy on account of the simplicity of the reaction and the purity of the gas obtained. Sodium is converted into sodium-ammonium by the action of liquid ammonia, and this, treated with methyl chloride, gives methane, readily obtained in a pure state by liquefaction by means of liquid air. Ethyl and propyl iodides react with the same ease, giving rise to ethane and propane, the purity of which was verified by combustion analysis. It is pointed out by M. Lebeau that as these reactions take place below the boiling point of liquid ammonia there is small probability of any secondary reactions taking place.

The current number of the *Quarterly Review* contains an article by Mr. A. E. Shipley on "Pearls and Parasites."

We have received from Messrs. Isenthal and Co. a well illustrated and conveniently arranged catalogue of technical and laboratory electric measuring instruments and rheostats.

The issue of the *Journal* of the Royal Sanitary Institute for April contains a full account of the papers read and the speeches delivered at the conference on school hygiene held at the University of London in February last, and reported in Nature for February 16 (p. 377).

Many characteristic scenes of the western coast and fjords of Norway are described and illustrated in a pamphlet just issued by the Albion Steamship Co., Ltd., Newcastle-on-Tyne, as an itinerary of cruises to be taken this year by the yachting steamer *Midnight Sun*.

Messrs. John J. Griffin and Sons, Ltd., have published a ninth edition of their illustrated and descriptive catalogue dealing with apparatus suitable for the practical study of sound, light, and heat. An examination of the contents of the catalogue shows that a great improvement is taking place in the apparatus employed in the laboratories and lecture-rooms where physics is taught. Teachers and others should find this catalogue helpful and suggestive.

OUR ASTRONOMICAL COLUMN.

Astrophysical Work at the Smithsonian Institution.—Prof. Langley's report of the work performed in the various departments of the Smithsonian Institution during the year ending June 30, 1904, contains a report by Mr. C. G. Abbot of the observations made in connection with the solar radiation at the astrophysical observatory.

Among many items of interest, the following may be briefly mentioned: The bolometer apparatus has now been improved to such a state of perfection that a duplicate set for investigating the radiation of stars has been constructed. A series of experiments with the improved pyroheliometer has shown that this instrument may now be used with confidence to measure the solar radiation.

The definition of the long focus mirror has been considerably improved by churning the air inside the tube, by protecting the tube from the direct solar rays with a covering of canvas, by employing a number of supporting plates as suggested by Prof. Ritchey in order to preserve the shapes of the mirrors, and by nullifying the vibrations due to traffic by placing indiarubber pads behind the mirrors. Prior to these alterations the solar image was ill-defined; different parts of it came in focus in different planes, whilst the variation in the focal length of the instrument often amounted to 10 feet during a single day. Now the image is much better defined; all parts of it are focused in the same plane, and the focal length never varies so much as 12 inches during a day.

Well marked variations, amounting to 10 per cent. of the total, have been recorded in the value of the solar radiation, and Mr. Abbot expresses a strong hope that, on combining the solar radiation and atmospheric transparency results, long range climate forecasting will ere long become possible.

Value of the Astronomical Refraction Constant.—The third volume of the *Publications* of the Grandueal Observatory at Heidelberg contains 234 pages devoted to the discussion of the results obtained by M. L. Courvoisier in a research undertaken by him for the determination of the refraction constant.

The instrument employed was a 6-inch Repsold meridian circle, which, together with its various constants, is described at length. Two hundred stars were observed, and the observations and their peculiar errors are discussed. The meteorological data for several periods during each observing day are next given, the observations extending from June 3, 1899, to July 9, 1901, and this table is followed by sections dealing with the stellar, latitude, and declination observations respectively.

The value obtained for the refraction constant is $60''{\cdot}161 \pm 0''{\cdot}037$.

Reality of Various Features on Mars.—In No. 4007 of the *Astronomische Nachrichten* Signor V. Cerulli, of Teramo, discusses the actual subjectivity of various Martian phenomena, as seen in the telescope, from a physiological standpoint. Having observed Mars regularly for ten years, he appears to have arrived at the conclusion that the actual existence of these features is as much a subject for physiological as for astronomical investigation. He states that the phenomena observed are so near to the limit of the range of the human eye that in observing them one really experiences effects accompanying "the birth of vision." That is to say, the eye sees more and more as it becomes accustomed, or strained, to the delicate markings, and thus the joining up of spots to form "canals" and the gemination of the latter follow as a physiological effect, and need not necessarily be subjective phenomena seen by the accustomed eye.

Stonyhurst College Observatory.—In addition to the results of the meteorological and magnetic observations made during 1904, Father Sidgreaves's annual report briefly refers to the solar and stellar spectroscopical work carried out at Stonyhurst during last year.

Two series of spectrograms of β Aurigæ and γ Cassiopeiæ were commenced, and the results already obtained are very promising. A short table showing sun-spot areas and the range of the magnetic declination appears to confirm the connection between these two values for the years 1898–1904. The spectra of sun-spots in the green and violet regions have been photographed with a Rowland grating spectroscope, and a number of experiments have been made with the view of photographing the spot spectra in the red region.

Nature of Sun-spots.—In the April number of the *Bulletin de la Société astronomique de France* Abbé Th. Moreux re-discusses his theory concerning the formation and nature of sun-spots in the light of data more recently acquired, more especially during the great spot of February last. He gives numerous drawings of this spot, and several schematic diagrams showing the possible arrangement of the photospheric clouds in and over the spot, and arrives at the conclusion that spot areas are analogous to *anti-cyclonic* areas in the terrestrial atmosphere.

Instructions to Solar Observers.—Amateur observers of solar phenomena will find the instructions to solar observers, formulated by the "commission solaire" of the Société astronomique de France, of great use and interest. Chapter v. is published in the April *Bulletin* of the society, and deals with daily spectroscopic observations of the chromosphere and prominences by the Lockyer-Janssen method.

RECENT CHANGES IN THE CRATER OF STROMBOLI.[1]

STROMBOLI is the most easterly and northerly of the Lipari Islands. It is situated north of Sicily, close to the track of steamers plying between Naples and the Straits of Messina, and is thus an object familiar to passengers to or from Egypt or the East, though comparatively few have landed on its shores. Its almost constant eruptions have gained it the name of the lighthouse of the Mediterranean. It is almost circular, as its old name Strongyle indicates, and rises as an irregular cone out of deep water. On the north-west side are the crater, and the Sciara or steep slope down which the ejecta roll into the sea.

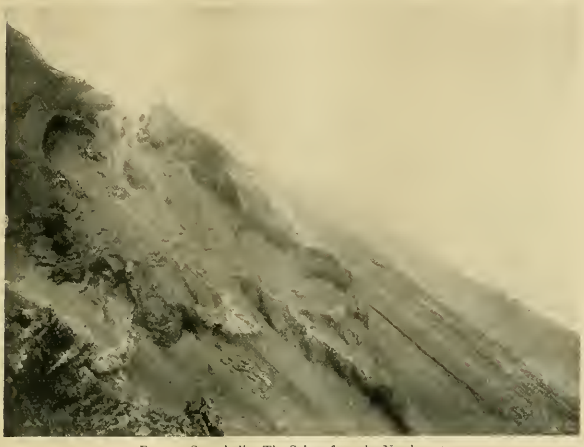

FIG. 1.—Stromboli. The Sciara from the North-east.

The summit of the mountain, which is about 3000 feet high, consists of a crescentic ridge, the Serra di Vancori, open towards the north. It forms part of an old crater ring, and thus presents points of similarity to Somma. Inside the crescentic ridge, and in places joined to it by irregular crests of rock, but mainly separated from it by a valley, "A Fossieiedda," similar to the Atrio del Cavallo of Vesuvius, is another crescentic ridge, connected with the two extremities of which, and immediately overlooking the sides of the crater, are two conspicuous pointed rocks, the Torrelle, which partly obstruct the view of the crater when viewed from the cliffs overlooking the Sciara on its north-east and south-west respectively. These Torrelle, being practically unaltered by ordinary eruptions, present good points of comparison for estimating the changes that take place, and one or other of them is included in most of the photographs. Between the two Torrelle, in the midst of a sort of amphitheatre formed by them and the crescentic ridge last mentioned, are the crater and its appurtenances, the "Apparato Eruttivo" of Italian observers. This amphitheatre is open to the north-west, and from its open side beyond the craters the steep slope of the Sciara extends down into the sea. This slope is bounded on each side by two steep cliffs, Filo di Sciara and Filo di Baraona, which are formed, like the Sciara itself, of lava-streams, agglomerates, and dykes; in fact, of almost every kind of compact volcanic material, chiefly of basic composition.

This Sciara, as is well known, is one of the most peculiar features of this volcano. It extends at an angle of about 35°, which is the "angle of repose" for the kind of material of which it is composed, down into the deep water of the Mediterranean; and though the volcano has certainly been in almost constant eruption during the whole of the historic period, and probably much longer, it has never been able to build up a talus sufficient to rise to the level of the sea, much less to that of the lip of the crater, about which, according to the analogy of other volcanoes, it might have been expected to have built up a cone on this side comparable to the portion on the south described above. Fig. 1, from a photograph[1] taken by the author in 1888 from the ridge overlooking the north-east side of the Sciara, and consequently looking south-west, shows the Sciara extending down to the right of the picture with the Filo de Barcuna behind it. The pointed rock to the left of the picture is the eastern Torrella, with a gap to the left of it through which the ejecta are thrown during the larger eruptions, and roll on to the steep slopes in front and down the Sciara into the sea. The western Torrella is just visible in the distance beyond the eastern Torrella. The crater situated between the two was in 1888 a large pit obviously formed by severe explosions. It contained two small secondary cones. One, towards its western part, and close to the edge of the Sciara, was that from which the explosive eruptions took place several times an hour; the other, towards the eastern part, emitted only smoke.

FIG. 2.—Stromboli. The Sciara from the West.

[1] Abridged from a paper by Dr. Tempest Anderson in the *Geographical Journal* for February.

[1] From "Volcanic Studies," by Tempest Anderson, plate xxi.

In 1904, when the author took comparison photographs from nearly the same spot, this large crater was almost entirely filled up, and the slope of the Sciara was continued upwards, so that the cone of ejecta overtopped and was visible behind the eastern Torrella. The activity in this eastern part of the crater still maintained the same quiet character as in 1888. The whole area constantly emitted vapour; there was more than one bocca visible, but they were quite small and only gave very feeble explosions, and these with a rhythm quite independent of those at the western part of the crater.

Fig. 2, taken by the author on April 20, 1904, from a point to the west of the crater, and consequently in almost exactly an opposite direction to Fig. 1, shows the condition of the western part of the crater sixteen years later. The conspicuous rock to the right of the plate is the western Torrella, behind which, in 1888, was the great crater above referred to. The bocca to the left, from which the explosion is taking place, is shown in some of the earlier photographs as situated on the edge of the large crater at its junction with the Sciara. The great crater is now seen to be filled up by ejecta which prolong the slope of the Sciara upwards over what was previously its site, while the bocca itself remains in all probability really in its former position, though apparently on the slope of the Sciara instead of on its edge.

It will be interesting to future visitors to see whether the volcano will continue to prolong the slope of the Sciara much further upwards, or whether a paroxysmal explosion will occur which will clear the great crater again.

The paper in the *Geographical Journal* is illustrated with twelve photographs and a map showing these and other points more in detail.

THE INSTITUTION OF NAVAL ARCHITECTS.

The annual spring meeting of the Institution of Naval Architects was held last week, commencing on Wednesday, April 12, and being continued over the two following days. The president of the institution, the Right Hon. the Earl of Glasgow, occupied the chair. A very full programme had been arranged, there being no less than fifteen papers set down for reading and discussion, and there was also the presidential address.

The first business after the usual formal proceedings was the reading by the secretary, Mr. R. W. Dana, of the report of the council. By this it appeared that the institution is in a prosperous condition, both in regard to finance and membership. Reference was made to the proposed foundation of an experimental tank for the purpose of scientific investigation of problems connected with ship design. It will be remembered that it was proposed, at the initiative of Mr. A. F. Yarrow, Dr. Elgar, Sir William White, and other prominent members of the institution, that an institution tank should be founded in connection with the National Physical Laboratory. Such a tank, devoted to research of a scientific nature, would be of great benefit to the ship-building industry, and would do much to raise naval architecture to a higher plane by the substitution of scientific principles for those empirical methods upon which ship designers too largely have to rely. It is much to be regretted, therefore, and not very creditable to an important and wealthy industry, that the appeal made by the council of the institution has met with so poor a response. Only six thousand pounds out of the fifteen thousand pounds needed has been underwritten, so that the project is shelved for the present. In spite of the enormous preponderance of the ship-building interests of this country, there are but two experimental tanks in the kingdom. One is the property of the Government, and is devoted wholly to the Royal Navy, the other being the property of a private firm of ship-builders on the Clyde. Both these tanks are devoted entirely to what is known as "practical work," that is to say, they attack subjects piecemeal, and therefore in a more or less empirical fashion. They have no time for ordered investigation of fundamental principles, upon a knowledge of which, alone, can a useful superstructure of applied science be raised. The tanks are not to blame for this. They were established for a definite purpose, which they admirably fulfil.

In the presidential address Lord Glasgow, among other subjects, referred to the spread of the steam turbine for marine propulsion, alluding more particularly to the recent trials of H.M.S. *Amethyst*. Some interesting comparisons were made between the performances of this cruiser, which is fitted with steam turbines, and the *Topaze*, a similar ship in all respects, excepting that she has ordinary crank and cylinder engines. As is well known, the steam turbine is less "flexible," to use an expression that has come into use, than the reciprocating engine; that is to say, its efficiency falls off rapidly when it is run at lower powers than that for which it was designed to give maximum efficiency. This point was well illustrated during the trials of the *Amethyst* and the *Topaze* by the coal consumption, the figures being given in Lord Glasgow's address. The steam turbines of the *Amethyst* drove her at $23\frac{1}{2}$ knots, 5·45 per cent. faster than her sister ships with reciprocating engines. At the higher speeds the turbine engines appeared decidedly more economical; at lower speeds the reciprocating engines had the advantage. At 10 knots a ton of coal would carry the *Amethyst* 7·42 miles, or the *Topaze* 9·75 miles. From this speed upwards the margin in favour of the reciprocating engines decreased, until the consumption curves would cross at a little above 14 knots, when approximately $6\frac{1}{2}$ miles would be steamed on a ton of coal. At a speed of 20 knots the *Amethyst* ran 4·22 miles, and the *Topaze* 2·9 miles, per ton of coal burnt. At 23·6 knots, a speed the *Topaze* did not reach, the *Amethyst* would steam a little more than 2 miles per ton of coal. If it may be allowed that about 14 knots is the lowest speed at which these cruisers could be advantageously run in time of war, the steam turbine has a marked advantage for warlike purposes; but it might lead to higher coal consumption in time of peace.

The first paper taken was a contribution by Mr. W. E. Smith, of the Admiralty, upon the design of the Antarctic exploration vessel *Discovery*. This was a single screw wooden steamer 175 feet long, 34 feet wide, and about 1620 tons displacement. The propeller was so arranged as to be disconnected from the shaft and lifted into a well, after the manner adopted in the old steam frigates. The rudder was also arranged to be readily unshipped. The scantling of the hull was massive, but in general plan followed the designs adopted in the days of wooden construction. The vessel was fully rigged as a barque. The fitting of a magnetic observatory was one of the special features of the design. The work done here was of great magnitude, and the observations taken are now being analysed by Captain Chetwynd, the Admiralty superintendent of compasses. No magnetic metal was allowed within a radius of 30 feet of the observatory. Main shrouds were of hemp, the lanyards being rove through wooden dead eyes. Great care was taken to lag the living part of the ship so as to economise coal. Professional details of the design were dealt with at some length. In the discussion on this paper, Sir Clements Markham gave some historical details of former Polar expeditions, and dwelt upon the advantage of having a ship expressly built for the purpose. Captain Scott, who was in charge of the expedition, Sir William White, and Admiral Fitzgerald also spoke.

The next paper was by Colonel Soliani, of the Royal Italian Navy, and gave technical details of the Japanese war vessels *Kasuga* and *Nisshin*, both built in Italy. A paper by Mr. H. Rowell giving an account of the Russian Volunteer Fleet followed.

The second day of the meeting opened with a paper by Prof. J. H. Biles, who gave details of trials made to test the strength of a torpedo-boat destroyer supplied for the purpose by the Admiralty. The vessel was placed in dry dock, being supported on cradles near the ends, so as to produce sagging stresses, and in the middle in order to induce hogging. The experiments were part of the investigation of the Admiralty Destroyer Committee. The results were set forth at considerable length in the paper and in the large number of diagrams which accompanied it. It will be sufficient to say here that the actual results observed on these practical trials established the usual methods of calculation as affording a good margin of safety, the stresses in the observed results being consistently below those calculated by the formulæ commonly used by naval architects.

A paper on a similar subject was read by Mr. F. H. Alexander.

A long and elaborate paper, illustrated by numerous diagrams, was next taken. The subject was the structural arrangements of ships, the author being Mr. J. Bruhn. Details of tests of frame girders, on the strength of flanged plates, on intercostal stringers, on the tripping of frames, and the strength of rivet attachments, were described. The paper was of considerable professional interest, and will form a valuable source of information to naval architects; but without the aid of the numerous illustrations and diagrams it would be impossible to make the descriptions clear.

At the evening meeting of the same day a paper by Mr. R. E. Froude on hollow *versus* straight lines opened the proceedings. The subject has attracted a good deal of interest of late, and has already led to some discussion. A number of naval officers, led by Admiral Fitzgerald, hold that a great mistake is made by building ships for the Royal Navy with hollow lines. Sir William White and the other naval constructors naturally defend their practice, supporting their arguments by the actual results obtained at the Haslar tank. The naval men reply that, even allowing the superiority of hollow lines in the smooth water, at which all tank experiments were made, the hollow lines gave a slower vessel amongst waves, and also a wetter ship. In order to bring the matter to a practical issue, a number of experiments were made by Mr. Froude at the Haslar tank, in which artificial waves were created by a mechanical device. The results were plotted on diagrams attached to the paper, the general conclusion arrived at by Mr. Froude being that though there was a distinct diminution in average effective horse-power due to straight lines, yet this was insufficient to annul the greater efficiency of the hollow lines in smooth water. In the discussion that followed, Admiral Fitzgerald joined issue on this point. He held that quite smooth water was comparatively rarely met with at sea, and he considered it was a question for naval officers, and not for naval architects, to decide under which condition they would prefer the higher efficiency. Moreover, the straight lines gave greater displacement forward without extra cost, and the additional buoyancy could be used for placing heavier guns forward, or in other useful ways. Prof. Biles also joined in the discussion. He gave the results of trials on this subject made at the Dumbarton tank. These results were in contradiction to those given in Mr. Froude's paper, and until this discrepancy is explained the subject must remain unsettled. The need for an independent tank devoted to experimental investigation is apparent. Mr. Froude's experiments are extremely interesting, as being the first tank trials made in other than smooth water. When it is remembered how little smooth water there is at sea, and how widely the conditions of resistance and other qualities are altered by waves, the advantage of the new departure will be apparent.

An interesting paper by Mr. A. W. Johns, of the Royal Corps of Naval Constructors, was also read at this sitting, the subject being the effect of motion ahead on the rolling of ships. The subject is one both of interest and importance, and was worked out by the author with considerable ingenuity, theoretical results being compared, with those obtained by experiment. It would appear that the effect of speed is to reduce rolling, but no doubt further tests will be made, the actual experimental data up to now being somewhat meagre.

Mr. Stromeyer also read a paper on the effect of acceleration on ship resistance.

Another paper was down for reading at this sitting, but unfortunately time did not permit of it being read. It was by Mr. S. Popper, of Pola, the subject being the results of model experiments in deep and in shallow water. The subject is one of considerable practical importance at the present time, when builders of destroyers in the south find it pays them to send their vessels to the measured mile on the Clyde, where there is deep water. They find the Clyde mile permits of a knot more being made than can be obtained on any of the comparatively shallow miles of the south.

On Friday, April 14, five papers were taken. Mr. A. E. Seaton contributed the first, the subject being margins and factors of safety and their influence on marine designs. Mr. J. H. Heck followed with some notes on the variation of angular velocity in the shafting of marine engines; and Mr. Mallock read a brief paper in which he described an ingenious device for keeping the two sets of engines of a twin screw vessel out of step, so as to prevent vibration. Mr. Attwood also read a paper on the Admiralty course of study for the training of naval architects.

Perhaps the most interesting paper of the meeting was that which came last. It was by Mr. J. B. Millet, of Boston, Massachusetts, and described a means of submarine signalling by sound, of which more will probably be heard in the future. Briefly it may be said that the sides of the ship itself are used as receivers. A tank filled with a dense liquid is attached to each side of the ship. In this a transmitter is placed, and the sound collected is taken by wires to an observer, who may be in any part of the vessel. If the source of sound is on the port side the sound will be apparent from the port transmitter; if on the starboard side the starboard transmitter will be affected; if it is directly ahead it will be heard equally through both transmitters. When the sound is astern a different effect is produced. As the result of practical trials, the positions of passing ships and of submarine bells were accurately defined. When it is remembered how untrustworthy sound signals are when passed through air, and how unchanging is the density of water, it will be seen that the new system promises to reduce the chief dangers of modern navigation, collisions, or strandings through fog. The idea of submarine sound signals, of course, is not new, but the hitherto insuperable difficulty in the way has been the confusion of sound through the overwhelming nature of the noises in the ship itself. Mr. Millet, however, appears to have overcome this difficulty, and the testimony as to the value of his invention is very strong.

The meeting was brought to a conclusion by the usual votes of thanks.

UNSOLVED PROBLEMS IN ELECTRICAL ENGINEERING.

ON April 10 Colonel R. E. Crompton delivered the annual "James Forrest" lecture of the Institution of Civil Engineers, an abstract of which is given below.

There are two groups of electrical problems, those which concern the scientific investigator and those presenting themselves to engineers. The lecturer dealt with the latter only. The phenomena of lightning discharges, especially where they affect the distribution systems of large electric power plants, require further study. Many failures are due to causes which the lecturer believes to be static discharges due to gigantic condenser effects set up in systems of well insulated overhead and underground conductors, each system acting as a plate of the condenser.

Interesting problems arise out of terrestrial magnetism; the present hypotheses are based on scant knowledge. It is known that the earth's magnetic field is not symmetrical, but the work of observing the variations of the earth's field at public observatories all over the world may eventually enable the earth's field gradually to be plotted out.

Another problem passing into the domain of engineering is the etheric transmission of power. What is now required is a better solution of the problem of producing continuous trains of Hertzian waves either by mechanical means or by electrochemical means.

The lecturer dealt rather fully with what he called the "core and coil" problem of electrical machinery, that is to say, the problems connected with the perfecting of the cores, hitherto of iron, but which in future may be made of some of the alloys invented by Dr. Huesler, which are now under test.

Dealing with the present means of using iron or steel castings of high permeability, the best methods were discussed of freeing them from blow-holes or porosity to ensure that the magnet cores should be of equal density of mass, and therefore of equal magnetic moment. In this connection the lecturer alluded to Prof. Barrett's discovery of adding silicon, thereby increasing the fluidity and reducing the tendency to form blow-holes; he also gave reasons why increased permeability might be expected from this, as the addition of silicon probably acts by reducing the combined carbon in the iron, leaving the pure iron with a sponge or network structural formation calculated to give great freedom for molecular movement.

On the subject of coil winding, he showed by diagrams that at present the space occupied by insulation may be reduced by winding the copper upon the coils in the form of thin strip on edge, and insulating the portions from one another by a paint or varnish of sufficient dielectric strength, high heat conductivity, and power of retaining its dielectric strength at temperatures of 200° C. The thinness and fragility of the copper strip, however, demand that this should be done by a machine which will roll the copper to the section and curvature just as it is ready to be wound on. The difficulty was alluded to of designing the cores and windings of high-speed turbo-generators, owing to the trouble of resisting mechanical stresses due to centrifugal forces, and at the same time of subdividing them sufficiently to prevent the formation of eddy currents.

It was pointed out that although recently the developments of electrical storage have not been much discussed, it would be better to go on improving the lead couple accumulator we now have instead of waiting for the invention of some new storage couple which we may never obtain. The combination of the internal combustion engine driving a generator and worked by suction gas plant for long hours, thereby charging a battery of accumulators, is, if combined with a small steam plant capable of taking the peak load, probably the most economical method of producing energy for the short hours of lighting. Portable storage is much required for the modern automobile, and some progress has been made, but much still remains to be done. The lecturer did not believe that much could be gained from Edison's newly invented couple.

The utilisation of single phase alternating currents for railways is already within reach, the choice of systems lying between the Finzi type of series motors and the Winter and Eichsberg compensated repulsion motors. Electric traction can supersede existing steam haulage for passenger work at the present schedule speeds with economy and advantage. It is not quite certain that electric haulage will supersede steam haulage for high-speed passenger work, as, although undoubtedly electric haulage can work trains at 100 miles an hour, the steam locomotive can be improved to work at the same speed with equal safety. Engineers will not attack the long distance haulage of goods for years to come, at least not in our present state of knowledge of the cost of generating electrical energy. The successful development by electrical means of change speed and torque gear is much needed by the mechanical engineer, not only for railway work, but for rolling mills and similar purposes.

The measuring instruments used by electrical engineers have made great strides towards perfection, but there are some problems still unsolved, notably the power measurements of alternating currents.

Although there have been recently many attempts to improve the efficiency of electric lamps, both of the arc and incandescent type, yet much remains to be done. By using a beam of violet-blue light of considerable intensity it is nearly certain that many substances hitherto considered opaque, but which owe their opacity to the diffused refraction of the red and yellow rays, will be rendered transparent.

A problem of great importance will be the discovery of a direct method of producing cold by electric means, as by such methods cold storage will be facilitated in the larders of private houses.

Electric smelting has made great advances, and although it presents many unsolved problems, much may be hoped for in this direction.

The problem which is of the greatest interest to the world in general is the satisfactory development of power schemes by which the population can be sent back to the land. The solution is more difficult in this country, where we have no power supply from natural water power, but progress may nevertheless be expected.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

At the graduation ceremony of Glasgow University on Tuesday, the degree of Doctor of Laws was conferred upon Prof. A. Crum Brown, F.R.S.

It is announced by *Science* that gifts of 20,000*l.* to Rochester University for the construction of a scientific building, and of 10,000*l.* to Norwich University, Vermont, half for a library and half for an engineering department, have been announced. A donation of 50,000*l.* has been made to Northwestern University by Mr. Milton H. Wilson, a resident of Evanston, and one of the trustees of the institution.

Replying to a discussion on university education in Ireland which was raised on the Civil Service Estimates in the House of Commons on April 13, Mr. Balfour gave it as his opinion that Ireland is not provided for adequately in respect of university education. The decline in the number of students in Trinity College he ascribes to the great revolutions in the system of land tenure, which have diminished substantially the resources and the numbers of the class that send students to that institution. There is also a diminution of attendance at the Queen's College, Belfast, which is largely due to the influence which the Royal University is exercising on education in its higher forms by substituting a mere system of examination for a university training. Another reason for the falling off at the Queen's College is that the institution is without the funds necessary for complete equipment.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 16.—"On the Absence or Marked Diminution of Free Hydrochloric Acid in the Gastric Contents in Malignant Disease of Organs other than the Stomach." By Prof. Benjamin **Moore**, in collaboration with Dr. W. **Alexander**, Mr. R. E. **Kelly**, and Mr. H. E. **Roaf.**

It has long been known that free hydrochloric acid is absent or reduced in amount in the great majority of cases of cancer of the stomach.

The absence of the acid in such cases has been attributed to local action, to continued irritation of the mucous membrane of the stomach by the presence of the growth, to retention of the food in the stomach acting as an irritant and causing gastritis when the growth has narrowed the pyloric opening, or to alkaline products thrown out at the seat of the growth and neutralising the acid.

The facts that the acid is not nearly so frequently absent in gastritis due to causes other than cancer of the stomach, and that the acid may be absent in cases of cancer and where there is no marked gastritis, and where the growth is confined to a small part of the mucous membrane, the remainder being normal, led to the surmise that the absence of free hydrochloric acid in the gastric secretion might not be due to local conditions in the stomach, but to a general condition of the blood which rendered it difficult or impossible for the oxyntic cells of the cardiac glands to secrete the acid.

To test this view, the amount of free hydrochloric acid in the gastric contents was determined in *seventeen* cases of malignant disease in which the growths were situated in regions remote from the stomach, such as tongue, cheek, floor of mouth, rectum, prostate, breast, and uterus.

As a result of the determinations it was found that free hydrochloric acid was either entirely absent (two-thirds of the cases) or greatly reduced in quantity. This shows that the absence of free hydrochloric acid in cancer of the stomach is not due to local action in that organ, but, on the other hand, that cancer, *wherever occurring*, is associated with diminution or absence of the acid from the gastric secretion.

Such a result can only arise by an alteration in the blood, which increases the difficulty of separating free hydrochloric acid by the secreting cells.

It is pointed out in the paper that the most probable alteration in the blood plasma increasing the difficulty of secretion of hydrochloric acid by the gastric glands is a decrease in the concentration of the hydrogen ions.

Blood plasma is alkaline to some indicators and acid to others, indicating the presence of both hydroxyl ions, upon which its alkalinity depends, and hydrogen ions, giving an acid reaction. Any agency which increases the effective alkalinity of the blood, that is to say, which increases the hydroxyl ions and diminishes the hydrogen ions, will increase the difficulty of separating a secretion containing free hydrochloric acid.

In cases where the gastric secretion has its acidity diminished or reduced to zero, as is found to be the case in carcinoma, it is hence highly probable that the concentration of the hydrogen ions in blood plasma is reduced. The action of the kidney cells in maintaining a definite degree of alkalinity of the plasma is hence altered, so that a greater degree of alkalinity is maintained than in the normal individual.

It has been shown by Loeb that slight increase in alkalinity of the medium leads in certain instances to a more rapid cell division and growth, and if this holds good generally, it is possible that increased alkalinity of the blood plasma may lead to increased activity in cell division, and hence be a stimulating cause leading to formation of new growths.

The acidity was determined by the following methods :—

(*a*) *Total acidity* by titration with phenolphthalein as indicator. This lay very low in the seventeen cancer cases, being normal in one case only, above 0·1 per cent. in four cases, and in the majority one or two drops of decinormal alkali sufficed to render neutral.

(*b*) *Günzberg's reagent for free hydrochloric acid* gave entire absence in eleven out of seventeen cases, a minute trace in five cases (0·0036 per cent. to 0·0109 per cent.), and 0·0365 per cent. was the highest value attained in a single case only.

(*c*) *Hydrolysis of methyl acetate by the filtered gastric contents* for the determination of the concentration of free hydrogen ions was carried out in ten cases, and it was found that the concentration in all these never exceeded one-fifteenth of the average concentration in three normal cases tested by the same method.

March 30.—"Note on Fluorescence and Absorption." By J. B. **Burke.** Communicated by Prof. Larmor, Sec.R.S.

In a paper "On the Change of Absorption produced by Fluorescence"[1] the author gave an account of the experiments by which he found the existence of a very remarkable difference in the absorption of the fluorescent light of uranium glass when in the luminous and non-luminous states. This difference he has attributed[2] to a temporary change in structure or chemical composition of the body when exposed to the influence of the exciting light, and he has been led to regard this as due to new atomic connections giving rise to new frequencies during the period of luminosity, by the formation of unstable aggregates, which radiate intensely, as they disintegrate, the energy which was stored up in their formation; the luminosity being thus the visible manifestation of a process of building up and breaking down of molecules.

Messrs. Nichols and Merritt have found recently[3] that the change of absorption depends upon the intensity of the fluorescence, and that a saturation effect takes place in the absorption as the intensity of the luminosity increases, attaining a maximum with a certain intensity of the fluorescent light. They used, not the fluorescent light from another similarly excited body, but an acetylene flame as the source of the transmitted rays.

M. Camichel has encountered some difficulty in detecting the change with the light from a flame, and this appears to have been due to the use of a screen of uranium glass, 7 cm. in thickness, to cut off the more refrangible rays from the flame, a precaution which is by no means necessary, since the effect has been observed without it. The fluorescence caused by the flame merely diminishes the apparent absorption. The screen, on the other hand, must itself fluoresce, and in so doing—if the effect sought for occurs—absorb to a considerable extent the rays the absorption of which it is proposed to measure on the assumption that they are transmitted by the screen.

[1] *Philosophical Transactions*, (A) 1898; NATURE, July 15, 1897.
[2] British Assoc. Report, Belfast, 1902, and *Phil. Mag*, 1901.
[3] *Physical Review*, December, 1904.

For fluorescence of very feeble intensity the effect may not in any circumstances be perceptible.

Furthermore, the fluorescent spectrum of uranium glass is composed of several bands, and these in turn the author regards as discontinuous, and made up of more finely divided bands or lines.

Thus the use of the screen filters the rays, and only those which are not absorbed by uranium glass are transmitted. These would not undergo any change of absorption.

The change of absorption cannot be due to the increased amplitude if the vibrations are linear, but where new free periods are produced by the exciting rays, the intensity and the absorption of the fluorescent light would both depend upon the number and duration of the periods thus produced, and it is this which the change of absorption in fluorescence most distinctly proves.

"The Direct Synthesis of Ammonia." By Dr. E. P. **Perman.** Communicated by Principal E. H. Griffiths, F.R.S.

(1) So far as can be shown by one of the most delicate tests known to chemists, ammonia cannot be synthesised by heat (except under special conditions specified below). The decomposition of ammonia by heat may, therefore, be regarded as an irreversible reaction. (2) Ammonia may be synthesised in small quantities from its constituent elements (*a*) by heating with many of the metals; (*b*) by exploding with oxygen; (*c*) by sparking. These are reversible reactions. (3) It would appear that the synthesis of ammonia is effected only when the gases are ionised; the ionisation would be brought about by sparking, or by the high temperature of an explosion of hydrogen and oxygen. The immediate decomposition of the ammonia formed would be prevented by its sudden cooling. The metals in the presence of moisture also produce "nascent" or ionised hydrogen. (4) It does not appear that nitrides of the metals form an intermediate stage in the formation of ammonia, for it was found that metals readily forming nitrides, *e.g.* magnesium, did not produce more ammonia than the others. (5) There is a close analogy between ozone and ammonia with regard to their synthesis and decomposition; both are formed by sparking, and both are completely decomposed by heat.

"Determination of Vapour-pressure by Air-bubbling." By Dr. E. P. **Perman** and J. H. **Davies.** Communicated by Principal E. H. Griffiths, F.R.S.

It was shown recently by one of the authors that the vapour-pressure of water can be determined with a considerable degree of accuracy by bubbling a current of air through water in a thermostat, and estimating the amount of water evaporated by absorbing it in strong sulphuric acid.

The accuracy of the method has since been questioned, supersaturation being specially suggested as likely to cause error. Experiments have therefore been made in order to discover what error (if any) is introduced by supersaturating the air with moisture before it enters the water in the thermostat. The effect of dust in the air and of electrification have also been investigated. In each case the arrangement of the apparatus was as described in the previous paper.

Supersaturation.—Before passing into the flasks in the thermostat, which was maintained at 70°, the air was bubbled through a large wash-bottle containing water at about 85°.

Dust in the Air.—A thick smoke was made by burning pieces of phosphorus near the inlet tube of the apparatus described in the former paper.

Electrification of the Air.—(1) The air was made to pass through a large flask in which hydrogen was being rapidly evolved from zinc and dilute sulphuric acid.

(2) One terminal of an induction-coil, capable of giving (with the battery power used) a 6-inch spark, was connected with a wire passing into the first (nearest the inlet) flask in the thermostat; the other terminal was connected with the bath, so that the silent discharge passed through the flasks and the air inside.

(3) The X-rays from an ordinary focus-tube were allowed to fall on the flasks in the thermostat, and were specially directed on to the last (nearest outlet). A wire from one of the terminals of a Wimshurst machine was passed down the gauge-tube into the last flask, the other terminal being connected with the bath.

The last mentioned experiments gave vapour-pressures 237·5 and 238·0, instead of the normal value 234·0.

The greatest deviation from the normal value obtained in the other experiments was slightly more than 0·5 per cent., which is almost exactly the same as that obtained in the original investigation.

It may safely be concluded, therefore, that no naturally occurring supersaturation, or dust, or electrification of the air would have any appreciable effect on the result.

April 6.—"On Endophytic Adaptation shown by *Erysiphe Graminis* DC. under Cultural Conditions." By E. S. **Salmon.** Communicated by Prof. H. Marshall Ward, F.R.S.

In recent papers by the author the fact has been pointed out that certain species of the Erysiphaceæ are able, under cultural conditions, to infect their host-plants vigorously when their conidia or ascospores are sown on the cells of the internal tissues exposed by means of a wound, although the fungi in question are confined normally to the external surface of the epidermal cells.

The author, reviewing the results of the present investigations, points out that they afford proof that *E. graminis* is not, as perhaps might have been expected, so highly specialised as an ectoparasite as to be necessarily restricted for its food-supply to cells of the epidermis, but shows itself capable of immediate adaptation to conditions closely resembling those obtaining in endophytism.

This fact suggests the possibility that in some circumstances the mycelial hyphæ of species of the Erysiphaceæ which are normally ectoparasites may penetrate into the internal tissues of their host-plants exposed through wounds caused in nature by the attacks of animals or by physical agency. It is pointed out, however, that the successful entry of the hyphæ might be prevented, either by the drying up of the superficial layers of cells, or by the healing processes shown by many actively growing leaves.

"On the Physical Chemistry of the Toxin-Antitoxin Reaction: with Special Reference to the Neutralisation of Lysin by Antilysin." By J. A. **Craw.** Communicated by Dr. C. J. Martin, F.R.S.

Summary of Conclusions.—(1) Megatherium lysin passed through a gelatin filter, and is diffusible through gelatin. (2) Megatherium antilysin does not pass through a gelatin filter, and is not appreciably diffusible through gelatin. (3) The filtration and diffusion of mixtures show that free lysin is present in neutral mixtures and in mixtures containing excess of antilysin. (4) Free antilysin exists in neutral mixtures, and in mixtures containing excess of lysin. (5) The reaction is at least partially reversible when excess of antilysin is present. (6) False equilibria are produced with greater facility when the lysin is in excess. (7) The neutralisation equation of Arrhenius and Madsen does not hold for multiple mixtures. (8) The removal of lysin from a solution by antilysin is not capable of interpretation as a purely chemical change, but is more analogous to certain adsorption phenomena.

Faraday Society, April 4.—Prof. A. K. Huntington in the chair.—Alloys of copper and bismuth: A. H. **Hiorns.** Results of a further research on copper alloys carried out in a similar manner to that on the copper-arsenic series published in the *Transactions* of the society, April, 1904. Prof. Arnold has investigated the effect of bismuth, from 0·1 per cent. to 0·5 per cent., on copper, and found that the investing membranes surrounding the grains of copper appeared to be split down the centre, presenting a definite plane of cleavage. Dr. Gautier obtained a freezing-point curve similar to the author's, but his temperatures are generally higher. The microscopic evidence mainly confirms the records of the freezing-point curves, of which there are four branches.—Refractory materials for furnace linings: E. Kilburn **Scott.** (Discussion.)—Electrically heated carbon tube furnaces, part i.: R. S. **Hutton** and W. H. **Patterson.** This type of furnace seems to be the most readily available for the very highest temperatures, and the authors have been able to get satisfactory results with a very simple type of construction. The important points to bear in mind are the end connections (which must be kept cool), protection of the tube from contact with air, and heat insulation. Two types of furnace are described:—(1) graphite tube furnace; (2) agglomerated carbon tube furnaces.

Anthropological Institute, April 4.—Prof. W. Gowland, president, in the chair.—The fort and stone-lined pits at Inyanga contrasted with the Great Zimbabwe: R. N. **Hall.** The walls of the fort are built upon a curved plan, and the fort itself is divided into enclosures for purposes of defence. The fort has twenty-five entrances pierced through the walls which are themselves pierced with a great number of loopholes. The fort is also peculiar for the employment of banquette walls, which are not met with except in a few ruins in southern Rhodesia. Another peculiarity of the building is the absence of buttresses. The stone-lined pits are very numerous throughout Inyanga, and are usually found in clusters of twos and threes. Mr. Hall was of opinion that they were not used as slave-pits, as had been supposed, but as shelters from the variable temperature. The pits consist of a hole lined with masonry, and a curved, paved passage used as an entrance. In almost every case the pits have a drain running through the rampart, and another peculiarity is the erection near them of a stone monolith. Mr. Hall also referred to the hill terraces found in the neighbourhood, and in conclusion contrasted the architecture of the fort and pits with the temple and acropolis at Zimbabwe.

Chemical Society, April 6.—Prof. R. Meldola, F.R.S., president, in the chair.—The kinetics of chemical changes which are reversible. The decomposition of *as*-dimethylcarbamide: C. E. **Fawsitt.** This investigation is a continuation of those already published on carbamide and methylcarbamide, and the same explanation of the decomposition holds good.—A new formation of acetylcamphor: M. O. **Forster** and Miss H. M. **Judd.** The imine

$$C_8H_{14}\begin{cases} CH.CMe{:}NH \\ CO \end{cases},$$

obtained by the action of magnesium methyl iodide on α-cyanocamphor, is resolved quantitatively by acids into acetylcamphor and ammonia.—Preparation and properties of 1:4:5-trimethylglyoxaline: H. A. D. **Jowett.** This base was prepared in the course of an attempt to obtain substances having a constitution analogous to that of pilocarpine. The base and a number of its salts are described.—Bromomethyl heptyl ketone: H. A. D. **Jowett.** This bromoketone is obtained by the action of bromine in chloroform solution on methyl heptyl ketone obtained from oil of rue.—Limonene nitrosocyanides and their derivatives: F. P. **Leach.** The α-nitrosocyanide crystallises in prisms whilst the β-compound forms fine woolly needles. These isomerides are regarded as having the *cis* and *trans* configurations, since on hydrolysis both give rise to the normal oxime of dihydrocarvone.—The action of carbon monoxide on ammonia: H. **Jackson** and D. **Northall-Laurie.** The authors find that the main reaction is the formation of ammonium cyanate, which rapidly changes to carbamide.—The action of acetylene on aqueous and hydrochloric acid solutions of mercuric chloride: J. S. S. **Brame.** The first action of acetylene on mercuric chloride is shown to be one of simple combination, the product being then decomposed by water forming aldehyde and the substance $C(HgCl)_3.CHO$.—The basic properties of oxygen at low temperatures. Additive compounds of the halogens with organic substances containing oxygen: D. **McIntosh.** Crystalline compounds of chlorine and bromine with methyl and ethyl alcohols, methyl ether, acetone, ethyl acetate, acetaldehyde, and acetic acid have been obtained.—Note on the interaction of metallic cyanides and organic halides: N. V. **Sidgwick.** A possible explanation of the formation of both nitriles and *iso*cyanides in this reaction from the same initial additive compound is given.—The chemical dynamics of the reactions between sodium thiosulphate and organic halogen compounds, part ii., halogen substituted acetates: A. **Slator.** The reactions of the thiosulphate with ethyl iodoacetate and methyl, ethyl and sodium bromo- and chloro-acetates have been investigated, and shown in all cases to be bimolecular reactions.—The tautomerism of acetyl thiocyanate: A. E. **Dixon** and J. **Hawthorne.**—A method of determining the specific gravity of soluble salts by displacement in their own mother liquor, and its application in the case of the alkali halides: J. Y. **Buchanan.**—The combination of mercaptans with unsaturated ketonic compounds: S. **Ruhemann.** —The existence of a carbide of magnesium: J. T. **Nance.** The yellow residue formed when magnesium is heated with carbon evolves hydrogen and acetylene when dissolved in acids, and may contain a carbide.—Isomeric salts of the type $NR_1R_2H_3$. A correction. Isomeric forms of *d*-bromo- and *d*-chloro-camphorsulphonic acids: F. S. **Kipping.** The further study of the isomeric α and β salts has shown that the isomerism of these compounds is not due to difference in the spatial arrangement of the groups attached to the quinquevalent nitrogen atom, but to the existence of *cis* and *trans* forms of *d*-bromo- and *d*-chloro-camphorsulphonic acids.—Isomerism of α-bromo- and α-chlorocamphor: F. S. **Kipping.**—*l*-Phenylethylamine: F. S. **Kipping** and A. E. **Hunter.**—The influence of the hydroxyl and alkoxyl groups on the velocity of saponification, part i.: A. **Findlay** and W. E. S. **Turner.** The numbers obtained show that the hydroxyl group exercises an accelerating influence on the velocity of saponification, but that on replacing the hydrogen of the hydroxyl by an alkyl group the rate diminishes, and the effect increases regularly with the mass of the alkyl group.

Linnean Society, April 6.—Mr. A. C. Seward, F.R.S., vice-president, in the chair.—Specimens and drawings of pitchers of Nepenthes, supplemented by slides, prepared by Mr. L. Farmar, to illustrate the various types of pitchers and their marvellous glandular systems: W. Botting **Hemsley,** F.R.S. Mr. Hemsley first exhibited a new species, *Nepenthes Macfarlanei,* which differs from all other known species, except *N. Lowii,* in the underside of the lip being thickly beset with stiff bristles, interspersed with honey-glands. Other species were compared with *N. Macfarlanei.* Briefly, all the complex arrangements of these plants favour the descent of insects and other creatures into the pitchers, and hinder almost all visitors from getting out again; once in, there is little hope of escape. A few hybrids were also shown, notably one named "Sir William Thiselton-Dyer," which has produced the largest pitcher known in cultivation, being a pint and three-quarters in capacity.—The axillary scales of aquatic Monocotyledons: Prof. R. J. Harvey **Gibson.** The author compared the ligule of Selaginella with the scales in question, and suggested that the latter may be looked upon as evidence that the Monocotyledons may be regarded as modern representatives of primitive Angiosperms, and in turn may have been genetically related to some ancestral form allied to Isoetes.—A further contribution to the study of *Pelomyxa palustris* (Greeff): Mrs. L. J. **Veley.** After alluding to her previous memoir in the *Quarterly Journal of Microscopical Science,* n. ser. xxxvi. (1894), pp. 295–306, the author explained that the "rods" present in *Pelomyxa palustris* (Greeff) are symbiotic bacteria (*Cladothrix pelomyxae,* Veley); they complete their development within the animal and are then ejected, breaking down into free "swarmers," which are ingested by other Pelomyxæ, and immediately re-commence the cycle. The "refringent bodies" are proteid in nature, viz. some form of albumin which is a waste product of the metabolism of Pelomyxa. They supply the bacteria with a point of attachment necessary for development, and (probably) also with nourishment.—Mansonieæ, a new tribe of the natural order Sterculiaceæ: Dr. D. **Prain.**

Paris.

Academy of Sciences, April 10.—M. Troost in the chair. —Remarks on the recognition of the solar corona at times other than during total eclipses: H. **Deslandres.** A criticism of the results recently obtained by Hansky, in which the difficulties introduced by diffused light in the apparatus do not appear to have been sufficiently taken into account. The use of a simple concave mirror, as employed by Huggins in 1883, is decidedly preferable to the system of two lenses and a mirror used by Hansky. Details are given of the method suggested by the author. —The conclusions to be drawn from the study of homogeneous enclosures in petrography: A. **Lacroix.**—The plants of the plateau of the Nilghirris: Gaston **Bonnier.** The mean temperature of Ootacamund is practically the same as that of Paris, and a detailed comparison of the flora of the two places is given. The altitude of the Nilghirris is not sufficient for the plants to acquire all the characteristics of alpine plants, but they acquire certain alpine characters. There are also special modifications induced by the large difference between the day and night temperature.—On the Peneideæ and Stenopideæ collected by the French and Monaco expeditions in the eastern Atlantic: E. L. **Bouvier.**—The conflict between the primary and accidental images, applied to the theory of inevitable variability of retinal impressions excited by objects illuminated by sources of light of constant value: A. **Chauveau.** The impression produced on the retina by a geometrical figure is complex, and is a resultant formed by the superposition of two images, the one objective, the other subjective, and an experiment is described showing how these may be separated. The effects of colour, intensity of illumination, motion of the retina, displacement of the eye or the object, and accommodation are considered systematically. The case of the *n*-rays is not actually taken by the author, but the considerations here put forward clearly suffice to explain many of the phenomena ascribed to the action of these rays.—The heat of formation of sodium hydride. The acidity of the molecule of hydrogen: M. **de Forcrand.**—On the reduction of oxyhæmoglobin: R. **Lepine** and M. **Boulud.** The oxyhæmoglobin is reduced with a titrated solution of ferrous sulphate, and the time of reduction noted, the colouring matter being considered as reduced when the two absorption bands fuse together. In normal blood from the dog the time of reduction is fixed, and is between eighteen and twenty minutes, and this time is independent of the dilution. In anæmia, with a quantity of the reducing agent proportional to the amount of hæmoglobin, the time of reduction is much increased. Prolonged inhalation of ether or chloroform also increases the time of reduction. Human blood from anæmic patients shows the same characteristics.—On Rhabdocarpus, the seeds and the evolution of the Cordaiteæ: M. **Grand'Eury.**—Report presented in the name of the committee charged with the scientific control of the geodesic operations at the equator. The operations have been much delayed by the unfavourable meteorological conditions and by the illness of several members of the expedition. A short account is given of the progress made in triangulation, levelling, and pendulum observations. An astronomical station has been installed at Cuenca, and another will be set up near the fourth parallel. On account of the limited financial resources of the expedition, it is proposed that a portion of the original scheme be dropped.—Observations of the Giacobini comet (1905 *a*) made at the Observatory of Algiers with the 31·8 cm. bent equatorial: MM. **Rambaud** and **Sy.** The observations were made on March 28, 29, and 30, and give the apparent positions of the comet with the positions of comparison stars. On March 28, when the atmospheric conditions were exceptionally favourable, a nucleus could be clearly made out of about the thirteenth magnitude.—Actinometric observations at the summit of Mont Blanc in 1904: A. **Hansky.** The weather conditions were not favourable. The most probable value of the solar constant from the 1904 observations is 3·28 calories.—On integral functions: Eugène **Fabry.**—On Monge's problem: P. **Zervos.**—On the equilibrium of arches in circular arcs: M. **Belzecki.**—On the longitudinal stability of aërostats: L. **Torres.** A discussion of a paper on the same subject by M. Renard, in which, as the result of a theoretical investigation, certain modifications of the stern are suggested. In the present paper it is shown that this investigation is not strictly correct, and that the modifications suggested will not have the desired effect.—On the diamagnetism of bismuth: A. **Leduc.** Bismuth was fused in small spherical flasks and allowed to solidify in a strong magnetic field (4000 to 5000 C.G.S. units). The sphere of solid bismuth, suspended in the same field, took up the same position as it had at the moment of solidification.—Contribution to the study of ionisation in flames: Pierre **Massoulier.** The conductivity of an ether flame is considerable. By introducing increasing proportions of carbon dioxide into this flame, although the temperature is lowered, the ionisation, as measured by the current between two electrodes in the flame, is increased. The results are interpreted by the author as being due to the dissociation of the carbon dioxide in the flame.—On the variation of the difference of contact potential for miscible solutions of electrolytes: M. **Chanoz.**—On the dichroism produced by radium in colourless quartz and on a thermoelectric phenomenon observed in striated smoky quartz: N. **Egoroff.** Colourless quartz, exposed to the action of radium for a week, exhibited dichroism identical with that ordinarily observed with smoky quartz. A plate of smoky quartz, heated to 100° C. and treated with a mixture of sulphur and red lead, gave a figure reproducing the striations.—An automatic damping arrangement applicable to pendular and oscillatory movements: V. **Crémieu.**—On a photograph of a lightning flash showing the air in incandescence: Em. **Touchet.** The persistent glow which is visible in some cases after a lightning flash is due to the incandescence of the air. This effect is not physiological, as it is clearly shown in some photographs taken by the author and by other experimenters.—The etherification of glycerin: Marcel P. S. **Guédras.**—The liquefaction of allene and allylene: MM. **Lespieau** and **Chavanne.** The two gases were prepared with great care in a pure state and solidified in liquid air. Allene melts at −146° C., boiling at −32° C., its critical point being about 121° C. Allylene melts at −110° C., boils at −23°·5 C., and has a critical point of 129°·5 C., the temperatures being all measured by an iron-constantan thermo-couple. The purity of the gases was determined by a combustion analysis.—On the hydrogenation of benzonitrile and paratoluonitrile: A. **Frébault.** Sabatier and Senderens, who have already applied their reaction to this case, found that nickel carried the reduction too far, toluene and ammonia being the only products, and were obliged to replace the nickel by copper to obtain benzylamines. Working under somewhat different conditions, the author has obtained results with nickel.—Secondary diazoamines: Léo **Vignon** and A. **Simonet.**—On the hydrates of acetol: André **Kling.**—On the use of the metal ammoniums in chemistry: the preparation of paraffins: Paul **Lebeau** (see p. 592).—On isodimorphism: Fred. **Wallerant.**—On a new indiarubber Euphorbia: Henri **Jumelle.** This tree grows in the north-west of Madagascar, and its indiarubber producing properties were discovered accidentally by the natives. It appears to be a new species, and is named *Euphorbia elastica*.—The action of ether and chloroform on dried seeds: Paul **Becquerel.** The result is due to action of these substances on the fatty material of the cell, but the effect of the chloroform is much more energetic.—On the formation and function of fatty materials in fungi: A. **Perrier.** It is shown that the fat acts as a reserve food material for the plant.—On some points of anatomy of the male organs of the Edentata, and on their means of fixation: Rémy **Perrier.** It is shown that this is not a case of retrogression, but that the condition of the male organs corresponds to a primitive form. This view confirms the palæontological results as to the age of the Edentata.—The weight of the brain as a function of the body weight in birds: L. **Lapicque** and P. **Girard.** The exponential formula given by Dubois for expressing the weight of the brain as a function of the body weight holds for the case of birds, the index having the same numerical value as in mammals (0·56).—On the alternation of eclipses and the lustre of feebly lighted objects: Th. **Lullin.**—The spectroscopy of the blood and of oxyhæmoglobin: M. **Piettre** and A. **Vila.** The reaction of sodium fluoride upon the absorption spectrum of blood is a very delicate one, and can be used to detect traces of fluorides down to 5 parts in a million. A diagram is given of the relation between the intensity of the absorption bands of oxyhæmoglobin and the dilution.—On the normal presence of alcohol and acetone in the liquids and tissues of the organism: F. **Maignon.**—Researches on hæmatogen: MM. **Hugounenq** and **Morel.**—The influence of the state of liquefaction of starch on its transformation by diastases: A. **Fernbach** and J. **Wolff.**—Experimental acid dyscrasia: M. **Charrin.**—On the age of the granite of the western Alps and the origin of the crystalline exotic blocks of Klippes: C. G. S. **Sandberg.**—On the Lahore earthquake and the variations of the magnetic needle at Paris: Th. **Moureaux.** Disturbances of the magnetic records at Paris were observed on the day of the Lahore earthquake.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part vi. for 1904, contains the following memoirs communicated to the society:—

October 29.—W. **Voigt**: Remarks on tensor-analysis. A. **Schœnflies**: On the geometrical invariants of the analysis of position. Eduard **Riecke**: Researches on the phenomena of discharge in Geissler tubes. F. **Bernstein**: On the theory of aggregates.

December 17.—G. **Herglotz**: On the calculation of retarded potentials.

DIARY OF SOCIETIES.

THURSDAY, APRIL 27.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Discussion*: Mr. B. J. Arnold's Address to the Joint Meeting at St. Louis on the Problem of the Alternate Current Motor applied to Traction.—*Paper*: The Alternate Current Series Motor: F. Creedy.

FRIDAY, APRIL 28.

EPIDEMIOLOGICAL SOCIETY, at 8.30.

CONTENTS.

THURSDAY, APRIL 27, 1905.

THREE CAMBRIDGE MATHEMATICAL WORKS.

The Algebra of Invariants. By J. H. Grace, M.A., and A. Young, M.A. Pp. vii+384. (Cambridge: The University Press, 1903.) Price 10*s.* net.

The Dynamical Theory of Gases. By J. H. Jeans, M.A. Pp. xvi+352. (Cambridge: The University Press.) Price 15*s.* net.

A Treatise on the Analytical Dynamics of Particles and Rigid Bodies. By E. T. Whittaker, M.A. Pp. xiii+414. (Cambridge: The University Press, 1904.) Price 12*s.* 6*d.* net.

WHATEVER opinions may be felt as to the desirability of University Presses competing with private firms in swelling the already too large flood of school geometries or issuing cram books for compulsory Greek examinations, there can only be one opinion as to the series of standard treatises on higher mathematics emanating at the present time from Cambridge. In a country which, in its lack of national interest in higher scientific research, particularly mathematical research, stands far behind most other important civilised countries, it necessarily devolves on a University Press to publish advanced mathematical works. We may take it as certain that the present volumes will be keenly read in Germany and America, and will be taken as proofs that England contains good mathematicians, though Englishmen as a nation may be unaware of their existence, with the exception of the senior wrangler of one year, who is forgotten the next.

For years Salmon's "Higher Algebra" has been the treatise which has done most to interest English students in invariants. At the present time a good deal more is wanted in order to bring our knowledge up to date. Messrs. Grace and Young have endeavoured to meet present requirements in a well defined direction. As they state in their preface, the book

"was started as an attempt to meet the need expressed by Elliott in the preface to 'The Algebra of Quantics'—'a whole book which shall present to the English reader in his own language a worthy exposition of the method of the great German masters remains a desideratum.'"

While no book, unless it were written in four languages, could satisfy the patriotic aspirations of every native of our country by appealing to him "in his own language," the production of an English book on a subject largely developed in Germany meets a distinct want.

The subject is practically started *ab initio*. The treatment does not strike us as very hard to follow, although it is difficult for a beginner at first to master the symbolical notation, especially in the definition of transvectants (chapter iii.). In chapter vi. the authors introduce Gordan's theorem, according to which the number of covariants of a binary form is always finite, and in the next chapter they employ his method of proof to obtain the complete irreducible set of covariants of the quintic. A short chapter on simultaneous systems brings us to Hilbert's theorem, with which the algebra of binary forms may be said to end. Chapters x. and xi. deal with geometrical interpretations, and in particular with apolarity. The sections dealing with ternary forms are less complete, as the authors have considered that "with the methods known up to the present the treatment of ternary forms is too tedious for a text-book."

Mr. Grace has previously been associated with the production of several mathematical text-books of a quite elementary character, and the present book bears many unmistakable traces of his experience as a writer in making a somewhat difficult subject appear relatively easy.

We say "somewhat" difficult, because the subject of Mr. Jeans's new book is incomparably harder than the "Algebra of Invariants." This difficulty arises largely from the fact that the kinetic theory of gases is closely associated with the representation of physical phenomena as they actually exist, and with all the difficulties connected with irreversibility and the existence of temperature. It is only by statistical methods that these phenomena are amenable to the equations of reversible dynamics, and with every method of attack some assumption must be made, since if any motion of a molecular system exists it is equally conceivable that the opposite motion should exist.

Even Willard Gibbs's appeal to experience quoted on p. 167 does not get over the difficulty. If we put red and blue ink together into a vessel and stir them up, it is true that if the inks differ in nothing more than colour the result is a uniform violet ink. But this is because the inks are viscous liquids the motions of which are irreversible. If they were perfect liquids perfect mixing would not take place, and the effect of stirring would merely be to produce vortex motions in which the vortex lines always contained the same particles and remained constant in strength. If we mix counters in a bag, the motions of the counters are retarded by friction; if the counters correctly represented perfectly reversible systems they would never come to rest.

Mr. Jeans in his preface considers that the discrepancy between theory and experiment in connection with the ratio of the specific heats of a gas "is of greater importance than all the others together," and he has endeavoured to emphasise the fact that when account is taken of the interaction between matter and the ether, theory and experiment harmonise as well as could be desired. But as soon as this ether is taken into account we have a simple means of obviating the irreversibility difficulty by saddling the ether with the whole responsibility. So long as physicists are contented, in solving the differential equations of wave motion in a medium, to omit the terms which represent waves converging from an infinite distance towards a centre of disturbance, so long will there be an easy way out of the puzzling contradictions arising out of Boltzmann's H-theorem.

But there is really no reason why the presence of a molecule in an indefinitely extended ether which undoubtedly possesses some energy should not bring about the convergence of waves coming in from an infinite distance in all directions, and gradually increasing in intensity as they approach the molecule. We do not think such cases exist, but we did not expect to discover radium a few years ago.

Let us now see how Mr. Jeans attempts to deal with the difficulties here suggested. In the first seven chapters he follows fairly closely on conventional lines, and deduces the Boltzmann-Maxwell law of distribution, the minimum theorem, the law of partition of energy, and the isothermal equations according to the Boyle-Mariotte and van der Waals's laws. In chapter viii. the author throws over the principle of conservation of energy and assumes that his gas is a dissipative system in which loss of energy occurs by radiation. On this hypothesis he finds that when the rate of dissipation has become very slow probability considerations indicate a tendency to assume a definite statistical specification different from that given by the ordinary theory. It further appears that such a gas has one principal and a number of subsidiary temperatures, a notion which we believe has been previously advanced. In chapters ix. and x. Mr. Jeans considers applications of the theory of a non-conservative gas, particularly in connection with rates of dissipation of energy, and ratios of specific heats.

We thus have a definite attempt to break away from traditional methods and boldly introduce the notion of dissipation into the kinetic theory. The idea is certainly an excellent one. Whether it is free from objection is a matter which cannot be answered as the mere result of a critical examination. Often objections to theories strike the mind of a reader quite unexpectedly.

In the remaining chapters Mr. Jeans deals with "free path phenomena" such as diffusion, conduction of heat, viscosity, and the escape of gases from planetary atmospheres. In this work he is more on the ordinary lines. We notice as an important feature the sections dealing with encounters according to the law of the inverse fifth power. This series of chapters is of considerable use in affording easy access to investigations contained in a much longer form in the original papers of Boltzmann and other writers.

Turning back to the chapter on equipartition of energy, we are led to the following inference:—Mr. Jeans leaves it an open question whether the conventional law of distribution with its attendant consequences of equipartition may represent the ultimate state of a gas, but concludes that in actual gases such as we see around us where dissipation of energy occurs a different distribution holds good.

The second conclusion seems plausible. But the assumption that equipartition of energy holds *even in a conservative system* presents difficulties in connection with Stefan's law of radiation in a black cavity. According to that law the energy of the ether should vary as the fourth power of that of the molecules. It might be said that in the "conservative system" Stefan's law would not necessarily hold good, and that there would be no objection to assuming the energy of the ether to be then directly proportional to that of the molecules, or to the temperature. But the usual thermodynamic investigation—which is more certain to be valid in the case of the conservative than in that of the dissipative system—would then give a different form for the radiation pressure—apparently $f=\psi(\log\psi+\text{constant})$—and this result would have to be admitted. On the whole it appears more likely that while distributions satisfying Maxwell's law of equipartition are always theoretically possible, other distributions may exist, and may, indeed, represent a normal and *persistent* state of affairs even in *conservative* systems.

It is remarkable that physicists strain at gnats when put down to study kinetic theory or thermodynamics, and yet they swallow camels with complacency when they read the subject of Mr. Whittaker's book, "Analytical Dynamics." Some writers even go so far as to introduce pages and pages of the most unreal dynamical problems into what they call treatises on physics.

"The soluble problems of particle dynamics" mostly represent things which have no existence. It is impossible for a particle to move on a smooth curve or surface because, in the first place, there is no such thing as a particle, and in the second place there is no such thing as a smooth curve or surface. What constitutes the chief interest of "Analytical Dynamics" is the possibility of forming clear mental pictures of its results by *imagining* bodies capable of performing the motions discussed.

Mr. Whittaker's treatment is essentially mathematical and advanced in character. He opens with sections on the displacements of rigid bodies in which Klein's parameters and Halphen's theorems on composition of screws figure near the commencement. In his chapter on equations of motion physico-philosophical discursions on force and mass are reduced to a minimum. This is as it should be, for there are plenty of people who can write about such matters, but few whose knowledge extends to the more important theorems which follow later. The Lagrangian equations are reached by § 26, which is preceded by a definition of holonomic systems. This distinction might with advantage be put into treatises in physics, for at present students of that subject are apt to assume that Lagrange's equations in their ordinary form are universally applicable, which is far from true. Passing on to chapter v., which deals, *inter alia*, with moments of inertia, our old friend the "principle of parallel axes" is treated generally for a quadratic function of coordinates, velocities and accelerations, readers being doubtless assumed to know the proof for simple cases. Chapter vii. deals with the general theory of vibrations, and the next chapter with non-holonomic and dissipative systems, the first of these two chapters consisting mainly of theory, and the second mainly of examples. The most important chapters are those which follow, dealing with the principles of Hamilton and Gauss, the integral invariants of the Hamiltonian system, and the representation of a dynamical system of equations by means of contact transformations.

Mr. Whittaker some time ago presented a valuable report to the British Association on the problem of three bodies, and he tells us that between 1750 and 1904 more than eight hundred memoirs were published on this problem. Even at the Heidelberg congress last August further additions were made to this literature. In his chapter on the subject, which is very brief, he discusses the reduction of the equations to a system of the sixth order, thus affording a useful insight into the main features of this difficult investigation. Several other interesting chapters follow.

It will thus be seen that Mr. Whittaker's treatise collects into book form the outlines of a long series of researches for which hitherto it has been necessary to consult English, French, German, and Italian transactions. In recent years Italy has played no small part in the development of dynamics, as may be seen by the number of papers by Levi Civita and other writers which have from time to time appeared in the *Atti dei Lincei*, dealing with integrals of the equations of motion of holonomic systems, particular cases of the problem of three bodies, and allied questions.

The book is thus written mainly for the advanced mathematician. But an interesting feature is the large number of examples both in the text and at the end of the chapters. Of these a good many really contain the substance of minor papers that have been published abroad. Others are followed by the reference "Coll. Exam.," and while it may be taken for granted that Mr. Whittaker has made a judicious selection, some of the questions bearing these references may give foreign mathematicians a little insight into the unpalatable nuts which Cambridge students are expected to waste time in trying to crack for examination purposes. The antics of insects crawling on epicycloids, or the vagaries of particles moving along the intersections of ellipsoids with hyperboloids of one sheet, are of no scientific interest, and the time spent in "getting out" problems of this character might better be employed in learning something useful. Moreover, Cambridge college examiners have a habit of endowing bodies with the most inconsistent properties in the matter of perfect roughness and perfect smoothness. A perfectly rough body placed on a perfectly smooth surface forms as interesting a subject for speculation as the well-known irresistible body meeting the impenetrable obstacle. What the average college don forgets is that roughness or smoothness are matters which concern *two surfaces*, not *one body*.

In our opinion a great deal of the artificiality of the more elementary parts of dynamics might be removed by the more frequent introduction of simple problems in resisted motion. There are plenty of easy ones to be found which would be more helpful to the beginner than problems about ellipsoids rolling on perfectly smooth surfaces formed by the revolution of cissoids or witches about their axes. Those who have the ability to do more difficult work should pass on to the advanced parts of a book like Mr. Whittaker's and learn what foreign mathematicians have been doing; this is much more useful.

It remains to add that the books are neatly bound; the printing and paper are somewhat unnecessarily luxurious in quality, and—most important of all—the Cambridge printers have *not* forgotten to cut the pages with their guillotine.

G. H. BRYAN.

REIN'S "JAPAN."

Japan nach Reisen und Studien. By J. J. Rein. Vol. i. Natur und Volk des Mikadoreiches. Second edition. Pp. xv+749. (Leipzig: Wilhelm Engelmann, 1905.) Price 24*s.* net, paper; 26*s.* net, cloth.

THIS is the second edition of a book first published in 1880. The author, now professor of geography in the University of Bonn, was, in 1874, commissioned by the Prussian Ministry of Commerce to go to Japan for the purpose of studying and giving an account both of the trade of Japan and the special branches of industry there carried on to so high a degree of perfection. The writer of this notice had the pleasure of making the acquaintance of Dr. Rein while in Japan, and can testify to the German thoroughness with which Dr. Rein carried out the work for which he was commissioned. The results of that work were two volumes which, from the point of view of the author, have been looked upon as the most scientific and complete of their kind. Some years after their appearance in Germany translations were published in England (Hodder and Stoughton), but both the German and English editions have for some time been out of print, and the author has done well to bring out a new edition, brought up to date in matters both of history and science. For students of Japan it is almost unnecessary to review the work of Dr. Rein, as it has long had an assured position.

The opinion of competent authorities was reflected by Prof. Chamberlain more than fifteen years ago, when, in an edition of his well known book "Things Japanese," he said:—

"At the risk of offending innumerable authors, we now venture to pick out the following works as probably the best in a general way that are accessible to English readers: (1) Dr. Rein's 'Japan,' with its sequel 'The Industries of Japan.'" No person wishing to study Japan seriously can dispense with these admirable volumes. Of the two, that on the "Industries" is the better; agriculture, cattle-raising, forestry, mines, lacquer-work, metal-work, commerce, &c., everything, in fact, has been studied with a truly German patience, and is set forth with a truly German thoroughness. The other volume is occupied with the physiography of the country, that is, its geography, fauna, flora, &c., with an account of the people, both historical and ethnographical, and with the topography of the various provinces.

It is this latter volume which is at present before us, and although it may not be so interesting, from the practical point of view, as its sequel, it is more valuable from a scientific and historical point of view. The book is essentially the same as the first edition, but the author has had the assistance of many friends in Japan in bringing it up to date, both from a scientific and a historical point of view. It is, however, unnecessary to enter into a detailed account or criticism of its contents.

The first part of the book is a very complete and interesting account of the physical geography of Japan; in fact, it is the only systematic account which has been published in a European language. When

Dr. Rein was in Japan he had, for the most part, to depend on himself for the collection of information on this part of his subject; but in the interval many ardent students of science have been trained in Japan, and they have collaborated with him in bringing the matter up to date, so we have very valuable chapters on the geological formation of the country, its physiography, hydrography, climate, flora and fauna; while very complete lists of books and papers dealing with the various departments of the subjects are given which will be useful to those who wish to study them thoroughly.

The part relating to the history of the country has had a section added to it dealing more fully with the events which have occurred during the past quarter of a century, and gives a very good outline of the developments which have taken place. It deals, however, only with what may be called the natural history or facts of the subjects involved, and does not attempt to explain the natural philosophy or dynamics. No doubt the author would say that that was beyond the scope of his work; but it is possible to make descriptions much more interesting and intelligent when the forces at work are at least indicated, and the directions and amounts of their resultants explained. The full discussion of this, however, would take us into details of historical methods about which there is still considerable difference of opinion.

Under anthropology and ethnology a considerable amount of new matter has been introduced, in which are given the results of recent investigations and speculations. An interesting sketch is given of the Japanese language and literature and of the manners and customs of the Japanese. A short account is given of the Japanese calendar and of the national festivals. The part dealing with the religious conditions of Japan is too short to allow justice to be done to it, and it does not give an adequate account of recent developments. The present war with Russia has been a revelation of the "soul of the people," a full explanation of which would require a book for itself. Still, Dr. Rein might have tried to bring this section up to date as well as the others. Its full comprehension, however, requires something more than what is usually called a scientific mind, and comparatively few men of science seem capable of entering on it with understanding. They for the most part are content to look at a people from the outside, forgetting the fact that the most powerful factors in the evolution of a nation are intellectual and spiritual.

The concluding part of the book deals with the topography of the country, and is a valuable contribution to the subject. Some useful maps are included in the book, and a very complete table of contents renders the various subjects very accessible. We venture to hope that a new edition of the second volume on the "Industries of Japan" will soon be forthcoming, for, notwithstanding all the changes which have taken place, the industrial Japan depicted by Prof. Rein still, to a very large extent, remains, and only from it can the real Japan be known.

HENRY DYER.

MAKING A PASTURE.

The Agricultural Changes required by these Times, and Laying down Land to Grass. By R. H. Elliot. Third edition. Pp. xxiii + 197. (Kelso: Rutherford, 1905.)

MR. ELLIOT and "Elliot's system" and "Elliot's mixtures" have been not a little before the agricultural public during the last ten years or so, but we have not before had the opportunity of reading at length a full account of "the system" as set out by the author.

Indeed, we doubt if we should have been very much wiser now, so formless and discursive is the book, had not the publishers been kind enough to provide a synopsis for the guidance of the reviewer.

To put the matter briefly, Mr. Elliot farms some poor high-lying land in the neighbourhood of Kelso, and has found it profitable to adopt a system of laying it down to grass for periods of four to six years, after which it will carry two crops of turnips and two of cereals, in the last of which it is laid down again to grass for another period. The essence of the system is that with the usual grass seeds, or rather with a grass mixture containing a large proportion of cocksfoot and the coarse fescues instead of rye grass, a considerable amount of chicory, burnet, sheep's parsley, kidney vetch, and other tap-rooted plants are sown, although some of these, like the burnet and the chicory, are regarded as undesirable weeds in many parts of the country. Mr. Elliot claims that the deep roots of these plants, by opening up and, on their decay, aërating the subsoil, act as the most efficient agents of cultivation and bring about a great amelioration in the texture of the soil. Further, he obtains a good turf quickly and at little cost, so that when the land comes under the plough again he can grow four crops on the accumulated fertility without the use of any manure.

It will be seen that the one point which can in any way be held to distinguish Mr. Elliot's from other systems of temporary pastures is the use of chicory, burnet, and similar plants in the grass mixtures. It is probably a sound idea to introduce these deep-rooting plants, though we should infinitely prefer the equally deep-rooting but far more valuable sainfoin and lucerne anywhere south of the Trent, yet it leaves us wondering what all the coil is about. What is there so novel or so fundamental about the scheme that the Board of Agriculture should have been expected to take up Mr. Elliot's 1250 acres and by preaching on that text revolutionise British agriculture? Mr. Elliot's system appears to have succeeded on his own somewhat special soil and climate, but there is little reason to suppose it would be equally suitable to the bulk of our farming land. Indeed, we have only Mr. Elliot's opinion that it has succeeded in his own case, for though he writes of the experiments on the Clifton on Bowmont farm, of experiments in any rigid sense we see no trace. We never read of comparative results when one part of a field was sown with Elliot's mixtures, the other with an ordinary seedsman's prescription, nor have we any balance sheet setting out the financial returns from two fields, farmed one on

Mr. Elliot's system, the other in the fashion followed by any reasonable farmer in the district. In fact, the book proves nothing more than that Mr. Elliot, by using good seed and looking carefully after his grass land, has improved his farm in his own opinion and in that of various of his visitors; otherwise the book is a farrago of irresponsible talk, of hard words for agricultural chemists and science generally, of diatribes against the Board of Agriculture and everyone else who does not see eye to eye with Mr. Elliot; it bears every mark, in fact, of the work of the man with one idea.

SOCIOLOGY.

Sociological Papers Published for the Sociological Society. Pp. xviii+292. (London: Macmillan and Co., Ltd., 1905.) Price 10*s*. 6*d*.

THESE papers, the *Transactions* of the Sociological Society, make known to the world what work the society has done during the first year of its existence, and explain the aim and scope of the work it hopes to do in the future.

The first paper recounts the history of the word sociology. After that we get to the fundamental question of eugenics, "the science which deals with all the influences that improve the inborn qualities of the race; also with those that develop them to the utmost advantage." Mr. Francis Galton, the author of this paper, would have the principles of eugenics "introduced into the national conscience, like a new religion," that so a fine race may be bred. The discussion that followed was very interesting. The view held by most medical men who have reached middle age was put without any qualification, the view that we cannot attempt to deal with "a mass of scientific questions affecting heredity," but that we must concentrate our attention on more practical questions, such as the feeding of infants. Mr. Archdall Reid, on the other hand, in a written communication, brings out with admirable lucidity the distinction between degeneracy properly so called and the defective development of the individual. These questions, both of them urgent, we must face. "In the first place we must improve the conditions under which the individual develops, and so make him a fine animal. In the second place we must endeavour to restrict as far as possible the marriage of the physically and mentally unfit." Mr. Reid might have gone on to say that the former method without the latter, the improvement of external conditions without any check upon the multiplication of the unfit, would merely hasten degeneration, as any slackening in the stringency of natural selection must inevitably do. Mr. Bateson declines to join in investigations carried on by the "actuarial" method, preferring experimental breeding with its more definite results. But is it possible to experiment with human beings?

Prof. Geddes, in his "Civics," recommends to students a geographical survey of some river basin in which is displayed the evolutionary process which, beginning with "hunting desolations" on the hill-tops, culminates in some great manufacturing city that darkens the heavens with its smoke. It is doubtful how far this method can afford definitely practical help in solving the problems of modern industrial society. Still, the historical method is capable of imparting an interest to a science which to not a few men is dismal, and certainly anything that can make our great cities interesting is to be welcomed. Dr. E. Westermarck investigates the position of woman in early civilisation, showing that she was by no means, as a rule, a slave and a nonentity, but he owns that "the condition of women or their relative independence is by no means a safe gauge of the culture of a nation." Mr. P. H. Mann follows with a paper on "Life in an Agricultural Village in England," an investigation of the economic condition of the inhabitants. He follows the method of Mr. Charles Booth and Mr. Rowntree in the study of city populations. Prof. Durkheim and Mr. Branford discuss the relation of sociology to the social sciences and to philosophy. Prof. Durkheim contends that sociology is not a mere organisation of more specialist sciences, but that it is capable of remodelling them. Historians, for instance, and political economists have already had to "reorient their studies."

In conclusion, we must congratulate the Sociological Society on its first year's work. Beyond the work which can be definitely gauged there has been the bringing together of men who hold very different views, and of men who are attacking the same great problem from different sides. F. W. H.

OUR BOOK SHELF.

First Report of the Wellcome Research Laboratories at the Gordon Memorial College, Khartoum. By the Director, Andrew Balfour, M.D., B.Sc., &c. (Khartoum: Department of Education, Sudan Government, 1904.)

The Wellcome Research Laboratories of the Gordon College, Khartoum, which were equipped by the munificence of Mr. Henry S. Wellcome, have certainly justified their existence, judging by the record of work done during the year February, 1903, to February, 1904, as detailed in the report of the director, Dr. Andrew Balfour.

The volume commences with a brief description of the laboratories, after which follows an account of the various researches that have been carried out in them.

Any medical director stationed where malaria is endemic and mosquitoes plentiful would at once direct his attention to the distribution of the latter, and institute measures to diminish their prevalence. This has been done by Dr. Balfour, and the first article is devoted to a description of his observations and administration in this respect. Of mosquitoes three species are particularly numerous, *C. fatigans*, an anophelina, *P. costalis*, and *Stegomyia fasciata*. Mosquito brigades have been organised, and anti-malarial measures conducted on the lines recommended by Ross, and there appears to be every probability that the prevalence of mosquitoes will be greatly diminished in Khartoum in the near future. Collections of mosquitoes have been received from various parts of Egypt, the Sudan, and Abyssinia, and have been examined and named by Mr. Theobald, who contributes an article descriptive of the species, many of which are new. Experiments were made on the use of an anilin dye, chrysordine, for the extermination of mossuito larvæ and pupæ. It was found to act satisfactorily in a dilution of 1 in 30,000, but for practical purposes its use in this strength would be prohibitive on account both of cost and of its yellow colour. Biting and noxious insects other than mosquitoes is the subject of the next article, the most interesting find being *G. morsitans*, the tsetse fly which carries nagana, on the Pongo River, Bahr-el-Ghazal, and a few pages are devoted to insects and vegetable parasites injurious to crops, the most important being an aphis destructive to the dura crop described by Mr. Theobald as *Aphis sorghi* (nov. sp.). Cyanogenesis, hydrocyanic production, in the dura (*Sorghum vulgare*) is another subject briefly dealt with, and of importance since considerable loss of horses and cattle has sometimes been occasioned thereby. The dura contains a glucoside which yields hydrocyanic acid on decomposition, the cause of which has been ascribed to abnormal growth, but may be due to the dura aphis as demonstrated by Dr. Balfour.

Lastly, the general routine work, pathological and chemical, of the laboratories is summarised, some interesting notes are given of the various diseases met with in the Sudan, and the occurrence of eosinophilia in Bilharzia disease and dracontiasis is discussed.

We congratulate Dr. Balfour on his first year's work contained in this report, which is copiously illustrated, some of the coloured plates of mosquitoes and other insects being beautifully executed.

R. T. HEWLETT.

Till the Sun Grows Cold. By Maurice Grindon. Pp. 113. (London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd., 1904.) Price 2s. 6d. net.

THOUGH this story is, so far as its main incidents are concerned, of a familiar kind, it differs from others in that several of the persons described are interested in science. For instance, there is a Sir John Harpur, who "was making important alterations in his Observatory; he was an ardent Astronomer, and F.R.A.S."; Lady Harpur, again, "had a love of flowers beyond that of a botanist, although she was adept in the science"; and the hero, Ralph Hillary, at one time of his life had a workroom "in which he could follow up chemical and other researches to his heart's content." Moreover, after Ralph takes as a second wife his early sweetheart, they engage together in scientific research, and discover a substance of "extraordinary radio-activity" to which they give the name Helenium after Ralph's sister. We cannot say that the author has been successful in blending fact and fiction together so that one can scarcely be distinguished from the other; yet this art is essential to the writer of scientific romance or romantic science.

A Short Introduction to the Theory of Electrolytic Dissociation. By J. C. Gregory. Pp. 76. (London: Longmans and Co., 1905.) Price 1s. 6d.

THIS is a useful little book for those students who, after taking a course of systematic chemistry, wish to know something of the behaviour of electrolytic solutions. The language and mode of presentation are simple, and although one might take exception to many points of detail, the book, on the whole, should prove a trustworthy guide. The headings of the four chapters into which the book is divided afford a sufficient indication of its contents: chapter i., the condition of dissolved substances; chapter ii., ions and precipitation; chapter iii., hydrogen and hydroxyl ions; chapter iv., electrolytic and general considerations.

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.*]

Electromagnetics in a Moving Dielectric.

SOME time ago, when considering the assumption that the ether inside a body is quite stationary when a body is moved, and that in the application to Maxwell's ethereal equations this involves the use of a fixed time differentiation for the ether, and a moving one for the matter, I argued that the same applied not only to the electric polarisation, as done by Lorentz and by Larmor, but also to the magnetic polarisation. I told the late Prof. FitzGerald that to make the extension seemed to be a sort of categorical imperative. For it involves no assumption as to how the magnetic polarisation is produced. At the time I made the application to plane waves only. Since then I have extended it to the general case. The principal interest at present lies in the mechanical activity, fundamentally involved in the question of the pressure of radiation, and electromagnetic moving forces in general. The results confirm the desirability of applying similar reasoning to the magnetic and to the electric polarisation, in so far as they are relatively simple, and cast light upon the subject.

Thus, let $\mathbf{M}=\mathrm{V}\mathbf{DB}$ be the complete *quasi*-momentum per unit volume, and $\mathbf{M}_0=\mathrm{V}\mathbf{D}_0\mathbf{B}_0$ the ethereal part. Then if the velocity of the matter is $\mathbf{u}$, and of the ether $\mathbf{q}$, the motional activity (in the absence of free electrification, or variation of the electrical constants in space) comes to

$$\{\mathbf{u}(d/dt)+\nabla(\mathbf{u}.\mathbf{u}\}(\mathbf{M}-\mathbf{M}_0)+\{\mathbf{q}(d/dt)+\nabla(\mathbf{q}.\mathbf{q}\}\mathbf{M}_0\,; \qquad (1)$$

or, in a more developed form,

$$\mathbf{u}\{d/dt+\mathbf{u}\nabla+\nabla\mathbf{u}+\nabla_u.\mathbf{u}\}(\mathbf{M}-\mathbf{M}_0)+\mathbf{q}\{d/dt+\mathbf{q}\nabla+\nabla\mathbf{q}+\nabla_q.\mathbf{q}\}\mathbf{M}_0. \qquad (2)$$

Here the factor of $\mathbf{u}$ is the moving force on the matter, and that of $\mathbf{q}$ the force on the ether. It will be seen that in the material part we simply deduct that part of the complete $\mathbf{M}$ which does not move with the matter. This makes a great simplification of ideas. To avoid misconception, the ∇ in (1) acts upon all that follows, whereas in (2) the first ∇ acts on the $\mathbf{M}$'s, but the second and third on the velocities only, as may be seen on comparison with (1).

It is necessary, however, to point out distinctly the data involved in the above, as the simplification comes about in a special way. Divide the displacement $\mathbf{D}$ into $\mathbf{D}_0=c_0\mathbf{E}$ in the ether, and $\mathbf{D}_1=c_1\mathbf{E}_1$ in the matter, where $\mathbf{E}_1=\mathbf{E}+\mathbf{e}$, and $\mathbf{e}=\mathrm{V}(\mathbf{u}-\mathbf{q})\mathbf{B}_0$. Similarly, divide the induction $\mathbf{B}$ into $\mathbf{B}_0=\mu_0\mathbf{H}$ and $\mathbf{B}_1=\mu_1\mathbf{H}_1$, where $\mathbf{H}_1=\mathbf{H}+\mathbf{h}$, and $\mathbf{h}=\mathrm{V}\mathbf{D}_0(\mathbf{u}-\mathbf{q})$. The electric energy is $U_0+U_1=\frac{1}{2}\mathbf{ED}_0+\frac{1}{2}\mathbf{E}_1\mathbf{D}_1$, and the magnetic energy is $T_0+T_1=\frac{1}{2}\mathbf{HB}_0+\frac{1}{2}\mathbf{H}_1\mathbf{B}_1$. Also, let there be four æolotropic pressures, of Maxwellian type, say P_0, P_1 electric, and Q_0, Q_1 magnetic. *E.g.* $P_1=U_1-\mathbf{E}_1.\mathbf{D}_1$, meaning a tension U_1 parallel to $\mathbf{E}_1$ combined with equal lateral pressure. The rest are similar. Finally, the two circuital equations are

$$\mathrm{V}\nabla(\mathbf{H}-\mathbf{h}_0-\mathbf{h}_1)=\dot{\mathbf{D}}, \qquad -\mathrm{V}\nabla(\mathbf{E}-\mathbf{e}_0-\mathbf{e}_1)=\dot{\mathbf{B}} \qquad (3)$$

where the motional electric and magnetic forces are defined by $\mathbf{h}_0=\mathrm{V}\mathbf{D}_0\mathbf{q}$, $\mathbf{h}_1=\mathrm{V}\mathbf{D}_1\mathbf{u}$, $\mathbf{e}_0=\mathrm{V}\mathbf{q}\mathbf{B}_0$, $\mathbf{e}_1=\mathrm{V}\mathbf{u}\mathbf{B}_1$. This completes the data, and from them may be derived the equation of activity

$$\nabla\{\mathrm{V}\mathbf{EH}+\mathbf{q}(U_0+T_0+P_0+Q_0)+\mathbf{u}(U_1+T_1+P_1+Q_1)\}$$
$$=\dot U+\dot T+(U_0/c_0)\dot c_0+(U_1/c_1)\dot c_1+(T_0/\mu_0)\dot\mu_0+(T_1/\mu_1)\dot\mu_1+\mathbf{F}_0\mathbf{q}+\mathbf{F}_1\mathbf{u}, \qquad (4)$$

where $\mathbf{F}_0$ and $\mathbf{F}_1$ are the forces displayed in (2). The meaning is that the left side of (4) is the convergence of the flux of energy made up of the Poynting flux, the convective flux, and the activity of the pressures, whilst the right side shows the result in increasing the stored energy *and* in work done upon the matter and ether, either, both or neither, according to the size of the two velocities.

The terms involving $\dot c$, &c., in (4) represent residual activity which may be of different sorts. The commonest is when the constants vary in space, especially at a boundary. For example, $\dot c_1=-\mathbf{u}\nabla.c_1$ if c_1 does not vary in the moving matter. This means a moving force $-(\mathrm{U}_1/c_1)\nabla c_1$. But if there is compression, c_1 probably always varies intrinsically as well.

It will be found that the omission of the auxiliary $\mathbf{h}$ has the result of complicating instead of simplifying the force formulæ. Similarly the omission of $\mathbf{e}$ complicates them. Now the use of $\mathbf{e}$ is founded upon the idea that the electric polarisation is produced by a separation of ions under the action of $\mathbf{E}$, for $\mathbf{E}_1$ is the moving force on a moving unit electric charge. Analogously $\mathbf{h}_1$ is the moving force on a moving unit magnetic charge or magneton. If there are really no such things, the interpretation must be made equivalent in other terms. But the categorical imperative is not easily to be overcome.

The application to plane waves I described in a recent letter (NATURE, March 9) will be found to harmonise with the above in the special case.

But a correction is needed. In the estimation of the moving force on "glass" receiving radiation, the assumption was made that the electric and magnetic energies in the transmitted wave were equal. So the result is strictly limited by that condition. The conditions $\mathrm{E}=w\mathrm{B}$ and $\mathrm{U}=\mathrm{T}$ are not coextensive in general, though satisfied together in Lorentz's case. When U not $=\mathrm{T}$, we have instead of (8), p. 439,

$$p_1 v - p_2 v - p_3 w = w(\mathrm{T}_3 - \mathrm{U}_3),$$

and the rate of loss of electromagnetic energy is

$$2\mu \mathrm{H}_1 \mathrm{H}_2 u + (w-u)(\mathrm{T}_3 - \mathrm{U}_3).$$

Now this is zero when $e=0$, or the polarisation is proportional to the electric force. The question is raised how to discriminate, according to the data stated above, between cases of loss of energy and no loss. To answer this question, let $\mathbf{e}$ and $\mathbf{h}$ in the above be unstated in form; else the same. Then, instead of (4), the activity equation will be

$$-\nabla \mathbf{W} = \dot{\mathrm{U}} + \dot{\mathrm{T}} + \{\tfrac{1}{2}\mathrm{E}^2(\partial c_0/\partial t) + \ldots\} + (\mathbf{f}_0\mathbf{q} + \mathbf{f}_1\mathbf{u}) - (\mathbf{e}\mathbf{J}_1 + \mathbf{h}\mathbf{G}_1), \quad (5)$$

where $\mathbf{W}$ is as in (4), whilst $\mathbf{f}_0$ and $\mathbf{f}_1$ are the forces derived from the stresses specified (not the same as $\mathbf{F}_0$ and $\mathbf{F}_1$), and $\mathbf{J}_1$, $\mathbf{G}_1$ are the electric and magnetic polarisation currents, thus, $\mathbf{J}_1 = \dot{\mathbf{D}}_1 + \mathrm{V}\nabla\mathbf{h}_1$, &c. It follows that it is upon $\mathbf{e}$ and $\mathbf{h}$ that the loss of energy depends in plane waves, when $\mathbf{u}$ and $\mathbf{q}$ are constant. For the stresses reduce to longitudinal pressures, so that by line integration along a tube of energy flux we get

$$\Sigma(e\mathrm{J}_1 + h\mathrm{G}_1) = \Sigma(\mathrm{U}+\mathrm{T}). \quad (6)$$

Thus, when a pulse enters moving glass from stationary ether, the rate of loss of energy is $\Sigma(-e\mathrm{J}_1)$. If e is zero, so is the loss, as in the special case above. There is also agreement with the calculated loss in the other case. That the moving force on the glass should be controlled by $\mathbf{e}$ is remarkable, for it is merely the small difference between the electric force on a fixed and a moving unit charge. The theory is not final, of course. If the electromagnetics of the ether and matter could be made very simple, it would be a fine thing; but it does not seem probable. OLIVER HEAVISIDE.

April 5.

The Dynamical Theory of Gases.

IN a letter to NATURE (April 13) Lord Rayleigh makes a criticism on my suggested explanation of the well known difficulty connected with the specific heats of a gas. He considers a gas bounded by a perfectly reflecting enclosure, and says "the only effect of the appeal to the æther is to bring in an infinitude of new modes of vibration, each of which, according to the law (of equipartition), should have its full share of the total energy."

The apparent difficulty was before my mind when writing my book. Indeed, as Lord Rayleigh remarks, something of the kind had already been indicated by Maxwell. (I think the passage to which Lord Rayleigh refers will be found in the "Coll. Works," ii., p. 433:—"Boltzmann has suggested that we are to look for the explanation in the mutual action between the molecules and the æthereal medium which surrounds them. I am afraid, however, that if we call in the help of this medium, we shall only increase the calculated specific heat, which is already too great.") It seemed to me, however, that the difficulty was fully met by the numerical results arrived at in chapter ix. of my book.

Suppose, to make the point at issue as definite as possible, we take a sample of air from the atmosphere, say at 15° C. Almost all the energy of this gas will be assignable to five degrees of freedom so far as we know, three of translation and two of rotation. Let us surround this gas by an imaginary perfectly reflecting boundary. The total energy of matter and æther inside this enclosure will remain unaltered through all time, but this total energy may be divided conveniently into two parts:—

(1) The energy of the five degrees of freedom, say A.

(2) The energy of the remaining degrees of freedom of the matter plus the energy of the æther, say B.

As Lord Rayleigh insists, the system is now a conservative system, so that according to the law of equipartition, the total energy A+B is, *in the final state of the gas*, divided in the ratio

$$\mathrm{A}:\mathrm{B} = 5:\infty \quad . \quad . \quad . \quad . \quad . \quad (1)$$

whereas observation seems to suggest that the ratio ought to retain its initial value

$$\mathrm{A}:\mathrm{B} = 5:0 \quad . \quad . \quad . \quad . \quad . \quad (2)$$

This I fully admit, but a further point, which I tried to bring out in the chapter already mentioned, is that the transition from the ratio (2) to the ratio (1) is very slow—if my calculations are accurate, millions of years would hardly suffice for any perceptible change—so that, although (1) may be the true final ratio, it is quite impossible to obtain experimental evidence of it.

If the sample of gas were initially at a much higher temperature than we have supposed, the transition would undoubtedly be much more rapid; but even here we could not hope for experimental verification. For the assumed boundary, impervious to all forms of energy and itself possessing none, cannot be realised in practice, and as soon as the energy of the enclosed æther becomes appreciable, the imperfections of our apparatus would become of paramount importance in determining the sequence of events. J. H. JEANS.

Growth of a Wave-group when the Group-velocity is Negative.

THE following may be of interest in connection with the recent discussion on the flow of energy in such cases.

Let the energy of an element of a linearly arranged mechanical system be

$$\{(d^2y/dxdt)^2 + y^2\}dx/2.$$

Such a system can be approximately realised by taking a bicycle chain, loading it so that the radius of gyration of each link has the same large value, and suspending it by equal threads attached to each link so that the chain is horizontal and the axes of the links vertical. By the principle of least action we immediately find the equation of motion to be $d^4y/dx^2dt^2 = y$. A simple harmonic wave is given by $y = \sin(pt - x/p)$. The group velocity is $-p^2$, and is negative. Let such a system, extending from $x=0$ to $x=\infty$, be at rest in its position of equilibrium at time $t=0$, and then let the point $x=0$ be moved so that its position at any subsequent time is given by $y = 1 - \cos t$.

By application of the usual method *viâ* Fourier's integral, the motion of the system is found to be given by either of the equivalent formulæ

$$y = \Sigma(-1)^n(t/x)^{n+1}\mathrm{J}_{2n+2}2\sqrt{(tx)},$$

or

$$y = 1 - \cos(t+x) - 1 + \Sigma(-1)^n(x/t)^n\mathrm{J}_{2n}2\sqrt{(tx)},$$

where the J's are Bessel's functions and the summations extend from $n=0$ to $n=\infty$. There are some doubtful points in the reasoning, however, and the proof consists in showing (1) that y satisfies the differential equation, (2) from the second formula that $y=1-\cos t$ when $x=0$, (3) from the first formula that y and dy/dt are both zero when $t=0$, (4) from the first formula that when t is finite y is small for all large values of x. If, now, x is finite and t great, the second formula reduces to $y=-\cos(t+x)$, so that the motion now consists entirely of waves proceeding *towards* the source of the disturbance—a most remarkable result. If in the formulæ for y we change the sign of x, the J functions are replaced by I functions. The resulting value of y does not satisfy (4), and cannot be accepted as a solution of the problem.

H. C. Pocklington.

The Transposition of Zoological Names.

Among the many radical changes in zoological nomenclature proposed of late years, none appear to me more open to objection than those where names which have long been in general use for particular species or groups are transferred to others on the ground that they were originally applied to the latter. One of the earliest of such transpositions was suggested by Prof. Newton, of Cambridge, who urged that Strix is not the proper generic designation of the barn-owl, and that while this species should be called *Aluco flammeus*, the tawny owl should take the generic title Strix, as *S. aluco*. I find, however, that this emendation is not accepted in the British Museum "Hand-list of Birds," where the barn-owl figures under its familiar title of *Strix flammea*. Uniformity is not, therefore, attained by this proposal.

Another instance occurs in the case of the walrus, which was long known as *Trichechus rosmarus*, until systematists discovered that the generic title refers properly to the manati, to which animal they transferred the name. Again, the *Simia satyrus* of Linnæus is now stated to be the chimpanzi, and not the orang-utan, and consequently Simia is made to stand for the latter instead of for the former. As a fourth example of this transference of a familiar generic name may be cited the case of the marmosets of the genus Hapale, to which it is now proposed to apply the title Chrysothrix, despite its practically immemorial use as the designation of the titi monkeys.

As an example of the transference of a species name, it will suffice to take the case of the African antelope commonly known as the white oryx (*Oryx leucoryx*). This name, it is stated, properly belongs to the Arabian Beatrix oryx, to which it is accordingly proposed that it should be transferred, after being so long used for the former animal.

Personally, I am very strongly of opinion that such transpositions should not on any account be permitted, and that when a species or genus has been known by a particular name for a period of, say, fifty years, this should, *ipso facto*, give such an indefeasible title to that name (altogether irrespective of its original application) as to bar its transference to any other group or species. It may, indeed, be deemed advisable that, as in the case of the walrus, the old name should not be retained in the generally accepted sense, but, if so, it should be altogether discarded, and not transferred. The practice of transferring names must, if persisted in, inevitably lead to much unnecessary confusion without the slightest compensating advantage. Indeed, it will render such works as Darwin's "Origin of Species" and Wallace's "Geographical Distribution of Animals," which are certain to live as biological classics, absolutely misleading to the next generation unless special explanatory glossaries are supplied.

Advanced systematists urge that those who refuse to follow their lead in this and other kindred emendations in nomenclature are not only old-fashioned and behind the times, but that they are absolutely doing their best to hinder the progress of zoological science. This, however, is but the opinion of a comparatively small (and, shall we say, somewhat prejudiced?) section. What we really want is the opinion of all those interested in zoology and natural history, namely, professional zoologists, palæontologists, geologists, physiologists, anatomists, zoogengraphers, amateur naturalists, and sportsmen. If the general consensus of opinion of all these were on the side of the proposed changes, and of others of a similar type, then, and then only, I venture to think, could they be regarded as obligatory.

It may be added that the use of combinations, which Mr. Stebbing has felicitously designated "comicalities in nomenclature," of the type of *Anser anser* and *asinus asinus* (or, still worse, *Asinus asinus asinus*, which is a possible contingency), is rapidly tending to discredit the common sense of scientific zoologists among matter-of-fact men of the world.

R. Lydekker.

A little known Property of the Gyroscope.

To my surprise I have found that the property of the gyroscope which I am about to describe, although perfectly elementary, appears to be little known to either physicists or astronomers. Neither is it mentioned in the text-books so far as I am aware. That it has a very important bearing on the mechanism of the solar system has been shown in some of my earlier papers, but the laws which govern the rotation and the simple facts themselves seem to be so little understood that I have thought it worth while to explain them more fully in this place.

If a gyroscope is mounted on gimbals so that it may shift its plane of rotation freely about an axis passing through the plane of the revolving disc, we shall find it is possessed of certain curious properties. To most persons the notable characteristic of a gyroscope is the resistance it offers to any force tending to change the plane of its rotation. This is true of it only, however, in case certain conditions are complied with. If these conditions are neglected, it will change its plane with the greatest facility.

If the wheel is properly balanced and mounted as above described, and we set it spinning, it will continue to rotate in one plane without change until it stops. Suppose that while it is spinning we set it upon a table, and cause the stand supporting it to revolve slowly about its vertical axis. Instantly the wheel will adjust itself so as to revolve in a plane parallel to the surface of the table.

Furthermore, the direction of rotation of the wheel upon its axis will be the same as the direction of rotation of the stand. If we turn the stand in the opposite direction the wheel will at once shift its plane, and turn over, so as again to rotate in the same direction as the stand.

Another way of showing the experiment is to hold the stand supporting the gyroscope at arm's length. The observer then slowly revolves upon his heels, first in one direction and then in the other. Each time the observer shifts his own direction of motion the gyroscope will shift its plane, and always in such a manner that its direction of rotation shall be parallel and in the same direction as its revolution in its orbit.

It is a well known fact that according to the nebular hypothesis all the planets should have rotated in a direction opposite to that of their revolution in their orbits, just as Neptune does at the present time. This is because by Kepler's laws the inner edge of a revolving ring must necessarily move faster than the outer edge. The fact that Neptune is the only planet that even approximately fulfils this condition has always been a source of trouble to the adherents of the nebular hypothesis. No one has ever even attempted to explain the anomalous rotation of Uranus, in a plane practically perpendicular to the plane of its orbit.

The interesting property of rotating bodies illustrated above in the case of the gyroscope, and fully explained by its theory, now at once makes the matter perfectly clear. In the case of the planetary bodies, the force rotating the stand of the gyroscope is supplied by the annual tide raised upon the planets by the sun. In former times, when the planets were large diffuse bodies, this tidal force was of considerable importance. Neptune, however, is so remote from the sun that the tidal influence upon it has always been small. The plane of its rotation, therefore, has been but slightly shifted from that of its orbit—about 35°. Uranus being nearer the sun has had its plane shifted nearly half-way over, or through 82°. The plane of rotation of Saturn has been shifted through 153°, while that of Jupiter has suffered a nearly complete reversal, and the planet now revolves approximately in the plane of its orbit. The deviation amounts to but 3°, and its plane of rotation has therefore shifted through 177°.

The explanation of the retrograde rotation of Phœbe is now also clear. Phœbe, the first-born of Saturn's numerous retinue, came into being while the planet itself still retained its original plane of rotation, that is, while it was still revolving in a retrograde direction. Before Iapetus, Saturn's second satellite, reckoning from without inwards, was created, the mighty tides acting upon the planet in its then diffuse condition had shifted its plane of rotation more than 90°. Two forces then acted on the plane of the orbit of the new satellite, one from the sun tending to bring the orbit into the plane of the orbit of Saturn, the other from Saturn tending to bring the orbit of the satellite into the plane of the equator of its primary. At first both forces tended to produce the same result, namely, to diminish the angle of inclination of the plane of the orbit of the satellite. They are now pulling in opposite directions, as is the case with our own moon, the inclination of the orbit of Iapetus, 19°, being less than that of the equatorial plane of its primary.

The inner satellites of Saturn are more powerfully affected by the equatorial expansion of the planet than by the action of the sun, the planes of their orbits, 27°, coinciding nearly with the plane of the planet's equator.

William H. Pickering.

Harvard Observatory, Cambridge, Mass., U.S.A.

Have Chemical Compounds a Definite Critical Temperature and Pressure of Decomposition?

So far nobody seems to have considered the question whether to every chemical compound there exists a definite critical temperature and pressure of decomposition. Yet I think the following considerations show that such constants probably do exist. Suppose we place a given compound (say $CaCO_3$) in a closed cylinder and subject it to a continually increasing temperature, keeping the pressure constant by means of a weighted piston. Then at a certain definite temperature range the compound will begin to decompose. Suppose, now, we increase the pressure sufficiently; then the decomposition ceases, and the substance can now bear a higher temperature than before without decomposition.

Proceeding in this way, it is, I think, obvious from the *finite* nature of the mass of the atoms, and from the limited intensity of the forces holding them together in the molecule, that ultimately at some definite finite temperature the external forces tending to drive the atoms apart will become equal to the maximum internal forces that the atoms can exert on each other in the molecule. It therefore follows that above a certain definite temperature, depending upon the nature of the molecule, no pressure, however great, can prevent the substance from completely decomposing. This temperature and pressure, above which a compound is incapable of existing, we will call the critical temperature and pressure of decomposition of the compound. The critical temperature and pressure of decomposition would therefore be completely analogous to the critical temperature of liquefaction of a compound—only in the latter case we are dealing with the temperature whereat a certain molecular condition of existence disappears, and in the former case with the temperature whereat a certain atomic condition of existence disappears.

Since atoms are a very much more finely divided form of matter than molecules, it is clear that the critical temperature of decomposition of a compound must be a very much sharper and clear-cut constant than its critical temperature of liquefaction. The critical temperature and pressure of even very unstable compounds is usually very high, provided there exist but a few atoms in the molecule. For example, $AuCl_3$, ozone, and the oxides of nitrogen, although very unstable at ordinary temperatures, seem capable of existing at very high temperatures. In general, the greater the number of atoms contained in the molecule the lower the critical temperature of decomposition, as is evident from the general observation that the more complex a compound is the easier it is to decompose. Many of the very complex carbon compounds—for example, the proteids—have, on account of their complexity, critical temperatures of decomposition which lie very close to the normal temperature of the earth's surface.

If, now, by some means we proceed to add on atoms to such a molecule so as to make it more and more complex, we would steadily lower its critical temperature of decomposition, and by adding on a suitable kind and number of atoms we could reduce the critical temperature and pressure of the compound until they coincided with the normal temperatures and pressures which hold upon the earth's surface. Such a compound would be possessed of an extraordinary sensitiveness to external influences on account of the sharpness of the constants called above the critical temperature and pressure of the compound. The slightest increase of temperature or decrease of pressure would serve to throw it into a condition of rapid chemical decomposition, whereas a slight increase of pressure and decrease of temperature would cause it to cease to decompose. Even did we maintain the external temperature and pressure exactly at the critical temperature and pressure of the compound, nevertheless the external impulses which are continuously pervading all space in the neighbourhood of the solar system, beating intermittently upon the sensitive substance, would be sufficient to throw it into a series of rapidly alternating states of decomposition and repose.

I suggest that the temperature range of animal life is probably nothing more or less than the range of the critical temperatures of decomposition of a series of certain very complex carbon compounds which are grouped together under the name "protoplasm," the external pressure of the atmosphere coinciding roughly with their critical pressures of decomposition. In fact, I suggest that just as a tuning-fork is set into motion by vibrations of a certain definite frequency and by no others, so living matter is so constructed as to respond continuously to the incessant minute fluctuations in the external conditions which hold upon the earth, the state of response being what is known as life. The temperature of animal life keeps remarkably constant, as it should do on our supposition, a temperature too high exceeding the critical temperature of decomposition of living matter and so destroying its structure, while a temperature too low causes it to cease to decompose, and the living matter becomes inactive.

Geoffrey Martin.

University of Kiel, April 4.

[The writer of the above will see his "suggestion" discussed in Lockyer's "Inorganic Evolution," book iii.—Ed. Nature.]

Experiment on Pressure due to Waves.

I have seen both in the *Physikalische Zeitschrift* (January) and in the *Physical Review* (February) an account of an experiment by Prof. R. W. Wood to demonstrate the pressure due to waves, and which he suggests as a lecture demonstration of the effect observed by Lebedeff and by Nichols and Hull. The same experiment is quoted by Prof. Poynting in his address on this subject to the Physical Society of London (*Phil. Mag.*, April). I venture to suggest that the experiment, which consists in setting a small windmill in motion by means of Leyden jar discharges maintained by a transformer, will bear a different explanation. It was shown long ago (1793) by Kinnersley, of Philadelphia, in his "Electrical Thermometer," that a jar discharge produces in air a violent explosive effect, which we should now explain by the repulsion between constituents of the current in opposite phase to one another. The repulsive force may be very great. I think it is this explosive effect that Prof. Wood shows in the experiment, and not the pressure due to reflection of a continuous train of waves. I do not think that the suggestion is new, but it appears to me that the same cause may account for the disruption which occurs when lightning strikes a building, an instance of which is recorded in Nature of April 13 (p. 565) in the displacement of some of the blocks of the small pyramid.

Sidney Skinner.

South-Western Polytechnic, Chelsea, April 15.

TANTALUM.

THE application of electricity to chemical problems has again borne fruit in the isolation and preparation of tantalum. Dr. Werner von Bolton, of the firm of Siemens and Halske, published the results of his very interesting research upon the preparation of tantalum in the *Zeitschrift für Elektrochemie* (January 20). Although the existence of tantalum was pointed out by Hatchett in 1801, it does not appear up to the present to have been prepared in the pure condition. Moissan, indeed, in 1902 prepared the metal by reducing tantalic oxide (Ta_2O_5) in the electric furnace. But the metal was extremely hard and brittle, a property which Dr. Bolton now shows only belongs to the impure product; Moissan's metal probably contained some carbide. Dr. Bolton has succeeded in obtaining the metal by an electrical and by a chemical method.

The Electrolytic Method.

As is well known, Nernst found that when a thin rod of magnesia (MgO) is heated to whiteness it becomes able to conduct the electric current, the magnesia being split up into its components, magnesium and oxygen; the magnesium, however, immediately re-combines with oxygen, the process of electrolysis therefore becoming continuous. Other metallic oxides, such as zirconium, ytterbium, thorium, calcium, and aluminium, &c., likewise behave in a similar manner. If, now, a rod of magnesium is strongly heated in vacuum and the electric current passed through it, the oxygen given off is so dilute that re-combination does not take place, and the rod becomes powdered. Dr. Bolton, working along somewhat similar lines, found that the coloured or lower oxides of vanadium, niobium (columbium), and tantalum will conduct the electric current without the necessity of being heated to very high temperatures. Strange to say, the colourless or higher oxides have not this property.

In order to prepare tantalum in this manner a filament of the brown tantalum tetroxide (Ta_2O_4) was prepared and fixed into an evacuated globe, which was connected with a vacuum pump, so that if oxygen was given off, on heating, it could be pumped out. On passing a current through this filament, at first the two ends of the filament became white hot, and then gradually the incandescence travelled along the filament until the whole of it became incandescent. A large quantity of oxygen was given out, and the filament, which at the commencement was brown, became metallic grey. The tantalum so obtained showed on analysis a purity of 99 per cent.

The Chemical Method.

Details as to how the chemical method is carried out are not given. Dr. Bolton simply says that the metal can be obtained by fusing a mixture of potassium tantalum fluoride with potassium by means of the electric arc furnace in a vacuum. This method is a modification of that used by Berzelius in 1824.

Properties of the Metal.

One of the most remarkable properties of the metal is its extreme ductility combined with extraordinary hardness. The red-hot metal can readily be rolled into sheets and foil, and easily drawn into wire. When the sheet is again heated and hammered it becomes so extremely hard that it was found impossible, by means of a diamond drill, to bore a hole through a sheet 1 mm. thick. The drill, rotating 5000 times to the minute, was worked day and night for three days, and at the end of the time had only made a depression 0.25 mm. deep, while the diamond of the drill was very much worn. This property may very probably lead to its being used for drills in place of the diamond.

The metal melts between 2250° and 2300°. The atomic heat agrees with the law of Dulong and Petit, being 6.64. The specific gravity is 14.08. When two electrodes of tantalum are placed in a bath of dilute sulphuric acid, the tantalum becomes passive, and even with an E.M.F. of 220 volts at the terminals no current passes. When placed opposite an electrode of platinum only one phase of an alternating current passes; it may thus be used for rectifying an alternating current in the same manner that aluminium can.

In the form of wire, sheet or ingots, the metal is unacted upon by sulphuric, hydrochloric, or nitric acid, and even by aqua regia. Hydrofluoric acid reacts very slowly, unless the metal is in contact with platinum, for example, in a platinum dish, when it dissolves readily with evolution of hydrogen. Fused alkalis have no action upon it.

When made the kathode in an acid electrolyte it absorbs hydrogen, which is only partially given up, even when the metal is fused. The metal may be heated to red heat in the air without taking fire. At 400° it turns slightly yellow, at a low red heat it turns blue, and finally becomes coated with a white protective coating of the pentoxide. It absorbs nitrogen at a white heat, and unites with sulphur when melted with it under fused potassium chloride. Tantalum apparently forms no amalgam with mercury, although it produces alloys with most other metals. When united with 1 per cent. of carbon it becomes hard and brittle, and can no longer be drawn into wire.

FIG. 1.—View of Tantalum Lamp. Half-size linear.

As already stated, the original idea in working with tantalum was to find a new material to be used for incandescent electric lamps. The first experiments were tried with the oxides of vanadium and niobium (columbium); the coloured or lower oxides of these metals were found to conduct the current and to give up their oxygen when thus heated in vacuum. Vanadium so obtained was found to melt at 1680° and niobium at 1950°; but owing to these comparatively low melting points they could not satisfactorily be employed for electric lighting purposes. Tantalum, however, which melts between 2250° and 2300°, has been successfully employed for this purpose by Messrs. Siemens and Halske.

Filaments of the metallic tantalum are fused into a globe, which is then evacuated in the usual manner. The first lamp was made with the usual bow-shaped filament, and required 0.58 ampere with a pressure of 9 volts, giving 3 candle-power. It was then found that in order to produce a 22 candle-power lamp suitable to being placed on a 110-volt circuit more than 20 inches length of filament was required. The difficulty presented was to get this great length of filament conveniently into the ordinary sized globe. The illustration (taken from the *Electrical Magazine* for March) shows how the difficulty was got over. The central support is a rod of glass, having a number of wires radiating from it to act as supports. This lamp gives 22 candle-power with an energy consumption of 1.7 watt per candle-power, or about half that required by the ordinary incandescent lamp. The weight of a single filament is 0.022 gram, so that 1 kilogram of metal would be sufficient for 45,000 such lamps.

Whether it will be possible to obtain sufficient mineral to produce tantalum on a really large scale remains to be seen, because if it is possible there should be hardly an end to the usefulness of this metal, which possesses the properties ductility and hardness in such an extraordinary degree, leaving entirely out of question its employment in electric lamps. F. MOLLWO PERKIN.

PRIMITIVE WATER-SUPPLY.[1]

THE mighty earthworks that still crown so many of our hills fill the archæologist alike with wonder and despair—wonder that prehistoric man, with the most primitive tools, was equal to the task of raising them, and despair that so little can ever be known about them, despite the most laborious and costly excavation. Plenty of books, however, of the kind now under notice would do much to solve the mystery and increase our admiration for Neolithic man, for it is to the period before bronze was known in Britain that the authors assign the stupendous works of Cissbury and Chanctonbury on the South Downs.

This is an open-air book that gives life to the dry bones of archæology, and reads like the record of a well-spent holiday. A keen eye for country is one of the qualifications possessed by one or both the authors, and evidence of ramparts long since levelled is wrung from the very daisies as they grow. The construction of dew-ponds by the early inhabitants of Britain has often been glibly asserted, but few, if any, have furnished such clear and circumstantial evidence as the authors of this short treatise. The water-supply for the occupants of our huge prehistoric "camps" has always been somewhat of a mystery, and it has been suggested that they were only temporary refuges, when the country was "up," so that a permanent supply was not regarded as a necessity. But the watering of men and animals on the scale indicated by the areas enclosed would be a formidable task even for a day, and another explanation must be sought. The late General Pitt-Rivers, for example, held that the water-level of the combes was higher then than now, and streams would have been plentiful on the slopes; but, feeling the inadequacy of this view, he also had recourse to the dew-pond theory. To those familiar with the process, this might seem an obvious expedient, but the interesting account given of the formation of such reservoirs might make us chary of crediting prehistoric man with such scientific methods.

An exposed position innocent of springs was selected, and straw or some other non-conductor of heat spread over the hollowed surface. This was next covered with a thick layer of well puddled clay, which was closely strewn with stones. The pond would gradually fill, and provide a constant supply of pure water, due to condensation during the night of the warm, moist air from the ground on the surface of the cold clay. Evaporation during the day is less rapid than this condensation, and the only danger is that the straw should be sodden by leakage. It is for this reason that springs or drainage from higher ground are avoided, as running water would cut into the clay crust.

Some ponds of this kind, no doubt of very early and perhaps of Neolithic date, may still be seen in working order: others are of modern construction; but to and from the ancient dew-ponds (or their sites) can sometimes be traced the hillside tracks along which the herds were driven, one leading from the camp, or cattle-enclosure hard by, to the watering-place, another leading back, to avoid confusion on the road. These and other details as to guard-houses and posts of observation are brought to our notice in the description of selected strongholds in Sussex and Dorset; and verification, if, indeed, such is demanded, must be sought on the spot by any who have doubts or rival theories.

FIG. 1—Cattle-ways leading down to Dew-pond at the North of Cissbury Ring. From Hubbards "Neolithic Dew-ponds and Cattle-ways."

The banks, that enclosed pasture-areas sometimes of vast extent, were no doubt stockaded against man and beast, and may be compared with the base-court defences of the Norman burh; but the excavator of Wansdyke had an alternative theory that such banks were sometimes erected for driving game. Incidentally, the authors discountenance the view that the "camps," not to mention the outworks, were ever efficiently manned. Their extent would necessitate for this duty a vast number of fighting men within call.

[1] "Neolithic Dew-ponds and Cattle-ways." By A. J. Hubbard and G. Hubbard. Pp. x+69; illustrated. (London: Longmans, Green and Co., 1905.) Price 3s. 6d. net.

Possibly, in a few instances, the ridges on the hill-slopes may be due to outcropping strata, and others might suggest terrace-cultivation; but there seems ample evidence for the view taken that Neolithic cattle-tracks have survived to this day around certain of our most imposing "camps."

Failing large-scale maps, a sketch-plan of the earthworks noticed would have made the description even more illuminating; but the only matters of complaint are that the book is all too short, and that the paper selected to throw up the detail of the photographs is as chalky as the Downs they illustrate so pleasantly.

HENRY BENEDICT MEDLICOTT, F.R.S.

On April 6 there passed away one of the few survivors amongst the small body of men who laid the foundations of Indian geology. Despite much excellent work, chiefly by non-professional men, very little was really known of the geology of India, and especially of Peninsular India, before the middle of the nineteenth century, and as one instance amongst many, the Vindhyans, now believed to be Archæan, were still classed with Gondwana Permo-Carboniferous strata, and both were regarded as of Jurassic age. A comparison of Dr. Carter's "Summary of the Geology of India between the Ganges, the Indus and Cape Comorin," published in 1853, with the "Manual of the Geology of India," issued in 1879, will show the great improvement that took place in the meantime in our knowledge of the country.

In this change none had a larger share than Henry Benedict Medlicott. Born in Loughrea, county Galway, he was the second of three sons of the Rev. Samuel Medlicott, rector of Loughrea, and of Charlotte, the daughter of Colonel H. B. Dolphin, C.B. All three sons were men of great intellectual capacity and of marked originality. The eldest, J. G. Medlicott, became a member of the Geological Survey of India before his brother joined; he was subsequently in the Indian Educational Service, and died in 1866. The third brother, Samuel, was a clergyman, who has also been dead several years. The subject of the present memoir was educated at Trinity College, Dublin, and, after taking his degree, was for a short time on the staff, first of the Irish, then of the English Geological Survey. In the spring of 1853 he joined the Geological Survey of India under the late Dr. Thomas Oldham, but was almost immediately appointed professor of geology at the Roorkee College of Civil Engineering, an appointment which he held until 1862, when, on some additions being made to the staff, he re-joined the Geological Survey of India, and was made deputy superintendent for Bengal.

But during his tenure of the Roorkee post he spent part of the year surveying for the Geological Survey, and in his first season's work he and his brother made a primary step towards the elucidation of Indian geological history by separating the ancient Vindhyans north of the Son and Nerbudda Rivers from the Indian Coal-measures and their allies to the southward. In subsequent years, whilst his brother mapped the last named strata, he surveyed the older Vindhyans and their associates, and to him we owe our first recognition of the Bijawur and other ancient rocks between the old gneissic formation and the Vindhyans. In other years he explored the Himalayas, and the ranges at their base, between the Ganges and the Ravi, and he drew up the description of the older unfossiliferous beds of the mountains, and of the Tertiary and other strata fringing their base, which was published in the third volume of the Indian *Memoirs*. This contains a sketch of the history of the Himalayas which has been generally accepted ever since.

After returning to the survey in 1862 (he always protested that he really had remained a member of the staff throughout), he examined in successive years the greater part of northern India. Various tracts of the Himalayas from the Punjab to Assam, the Assam valley and the hill ranges south of it, and, in the Peninsula, Rajputana, Nimar, the Nerbudda valley and Satpura ranges, Bundelkhand, South Rewah, Chhatisgarh and Sambalpur, Chota Nagpore, Hazaribagh, and Behar were visited and reported upon in turn.

Dr. Oldham retired in 1876, and Mr. Medlicott succeeded him as superintendent, a title subsequently changed to director of the survey. The first work undertaken by him as superintendent was a general account of Indian geology. This had long been urgent, and would probably have been written by Dr. Oldham but for failing health. The "Manual of the Geology of India" was published in 1879, and a very large portion, including the account of the Azoic rocks from gneiss to Vindhyans (which between them cover the greater part of the Indian peninsula), and of the geology of the Himalayas and sub-Himalayas, in fact, nearly half the entire work, was written by Mr. Medlicott himself. In many ways a great impulse was given to survey work by the new superintendent. As regards publication alone, the volumes of the *Records* from 1877 are doubled in bulk when compared with previous issues, and these volumes, containing accounts of recent geological observations, both economical and scientific, represent the actual field work of the survey to a larger extent than the longer memoirs and palæontologia.

Throughout his career as head of the survey Mr. Medlicott adopted a most liberal policy of publication. He allowed his staff to report on their own work freely, and whilst assisting them in every way, both in the field and in the study, he never took any of the credit of their work. Not only did he welcome reports from the geologists of the survey, but he published, whenever possible, contributions from independent observers. In this manner he secured the valuable assistance of the late General McMahon, the whole of whose most important observations on the physical history of the Himalayas appeared in the *Records* of the Geological Survey of India.

Modest and retiring, he was nevertheless a man of high courage and independence. One trait of this was shown in the Indian Mutiny, when, with one companion, despite the mutiny of the guard that should have accompanied them, he saved the lives of a Christian family who had fallen into the hands of the rebels, a most gallant action, the account of which is due to Colonel Baird Smith, the head of Roorkee College and the commanding officer. After retiring from the Indian Survey in 1887, he lived very quietly at Clifton, devoting himself to philosophical problems. He published a couple of short pamphlets on "Agnosticism and Faith" in 1888, and on "The Evolution of Mind in Man," but a larger work on which he was engaged is, it must be feared, incomplete. A strain caused by bicycling led to serious heart symptoms some years ago, and although a partial recovery was made, a relapse about a year since reduced him so much that it was not surprising to hear that he passed quietly away on April 6, whilst seated in his study.

Mr. Medlicott became a Fellow of the Geological Society as long since as 1856, and in 1888, on his retirement from India, he received the Wollaston medal. He was elected a Fellow of the Royal Society in 1877. He received the military medal for his services in the Mutiny. He was also a Fellow of Calcutta University, and from 1879 to 1881 he was president of the Asiatic Society of Bengal.

W. T. B.

NOTES.

The report on the natural history collections made in the Antarctic regions by the *Discovery* Expedition, to be published by the trustees of the British Museum, and edited by Prof. E. Ray Lankester, F.R.S., promises to be of particular interest and importance. The working out of the collections has been entrusted to nearly fifty naturalists, each of whom will deal with material in which he is specially interested. Inquiries concerning the zoological and botanical collections should be addressed to Mr. F. Jeffrey Bell, British Museum (Natural History), Cromwell Road, London, S.W.

The council of the Institution of Civil Engineers has made the following awards for papers read and discussed before the institution during the past session:—Telford gold medals to Lord Brassey, K.C.B., and Mr. C. S. R. Palmer; a George Stephenson gold medal to Mr. Lyonel E. Clark; a Watt gold medal to Mr. J. F. C. Snell; Telford premiums to Messrs. L. F. Vernon-Harcourt, R. W. Allen, and Wm. Marriott; a Crampton prize to Mr. A. Wood-Hill, and the Manby premium to Mr. E. D. Pain. The presentation of these awards, together with those for papers which have not been subject to discussion and will be announced later, will take place at the inaugural meeting of next session. Sir Alexander Binnie has been elected president of the institution in succession to Sir Guilford Molesworth, K.C.I.E.

Mr. W. E. Cooke, Government astronomer for Western Australia, writes to us from the observatory at Perth to direct attention to an unusual seismic disturbance in that place. During March 5 there were three marked earthquakes in the space of a few hours, and these reached their maxima at 16h. 25·8m., 19h. 0·1m., and 13h. 42·6m. The times are given in Greenwich civil time. Each maximum was preceded by tremors from fifteen to twenty minutes earlier, and by a large wave from ten to fifteen minutes before the maximum. It is noteworthy that the transit circle was displaced considerably in both level and azimuth. Another earth tremor, the greatest yet registered on the Milne seismograph at Perth, occurred on March 19. There were no preliminary tremors; the disturbance proper commenced abruptly, and reached a maximum in 19·6m.

The workers at the Port Erin Biological Station during this spring vacation include Prof. B. Moore, Dr. H. E. Roaf, and Mr. B. Whitley (all from the biochemical department of the University of Liverpool), Mr. J. A. Dell and Mr. E. Standing (from the University of Leeds), Prof. Herdman, Mr. W. Dakin, and Mr. W. A. Gunn (from the University of Liverpool), and Mr. Chadwick, the curator. Prof. Moore and his party are investigating the changes produced in the growth of embryos by alterations in the constitution of the sea-water and other conditions of the environment. The other workers are engaged on various lines of zoological research. The fish-hatching is now going on rapidly, and more than three millions of plaice fry have already been turned into the sea this month. The parent plaice in the spawning pond were evidently about a fortnight earlier in reproducing this season than last, as the first fertilised eggs were obtained on February 14, and in large quantity, as against March 3 in 1904.

It is proposed to send out a special series of telegraphic time signals beginning at 11.55 p.m., United States Eastern Standard Time (mean time of the 75th meridian west from Greenwich), on May 3, and ending at midnight, according to the plan followed daily at noon. These special time signals will be sent out by request of the American Railway Association, with the approval of the Secretary of the Navy, in honour of the International Railway Congress, which is to meet in the capital of the United States on the following day. It is hoped that the principal observatories of the world will make efforts to receive and time these signals accurately, and reports of such observations may be made at once, without expense, through the courtesy of the various telegraph and cable companies. This was done in the case of the New Year's Eve time signals from the United States Naval Observatory, which are reported to have reached the Toronto Observatory in 0·00s.; Lick Observatory, 0·05s.; City of Mexico, 0·11s.; Manila, 0·37s.; Greenwich, 1·33s.; Sydney, Australia, 2·25s.; Wellington, N.Z., 4·00s.; and Cordoba, Argentina, 7·7s. From the rapidity and accuracy with which these time signals are transmitted over connecting land lines, as a result of long experience in transmitting the daily noon signals, it seems very probable, if the telegraph companies will take especial care in their transmission and not interpose any secondary clocks or human relays, that they may serve to give fairly accurate determinations of longitude at any telegraph station on the American continent where they can be noted exactly and compared with accurate local time.

It was decided in the Chancery Division of the High Court on April 19 that the public has not the right of free access to Stonehenge. The question of free access was raised by an action in which the Attorney-General claimed an order against Sir Edmund Antrobus to remove the fencing which now encloses Stonehenge, and an injunction to restrain him from erecting any such fencing. The claim was based on two grounds:—(1) that Stonehenge is a national monument of great interest and is subject to a trust for its free user by the public; (2) that there are public roads running up to and through Stonehenge, and that those roads have been blocked by the defendant's fencing. Mr. Justice Farwell, who heard the action, decided that both these claims were untenable; and he therefore dismissed the action, with costs. In concluding this judgment, his Lordship is reported by the *Times* to have remarked:—"I hold that the access to the circle was incident only to the permission to visit and inspect the stones, and was, therefore, permissive only, and, further, that the tracks to the circle are not thoroughfares, but lead only to the circle, where the public have no right without permission, and, therefore, are not public ways. The action accordingly fails, and ought never to have been brought. It is plain that the vicinity of the camp and the consequent increase of visitors compelled the defendant to protect the stones if they were to be preserved; and he has done nothing more than is necessary for such protection. I desire to give the relators credit for wishing only to preserve this unique relic of a former age for the benefit of the public, but I fail to appreciate their method of attaining this. The first claim to dispossess the defendant of his property is simply extravagant, so much so that, although not technically abandoned, no serious argument was addressed to me in support of it. The rest of the claim—for rights of way over the network of tracks shown on the plaintiff's plan—if successful would defeat the relators' object. If these ways were left unfenced and heavy traffic passed through the circle, there would be great risk of injury, and even without such traffic there is great risk from the increased numbers of passers-by. As Sir Norman Lockyer (whose interesting application of the orientation theory to Stonehenge has recently appeared) says in one of his articles:—'The real destructive agent has been man himself—savages could not have played more havoc with the monument than the English who have visited it at different times for different purposes.' I feel no confidence that the majority of tourists have improved, nay, rather—'Aetas parentum, pejor avis, tulit Nos nequiores.' It is only fair to the defendant to say that he is not acting capriciously, but on expert advice for the preservation of the stones. If, on the other hand, the roads are all fenced off, the general appearance would be ruined, and no human being would be in any way the better. It is not immaterial to remark that this is not the action of the district or the county council to preserve rights of way, but is brought on the relation of strangers on the score of the public interest in Stonehenge."

The death is announced of Prof. A. A. Wright, professor of geology and zoology at Oberlin College since 1874.

The Rome correspondent of the *Daily Chronicle* reports that Vesuvius is again in full eruption, and that earthquake shocks are frequent in the Vesuvian communes.

The French Government, says the *British Medical Journal*, has granted a subvention of 4000*l.* in aid of the International Congress on Tuberculosis, which is to be held in Paris next October.

Dr. L. F. Barker, professor of medicine at the Rush Medical School, Chicago, has been appointed to the chair of medicine in Johns Hopkins University, Baltimore, in succession to Prof. Osler.

A dinner will be given at the Hotel Cecil on May 10, under the presidency of Mr. Chamberlain, and with the support of the present Secretary of State for the Colonies, in aid of the funds of the London School of Tropical Medicine.

We learn from the *Times* that the twenty-fifth anniversary of the return of the *Vega* from Arctic regions after accomplishing the north-east passage under Baron Nordenskjöld was celebrated at Stockholm on April 24. The King of Sweden and the Crown Prince and the other members of the Royal Family were present at the commemorative meeting, as well as Admiral Palander, Minister of Marine, who commanded the expedition.

A distinct earthquake shock was felt shortly after 1.30 a.m. on April 23 over a large area in the north of England, including parts of Yorkshire, Derbyshire, Nottinghamshire, and Lincolnshire. The shock is reported to have been unmistakable, and to have lasted several seconds. There is a want of agreement in the reports as to whether the movement was from west to east, or *vice versâ*, and it is not clear if one or two shocks occurred. A heavy rumbling sound is said to have been heard at Sheffield, Selby, Worksop, and other places.

On Tuesday next, May 2, Prof. L. C. Miall will deliver the first of three lectures on the "Study of Extinct Animals," on Thursday, May 4, Sir James Dewar will commence a course of three lectures on "Flame," and on Saturday, May 6, Prof. Marshall Ward will begin a course of two lectures on "Moulds and Mouldiness." The Friday evening discourse on May 5 will be delivered by Prof. H. E. Armstrong, the subject being "Problems Underlying Nutrition," on May 12 by Prof. E. Fox Nicholls on "The Pressure due to Radiation," and on May 19 by Sir Charles Eliot on "The Native Races of the British East Africa Protectorate."

The annual meeting and conversazione of the Selborne Society will be held by kind permission in the theatre and halls of the Civil Service Commission, Burlington Gardens, on the evening of May 3. Lord Avebury will give the annual address, Mrs. Dukinfield Scott will show her kammatograph pictures of opening flowers, Mr. Fred Enock will describe the work of a wood-boring wasp with the help of some moving slides, Mr. Oliver G. Pike will contribute a short lecture, while Mr. Percival Westell has promised to give an account of the actions of a young cuckoo, and to show photographs in illustration of them. There will also be many exhibits, including microscopes lent by members of the Royal Microscopical Society and the Quekett Club. All particulars may be obtained from the honorary secretary, Mr. Wilfred Mark Webb, 20 Hanover Square, W.

A large portion of the second part of the first volume of the *Proceedings of the Manchester Field Club* is taken up by the beautifully illustrated article on protective resemblances in insects, by Mr. M. L. Sykes, which was summarised in Nature of March 30. In addition to a number of shorter articles, mostly the reproductions of addresses delivered at meetings of the club, the volume contains the reports for the years 1900 and 1901, together with lists of officers and council.

The first article in the *Irish Naturalist* for April is devoted to an illustrated description of the Patterson Museum in the new People's Palace at Belfast. The greater portion of this natural history exhibition is contained in a lofty chamber 75 feet in length by 25 feet in width. The work of planning the cases and obtaining specimens with which to fill them was entrusted by the managers of the palace to Mr. R. Patterson, who seems to have carried out his task with conspicuous success. Specimens were contributed by a large number of donors, and Mr. Patterson himself has consented to act as honorary curator.

From the Bergen Museum we have received copies of the *Aarsberetning* and the *Aarbog* for 1904. The former contains photographs of three exhibits added during the year to the vertebrate series. Of these, the groups of snowy owls and of sea-eagles appear unexceptionable, but we cannot congratulate the authorities on the plan of placing a red deer mounted on a quadrangular wooden stand in front of a background formed by a picture of a fir-plantation bordering a church. In the *Aarbog* the most important communication is one by Mr. R. Høye dealing with the methods of curing salt and kippered fish, and describing the mycetozoa frequently developed during or after the process.

We have received a bound copy of the second volume of "Marine Investigations in South Africa," issued at Cape Town by the Department of Agriculture of Cape Colony. Although the title-page is dated 1904, the whole of the eleven papers contained in the volume were published during 1902 and 1903. The subjects include Crustacea, by the Rev. T. R. R. Stebbing; Mollusca (two papers), by Mr. G. B. Sowerby; fishes (three papers), by Dr. Gilchrist; deep-sea fishes, by Mr. Boulenger; corals, by Mr. Gardiner; sponges (two papers), by Mr. Kirkpatrick; and ocean currents. Several of the articles have been noticed in our columns as they were issued.

To the April number of the *Journal of Anatomy and Physiology* Dr. A. Keith contributes a thoughtful article on the nature of the mammalian diaphragm and pleural cavity. The pleural cavity he considers to have been formed by a hernia-like outgrowth from the general body-cavity, the diaphragm thus being formed by a portion of the original outer wall of that cavity. Considerable interest also attaches to a paper by Dr. A. A. Gray on the membranous labyrinth of the internal ear of man and the seal, in the course of which it is shown that seals possess in this region large otoliths comparable to those of fishes. Although the precise function of these structures is at present unknown, it would appear from their occurrence in the two groups that they are correlated with an aquatic existence.

In the second of a series of articles on Canadian life, published in the April number of the *Empire Review*, Mr. A. P. Silver, of Halifax, gives a graphic description of the wild, or "feral," horses inhabiting in large droves the storm-swept Sable Island. This island, which lies about eighty miles to the eastward of Nova Scotia, consists of an accumulation of loose sand, forming a pair of ridges united at the two ends and enclosing a shallow lake; tracts of grass are to be met with in places, as well as pools of fresh water. The droves of wild horses, or ponies, and herds of seals appear to be the chief mammalian inhabitants of the island. It is generally supposed that the original stock was landed from a Spanish wreck early in the sixteenth century, although some writers make the introduction much later. Five-and-twenty years ago the number of ponies was estimated at between 500 and 600; at the present day there are less than 200, divided into five troops. Not more than two-thirds of these are pure-bred, the remainder being the offspring of mares crossed with introduced stallions. The introduction of these foreign stallions (which is to be regretted by the naturalist) has been a matter of great difficulty, as the strangers were attacked and wounded by the leaders of the droves. The author comments on the striking likeness of these wild ponies to the horses of the Parthenon frieze and to the now exterminated tarpan of Tartary. They also seem to resemble the wild horses of Mexico, although their coat is doubtless longer. These resemblances seem to point to reversion to the primitive type of the species. All colours save grey characterise the pure-bred stock; but chestnut, with a dark streak on the back and on the withers, is the most common tint, after which come bays and browns.

PROF. H. F. OSBORN has been good enough to send us a collection of papers published by himself during the past year, some of which have been already noticed in our columns. Among the latter is one on a re-classification of reptiles, from the *American Naturalist* of February, 1904, in which it is proposed to divide the class into the brigades Diapsida and Synapsida. This plan is further elaborated in part viii. of the first volume of the *Memoirs* of the American Museum, which is well illustrated, and gives the leading characteristics of a number of the chief groups. The budget also includes three papers from the *Bulletin* of the American Museum, one dealing with sauropod dinosaurs, the second with new Oligocene representatives of the horse line, and the third with armadillos from the Bridger Eocene. An interesting feature recorded in the first of these is the discovery that in some at least of the sauropod dinosaurs the first digit of the fore-foot was alone furnished with a claw, or, at all events, with a claw of large size. The discovery of what are regarded as ancestral armadillos (apparently furnished with a leathery skin) in the Bridger Eocene is of much interest from a distributional point of view. It is noteworthy that these animals were described under the name of Metacheiromys, under the impression that they were allied to the aye-aye (Chiromys).

IN a communication published in the *American Journal of Science* for April, 1904, Prof. Osborn summarises the palæontological evidence in favour of the theory that mammalian teeth are derived from a primitive tritubercular type, and comes to the conclusion that it strongly supports the theory. Reference may also be made to the preface to vol. ii. of the *Bulletins* of the American Museum (1898–1903), in which Prof. Osborn gives an interesting account of the explorations and researches carried out by the department of vertebrate palæontology during that period. Special endeavours have been devoted to collecting the dinosaurian remains from the Upper Jurassic of Wyoming and Colorado.

A CATALOGUE of second-hand books in various branches of botany, offered for sale by Mr. F. L. Dames, Berlin, has been received; the sections best represented are the diatoms and desmids, floras, and the works on anatomy and physiology.

AN abridged report on the experiments with seedling and other canes in the Leeward Isles in 1903–4, forming No. 33 of the pamphlet series of publications of the Imperial Department of Agriculture for the West Indies, shows a certain amount of divergence from the results of previous years in the list of canes arranged according to sugar production; Dr. F. Watts, the officer in charge, attributes it to the dryness of the season. In Antigua, Sealy Seedling, a cane of great vegetative vigour, appears first on the list, while B 208, which still retains its character of producing the purest juice, drops to the fourth place. A system of comparing the plants according to the number of stations in which they figure among the first seven promises to determine those most suitable for general planting.

A FLORA of the Calcutta district, where the district extends sixty miles south and forty miles in other directions, has been compiled by Dr. Prain, and is published as vol. iii., No. 2, of the *Records of the Botanical Survey of India* under the title of the "Vegetation of the Districts of Hughli-Howrah and the 24-Pergunnahs." The larger part of the district is alluvial rice-country, but a dry area occurs in the north-west, and the West Sunderbuns in the south comprise swamp forest and muddy creeks. The flora is not confined to wild plants, but includes crops and trees or shrubs of cultivation. The list of crops, with the original home of each, brings out very clearly the varied sources from which they are derived; as compared with fifty native plants, twenty-five are traced to the Mediterranean area, and about twelve each to Africa and America, besides other Asiatic species.

BEFORE vacating the post of Government mycologist in Ceylon, Mr. J. B. Carruthers placed on record in the *Circulars* (vol. ii., Nos. 28 and 29) of the Royal Botanic Gardens his observations on two cankers, caused by species of Nectria, on tea bushes and rubber trees respectively. The tea canker which has been known in India for some years was found over a large area of the tea districts, more especially at the high elevations and on some of the finest tea plantations; the fungus spreads in the soft tissues under the bark, but produces cracks where the spores are formed. The Nectria on the Para rubber trees is more insidious, as there is generally little or no evidence of the disease until the bark is peeled. The same remedy, that of cutting out and around the diseased areas, is recommended in both cases.

The *Transactions of the Leicester Literary and Philosophical Society* (vol. ix., part i.) contain useful notes on the excursions made by the several sections. The society seems to have gone far afield in its studies. Thus Mr. Fox Strangways conducted a highly interesting excursion to Whitby, and Dr. B. Stracey contributes a sketch of the igneous rocks of Morven and the Inner Hebrides.

Mr. G. K. Gilbert has submitted to the trustees of the Carnegie Institution ("Year Book" No. 3, Washington) a plan for the investigation of subterranean temperature-gradient by means of a deep boring in plutonic rock. It is proposed that the boring be carried to a depth of 6000 feet, and that a site be selected in the Lithonia district of Georgia. Here a fairly uniform and massive granite extends about three miles in one direction and ten miles in another. It is regarded as of early Palæozoic or older age.

In an article on the pre-Glacial valleys of Northumberland and Durham (*Quart. Journ. Geol. Soc.*, February), Dr. D. Woolacott points out that while borings have proved buried valleys in the lower reaches, the higher parts of the ancient valleys belong to the present drainage. The Tyne and Tees were the major rivers, and the land stood at a higher elevation than now. The greatest recorded thickness of drift is 233 feet, and the maximum depth below sea-level is 141 feet. The author discusses the character of the uplift, the distribution of the drift, and its subsequent erosion.

The Nile flood in relation to the variations of atmospheric pressure in north-east Africa has been the subject of investigation by Captain H. G. Lyons, Director-General Survey Department of Egypt, and the important results of the inquiry were recently communicated to the Royal Society. The paper itself is too lengthy to allow of even a brief abstract being made in this place, but a *résumé* of the conclusions at which Captain Lyons has arrived may be given here instead. The curve of the Nile flood on the average varies inversely as the mean barometric pressure of the summer months, high and low pressures accompanying low and high floods respectively. The pressure variations are similar over wide areas from Beirut to Mauritius, and from Cairo to Hong Kong, and are generally of the Indian type of curve of the Lockyers or Bigelow's "direct" type. Sometimes the pressure at Beirut and Cairo is in disagreement with that of the rest of the area, approaching the "Cordoba" type of pressure of the Lockyers or the "indirect" type of Bigelow. Considering monthly means of atmospheric pressure, this relation is more clearly shown, and pressure above or below the normal in months of the rainy season of Abyssinia coincides closely with deficiency or excess of rainfall. From 1869 to 1903, an accurate prediction of the flood from month to month could have been made in six years out of seven. Using the conclusions derived from the above discussion for the condition of the Nile flow during the present year, Captain Lyons writes:—"With weak summer rains and high pressure conditions in September and the first part of October, no large amount of water can have been stored up in the soil of Abyssinia, so that the springs will run off early, and a very low stage may be expected in 1905."

The next meeting of the American Institute of Mining Engineers will be held at Washington in May. Special attention will be devoted to the discussion of papers relating to the genesis of ore deposits.

The gas turbine has been regarded as the logical successor of the steam turbine, and numerous devices have been suggested to convert the energy of the confined products of combustion into mechanical power. In a paper in the current issue of the *Engineering Magazine* Dr. C. E. Lucke examines the thermodynamic principles involved in such devices, and shows, as the result of experiments conducted at Columbia University, that this conversion is not effected by free expansion in simple nozzles. In short, the pure gas turbine, provided with the simple nozzles used by steam turbines, is a failure commercially, and cannot be otherwise until some method has been found to make results by free expansion more nearly equal to those obtained in cylinders.

In the *Engineering and Mining Journal* Mr. J. B. Jaquet gives particulars of a severe explosion of rock that occurred in the New Hillgrove Mine, New South Wales, on December 15, 1904. The shock was felt throughout the country for a mile or two around, and the area affected was more than 300 feet long and 100 feet high. These sudden outbursts have long been a source of anxiety to the miners of Hillgrove, and there is evidence to show that they are increasing in violence as greater depths are reached. Explosive rocks have been described as occurring in many parts of the world. In the Derbyshire lead mines, for example, slickensided rocks were described by Mr. A. Strahan as being liable to burst on being scratched with a pick. It has been suggested that the bursts are due to molecular strain, to occluded gases, or to a compression of the slates upon their being intruded by a mass of granite. Mr. Jaquet believes that the Hillgrove bursts are due to the walls being in a condition of strain and to the fact that the slate will not bend; it only breaks and disintegrates into a number of fragments.

On account of their resistance to the action of sea-water and of their mechanical properties when heated, a number of special brasses have during the past few years been applied in naval construction. In view of this, a paper published by M. L. Guillet in the *Bulletin de la Société d'Encouragement* becomes of some general interest; it deals in detail with the changes in the mechanical properties and in the microstructure of typical brasses which are caused by the addition of lead, tin, aluminium, and manganese. The influence of aluminium is particularly noteworthy. On adding from 0·5 per cent. to 5·0 per cent. of this metal to a brass containing 60 per cent. of copper and 40 per cent. of zinc, a deep golden colour is produced, whilst after adding more than 5 per cent. of aluminium the alloy becomes superbly rose-coloured. This effect is at its maximum at 7 per cent., and with 10 per cent. of aluminium the colour has become a silvery white. Corresponding with these variations of colour, striking changes in the internal structure of the alloy may be traced. It may be added that aluminium brasses have been applied in France in the construction of submarines, but they have not as yet given complete satisfaction.

The March number of the *Gazzetta* contains an interesting paper by Nicola Pappadà on the coagulation of dilute solutions of silicic acid under the influence of various substances. Organic compounds such as glucose, saccharose, the alcohols, &c., do not produce coagulation, and the phenomenon seems to be initiated solely by the presence of the positive ion of an electrolyte. The negative ion apparently is quite without influence on the rate of coagulation; equivalent quantities, for instance, of sodium chloride, sodium nitrate, and sodium sulphate cause coagulation to occur at exactly the same rate. The nature of the positive ion, on the other hand, exercises great influence on coagulation; in the case of the alkali metals the rate depends on the atomic weight, there being a regular sequence in the order lithium, sodium, potassium, rubidium, cæsium, the metal of greatest atomic weight bringing about coagulation most rapidly. Traces of acids and of acid salts, however, inhibit coagulation, an abnormal behaviour of the hydrogen ion being thus indicated, whilst alkalis always increase the rate of formation of a coagulum.

MESSRS. BURGOYNE, BURBIDGES AND CO. have recently sent us a new edition of their price list of pure chemicals and reagents manufactured by them. Part ii. of the catalogue contains a list of chemical and physical apparatus for laboratory or lecture purposes.

WE have received the May issue of the *Stonyhurst Magazine*, an excellent example of an illustrated college magazine. The "science notes," which are entirely astronomical, are illustrated by drawings made at Stonyhurst Observatory of the great sun-spot of February. There is also a collection of notes on the bird-life of the college district.

THE Cambridge University Press has published the first supplement of the second volume of "The Fauna and Geography of the Maldive and Laccadive Archipelagoes, being the Account of the Work carried on and of the Collections made by an Expedition during the Years 1899 and 1900," which is being edited by Mr. J. Stanley Gardiner. An index is in course of preparation, and will be published shortly.

PROF. J. J. THOMSON'S work on "Electricity and Matter," containing six lectures delivered by the author at the University of Yale in 1903, has been translated into Italian by Prof. G. Faè, and published as one of the Hoepli manuals. In the opening paragraph of a short introduction to the work, Prof. Faè quotes the remark made by Sir Oliver Lodge in our columns that the volume is "Altogether a fascinating and most readable book for students of physics and chemistry."

WE have received from Messrs. Taylor, Taylor and Hobson, Ltd., of Leicester, a very neatly got up catalogue of their photographic lenses. These, as is well known, are of many varieties, and the particular features are that they are composed of three thin glasses, uncemented, and accurately adjusted to produce with full aperture sharp definition evenly throughout the plate. The principles of the action of a lens are clearly described and illustrated by Mr. William Taylor, and an interesting series of illustrations is given showing the manipulation of the glass in their works from the rough blocks to the finished lenses.

THE 1905 issue of the "Statesman's Year-book" has now been published by Messrs. Macmillan and Co., Ltd. The statistical and other information in the new issue has been brought up to the latest available date, in some cases to the end of 1904. Much alteration has been involved by the Anglo-French Convention of 1904 and by the administrative re-arrangement of French West African possessions. The space devoted to Germany as a whole, especially education, has been increased; Bulgarian statistics have been much extended; the Philippine Islands have been treated more fully; and numerous other sections have been largely re-written and thoroughly revised. Two interesting tables are included, one showing the losses sustained by the Russian and Japanese forces in the present war, and the other showing the penetrative power of the projectiles used. As usual, the maps and diagrams are numerous, well executed, and of great value—among them may be mentioned one showing the new naval distribution scheme, and one illustrating the British meat imports from abroad. The "Statesman's Year-book" is likely long to retain the high place it has held for many years among books of reference.

THE annual report of the Board of Scientific Advice for India for the year 1903–4 has been received. With the exception of that part of the report relating to the work of the Survey of India, it is based upon the departmental reports for the year under consideration. The information included is arranged under the following headings:—trigonometrical survey, topographical survey, forest survey, cadastral and traverse survey, geographical surveys and reconnaissances, total outturn, geodetic, marine survey, astronomical work, meteorology, geology, zoological survey, veterinary science, botanical survey, applied botany, and chemistry. It is worthy of note that the report contains no list of names of the men of science constituting the Board of Scientific Advice, nor are there reports of any meetings of the Board. The portion of the report relating to the work of the Survey of India is based on the report of that department for 1902–3 published in 1904, and certain other items embodying information of later date than the period covered by any of the other reports. The publication as a whole may be described as a *résumé* of individual departmental reports; it contains scarcely anything in the way of recommendations for the future guidance of departmental work, and little that is to be identified as the special function of a Board of Scientific Advice.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN MAY:—

May 1. Vesta 6° S. of β Leonis.
,, 2. 9h. 38m. Minimum of Algol (β Persei).
,, 2. 6h. Epoch of Aquarid meteoric shower (Radiant 338°–2°).
,, 3. 18h. Jupiter in conjunction with the Sun.
,, 6. 5h. 28m. to 6h. 30m. Moon occults α Tauri (Aldebaran).
,, 8. 8h. Mars in opposition to the Sun.
,, 12. 8h. 46m. to 9h. 53m. Moon occults A Leonis (mag. 4·6).
,, 15. Venus. Illuminated portion of disc = 0·100; of Mars = 0·997.
,, 17. 10h. Mars in conjunction with Moon, Mars 5° 10′ S.
,, 20. 23h. Mercury at greatest W. elongation, 25° 26′.
,, 22. 11h. 20m. Minimum of Algol (β Persei).
,, 24. Saturn. Outer major axis of outer ring = 39″·50; minor axis of outer ring = 5″·88.
,, 25. 13h. Saturn in conjunction with Moon, Saturn 1° 39′ S.

ELEMENTS AND EPHEMERIS FOR COMET 1905 *a* (GIACOBINI).—A set of elements and an ephemeris (April 6–30) for comet 1905 *a* have been communicated, by General Bassot, of the Nizza Observatory, to No. 4010 of the *Astronomische Nachrichten*. These were computed from observations made at Nice on March 26, 28, and 30, and the elements agree closely with two other sets computed at Harvard and Paris respectively, and published in the same journal. The elements and an extract from the ephemeris are here given:—

Elements.

T = 1905 April 4·141 (Paris M.T.)

$$\left.\begin{array}{l} \omega = 358^\circ\ 18'\cdot 0 \\ \Omega = 157\ \ \ 7\cdot 1 \\ i = 40\ \ 24\cdot 8 \end{array}\right\} 1905\cdot 0$$

$$\log q = 0\cdot 04836$$

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

1905	α h. m. s.	δ ° ′	log Δ	Brightness
April 26	8 9 33	+43 1·0	9·9079	0·70
27	8 15 24	+43 38·8		
28	8 21 17	+44 14·3		
29	8 27 13	+44 47·3		
30	8 33 11	+45 17·5	9·9247	0·61

Brightness at time of discovery = 1·0.

An observation by Dr. Palisa at Vienna on April 8 gave a correction of +2s. and +0′·2.

Changes on Mars.—A telegram from Mr. Lowell, published in No. 4010 of the *Astronomische Nachrichten,* announces that colour changes similar to those previously reported are again taking place in some of the Martian features. The Mare Erythræum, just above Syrtis, has again changed from a blue-green to a chocolate-brown colour. This change was first observed by Mr. Lampland on April 4, and the Martian season now corresponds to our February.

In a communication to No. 4, vol. xiii., of *Popular Astronomy,* Prof. W. H. Pickering observes that ice will probably begin to form at *both* poles of Mars during the present month, the north pole being turned towards the earth at an angle of 10°–13°. This opposition is particularly favourable for observations of the green colour over a greater part of the planet's surface, as Mars will be more favourably situated than during the preceding or the following opposition. Its apparent diameter will be from 13″ to 17″, and the poles should appear either of a pure white, a light yellow, or a vivid green colour, the first named being due to hoar-frost or snow, the second to clouds, and the last named, in part at least, to vegetation.

Photography of Planetary Nebulæ.—In No. 356 of the *Observatory* Mr. W. S. Franks suggests that special attention should be paid to the photography of planetary nebulæ by those observatories which possess *long-focus* cameras. Whilst using the late Dr. Roberts's 98-inch "Starfield" reflector, Mr. Franks attempted to photograph these interesting objects both with and without a secondary magnifier, but in the first case the images obtained were indistinguishable from those of the surrounding stars, whilst in the latter the definition was very unsatisfactory.

One point which is strongly in favour of anyone entering this field of research is the fact that the light emitted by these objects is of a highly actinic character necessitating only short exposures.

Radial Velocities of "Standard-velocity Stars."—No. 3, vol. i., of the *Mitteilungen* of the Nicholas Observatory, Pulkowa, contains a number of results obtained by Prof. Belopolsky for the values of the radial velocities of the "standard-velocity" stars. Each of the values was obtained from the measurement of about fifteen iron lines on a single plate, and the date, time, and hour-angle is given in each case. The stars dealt with in the present publication are α Arietis, α Persei, ε Pegasi, and β Geminorum, and taking the mean of the several values given in each case the following respective velocities are obtained:— −12·30 km., −2·14 km., +5·72 km. (one plate) and +4·21 km.

Magnitude Equation in the Right Ascensions of the Eros Stars.—In *Bulletin* No. 72 of the Lick Observatory Prof. R. H. Tucker discusses the magnitude equation which enters into the observations of the right ascensions of the Eros stars as observed at various stations engaged in the work. Comparing the equations in the first and second Eros lists, it is found that there is no marked similarity between the two sets observed at the same station; different instruments, and probably in some cases different observers, having been employed. At Lick the effect of magnitude has been measured by screen observations at three different epochs for the same observer and instrument. For clock stars the correction obtained was 0·007 second per magnitude, and, assuming it to vary with declination, this would give 0·010 second and 0·008 second per magnitude for the first and second lists respectively. Confirmation of this, in general, is found in the Königsberg results obtained with a clock-driven micrometer in which it is assumed that the magnitude equation is eliminated. Other tables given show the variation of the error with varying magnitudes.

MEMOIRS ON MARINE BIOLOGY.

The study of marine life by the sea-side is not only a delightful occupation in itself, but is now considered as an almost essential part of the training of every young biologist. It is also one of the most fruitful fields of inquiry for the elucidation of the fundamental problems of biology. Several marine stations have now been erected on our coasts, in which a naturalist may gain a practical knowledge of the rich fauna and flora of the sea, and where he may apply those modern and often expensive methods of experiment and research which can only be carried out in a well equipped laboratory.

Among the most successful of these institutions is that of the Liverpool Marine Biology Committee, established first on Puffin Island in 1887, and subsequently moved to its present quarters at Port Erin. It is chiefly due, we believe, to the efforts and enthusiasm of Prof. W. H. Herdman that this laboratory was founded. To help the student to make good use of its resources, Prof. Herdman is now editing a series of small practical monographs known as the L.M.B.C. *Memoirs.* Much valuable time may be wasted, many serious errors may be committed, and many precious opportunities may be lost in the practical study of marine biology through the want of proper guidance, or through the ignorance of the literature of the subject. Well stocked libraries are rarely to be found near at hand, and, moreover, it often happens that the commonest animals and plants are just those which have been least completely described in readily accessible works. It is with a view to remedy these defects that the memoirs are being published. As the editor tells us in his preface, the series deals with those types which have hitherto not been adequately described in English text-books and laboratory manuals.

Some thirty volumes are promised. They range over almost the whole of marine life—from the diatom to the sea-weed, from the sponge to the porpoise. Twelve volumes have already appeared. These are:—(1) Ascidia, by the editor; (2) Cardium, by J. Johnstone; (3) Echinus, by H. C. Chadwick; (4) Codium, by R. J. H. Gibson and Helen Auld; (5) Alcyonium, by S. J. Hickson; (6) Lepeophtheirus and Lernæa, by Andrew Scott; (7) Lineus, by R. C. Punnett; (8) Pleuronectes, by F. C. Cole and J. Johnstone; (9) Chondrus, by O. V. Darbishire; (10) Patella, by J. R. A. Davis and H. J. Fleure; (11) Arenicola, by J. H. Ashworth; (12) Gammarus, by M. Cussans. Not only is a detailed and accurate account given of the structure of each type, but its habits, life-history, and embryology are also dealt with, and its "economic" aspects are not forgotten.

On the whole, the various monographs seem to us most trustworthy, and reflect great credit on the work of the authors, who, indeed, are for the most part specialists thoroughly familiar with the types they describe. Yet it must be confessed that the volumes differ considerably in merit and attractiveness. Some of them contain little that is either new or original. Among the most interesting of those already published we may mention the excellent volume on the plaice, Pleuronectes, by Messrs. Cole and Johnstone, which has already been reviewed in Nature, also the memoir on Arenicola by Mr. Ashworth. Both these seem to us models of what such monographs should be—clear and practical descriptions of the anatomy and life-history of the animals concerned, with some discussion of the general problems suggested, and good illustrations. Naturally enough the embryology is in most cases very briefly described, and often the accounts provided are chiefly derived from the works of other authors. We question, indeed, whether it is really worth while reproducing in such monographs figures illustrating the development which can be found in almost any text-book.

While both a table of contents at the beginning, and an index at the end, may not always be necessary, yet it is a pity that many of the monographs should be published with neither. In some cases, also, the figures are scarcely clear enough; but considering the very moderate price at which they are issued, the L.M.B.C. *Memoirs* are excellently printed and illustrated. They will doubtless fully justify the hope of the editor, and will prove most useful to students of marine biology, who will await with eagerness the appearance of the remaining volumes.

THE PHYSICAL HISTORY OF THE VICTORIA FALLS.[1]

WHEN Dr. Livingstone discovered the Victoria Falls in 1855, he sought to explain their origin by calling in volcanic agency, and stated that they were "simply caused by a crack made in the hard basaltic rock from the right to the left bank of the Zambezi, and then prolonged from the left bank away through 30 or 40 miles of hills." All subsequent travellers support the same idea; but in his article Mr. Molyneux, in the *Geographical Journal*, claims that, as at Niagara, the combination of cañon, gorge, chasm, and falls is due to erosion and the constant reducing action of the Zambezi River (Fig. 1).

In explaining his theory, the author first refers to present-day conditions of the river, and divides it into three portions; the coastal, stretching 360 miles up as far as the Kebrabasa Range—a portion of the mountain axis of South Africa—through which it runs in a gorge 35 to 40 miles in length. The middle reach is 600 miles long, in low-lying country, and is divided from the upper regions of the river by the high Victoria Falls, 1000 miles from the coast.

The geology of the country around the falls is then sketched briefly. During what was probably the Tertiary period, South Central Africa was subject to vigorous volcanic action, the concrete forms of which can now be seen in the denuded and exposed lava-flows of the Limpopo and Zambezi valleys. In the vicinity of the falls, the Batoka country, the basalt is interbedded with the soft forest sandstones, but the Zambezi River, in draining the ancient lake regions of Central Africa, has eaten into the overlying sediments until it has reached the hard and almost level igneous sheet in which the falls occur. This sheet extends from the end of the cañon, 40 miles east of the falls, to beyond the Gonye Falls, 120 miles north-west.

On reaching the top of this sheet, the erosive action of the river was checked; but conditions were more favourable in the middle regions of the river, which had no protective covering, and where the rocks are unresisting sandstones and Coal-measures. A difference of level between the two regions came into existence—defined by the eastern edge or fringe of the basalt sheet.

It may be understood that the eastern edge would be thin, and the backward erosion of the Zambezi from its middle reaches would quickly break into it. But as the thickness of the basalt increased as the river receded westwards, the cutting action became slower, until the rate of deepening of the middle reach and Kebrabasa gorge far outstripped the slower process of forming the Grand Cañon of the Victoria Falls. The difference between the river bed where running on the basalt sheet and the altitude of the central reach became more exaggerated as time passed. Including the height of the falls (400 feet), this difference is now about 1000 feet.

Of the process by which the river cut back this Grand Cañon and shaped the falls as they are seen to-day, the author states that, as is common to all rocks of this nature, it is full of cracks and fissures due to contraction, generally assuming a columnar form. These columns can be seen at low water along the lip of the falls, more or

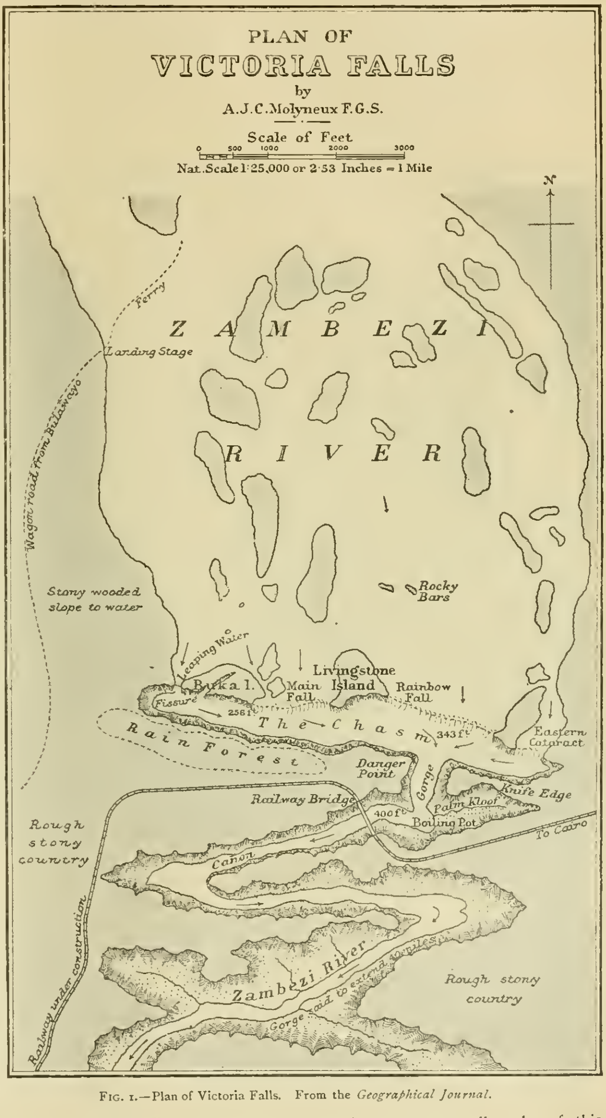

FIG. 1.—Plan of Victoria Falls. From the *Geographical Journal*.

[1] Abstract of a paper by Mr. A. J. C. Molyneux in the *Geographical Journal* for January.

less truncated as the verge is reached, and bearing little evidence of attrition (Fig. 2). Mr. Molyneux is of opinion that the cutting back of the falls is due to the perpetual hammering action of the vast bodies of water falling into, and down upon, the cracks between the basalt columns, assisted by the constant vibration of the rock from the precipitated masses of water, and that by this constantly exerted force the columns are rent asunder and fall into the chasm, taking with them huge and deep flakes of the precipice. At low water heaps of these blocks, as yet angular and unreduced, may be seen in the shallower ends of the chasm.

Such is one phase of the erosion of the falls. Another power is at work below the water line. The blocks that fall into the chasm disappear in the deeper waters at the jaws of the gorge—yet, impelled by the rush of the current in the confined walls, they must be grinding down and perpetually deepening the cañon, to emerge at the eastern end as rounded pebbles and form the shingle beds of the middle reaches.

The extraordinary zig-zags or acute angles in the cañon have always aroused comment, and the author thinks that two main causes are responsible for them—the position of islands that probably studded the river (as now) and also the existence of master joints and fissures in the basalt. On Boaruka Island this action is exemplified in a striking manner, for a stream can be seen falling down a crevice, that forms, peculiarly enough, another acute angle with the chasm.

Granted that the falls are due to the action of moving water, such parts as are protected by islands must be free from such erosion. To-day there are three important islands on the lip of the chasm, and more than fourteen large ones in 4 miles of river above the falls. In the channels between, there must be more prolonged submission to moving currents, by which the cataracts at the ends of the chasm are being deepened into sloping by-washes.

The falls have checked the deepening of the Upper Zambezi, and until they chisel the groove of the Grand Cañon back to the western edge of the basalt sheet, the upper reaches must continue to run at a high altitude and amid low-lying hills. This has prevented the Zambezi becoming a navigable river throughout, and has also had a marked influence on the geography of South Africa.

Photo. by Pedrotti, Bulawayo.

Fig. 2.—View of Victoria Falls seen through the jaws of the Gorge. Danger Point on the left; the promontory of the "knife edge" on the right. From the *Geographical Journal*.

SEISMOLOGICAL NOTES.

THE attraction of the moon has always been felt by earthquake workers, whatever may be its effect on earthquakes themselves. The latest contributions to this aspect of seismology are two papers in No. 18 of the *Publications* of the Earthquake Investigation Committee in Japan. Prof. Omori deals with the lunar daily distribution, finding maxima of frequency between oh. and 5h., and again between 12h. and 13h., reckoning from the upper culmination. Dr. Imamura, dealing with the synodic monthly variation in frequency, finds that this shows an increase at the syzygies and quadratures; the former is attributed to the combined effects of the attraction of the sun and the moon, while the latter is explained by the fact that the time of high water at Tokio then coincides with that of the diurnal maximum of barometric pressure. In spite of the ingenuity of this explanation, its validity seems doubtful, for the stresses involved can at most be only a subsidiary cause of earthquakes, and consequently any effect due to them would naturally be looked for at the time when they vary most rapidly in amount rather than at that of their maximum.

The same publication contains a paper, of some importance in this connection, on daily periodic changes of level in artesian wells, by K. Honda. It is the account of a record, obtained by a self-registering instrument, of the daily changes in level of two artesian wells, 380 metres and 300 metres depth, in Tokio and Yokohama. Each of them showed a periodic change of level which is directly correlated with the tides in the neighbouring sea, and also a variation due to changes in barometric pressure, of such amount as to show that one-third of the changes in the first case, and one-fourth in the second, are absorbed by the rocks overlying the water-bearing stratum.

The catalogue of earthquakes felt in Austria during the year 1903, forming No. 26 of the *Mitteilungen* of the Austrian Earthquake Commission, is the last of the series which will be published under the auspices of the Academy of Sciences. In the introduction to the catalogue it is announced that from the beginning of 1904 the task of collecting and publishing the records of all earthquakes, whether of local or distant origin, observed in Austria, was taken over by the Zentralanstalt für Meteorologie und Geodynamik. The Earthquake Commission, having published the earthquake registers up to the end of 1903, will in future confine itself to the encouragement and publication of purely scientific investigations.

After the collapse of the campanile of St. Mark's, in 1902, there was a popular demand, inspired by the idea that the detonation was likely to precipitate the destruction of other historic buildings in Venice, for the cessation of the usual mid-day gun. The idea was, of course, unfounded, but to allay the alarm Prof. Vicentini was requested to instal one of his microseismographs, and his report has now been published. The instrument was attached to the wall of the ducal palace which faces the lagoon and is directly exposed to the sound waves of the cannon; it indicated a vertical displacement, in consequence of the report, of 0·012 mm. to 0·014 mm., and a horizontal displacement of 0·007 mm. to 0·012 mm., being about one-half of those produced by a person jumping on the floor of the room in which the instrument was installed, and one-fifteenth of the displacement caused by a high wind. From these figures it is evident that the sound waves of a cannon can have no appreciable effect on a building, though plaster may be detached where this has become loosened and separated from the wall by an air space.

SOCIETIES AND ACADEMIES.

London.

Royal Society, February 23.—"The Colour-physiology of the Higher Crustacea," Part iii. By F. **Keeble** and Dr. F. W. **Gamble**. Communicated by Prof. Sydney J. Hickson, F.R.S.

(1) The chromatophores of Hippolyte and Crangon are multicellular structures. Their branches show differentiation into a firmer ectoplasm and a more fluid mobile endoplasm in which the pigment occurs. (2) The formation of the pigments in the larval and post-larval chromatophores is described. (3) In addition to pigments, fat, in the form of colourless globules, occurs in the chromatophores of Hippolyte. This fat lies in special cells of the chromatophore, and exhibits a mobility similar to that of the pigments of the chromatophore. (4) If fed and kept in the dark, or if starved and kept in the light, Hippolyte loses little of its chromatophoric fat. Depletion of fat occurs, however, in starved, dark-kept animals. These, when exposed to sunlight for five or six hours, show fat in their chromatophores. These results show that the colourless chromatophoric fat is a reserve food material, and point to the conclusion that in the accumulation of this reserve fat light plays an important part. (5) At the time of settling on the weeds of the sea-shore, *Hippolyte varians* is a colourless or faintly brown-striped animal. At this stage it is extremely sensitive to the light conditions of its environment, assuming the colour of its surroundings within twenty-four hours. If the environment be changed, sympathetic change of colour takes place in three days. Half- and full-grown Hippolyte are less susceptible. With them sympathetic colour-change occupies a week or more.

March 30.—"On the Distribution of Velocity in a Viscous Fluid over the Cross-section of a Pipe, and on the Action at the Critical Velocity." By J. **Morrow**. Communicated by Prof. H. S. Hele-Shaw, F.R.S.

Summary and Conclusion.—(1) The experiments provide a partial confirmation of the theoretically obtained law of velocity distribution, but show that this distribution can only be obtained under very special conditions, of which absolute freedom from obstructions and end effects are important; and hence (2) When the flow is direct and stream-lines exist, the velocity distribution is not necessarily exactly that which may be described as characteristic of "normal" flow. (3) At the critical velocity the irrotational straight line motion ceases and is followed by one in which the paths of the particles of fluid are eddying and turbulent. The law of distribution of mean linear velocity parallel to the axis simultaneously changes from the parabolic (or approximately parabolic) to that typical of eddying motion. (4) The critical velocity in question (being that at which eddying motion ceases to be transformed into direct motion, and not that at which a highly unstable stream-line motion is suddenly disturbed) is not accompanied by a sudden change in the velocity parallel to the axis at any point in the cross-section. On the other hand, as the total flux increases, the experiments show a gradual transition from one state to the other, due to the change which has occurred in the law of velocity distribution. (5) The observations have little bearing on the upper limit of stream-line flow, as observed by colour bands. They indicate, however, that the unstable direct motion would follow an approximately parabolic law of velocity distribution (as represented by the equation obtained for stream-line motion), and that at the higher critical velocity this distribution would suddenly change to that represented by the equation given for eddying motion. In this case, then, instead of a gradual change of velocity, there would actually be sudden and large changes in the velocity parallel to the axis at different points in the cross-section of the pipe. (6) The "Pitot law" ($v=\sqrt{2gh}$) is at least approximately true at exceedingly low velocities.

April 6.—"The Influence of Cobra-venom on the Proteid Metabolism." By Dr. J. **Scott**. Communicated by Sir Thomas R. Fraser, F.R.S.

Conclusions.—(1) Practically no change in rate of proteid metabolism was induced by the administration of cobra-venom, in spite of well marked local reaction. (2) A slight decrease in the proportion of urea nitrogen, quite insignificant compared with that produced by diphtheria toxin and various drugs, was observed. (3) A slight rise in the proportion of ammonia nitrogen occurred. (4) There was a slight rise in the proportion of nitrogen in purin bodies. (5) The nitrogen in other compounds showed no constant change. (6) The P_2O_5 excreted showed no constant change, but in two experiments there was a slight rise. The change produced in the proteid metabolism is, therefore, small, and such as it is, being in the directions of decreased elaboration of urea and increase in the proportion of nitrogen excreted as ammonia, it seems to indicate a slight toxic action on the hepatic metabolism rather than a general action on the proteid changes, and tends to confirm the view that the poison acts chiefly upon the nervous system.

Entomological Society, April 5.—Mr. F. Merrifield, president, in the chair.—Specimens of a melanic Grammoptera, discovered by Mr. J. C. T. Poole at Enfield, and apparently quite distinct from any member of the genus taken in Britain: H. St. J. **Donisthorpe**. Mr. Gahan, to whom the species had been referred, considered it to be a form of *G. ruficornis*.—A specimen of *Megalopus melipoma*, Bates, an insect which so much resembles a bee that Bates had said they were indistinguishable in nature: M. **Jacoby**.—Specimens of *Papilio macleayana* and *Hypocysta metirius* captured in Queensland, illustrating the use of "directive" markings in the Rhopalocera in influencing their enemies to attack non-vital parts: A. **Bacot**.—An example of *Ceratopterus stahli*, Wast., a beetle from Australia possessing notable powers of crepitation: G. J. **Arrow**.—A series of *Erebia alecto* (*glacialis*), var. *nicholli*, Obth., taken at about 8000 feet at Campiglio, South Tyrol, with specimens of *Dasydia tenebraria*, var. *wockearia*, caught in the company of the Erebias in the same localities; when upon the wing the two species were not dissimilar: A. H. **Jones** and H. **Rowland-Brown**. Mr. Jones also exhibited examples of *Erebia melas* from the Parnassus Mountains, Greece, for comparison, and fine forms of butterflies found at Mendel, near Botzen.—A series of *Morpho adonis* from British Guiana, with the very rare dimorphic black and white female: W. J. **Kaye**.—The social web and pupal shells of *Eucheira socialis*, Westw., together with specimens of the perfect insect, being the actual nest from Mexico described and figured by Westwood in the *Transactions* for 1836: Dr. F. A. **Dixey**. After Dr. Dixey had read a note upon the habits of this and similar species, the Rev. W. T. Holland, of Pittsburg, Pa., U.S.A., gave his personal experiences of social silk-cocoon spinning species also from Mexico. —A note recently received from Mr. S. A. Neave giving further interesting evidence of the superstitious dread of larvæ with terrifying eye-like markings entertained by South African natives: Prof. E. B. **Poulton**.—Experiments to ascertain the vitality of pupæ subjected to submersion: F. **Merrifield**.—*Pseudacraea poggei* and *Limnas chrysippus*; the numerical proportion of mimic to model: H. A. **Byatt**.—A monograph on the genus Ogyris: G. **Bethune-Baker**.

Geological Society, April 5.—Dr. J. E. Marr. F.R.S. president, in the chair.—On the divisions and correlation of the upper portion of the Coal-measures, with special reference to their development in the midland counties of England: R. **Kidston**. The following classification of the Coal-measures is proposed by the author:—

Proposed names		Names previously used
(4) Radstockian Series	=	Upper Coal-measures.
(3) Staffordian Series	=	Transition Series.
(2) Westphalian Series	=	Middle Coal-measures.
(1) Lanarkian Series	=	Lower Coal-measures (including the Millstone Grit).

—On the age and relations of the phosphatic chalk of Taplow: H. J. O. **White** and L. **Treacher**. The rocks at the locality of Taplow are described in detail, and the following classification is adopted:—(E) Upper White Chalk (visible), 16 feet; (D) Upper Brown Chalk, or rich phosphatic band, about 8 feet; (C) Middle White Chalk, about 16 feet; (B) Lower Brown Chalk, or rich phosphatic band, about 4 feet; (A) Lower White Chalk (visible), 17 feet. Fossil-lists are given from each of the above divisions, and the authors conclude that the Lower White Chalk belongs to the zone of *Micraster cor-anguinum*, and the succeeding beds to that of *Marsupites testudinarius*; while the lower phosphate-band represents the lower part of the Uintacrinus-band, and the upper one that of the Marsupites-band of that zone.

Physical Society, April 14.—Dr. R. T. Glazebrook, F.R.S., past-president, in the chair.—Ellipsoidal lenses: R. J. **Sowter**. The paper extends the treatment of thin ellipsoidal or astigmatic lenses, and gives a simple solution for complex problems of the following types:—"To determine the astigmatic pencil, after refraction of an astigmatic pencil by an ellipsoidal lens." And "to find the ellipsoidal lens equivalent to two cylindrical lenses placed a definite distance apart, with their axes inclined at any angle." The method of treatment can be applied to crossed ellipsoidal lenses, in contact, or separated, and is applicable in general to astigmatic pencils.—Determination of the moment of inertia of the magnets used in the measurement of the horizontal component of the earth's field: Dr. W. **Watson**. One of the constants required when determining the horizontal component of the earth's magnetic field by the ordinary method is the moment of inertia of the magnet which is used in the vibration experiment. It is usual to determine the moment of inertia of the cylindrical brass bar supplied with each instrument by calculation, then by measuring the period of the magnet alone, and when loaded with this bar to calculate the moment of inertia of the magnet. This method presupposes that the density of the inertia-bar is uniform throughout. It is not easy to secure a bar of which the density is uniform throughout, and further it is difficult to test whether such uniformity has been secured. The author thinks that more trustworthy and uniform results would be obtained by determining once for all, with very great care, the moment of inertia of a standard bar and then determining the moment of inertia of the bars supplied with the different magnetometers, by comparing them with the standard bar experimentally. In the paper is described an instrument suitable for comparing the moment of inertia of bars, together with some experiments made with a view to determine the moment of inertia of a standard bar, and an investigation of the influence of the air upon the period.—Exhibition of a series of lecture experiments illustrating the properties of the gaseous ions produced by radium and other sources: Dr. W. **Watson**.

Royal Astronomical Society, April 14.—Mr. W. H. Maw, president, in the chair.—Spherical aberration of object glasses: A. E. **Conrady**. The paper dealt with the difference of phase at the focus caused by the spherical aberration. Two different rigorous solutions, by which such differences could be conveniently computed, were deduced and discussed. The paper also dealt with the relation between these differences of phase and spherical aberration in the geometrical sense.—(1) A suggested arrangement for the mounting of a cœlostat; (2) point distributions on a sphere, with remarks on the determination of the apex of the sun's motion: H. C. **Plummer**.—The four-prism spectrograph attached to the Newall telescope of the Cambridge Observatory, with remarks on the general design of spectrographs for equatorials of large aperture, considered from the point of view of "tremor-discs": H. F. **Newall**.

Royal Meteorological Society, April 19.—Mr. Richard Bentley, president, in the chair.—An account of the observations at Crinan in 1904, and description of a new meteorograph for use with kites: W. H. **Dines**. These observations, which are carried out under the direction of a joint committee of the Royal Meteorological Society and of the British Association, are made with meteorographs attached to kites with the object of ascertaining the conditions prevailing in the upper atmosphere. During last summer the kites were flown from the deck of H.M.S. *Seahorse*, which was placed at the disposal of the committee by the Admiralty. Mr. Dines designed a new and inexpensive meteorograph, which he now fully described. The weather conditions of last summer were somewhat unusual, there being a decided preponderance of east and south-east winds. Near the summit of Ben Nevis the air was often dry, and was on several occasions warmer than the air at the same level at Crinan. As a rule, however, the temperature on Ben Nevis is generally much lower than the temperature in the free air at the same level. On several occasions temperature inversions were observed at levels between 3000 feet and 7000 feet. A fact previously noticed was again observed, viz. the decrease of strength of easterly winds with elevation.—Rate of fall of rain at Seathwaite: Dr. H. R. **Mill**. This is a discussion of the records from a Negretti and Zambra self-recording rain gauge during a period of eighteen months. Seathwaite, which is in Borrowdale, Cumberland, is in almost the wettest spot of the British Isles, the average yearly rainfall being about 137 inches. Dr. Mill's results seem to show that the rainfall at Seathwaite in an average year indicates a tendency to be greater during the hours of darkness than in daylight, that rather less than half the time during which rain is falling it continues without intermission for at least six hours at a time, and that rather more than half the total amount of rain is deposited in such long showers.

DUBLIN.

Royal Dublin Society, March 21.—Sir Howard Grubb, F.R.S., in the chair.—(*a*) The temperature of healthy dairy cattle, (*b*) the temperature of tuberculous cattle, not clinically affected: Prof. G. H. **Wooldridge.** The author made 520 observations on 63 healthy dairy cattle which were subsequently submitted to the tuberculin test, and failing to react were considered free from the disease. His conclusions are that the temperature may vary between 100°·4 F. and 100°·8 F., with an average mean temperature of 101°·4 F. Feeding caused an average rise of 0°·3 F. above the temperature of the same cattle at the same time on other days, but not feeding. In the afternoon, between 4 and 5 o'clock, the average temperature was 0°·5 higher than at 8 a.m. Pregnant cows had an average temperature 0°·3 F. higher than the average of the other cattle in the same building. Tuberculous cattle numbering 74, apparently perfectly healthy, but subsequently reacting to tuberculin, were the subjects of 505 observations. These animals had a much wider range of variations. The average was 101°·7 F. The lowest observed was 100°·4 F. and the highest 104°·3 F. The widest range of an individual was from 100°·7 F. to 104°·3 F., with an average of 102°·2 F. (temperature taken 15 times). Out of 137 apparently healthy dairy cattle, 74 (54 per cent.) reacted to tuberculin, thus emphasising the advisability of using that agent in attempts to obtain a dairy free from tuberculosis.—On the petrological examination of macadam: Prof. J. **Joly,** F.R.S. Various specimens of macadam used on Scottish roads have been examined. The general results of the investigation are to elucidate the characteristics of these macadams, as well as apparent abnormalities of behaviour, and to demonstrate the value of petrological methods in such cases.—On the construction of fume-chambers with effective ventilation: Prof. W. N. **Hartley,** F.R.S. The results of a series of experiments on ventilation and of practical experience with fume-chambers have shown the conditions which are necessary for the removal of noxious fumes from a chemical laboratory with the greatest efficiency and the least possible trouble and expense. Measurements were made daily over a period of six months of the gas burnt, the air extracted, the difference between inside and outside temperatures, the barometric pressure, the direction of the wind and its strength. The direction and dimensions of the flues, and the relation of the passage of air up the flues to the cubic contents of the chambers, are stated. The average quantity of air exhausted per minute was 354 cubic feet per chamber of 51 cubic feet, and on an average the air of each chamber is completely changed every nine seconds. The small height of the flues, being 25 feet, renders such a means of ventilation as that described readily adaptable to small out-buildings, such as school laboratories. Details are given as to the construction of flues with a descending draught as fitted to a lecture table and fume-chamber in a lecture room.—On the structure of water-jets and the effect of sound upon them, part ii.: Philip E. **Belas.**

EDINBURGH.

Royal Society, February 20.—Sir John Murray in the chair.—On the graptolite-bearing rocks of the South Orkney Islands: Dr. J. Harvey **Pirie.** The presence of Silurian sedimentary rocks in these isolated islands indicates a former much greater extension of land in the area lying to the south-east of Cape Horn. The fossils Pleurograptus and Discinocaris indicate their age as corresponding to the Caradoc or Lower Llandovery, and the structure of the rocks suggests that they belong to the same series as the Silurian rocks of the Argentine.—Palæontology of the Upper Old Red Sandstone of the Moray Firth area: Dr. R. H. **Traquair.** The fossils discussed in this paper, which embodied the research of the past fourteen years, were almost entirely fish remains, other remains, in the shape of badly preserved plants and certain tracks, probably of invertebrate animals, being rare. Twenty-one species of fish were recorded, of which only seven were known from the Upper Old Red of this region when the author took up the subject. The character of the fish remains suggested the division of the strata of the Moray Firth Upper Old Red into three zones, these being, in ascending order, the Nairn, Alves, and Rosebrae beds. Reference was made to the affinity of the Rosebrae fish-fauna with that of Dura Den, the yellow sandstones of which locality constitute the highest member of the Upper Old Red of Fifeshire. Dr. Traquair specially desired to acknowledge his great indebtedness to Mr. W. Taylor, of Lhanbryde, without whose assistance in furnishing material the paper could not have been prepared.—The constitution of complex salts, i., derivatives of the sesquioxides: A. T. **Cameron.** Retger's method of investigating isomorphous mixtures was applied to the blue chromoxalates of ammonium and potassium, and showed that they had no definite composition, there being, therefore, no conclusive reason for doubling the formulæ of these and similar compounds. The striking analogy between the so-called double fluorides, chlorides, cyanides, &c., and the complex derivatives of dibasic acids was pointed out. It was shown that to almost all such compounds, whether derived from monobasic or dibasic acids, simple constitutions can be assigned by supposing the hydroxyl radicals of the metallic hydroxide to be replaced by complex groups.—Theorems relating to a generalisation of Bessel's function, ii.: Rev. F. H. **Jackson.**

March 6.—Lord M'Laren in the chair.—A study of three vegetarian diets: Drs. Noël **Paton** and J. C. **Dunlop.** Of the three diets described, one was a totally insufficient diet of bananas, a second was a fairly typical vegetarian diet showing the difficulty of avoiding an excess of sugary food, and the third was the far from economical diet of a vegetarian glutton. These were compared with the diets of the labouring classes in cities as illustrated by the author's own investigations in Edinburgh, and those of Rowntree, Alswater, and Lumsden respectively in York, New York, and Dublin, and as regards rural districts by Wilson Fox's report. It was shown that these normal diets more nearly approached the physiological standard than the vegetarian diets studied.—A further contribution to the fresh-water plankton of the Scottish lochs: W. and G. S. **West.** The thirty-six lochs studied were in the north-west Highlands. There was an abundance of Desmids, a fact attributed to the geological character of the country. The Protococcoideæ were not abundant, in marked contrast to what occurs in Continental Europe. Diatoms were very abundant, and did not disappear in May and June. Myxophyceæ, again, were relatively few. The Swedish lakes alone approached the Scottish in the richness of the plankton. The Danish plankton was relatively much poorer in Chlorophyceæ, especially Conjugates. This was to be attributed principally to the fact that the geological formations are mostly of Tertiary age.—On the Sarcodina of Loch Ness: Dr. E. **Penard.** Of a list of nearly fifty species of Rhizopods and Heliozoa obtained at depths of upwards of 250 feet, several were of interest on account of their rarity, some being found for the first time in Europe, others being previously known only from the Lake of Geneva. The majority of the Rhizopoda had probably been derived from the shallow margins of the lake or from the neighbouring peat bogs; but some half dozen species or varieties were regarded as peculiar to the abyssal portions of large lakes.—The Rhizopods and Heliozoa of Loch Ness: J. **Murray.** In this paper the list of species given in the previous paper by Penard was supplemented by a number of species observed by the Lake Survey, bringing the list of Loch Ness Sarcodina up to sixty-six species. The difficulty of accounting for the transmission of peculiar abyssal forms from one deep lake to another was met by the suggestion that the abyssal forms originate separately in each lake and are probably not good permanent species, but modified forms due to the direct action of the environment on the growing individual.

PARIS.

Academy of Sciences, April 17.—M. Troost in the chair.—Second note on the principle of cellular flotation in ships: M. **Bertin.**—Mixed treatment by arsenious acid and trypan red of infection due to Trypanosoma: A. **Laveran.** Fresh experiments on monkeys confirm the favourable results previously obtained on rats and dogs.—Observations on the new comet Giacobini (1905, March 26) made at Toulouse Observatory: F. **Rossard.**—On the differential equation $y''+\lambda A(x)y=0$: Max **Mason.**—On the relation which exists between the velocity of combustion of powders and the pressure: R. **Liouville.**—Optical properties of iono-plastic iron: L. **Houllevigue.**—On the theory and imitation of the motion of sails: A. **Bazin.**—On the use of the centrifugal method in the analysis of cocoa and chocolate: F. **Bordas** and M. **Touplain.** It is necessary, to avoid some practically impossible filtrations, to use an apparatus capable of nearly 2000 revolutions a minute.—New method for a quick analysis of milk: F. **Bordas** and M. **Touplain.** By centrifugal means one avoids much filtration as well as the protracted desiccation of the casein.—An apparatus for giving warning of the presence of luminous gas and afterdamp: MM. **Hanger** and **Pescheux.**—The crystalloluminescence of arsenious acid: M. **Guinchant.** This appears to be due to a chemical phenomenon corresponding with the reversible reaction

$$As_2O_3+6HCl \rightleftarrows 3H_2O+2AsCl_3.$$

—On the emission spectrum of the high tension electric arc: J. **de Rowalski** and P. **Joye.**—On a simple method for the study of oscillating sparks: G. A. **Hemsalech.** The method depends on the fact that a current of air directed on such a spark can separate out the oscillations.—Apparatus and methods in the medical applications of statical electricity: L. **Benoist.** An attempt to systematise the usage based on the consideration of electric density.—On the mode of formation of some monosubstituted derivatives of urethane: F. **Bodroux.** When small quantities of ethyl carbonate are dropped into an ether solution of the magnesium derivative of an aromatic primary amine, a lively reaction takes place. If aniline be used, phenylurethane is formed.—On the mineralogical analysis of arable earths: J. **Dumont.** The author describes methods for quantitatively determining the proportions of sand, mica, felspar, quartz, &c.—On some Crustacea resulting from the expedition of the *Princess Alice*: H. **Coutière.** By the use of a net with a large aperture a considerably more valuable collection was made.—On the excitation of nerves by a minimum of energy, and its application to electrodiagnosis: M. **Cluzet.** By experiments made on the nerves of human beings, it has been found through the application of a formula that the duration of minimum excitation may be 0·00020 second.—Physiology of the spleen: MM. **Charrin** and **Moussu.** The experiments made tended to elucidate the much discussed question as to the functional relationship between the liver and the spleen.—The action of intestinal fluid on enteric secretion: A. **Frouin.** Many facts seem to prove that this exciting action is not due to secretin.—Researches on animal lactase: H. **Bierry.** The experiments show that lactase is not contained in the pancreatic juice of suckling puppies.—On the production of alcohol and acetone by muscles: F. **Maignan.** The author replies in the affirmative to the question as to whether these substances, which are normally present in muscle tissue, arise by alcoholic fermentation of glucose by the agency of protoplasm. But while the acetone continues to be formed, the alcohol is sooner or later destroyed again.

DIARY OF SOCIETIES.

THURSDAY, APRIL 27.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Discussion*: Mr. B. J. Arnold's Address to the Joint Meeting at St. Louis on the Problem of the Alternate Current Motor applied to Traction.—*Paper*: The Alternate Current Series Motor: F. Creedy.

FRIDAY, APRIL 28.

EPIDEMIOLOGICAL SOCIETY, at 8.30.

MONDAY, MAY 1.

ROYAL INSTITUTION, at 5.—Annual Meeting.
SOCIETY OF CHEMICAL INDUSTRY, at 8.—(1) The Study of the Action of Hydrogen Peroxide on a Photographic Plate in the Dark; (2) On the Influence of the Length of the Time of Development on the Degree of Darkening of the Photographic Plate: Prof. Chiri Otsuki.
VICTORIA INSTITUTE, at 4.30.—The Influence of Physiological Discovery on Thought: Dr. E. P. Frost.

TUESDAY, MAY 2.

ZOOLOGICAL SOCIETY, at 8.30.—On *Leucosolenia contorta*, Bowerbank, *Ascandra contorta*, Haeckel, and *Ascetta spinosa*, Lendenfeld: Prof. E. A. Minchin.—Some Notes upon the Anatomy of the Ferret-Badger (*Helictis personata*): F. E. Beddard, F.R.S.—Contributions to the Osteology of Birds, Part vii., Eurylæmidæ, with Remarks on the Systematic Position of the Group: W. P. Pycraft.
ROYAL INSTITUTION, at 5.—The Study of Extinct Animals: Prof. L. C. Miall, F.R.S.
SOCIETY OF ARTS, at 4.30.—The Monumental Treatment of Bronze: J. Starkie Gardner.

WEDNESDAY, MAY 3.

ENTOMOLOGICAL SOCIETY, at 8.—The Structure and Life-history of *Psychoda sexpunctata*, Curtis: J. A. Dell.
SOCIETY OF PUBLIC ANALYSTS, at 8.
SOCIETY OF ARTS, at 8.—Recent Excavations in Rome: Mrs. Burton-Brown.

THURSDAY, MAY 4.

ROYAL INSTITUTION, at 5.—Flame: Sir James Dewar, F.R.S.
CHEMICAL SOCIETY, at 8.—The Synthesis of Substances Allied to Adrenaline: H. D. Dakin.—Methylation of p-Aminobenzoic Acid by Means of Methyl Sulphate: J. Johnston.—Some Notes on Sodium Alum: J. N. Wadmore.—Campboryl-ψ-Semicarbazide: M. O. Forster and H. E. Fierz.
RÖNTGEN SOCIETY, at 5, (1) to Medical Members only. Forty-two Cases of Ureteral Calculus Diagnosis by X-Rays proved by Operation on the Passage of the Calculi; (2) at 8.15 p.m., to the General Meeting, Measurement and Technique in Therapeutic Dosage: Dr. C. Lester Leonard, Philadelphia.
LINNEAN SOCIETY, at 8.—Œcology: its Present Position and Probable Development: A. G. Tansley.—The Flora of Gough Island: R. N. R. Brown.
CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 7.30.—Annual General Meeting.—At 8.—Card-Indexing and Filing: J. C. Osborne.

FRIDAY, MAY 5.

ROYAL INSTITUTION, at 9.—Problems underlying Nutrition: Prof. H. E. Armstrong, F.R.S.

SATURDAY, MAY 6.

ROYAL INSTITUTION, at 3.—Moulds and Mouldiness: Prof. Marsh. Ward, F.R.S.

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