THURSDAY, DECEMBER 30, 1909.

BLOOD-SUCKING FLIES.

Illustrations of African Blood-sucking Flies, other than Mosquitoes and Tsetse-flies. By E. E. Austen. With coloured figures by Grace Edwards. Pp. xv+221; 13 plates; 3 text-figures. (London: British Museum, Natural History, 1909.) Price 1*l.* 7*s.* 6*d.*

THE extraordinary progress that has been made of recent years in the study of tropical medicine has had the result of establishing clearly the general truth that most of the diseases peculiar to the tropics, whether of man or animals, are due to the effects of parasites, microscopic or ultra-microscopic, introduced into the system by the agency of blood-sucking invertebrates. The intermediate host in such cases is usually an arthropod, and most frequently a dipterous insect. Not only has this mode of infection been demonstrated beyond all possibility of reasonable doubt, for such formidable scourges as malaria, yellow fever, sleeping sickness, and various diseases caused by trypanosomes in animals, such as nagana and surra, but it is highly probable that many other forms of disease, less thoroughly investigated at present, originate in a similar manner. Moreover, as in many other cases of parasitism throughout the animal kingdom, a particular disease-producing parasite may be transmitted from one vertebrate host to another only by one restricted group, perhaps even by a single species, of the blood-sucking invertebrates concerned, while other forms may be incapable of harbouring the parasite, or, to express the matter more correctly, are capable of digesting the parasite together with the blood, when taken up in the usual course of feeding.

For these reasons the study of the Diptera, or two-winged flies, has assumed an importance which, twenty years ago, could hardly have been foreseen either by the scientific or the practical man, even in the wildest flights of the imagination. At that epoch, which seems very remote when considered from the standpoint of present knowledge, none but professed entomologists, and not many even of them, occupied themselves with a group of insects unattractive or even repulsive when compared with such popular favourites as butterflies or beetles. Now, however, the Diptera and other blood-sucking arthropods are studied eagerly in all parts of the world, and not by specialists alone. The scientific knowledge of these creatures, their habits and life-histories, has become of immense importance from the economic and medical standpoint, and the distinction and recognition of forms harmful or harmless, from the human point of view, is a branch of study which has invaded even the medical curriculum, at least in schools of tropical medicine. The attention of the medical man is not directed solely, however, to blood-sucking insects, since it is becoming generally recognised that the common flies which haunt our houses and crawl over our food are also fruitful sources of disease.

An Englishman may feel legitimate pride in the lead taken by our national museum in this branch of study. Under the auspices of the British Museum of Natural History, and by the initiative and encouragement of its former director, Sir Ray Lankester, a number of works on blood-sucking Diptera have been published, works of the highest value both from the scientific and the practical point of view. The museum is especially fortunate in having the services of the foremost authority on the Diptera, Mr. E. E. Austen, whose monograph on the tsetse-flies is now a classic, and recognised all over the world as the standard work on these insects.

In the present work Mr. Austen excludes the tsetse-flies already dealt with by him, and the mosquitoes, on which a monograph by Theobald is in progress, and deals with other African blood-sucking flies. He aims at giving descriptions, figures, and general information such as will enable, not only experts, but more especially travellers and medical men in Africa to distinguish and identify the various forms already known, and to collect more material for the study of the Diptera, and so fill some of the many gaps in our knowledge of this group. It is not possible to praise the work more highly than by saying that it comes up to the standard of former works by the same author. Written with a view to the requirements of those who are not specialists, the book does not contain cumbrous descriptions in technical language, but relies chiefly on the excellent illustrations. Every species of fly dealt with is figured in colours at a scale of magnification indicated by a line below the figure. The distinctive characters of the families and genera are given in plain language, together with brief accounts of their habits, life-histories, and relations to disease, so far as such facts are known at the present time. The species are not described in detail, but where necessary their distinctive features are pointed out, and their distribution is given, with a list of the localities whence the specimens in the museum have been obtained. Finally, a list of the flies is given, arranged under countries, so that anyone residing in Africa or intending to travel there can see at once what biting flies other than tsetses or mosquitoes are known at present to occur in any particular region.

This book fulfils admirably the purpose for which it is intended, and will certainly be of the utmost value to travellers and residents in Africa. It will also stimulate the collection and study of these insect-plagues, and will thereby contribute more than any other cause to itself becoming out of date. It is to be hoped that supplementary volumes will be published as material accumulates and knowledge increases. If so, the supplements will probably far exceed in bulk the original work, in course of time. The subject-matter of the work could only be criticised by an expert, and is distinguished by erudition and accuracy. The arrangement of the contents is clear and time-saving, with a complete index. The illustrations are admirably executed and reproduced. If we might offer a suggestion, it is that a national achievement of such importance would have its value

and usefulness greatly increased if its price were more within the reach of modest means. Doubtless such a book is very expensive to produce, but surely this is a case where the wealthy treasury of a great nation might have balanced a possible pecuniary loss against a certain imperial gain. E. A. M.

A NEW TEXT-BOOK OF PALÆOZOOLOGY.

Lehrbuch der Paläozoologie. By Prof. E. Stromer von Reichenbach. I., Wirbellose Tiere. Pp. x+342. Naturwissenschaft und Technik in Lehre und Forschung. (Leipzig: B. G. Teubner, 1909.) Price 10 marks.

IN several features the present volume may well claim to be in advance of many of the text-books on the subject which have appeared during latter years. Instead of being a mere systematically arranged and uninteresting descriptive catalogue, it provides splendid material for the student who desires an intelligent understanding of the subject.

In a well-written introduction the author discusses the scope of the science, the history of its origin, the present state of our knowledge of the science, conditions of fossil-preservation, the relationship of palæozoology to other sciences, and, lastly, the constitution of the skeleton in different animals. For the most part the work is limited, except in some of the more thoroughly investigated groups, to the treatment of orders and higher divisions. Greater detail would have defeated the end in view—that of providing a clearly written exposition for beginners who are assumed to have only elementary knowledge of zoology and no acquaintance with geology. The lower animals receive much attention, and their discussion occupies a considerable portion of the volume. An attempt has been made to embody the recent researches in the different sections without unduly obscuring the clearness. Thus, for instance, in the section on the rugose corals is given the explanation of the septal plan as recently set forth by Carruthers.

Other important features are the paragraphs on the geological distribution and the evolution of each group, as well as the concise summary of the diagnostic characters of the several groups at the close of the treatment of each phylum. A general discussion of the contributions of palæozoology to the study of phylogeny is reserved for the second volume. A valuable list of the chief works at the end of each section provides the necessary guide to those students who might wish to continue the subject further.

The use of a special mark to signify extinct forms is unfortunate, since the necessary frequence of these signs in some parts proves to be a distracting eyesore. Moreover, Frech has used the same mark in his "Lethæa Palæozoica" to denote the last appearance of a form in the stratigraphical sequence.

Undoubtedly, one of the outstanding features of the book is the excellence of the illustrations and the introduction of so many that are new in a text-book. The clearness of the figures and the conciseness of the explanatory notes leave nothing to be desired. The inclusion of technical terms such as "latisellat," "kryptodont," and "iterative Formenbildung," in the index must prove very useful.

On the whole, the author can be congratulated upon producing a very good and serviceable text-book, for he has succeeded very well in preserving the educationist's ideal of a treatment proceeding "from the known to the unknown," and not, as is often the case, "to the unknown through the more unknown."

IVOR THOMAS.

CHEMISTRY IN COURT.

A Manual of Forensic Chemistry, dealing especially with Chemical Evidence: its Preparation and Adduction. Based upon a Course of Lectures delivered at University College. By William Jago. Pp. viii+256. (London: Stevens and Haynes, 1909.) Price 5*s.* net.

IN one way or another, chemical matters form no insignificant proportion of the cases dealt with by our police courts and civil tribunals. Poisoning tragedies, infringement of patents, adulteration of food, and even libel actions—these are some, but by no means all, of the causes which serve to bring chemist and lawyer professionally together; and, not infrequently, chemist and lawyer find themselves at loggerheads.

There are legal subtleties which the chemist is apt to overlook. For example, a well-known scientific witness once set out to explain what a certain claim in a specification meant. "Kekewich, J.," interposed with the remark, "That is for me, Sir James." So the witness had to cast about for a more acceptable form of words. "Speaking as a chemist," he said, "the following words in the claim mean to me" so and so. With this preliminary the evidence was admissible, and the witness was allowed to proceed.

On the other hand, there are chemical distinctions which to the lawyer are often a mystery of mysteries. Our author recognises this, and seeks, as far as may be, to make the rough places plain for the members of both professions.

For the lawyer, he explains shortly the objects and principles of chemistry. He gives examples of "direct" and "indirect" methods of analysis, and directs attention to such points as the collection of fair samples, the changes which in perishable articles may affect the analysis, the occurrence of "traces" of a constituent, and the control of results by "blank" experiments. For the chemist, there is very good advice on such matters as the preparation of the "proof," the form of the certificate, and the use of books in the witness-box. For both, there is a collection of illustrative cases, bringing out the chief points and rulings which affect present-day practice. Many of the *causes célèbres* of the last fifty years are quoted. Thus the Palmer and the Maybrick poisoning prosecutions, the cordite litigation, the "what is whiskey?" proceedings, the libel action in connection with altar candles, and the disputed validity of the Badische Anilin Company's patents, are some of the many cases which are made to point a moral for the reader's benefit.

Possibly a little more chemistry would have been welcome to the lawyer. Perhaps, also, the chemist would like to see a fuller discussion of the principles of evidence after the manner adopted on p. 245, where not only the practice but the reasons for it are adduced. Precedents, however, bulk largely in legal work; and if the chemist, from his training and mental leanings, would rather have had more principle and less precedent, it does not follow that he would have found it of more actual utility. Nevertheless, the author might note these suggestions in view of a second edition. In any case, the book can be recommended as a helpful and interesting one to those for whom it is written. C. SIMMONDS.

THE MORPHIA HABIT.

The Morphia Habit and its Voluntary Renunciation. A Personal Relation of a Suppression after Twenty-five Years' Addiction. By Dr. Oscar Jennings. Pp. x+492. (London: Baillière, Tindall and Cox, 1909.) Price 7*s.* 6*d.* net.

IT were well, if time permitted, that each physician should experience in his own person (meaning thereby his whole person, psyche and soma) a few typical examples of the complaints which he will have to treat. He would thus acquire an insight into disease obtainable in no other way, and with Æneas might exclaim:—

"Quæque ipse miserrima vidi,
Et quorum pars magna fui."

This apt quotation is found on the title-page of Dr. Jennings's book, and its aptness lies precisely in this, that the book includes, in the shape of a diary, the record, from within, of the overcoming of an addiction to morphia of twenty-five years' standing. Of habit, pernicious, no more typical example could have been selected than the morphia habit, and this treatise presents us with a valuable contribution to the study and solution of a very serious problem.

Dr. Jennings approaches the problem by two paths, the psychologic and the somatic, in this order. His primary demand is that the patient shall bring, on his part, the desire, the intention, the will (what remains of it), to get well; that before all else the psyche point in the right direction. His next demand is that the physician shall, on his part, supply encouragement, and shall instil into the patient, first a full confidence in himself as guide, and then a spirit of self-reliance; or the order may be reversed, it does not matter so long as hope, trust, and self-reliance find an entry. He urges, and it must be clear, that the best of all cures can only be upon these lines, and that cures which have been effected without the patient's willing cooperation, *a fortiori*, against his will, must be inferior in value. To seek a simile, the willing and the unwilling cure may be likened to the cure of an infectious disease, brought about, on the one hand, by the successful resistance of the patient's own tissues, on the other, by the aid of antidotal powers (anti-toxins) which the efforts of alien tissues have supplied. We have reason to believe that the immunity acquired by the former is the more complete and the more lasting.

Dr. Jennings, however, is not content with teaching a reasonable doctrine; he shows further, by his record of successful cases, the feasibility of the plan which he advocates. With much practical wisdom, he will not allow us to forget that the problem has a somatic side; he is too good a physiologist not to see that to deny this is to deny physiology, "the solid ground of nature"; also that to recognise a somatic side, yet to deny the possibility of material access to the body, as by the medicaments, is to deny physiology once again, since pharmacology is but a department of physiology. On this subject, the value of drugs in the treatment of the morphia habit, the author has much of interest to tell; in particular he insists upon "his therapeutic triad," the use, namely, of heart tonics—of alkalies, especially Vichy water—and of hydropathic measures, notably the Turkish bath. His views do not always fit in with pharmacological teaching, *e.g.* in the value which he assigns to sparteine, but here the last word must rest with the clinicist.

Dr. Jennings's dietetic handling of his subject strikes the reviewer as interesting and original, and as mindful of the dietetic wisdom of the Hippocratic aphorisms.

By means dietetic and medicinal, as set forth by the author, the stress of the bodily cravings is eased and the enfeebled will enabled to maintain its operation; maintaining its operation, volition, according to the law of growth, is gradually built up, the habit of right operation becoming ingrained. Thus in the re-education of the will, the great force of custom is called upon to help to overthrow that dominance which the great force of custom had established—"Certa viriliter"; said S. Thomas à Kempis, "consuetudo consuetudine vincitur." The victim of habit may take these words to heart, and in this record of Dr. Jennings find further encouragement to persevere, and along what lines to seek and find health.

SCHOOL GARDENS.

Practical School Gardening. By P. Elford and Samuel Heaton. Pp. 224. (Oxford: Clarendon Press, 1909.) Price 2*s.* net.

FEW educational movements of recent years have produced a more copious crop of text-books, hand-books, readers, and so on, than what is called nature-study. This result is not quite in harmony with the spirit of the movement, which is to avoid the book and study the thing. The child is to use his own eyes, to observe the thing itself in its proper habitat, and in relation to its ordinary surroundings; from these observations he is to make deductions, and thus he is to be trained to think. Of course, the scheme has to be modified to suit the exigencies of the time-table, but it has been shown to work and to give country children a living interest in their surroundings, besides providing the teacher with a powerful engine for education. The final success of the method depends, however, on how far the teacher himself possesses the proper habit of mind, and how far he has overcome the dependence on text-books

which has been fostered by his training and the habit, born of tradition and the old method of education, of looking a thing up in a book rather than discovering it by observation. One of the consequences of the movement, and one which we hope will prove permanent, has been the establishment of school gardens. Anyone who knows village schools where gardens exist knows the pride that teachers and scholars alike take in them, and their great value from every point of view. A school garden can be made to furnish a vast amount of matter for school lessons, and in addition it instils into the boys that love of gardening so characteristic of the English life of to-day.

The teacher is bound to have text-book help in managing his garden; the proper arrangement of his crops, the times of sowing, the pests or diseases likely to be troublesome, are all matters in which he needs guidance. He cannot afford to make mistakes, his scholars' parents are sometimes expert gardeners, always critical, and ever ready to derive amusement from his little efforts. The book before us will be found very useful in this respect by the teacher, and the instructions for working are quite clear and have been tested with satisfactory results in the school gardens of Oxfordshire. The book is copiously illustrated; indeed, we find a whole page devoted to the photograph of a wheelbarrow and an ordinary watering can. The teacher who intelligently follows the instruction given may quite expect his garden to be successful from a horticultural point of view, and will have little to fear from the carping village critics.

But we do not think this book represents the last word on the subject. Not enough is made of the garden as a means of education, in spite of a highly suggestive chapter by Mr. Meadon on "Discovery Lessons," which shows a full appreciation of the possibilities in this direction. We should like to have seen the book dominated by the spirit of the *experimenter*; instead, we find it dominated by the spirit of the horticultural *instructor*, whose personality comes out on every page, even to the amiable weakness for the long Latin name that we ever associate with the professed horticulturist. It must be admitted, however, that there are difficulties in the way of an experimental school garden. A garden often becomes much too personal an affair to be made the subject of experiment even by the man of science, and how shall the village schoolmaster treat it any more impersonally? The spirit of competition is there; each boy wishes his plot to be the best, and the teacher wishes the garden as a whole to be at least as good as the allotments; experiments, therefore, cannot come in, as he has no room for failures. We are aware, of course, that some schools make trials with artificial manures, but the schemes that we have seen have been entirely empirical, and designed to increase the crop rather than to yield information. We believe that ultimately the school garden will be as successful educationally as it now is horticulturally, and although the present book does little towards helping on this reform it will be found of real value for the school garden as at present conducted. E. J. RUSSELL.

ELECTRIC MOTORS.

The Alternating Current Commutator Motor and the Leakage of Induction Motors. By Dr. Rudolf Goldschmidt. Pp. viii+210. (London: The *Electrician* Printing and Publishing Co., Ltd., 1909.) Price 6*s.* 6*d.* net.

THOSE who are acquainted with Dr. Goldschmidt's writings will open this book with the expectation of finding a very intricate subject treated in clear and simple style, and this expectation will be fully realised. There is no padding, and consequently the reader must not skip, but if he follows the author conscientiously step by step in his close and methodical reasoning he will find his labour amply repaid.

A good deal has been written about the commutator motor, but we have never come across a treatise written so clearly and in such simple language. The simplicity of treatment is not attained by making inadmissible propositions. It is true the author takes us first through the theory of the so-called perfect motor, having no losses and no leakage, but after establishing the main principles which must count in any theory he goes on to introduce step by step those disturbing influences which are inseparable from the practically possible motor, and at every step he finds an easy way of taking account of these influences. The treatment is in the main graphical, and the author's position in the old controversy between the analytical and graphical school is shown by a passage on p. 30, which runs as follows:—

"The preference for the mathematical or graphical representation is a matter of taste, but I think that many people will agree with me that a very simple diagram, as the present one, will lead more quickly to a clear result, and can more easily be borne in mind, than a more or less complicated formula."

The first part of the book, dealing with the commutator motor, contains six chapters—introductory, the series motor, the repulsion motor, the Latour-Winter-Eichberg motor, some special types, and finally examples of motors, with views and curves of performance, but not many technical data of construction. The only example illustrated by dimensioned working drawings is a 60-h.p. motor made by the Oerlikon Co. The brevity of style is certainly commendable, but in some places it is carried too far. Thus on p. 44, when dealing with the minimum flux required for sparkless commutation, the author gives without proof a formula in which the total flux, that is, the flux per pole multiplied by the number of pairs of poles, is shown to be proportional to the square root of a fraction containing in the nominator the product, horse-power, volts, and length of armature, and in the denominator the product revolutions per minute and diameter of armature. As he says that this formula "will do good service in formulating a general idea of the amount of flux required," we may fairly expect that he should give a proof of it. Another matter in which a somewhat fuller treatment might well be expected is the Deri (not Dery, as the author writes) motor. One page can hardly be considered sufficient to deal with a motor which presents so many interesting features, and is also, from

a practical point of view, of immense importance. These are, however, minor blemishes of the author's work; the important thing is that he has given us an eminently useful and readable book on a subject which has too long been neglected in this country.

The second part of the volume under review deals in great detail with the leakage of induction motors and its predetermination. It is a careful investigation of all the different items which influence leakage, power factor, and overload capacity. The subject is highly technical, and will, therefore, mainly interest the designers of induction motors. Specialists in this branch will, however, find the author's method of dealing with the question of leakage, and especially his diagrams and tables, very useful.

GISBERT KAPP.

OUR BOOK SHELF.

Practical Microscopy. An Introduction to Microscopical Methods. By F. Shillington Scales. Second Edition. Pp. xvi+334. (London: Baillière, Tindall and Cox, 1909.) Price 5*s.* net.

ALTHOUGH nominally this is a second edition of Mr. Scales's "Elementary Microscopy," published in 1905, yet it is in effect a new book. The first edition was not so pretentious, and did not attempt to give so much information on widely varying branches of microscopy; in fact, if any criticism may be offered, it is that now too much is attempted.

The actual practical instruction in the use and manipulation of the microscope is particularly lucid, and it is difficult to imagine that it could be expressed more clearly. The theoretical side is practically untouched, perhaps wisely so, as to have gone into the theory with sufficient fulness to have made it intelligible to the ordinary reader would have entailed a great increase in the amount of matter.

The subject of photomicrography has been touched on, and this constitutes an entirely new chapter in the book, as in the first edition no attempt was made to deal with it at all. The instructions given are clear, but are in some respects not so full as an earnest student would desire.

The recently re-introduced methods of dark ground illumination are described, and practical instructions are given in the use of typical illuminators. The various methods of illumination of opaque objects are fully dealt with, both by means of an ordinary condensing lens used in conjunction with low powers and by vertical illuminators for use with high powers.

In general, the book may be commended to any student who requires to use the microscope for ordinary laboratory purposes or for research, as one that will afford him all the practical assistance he is likely to require in the course of his work.

Erosion of the Coast and its Prevention. By F. W. S. Stanton. Pp. 68. (London: St. Bride's Press, Ltd., n.d.) Price 3*s.* net.

THIS book is a reprint of a series of articles which recently appeared in *Public Works*.

It consists of five "parts," or chapters, relating respectively to general observations on coast erosion; the agents of destruction and construction, and their effects on the English coast; land reclamation and coast defence; with an appendix on the Thames estuary. There are several maps showing the coast of England and illustrations of defence works. The maps appear to have been reproduced from larger drawings, the writing and names of places being so diminished and indistinct as scarcely to be legible, even with the aid of a magnifying glass.

The contents of the book form an interesting summary of the condition of coast erosion and protection in England, suitable for a serial publication, but they are of too general and superficial a character to be of any use as a text-book on the subject, and contain no information of consequence that has not been more fully dealt with in books already published. The author does not appear to have made any use of the information contained in the evidence laid before the Coast Erosion Commission, and the fact of this commission being in existence is only once casually mentioned.

The author attributes the destruction of the coast, amongst other agencies, to the action of undercurrents below low water, and of submarine springs and "animal borers," and states that the consideration of such agents of destruction "leads to feelings approaching despair," and "bordering on consternation when the formation of the coast consists of glacial deposit, the London Clay and the like." It would have been more satisfactory if this theory had been supported by instances where this occurs. Although it is also stated that this class of erosion is beyond prevention, in another part of the book a solution of the difficulty is described as being effected by means of submerged chain cable groynes, and it is stated, on the authority of the inventor of this scheme, that these groynes have been laid on flat, sandy shores with excellent results. The locality where this has been done is not given, nor any particulars as to the condition of the shore before and after their use.

The Evolution of the Sciences. By L. Houllevigue. Translated from the French. Pp. 318. (London: T. Fisher Unwin, 1909.) Price 6*s.* 6*d.* net.

IN his preface to the English edition of his book, M. Houllevigue explains that it is not his object to teach men of science anything. "I only wish," he writes, "to interest those who love science as outsiders in the general ideas which form the atmosphere of the laboratory, and, above all, to make them familiar with that superior form of common sense which is called the scientific spirit." Nine subjects are dealt with—the tendencies of chemistry, transmutation and Sir William Ramsay's experiments, the existence of matter, the interior of the earth, the sun, eclipses, the Milky Way, the organisation of matter, and the frontiers of the sciences. Each essay presents the broad aspects of the subject surveyed, and is well calculated to set students thinking about fundamental principles of science. Judging from the absence of reference to work by Joly on radio-activity in relation to the age of the earth, Hale on his solar observations, Kapteyn and Eddington on star-drifts, and other researches of recent years connected with the subjects described, the author has not kept in close touch with all the points in which progress is now being effected.

History of Astronomy. By Prof. G. Forbes, F.R.S. Pp. ix+154; illustrated. (London: Watts and Co., 1909.) Price 1*s.* net.

IN this small volume Prof. Forbes describes the evolution of astronomical knowledge under three periods—the geometrical, the dynamical, and the physical. In addition, in book iii. he also describes the evolution of the instruments which have enabled astronomers of all ages to contribute to the store of knowledge on which our present-day astronomy is based.

The geometrical period covers the ages which elapsed between the time when man simply "wondered" and the time when his collected observations and knowledge had prepared the way for Kepler. This is a very interesting section, in which the methods and ideas of early astronomers are so clearly explained as to demand the attention of the general reader.

As a reference to ancient observations it should also prove valuable.

The dynamical period will appeal more to the student, its main theme being, of course, the establishment of the principles of universal gravitation by the work of Kepler, Newton, Laplace, Halley, and the others. The section on observation gives an abbreviated account of the methods and instruments employed in the more important and epoch-making researches, and contains a deal of interesting matter.

The fourth book, dealing with the physical period, is, perhaps, the least satisfying, but the chief reason for this, probably, is the confined space in which a tremendous amount of matter has to be discussed. As the author states on p. 147, he has been "compelled so often by the limits of space to stimulate without satisfying inquiry," and on these lines the book must be welcomed as a success. Those stimulated will find a useful, brief bibliography, to assist them in their further inquiries, given at the end of the volume.

W. E. R.

Wild Flowers and Trees of Colorado. By Dr. F. Ramaley. Pp. viii+178. (Boulder, Colorado: A. A. Greenman, 1909.)

THIS book consists of two chapters, in the first of which the author presents a general sketch of the vegetation, and in the second he deals with the forests. Vegetation in the State of Colorado is exceedingly diverse by reason of the varied conditions of climate, and owing to the great variation in altitude the vertical distribution is more pronounced than the horizontal distribution, so that the author groups his associations according to the zones of elevation. There is little information regarding specific wild flowers beyond the illustrations of a dozen selected types and no systematic enumeration is supplied. The book is copiously illustrated with photographs of characteristic scenes or formations and the flowers referred to, making the text shorter than might be anticipated. The survey of the forest formations is more concrete, and twenty of the principal tree or shrubby genera are detailed with respect to the species and their diagnostic characters. The author announces the book as an introduction to Colorado botany, so that he may perhaps be subsequently induced to compile a flora of this interesting region.

(1) *The Historic Thames.* By Hilaire Belloc. Pp. 204. (London: J. M. Dent and Co., 1909.) Price 3*s.* 6*d.* net.

(2) *The Heart of England.* By E. Thomas. Pp. xi+244. (London: J. M. Dent and Co., 1909.) Price 3*s.* 6*d.* net.

(1) THE first of these prettily-bound volumes is a new, cheaper edition of Mr. Belloc's essay on the Thames, which was issued originally in a limited edition, costing a guinea net. The Thames and its valley is dealt with from every point of view, and the interesting description reveals an intimate knowledge of the subject. The reader's task would have been easier had the book been divided into chapters; the index, notwithstanding its completeness, scarcely takes the place of a judicious division of the essay into sections according to subjects.

(2) The second volume is a similar re-issue of essays on subjects the most diverse. Ranging as they do from "Walking with Good Company" to "The Harvest Moon" or "Fishing Boats," they will make an appeal to readers who can enjoy something other than wild adventure or thrilling incident. Mr. Thomas does not treat his subjects too seriously, and to read his essays will give much the same pleasure as listening to bright, pleasant conversation in which quiet humour takes its proper place.

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.*]

Are the Senses ever Vicarious?

THE interesting correspondence in NATURE of December 2 from Mr. G. I. Walker and Prof. McKendrick has reminded me of a passage in Nietzsche which will be found at the end of paragraph 192 of "Beyond Good and Evil." The passage has been translated as follows:—

"In an animated conversation I often see the face of the person with whom I am speaking so clearly and sharply defined before me, according to the thought he expresses, or which I believe to be evoked in his mind, that the degree of distinctness far exceeds the strength of my visual faculty—the delicacy of the play of the muscles and of the expression of the eyes must therefore be imagined by me. Probably the person put on quite a different expression or none at all."

Nietzsche's experience appears to suggest that a presentation, which is in form purely visual, may show evidence of a synthesis out of elements which are not solely of visual origin. No doubt, as Nietzsche says, the imagination plays an important part, and the same may be said of the memory; but Mr. Walker's experience seems to prove that in his case some of the elements out of which such a visual presentation are synthesised may be definitely of auditory origin. Perhaps to a psychologist this may not appear very surprising; but it certainly does seem a little surprising that, when the main source of Mr. Walker's visual experiences was cut off by the loss of his sight, the surviving auditory elements should alone be strong enough to continue to evoke presentations in visual form.

That the above is the explanation of Mr. Walker's experiences there seems little doubt. The play of expression which he "sees" will naturally follow the variations in the tone, &c., of the speaker's voice; but it is scarcely so certain that it will reproduce the actual expression of the speaker. As to the circumstance that Mr. Walker only "sees" the upper part of the speaker's face, as a rule, one may hazard the guess that this arises from the fact that in conversation the attention is generally concentrated on that part, with the result that the elements corresponding to it in the visual presentation are the most intense, and hence most likely to survive the destruction of their principal source. Presumably that which Mr. Walker sees is devoid of colour; but it would be interesting to know how the present intensity of his visual presentations compares with their intensity when he originally lost his sight.

Mr. Walker's preference for a position at an angle to the speaker possibly depends on the fact that he thereby secures a more marked difference between the sensations proceeding from the two ears—a difference analogous to the difference between the sensations received from the two eyes.

HUGH BIRRELL.

Holyrood House, Bo'ness, Linlithgowshire, N.B., December 8.

THE very interesting observations recorded in Mr. Walker's letter in NATURE of December 2 confirm in a remarkable manner the view I have always held, that in a very literal sense "seeing is believing"; that is, that a visual image is not an image on the retina, but a mental representation of what the percipient believes to be before him. As a rule, no doubt this mental representation is suggested by sense impressions coming *via* one or both optic nerves, but this is not necessarily the case; and it ought to cause Prof. McKendrick no surprise whatever to find Mr. Walker, though blind, perceiving visual images, which in his case are apparently suggested mainly by sense impressions coming through the auditory nerve.

There are, of course, plenty of arguments drawn from everyday life which point to the same conclusion, but which are so commonplace that we take them for granted without attempting to analyse their significance. I will

mention one only. From my personal experience I am utterly unable to discover any distinction at the time of perception between a visual image in waking life and one in a vivid dream. It may be that afterwards I recognise that the latter were only baseless visions, but not, as a rule, from any quality or deficiency in the visual percept itself. I am aware that it has been suggested that even in dream images the retina is in some obscure way concerned, but this assumption seems to me quite gratuitous; it is not, so far as I know, supported by any evidence, and ought to be cut off by the razor of Occam.

EDWARD T. DIXON.

The Hard, Hythe, Southampton, December 5.

The Coloration of Birds' Eggs.

WITHOUT wishing to trespass further than I can help upon the space at disposal for discussing this topic, I may just explain that in my reply to Mr. Leslie, June 11, 1908, I distinctly gave it as my opinion that coloration had no connection with Mendelian principles. I concluded that coloration often depended on habitat, and was now useful as a means of protection; but the habitats (and nesting sites) of birds *change*, hence the anomalies met with which are cited as difficulties.

As to the colour-changes of the chameleon, Mr. Leslie ought to remember that this is an act of the animal itself, and a distinctly psychic act, in no way connected with reproduction. The coloration of the bird's egg is primarily the application of a pigment—depending in intensity on health and age—by the bird upon a *product* which has already ceased to form an integral part of the animal before the pigment is applied; and the bird's egg is not—like the mollusc's shell—an organic complement of the animal producing it. One might as well try to trace the evolution of a bird from the track of its foot in the sand as from the coloration of its egg!

So the parallel is inadmissible for this simple reason alone, apart from many others. Moreover, if number, form, size, texture in the shell itself have some morphological significance in relation to the bird's oviduct and secretory sacs, being also determined earlier in the phylogeny (as in the individual's ontogeny) of the group, coloration has little, except upon the selection and store of pigment; and the saurian and early avian eggs, furthermore, were uncoloured.

Thus coloration is a recent acquisition, which, as I have already pointed out, is intimately related—just as eggs and classification are, to some extent—to *habitat*, allied species (even genera or groups) laying allied types of eggs, adopting the same mode of life and nesting site. Thus it is a *physiological* adaptation, and as such cannot explain morphological origins, though as cause and effect we may compare coloration and protection from enemies, &c. In a word, coloration exists for concealment, and markings (*e.g.* the black blotch on the cuckoo's egg) for identification.

A. R. HORWOOD.

Leicester Corporation Museum, December 20.

THE CAPTURE AND TRAINING OF WILD ANIMALS.[1]

THE name of Carl Hagenbeck has attained such world-wide celebrity that a volume from the pen of the great animal-dealer and animal-tamer must surely receive a hearty welcome from the reading public. The publishers have therefore been well advised in bringing out an English edition of the original German work, although they might have taken care that it bore on the title-page some indication of its being from the pen of Mr. Hagenbeck himself. Whether the title is an exact translation of the German one we are unable to say, but if it be so, a slight modification would have been advisable, as it certainly does not read well in English. Neither, in spite of Dr. Mitchell's testimony as to the accuracy of their rendering, can we congratulate the translators on their style. "The menagerie owner Malforteiner" (p. 226) is not, for instance, elegant English; while a sentence on p. 153 conveys the astounding statement that Mr. Hagenbeck walked off with the fore-leg of a live elephant. On p. 157, as in many other places, we find "which" repeated in the first half of a very short sentence; and on p. 168 we find it stated that "this species is often captured, but in captivity they are very liable to die." On p. 58 the word "lime," in place of "bird-lime," completely spoils a sentence.

Mr. Hagenbeck commences his narrative with an account of his early life, in the course of which he tells his readers how he was initiated into the business of buying and exhibiting animals by his father, who took it up as a kind of supplement to his own proper trade late in life. When he once felt his feet, the author of the present volume forthwith proceeded to organise the trade of wild-beast catching on thoroughly business lines; and as he is the only man that has done so, the consequence is that he has practically monopolised the whole trade. Although it at times

Young Walruses at Stellingen. From Hagenbeck's "Beasts and Men."

undoubtedly yields large profits, and is always full of interest to a man of enterprise and resource, the trade is full of risk, and demands great stability of character and perseverance in the face of losses on the part of those by whom it is conducted. We hear, for instance, of a loss of 10,000*l.* owing to disease seizing a collection of animals at the Crystal Palace for which that sum had been offered; while a sum of 5000*l.* was lost in two unsuccessful expeditions dispatched to Central Asia for the purpose of capturing argali sheep. The sheep were, indeed, captured right enough, but all died on the way home.

One of Mr. Hagenbeck's periods of great prosperity took place in the middle 'sixties and up to 1876, when an enormous number of live animals was brought out of the Egyptian Sudan. The menageries of the world were, however, overstocked, and about the year 1877 the author had almost to give away giraffes: this state of affairs induced him to take up the exhibition and training of animals in an establishment of his own—a branch of his business which culminated in the inauguration of the present animal-park at Stellingen. One of his earliest experiments in this direction was

[1] "Beasts and Men, being Carl Hagenbeck's Experiences for Half a Century among Wild Animals." An abridged translation by H. S. R. Elliot and A. G. Thacker, with an introduction by P. Chalmers Mitchell. Pp. xiii+299; illustrated. (London: Longmans, Green and Co., 1909.) Price 12*s.* 6*d.* net.

the exhibition of a herd of reindeer in charge of a party of Lapps, an exhibition which led to the importation of parties of natives from many other parts of the world.

Either personally or by means of his representatives, Mr. Hagenbeck has explored a very large portion of the globe, having brought home, and reared, walruses from Greenland, giraffes, elephants, and rhinoceroses from the heart of Africa, tigers and sambar from the jungles of India, and wild horses and onagers from the fringe of the Gobi desert. The most interesting chapters in the book are undoubtedly those in which the author describes the various methods of capturing wild animals alive, and the behaviour and habits of particular species and groups. Did space permit, we might refer to many stories of adventures and escapes, but we must be content with mentioning one case where a party of some 3000 baboons attacked and beat off the captors of their fellows. These baboons, like many carnivora, are captured as adults by means of traps; but in the case of the larger herbivores Mr. Hagenbeck's most successful method is to train the natives (if they require it) to ride in pursuit of the herds until the young ones are brought to a standstill.

The book, which deserves a fuller notice than can be given here, is rich in interest from beginning to end; and should be of considerable value to all the custodians of zoological gardens. R. L.

THE SEXTO-DECIMAL YEAR OF BRITISH CALENDARS.

IN searching English and Welsh calendars for sequences of festivals at intervals corresponding with the sun's stations on quarter and half-quarter days, or, in other words, the quarter days of both the solstitial and the May years—the octave year consisting of eight half-quarters—I find another octave year definitely marked in the calendars, and to a large extent still observed by festivals and fairs. The year of British calendars is definitely sexto-decimal, both the solstitial and May quarter days being duplicated, with the striking result that the eight half-half-quarter days coincide within three days of the exact half-half-quarter stations of the sun, the unit interval being roughly three weeks. The interval between a solstitial and a May quarter day being roughly six weeks, the duplicate octave year may be called an intermediate year.

The intermediate year is evidently the oldest octave of the two. It is the year as observed previously to the publication of the Julian calendar. Its basis was a calendar which was not corrected for the precession of the equinoxes, but which in other respects has been kept up to date. Calendars of other countries present similar anachronisms, but the persistence in Britain of such a belated calendar calls for special notice.

The jumbling together of two festival reckonings, on bases two thousand years apart, has resulted in a strikingly symmetrical sexto-decimal year. The festivals of the older octave were accurately fixed on solar quarter and half-quarter days, a fact which implies either the continued use of astronomical monuments for solar or stellar observation on those days, or a computation based on the exact length of the year. Within the Christian era, the festivals of the older reckoning drifted out of correspondence with the original solar stations. When the dates of the older sequence of festivals were marked in the Julian calendar, it was found—and I think it is hardly possible that the fact could have been overlooked—that the dates were just midway between the solar stations of a Julian sequence of festivals, and it became possible to utilise the half-half-quarter stations of the sun to indicate the incidence of the belated festivals. What makes the subject still more interesting is the discovery by Sir Norman Lockyer and others of indications of similar half-time dates in monument measures (NATURE, November 12, 1908, p. 36).

A complete sexto-decimal solar year may be expressed as follows, the nearest round number of minutes of declination being given:—

Sun's decl.	Dates
N. 23° 30′ E.	June 22
,, 21 30 ,, ...	May 29–30, July 16
,, 16 20 ,, ...	May 6, August 8
,, 8 30 ,, ...	April 12–13, September 1–2
East	March 21, September 23
S. 8° 30′ E.	February 27–28, October 15–16
,, 16 20 ,, ...	November 8, February 4
,, 21 30 ,, ...	November 30, January 13–14
,, 23 30 ,, ...	December 23

Half-quarters of the Older Octave.

Date	Dedication	Character of Festival
November 30	Andrew	All Hallows
January 13...	Hilary	Winter solstice
February 28	Oswald	Candlemas
March 1 ...	David	
April 15 ...	Oswald	Vernal equinox
June 1... ...	Tekla	May day
July 15 ...	Swithin	Summer solstice
,, 17 ...	Kenelm	
September 1	Giles	Lammas
October 15...	Ulfrann	
,, 17...	Ethelreda	Autumnal equinox
,, 18...	Luke	

When the older octave only was marked in a calendar, such a calendar was doubtless a lunar one, and sometimes the interval between two festivals exactly corresponds with the solar interval only in a lunar reckoning. For instance, January 13–April 13 represents in the Roman lunar calendar the exact interval between the winter solstice and the vernal equinox, both dates being also Ides.

The intermediate year is clearly a May one, the first quarter, November–February, being rounded by the patron saints of Scotland and Wales. There is abundant evidence of St. Andrew's having been observed as New Year's Day. The interval between St. David's Day and St. Andrew's corresponds to the length of the vegetation year pure and simple. I think St. Patrick's Day, March 17, represents, like St. David's, a Candlemas festival, by a lunar calculation like that of the Coligny calendar. That date about the ninth century coincided with the vernal equinox, when it seems to have been given an equinoctial significance in connection with the commemoration of St. Patrick; but the shamrock, like the date, is reminiscent of a Candlemas festival (NATURE, July 25, 1907, p. 295).

In one parish in Glamorgan—namely, Llangeinor—the complete sexto-decimal year was, until recently, observed by holding a court every three weeks. The patronal day is October 8, three weeks before All Hallows, but originally an autumnal equinox festival.

There is much evidence to show that the Scandinavian and German invaders of England, on the one hand, and the Welsh-speaking invaders of Wales from the north in post-Roman times, are chiefly responsible for fixing permanently the intermediate year in our calendar. So much is indicated by the list of saints commemorated, but more particularly by the association in Wales of half-half-quarter fairs with traces of northern and Scandinavian settlements

While in Wales generally hiring fairs are held in May and November, in districts like South Pembroke, known to have been occupied by Scandinavians, the hiring fairs are in April and October, and they represent an old equinoctial division of the year.

JOHN GRIFFITH.

MARINE INVESTIGATIONS IN NORWAY.[1]

THE work done by the Norwegians takes a foremost place amongst the fishery and marine investigations which have been carried out in recent years under the general guidance of the International Council, which was established in 1901 to coordinate the researches of the different countries bordering on the North Sea. The present report gives a general review of this work in readable form, without being burdened with any excess of detail, such detail being reserved for special memoirs, some of which are already published.

The introductory account of the plan and organisation of the work is written by Dr. Johan Hjort, the director of the investigations, and sets forth in the clearest way that effective combination of precise and accurate scientific investigation with practical developments of commercial fisheries which has always specially characterised the work of this investigator. Hydrographical investigation, plankton research, the study of the bottom fauna, each has received its due share of care and attention equally with the study of the natural history of fishes and the experiments which have led to the establishment of new fisheries for cod and for deep-sea prawns off the Norwegian coast.

In one important respect Norway has been especially fortunate, that is in having had the use of a research steamer, the *Michael Sars*, designed and built for the particular work of fishery research, an advantage which a parsimonious Government has denied to those who have to carry out similar work in England and Scotland. A detailed description of this vessel and her special equipment is given by Dr. Hjort, and the efficient and seamanlike way in which she must have been used could not have been better brought out than by the illustration showing the arrangement adopted for working two Petersen young-fish trawls and five tow-nets at the same time, and each at a different water-level. Equally striking are the successful results obtained by working a 50-foot otter trawl at depths of from 400 to nearly 700 fathoms.

The section of the review dealing with hydrographical investigations, by Dr. B. Helland-Hansen, summarises the results which have been reached by a study of the salinities, temperatures, and currents of the Norwegian Sea. In the concluding paragraphs of the section attention is directed to a series of striking correlations between the hydrographical conditions prevailing in the Norwegian Sea and various climatic, fishery, and other phenomena, which appear to be affected by these conditions. Evidence is given for thinking that the amount of heat which the Gulf Stream conveys into the Norwegian Sea has a controlling influence on the winter climate of Scandinavia. From the amount of warmth in the water, recorded as early as the month of May, the author considers that it should be possible to tell whether the succeeding winter will be warmer or colder than usual. For the years 1902–6, in which the investigations took place, a low temperature in the Gulf Stream in the southern portion of the Norwegian Sea in May was followed by an early fishing for cod in Lofoten in the next winter, and *vice versa*. Other correlations of a similar character are also described.

In dealing with the plankton investigations, Dr. Damas gives an interesting account of his observations on the distribution of the medusa, *Cyanea capillata*, which is of considerable importance from its intimate association with the fry of the haddock, whiting, and cod. The fry of these fishes shelter themselves under the disc of the jelly-fishes, and are borne along with the latter in their passive wanderings. Shoals of these Cyanea have been traced from the shores of Jutland into the Skagerak, and thence along the coast of Norway to the north, carrying the young fish with them. Another medusa, *Cyanea lamarcki*, which has its home in the temperate Atlantic, occasionally reaches the west coast of Norway, accompanied by the fry of southern gadoid fishes, poor-cod, pout, and pollack.

But in addition to the more indirect, though not therefore less important or less fruitful, ways of approaching fishery problems, represented by the hydrographical and plankton investigations just mentioned, the Norwegians have devoted very considerable attention to the natural history of the fishes themselves. Dr. Damas writes on the distribution of the eggs and young stages of the gadoids, and gives also many results of the greatest significance concerning the age and growth of these fishes. By an examination of the scales it is now possible to determine with considerable certainty the age of each individual fish. Many catches of cod and haddock were examined in detail in this way, and the number of fish belonging to each year-group was ascertained. The important fact has been determined that fishes born in certain years largely preponderate in the catches, and the effect of these favourable breeding years can be traced in the catches year after year. Similar results have been obtained by Knut Dahl in the case of the herring. Thus in a sample of spring herring examined in the spring of 1907 the eight-year-old fish were in remarkable abundance. The same year-class, in the autumn of 1907, was the most numerous of all the thirteen year-classes which composed the large herring of the coast of Helgeland. In the spring of 1908 several thousand spring herring were examined, and the nine-year-old fish were conspicuously abundant. In the autumn of 1908, in a large sample of herring from Kristiansund, it was found that the 9½-year-old fish were more numerous than either the preceding or succeeding year-classes. In samples from the North Sea and Skagerak the data appear to indicate that here, also, the same year-class predominated. It is clear that knowledge of this kind, if regularly and systematically collected, will enable estimates of the yield of the fisheries to be made some years before the fishing actually takes place, a result which cannot but be regarded as a triumph for the scientific method of approaching fishery problems.

Space has only allowed us to touch upon a few of the more striking features of this report. One would imagine that a perusal of it must convince the most sceptical of the value of the new knowledge which is now being rapidly made available as the result of the labours of the International Council for the Study of the Sea. Unfortunately, in this country the continuation of the work still, to some extent, hangs in the balance, but it is to be hoped that our Government, representing as it does by far the largest fishery interest of the countries bordering on the North Sea, will be induced to take a broad view of its responsibilities.

1 "Review of Norwegian Fishery and Marine Investigations, 1900–8." Report on Norwegian Fishery and Marine Investigations, vol. ii., 1909, No. 1.

THE SURVEY OF INDIA.[1]

THE report on the operations of the Survey of India for the year 1907–8, in addition to the usual record of map-making of a utilitarian character, contains several features of scientific interest. We have long been accustomed to a high standard of work from this department, and it cannot be other than a subject of congratulation that we should see evidence, not only of the maintenance of its previous level, but also of continuous advance. The most recently completed geodetic triangulation, extending for a distance of 480 miles from the Indus to the peak Koh-i-Malik Siah, the junction point of India, Persia, and Afghanistan, is the most accurate operation of its class ever carried out in any country. Computed by the ordinary methods, the probable error of a single angle is 0″·21, a quantity not much more than half that of the corresponding figure obtained in any triangulation outside India.

This series of triangles carries the geodetic work to a point marking the most westerly limit reached by the principal triangulation of India. At this distance from the centre of the network the errors of the assumed spheroid become noticeable. Thus the astronomical azimuths observed along this line are consistently smaller than the azimuths computed from the triangulation, showing that the computation is taking the points too far to the north, *i.e.* that the curvature of the spheroid used for the reductions is, over this region, appreciably greater than that of the true geoid.

Pendulum operations were carried on during the year with the special object of ascertaining whether the force of gravity would be found in defect in submontane tracts in the south of India to the same degree as in the Himalayan region. In all cases the deficiency was found to be considerably less at these stations than at places of similar altitude in the north. It was also found that for stations on "isolated" hill-masses the degree of compensation of the visible mass is much less than it is on Himalayan stations. From this the general inference is drawn that it is chiefly the subjacent masses that affect the compensation of those visible on the surface.

All this is quite in accordance with the theory, first advanced by Osmond Fisher, that the "roots" of mountain masses are broader and shallower than the mountains themselves. The time is not far distant when it will be possible to draw an approximate section of these roots. It would be interesting to attempt this, in the first instance, by selecting a mountain, of as great a mass as can be found rising abruptly in a flat country, and carrying out a detailed gravimetric survey of the whole area, including the mountain and the flat region, for a considerable distance from it.

The year under review marks an important epoch in the history of the magnetic operations in India in that the preliminary magnetic survey was completed over the whole country with the exception of some frontier regions. Three iso-magnetic charts are published in the report, showing respectively (1) isogonals, and lines of equal secular change of declination; (2) isoclinals; (3) lines of equal horizontal force. During the current year the beginning of the detailed magnetic survey was projected.

Among other points of interest we may note a re-standardisation, with the international metre at Sèvres, of Colonel Everest's old 10-foot standard, indicating that no appreciable change has taken place in the lengths of the Indian standard bars during the last forty years.

Latitude observations were made with the view of eliciting some information as to the cause of the abnormally high deflection of the level found at Chaniana. It was observed that the deflection diminished rapidly in every direction from the apparent centre, and the conclusion is drawn that its magnitude originates "in a purely local cause, situated either at the surface or at a small distance below it."

E. H. H.

[1] General Report on the Operations of the Survey of India, administered under the Government of India during 1907–8. Prepared under the direction of Colonel F. B. Longe, R.E. Pp. iv+62, and maps. (Calcutta: Government Printing Office, 1909.) Price 3*s*.

NIGERIA AND ITS PLANTS.

THE first part of an account of "The Useful Plants of Nigeria," written by Mr. J. H. Holland, now of Kew, but sometime curator at Calabar, appears as one of the Bulletins of Miscellaneous Information (Additional Series, ix.) recently issued by the Royal Botanic Gardens, Kew. A brief outline of the history of Nigeria is given in the bulletin, followed by a survey of the physical features, climate, peoples, botany, agriculture, and forestry, and finally the first part of the account of the useful plants of Nigeria.

Mr. Holland complains that "all the maps constructed so far have been compiled in England from sketches made at various times by numerous surveyors independently of each other." This must have been written some years ago, as Government surveyors have been at work since 1902, both in Lagos and southern Nigeria, and some very good maps have been compiled and issued both by the Survey and the Intelligence Department since 1906. In this connection southern Nigeria has to be congratulated on the excellent work done by skilled native surveyors who have been trained on the coast by the heads of these departments.

It is only too true that the entrance to most of the rivers is too shallow to admit steamers of any great draught, but it has to be remembered that this difficulty has to a certain extent been met by the remarkable build of Messrs. Elder Dempster's steamers, and so far as Lagos is concerned by the indomitable will of Governor Egerton, who already has two great dredgers at work on the Lagos bar. Much larger steamers are now entering the Lagos lagoon, and the hope is that passengers for Lagos who are now transferred from the ocean-going steamers to branch boats will soon be able to land direct on the marina. When these difficulties are overcome, and the railway, already open as far as Jebba and beyond, reaches the hinterland of northern Nigeria, Europe will have easy access to a climate described by Mr. Holland as bracing and delightful, and a country rich in agricultural and mineral wealth.

Under the heading "Climate," Mr. Holland touches on the remarkable difference between the rainfall on the coast and the interior; "during 1906 the maximum rainfall was 251·49 ins. at Egwanga, and the minimum at Olokemeji 40·92 ins." The latter place is only ninety miles from the coast. The author also mentions the Harmattan, a wind which comes from the north-east, across the Sahara desert, characterised by excessive dryness. This wind is prevalent during the dry season, and it is this break in the seasons and this Harmattan that we fear are going to decrease the yield of latex of the Para (*Hevea brasiliensis*) introduced from Ceylon. The Director of Agriculture for the French Colonies on the West Coast of Africa is said to be satisfied, so far as the coast is concerned, that *Hevea brasiliensis* is not going to be a success. We know that the trees at Aburi, on the Gold Coast, have ceased to yield latex. From experiments, however, in southern Nigeria on trees nearly

eight years old, it is expected that the yield per tree will be more than that now given by the native tree (*Funtumia elastica*), but less than that extracted in Ceylon or other places where this break does not occur.

Mr. Holland, under the heading "Botany," touches on the remarkable "increase of our knowledge of the flora of Tropical Africa," which he says "is due to several causes. Old collections

"of very considerable extent which had only casually and partially been studied have now been worked up systematically (*e.g.*, Barter's West African, Schweinfurth's Sudan, and Welwitsch's Angola collections); fresh collections have poured in as new countries were opened up or the establishment of botanical stations in the older colonies facilitated a more exhaustive exploration of their neighbourhood; finally, it was just then Germany started with remarkable and well-directed energy on the botanical survey of her colonies, with the result that in not a few orders 50 per cent. or more of all the additions from recent collections are due to her enterprise."

Anyone who has resided in Nigeria, and has had other duties to attend to, must have had cause to bemoan his inability to make satisfactory horticultural, museum, or herbarium collections; well, in this book he will find full instructions how to make them, though the reader, while thankful to Mr. Holland, will still wonder why Hooker's country has not had the enterprise to do the same as Germany.

The botanical station at Ebutemeta, formed in 1887, has been reduced very greatly in area owing to the needs of the fast developing Lagos Railway, and as it cannot be extended in any direction, has almost ceased to be a distributing centre. But we may fairly conclude that the department's work has not been in vain from the following advertisement in the *Nigerian Chronicle*, October 22, 1909:—"FLOWERS, FLOWERS, FLOWERS! Apply to ONOFUNMI GARDENS, FAJI MARKET."

Olokemeji has quite taken the place of the gardens at Ebutemeta, and is a very large distributing centre. It has become the headquarters of the Forestry Department in southern Nigeria. Native pupils are being trained as agricultural and forest instructors in this interesting spot, once a great Abeokuta war camp. We note the omission of a plan of the gardens and reserve at Olokemeji, but plans are included of the now famous gardens in Calabar, which the author had so much to do in founding, and also of the plantations at Onitsha. He also gives a very interesting historical account of the founding of these botanical stations, and finally of the origin of forest conservancy in Nigeria.

The first part of this interesting publication closes with an incompleted list of the useful plants of Nigeria, a work long looked for by all those interested in the economic development of this remarkable dependency of Great Britain. Wherever we may happen to open this instructive book and commence reading we are at once interested, for be the subject fruit or seed, fibre or timber, the author has so much to say of their virtues and uses that we are for the moment apt to forget all sordid difficulties and to wonder how it is more fortunes have not been made in Nigeria. For instance, the author, describing the *Lophira alata*, writes:—"The wood is very hard and heavy . . . described in the trade as a first-class heavy fancy wood; used for furniture and turnery (Mus. Kew). Admiralty experts have valued it as better than teak (*Tectona grandis*), at about 8*d.* per foot." Now, knowing that this wood is very abundant in Nigeria, timber merchants there have shipped it home, and instead of the expected 8*d.* have had to receive 2½*d.* or 3*d.* If the Admiralty or any buyer in Europe would guarantee the merchants in Nigeria 5*d.* per foot for this timber the buyer could rely on a constant supply, and the merchants would make their fortunes. It is the varying uncertainty in the price of mahogany that makes the timber trade such a dangerous one for the merchant, and is perhaps one of the causes why the Forest Department has been urged to start plantations of teak, plantations, by the way, which are so far doing extremely well.

The need that Mr. Holland has so ably endeavoured to satisfy is a really great one, and we can only hope that the reception of his book by the public—so keen on the natural products of Nigeria—will be such that he will soon be tempted to give us another edition of "The Useful Plants of Nigeria," as full as possible of illustrations.

EUGENICS, MENDELISM, AND BIOMETRY.[1]

NOW that the public has become familiar with the word eugenics, it is right that an exposition of its meaning by Sir Francis Galton, the founder of the science, should be easily accessible, and this the Eugenics Education Society has wisely provided by the publication of "Essays in Eugenics." The first essay is on "The Improvement of the Human Breed, under Existing Conditions of Law and Sentiment." It was delivered as the second Huxley lecture before the Anthropological Institute on October 29, 1901. Then follow "Eugenics: its Definition, Scope, and Aims," "Restrictions in Marriage," "Studies in National Eugenics," and "Eugenics as a Factor in Religion," read before the Sociological Society in 1904 and onwards. After this comes the Herbert Spencer lecture delivered before the University of Oxford in 1907, on "Probability, the Foundation of Eugenics," and the volume is concluded by an address to a meeting of the Eugenics Education Society in 1908 on "Local Associations for Promoting Eugenics." The volume, of which the titles quoted give an indication of the contents, forms an admirable introduction to the subject. The host of objections which immediately spring to the mind and tongue of ordinary educated people on first receiving the idea of conscious selective breeding in man are here met with easily intelligible arguments and with common sense. It is to this and to the moderation with which the author expounds his thesis that the present wide realisation of its practicability must be due.

The *Mendel Journal*, of which the first number appeared in October, has been founded in order "that Mendelism shall be presented to a wider public by men who believe in its truth, foresee its future, and who recognise their responsibilities in the work they do," also in order "to gather for the science of genetics a harvest rich in facts relating to human pedigrees and the inheritance of normal characters as well as of peculiarities," and finally "to make it a medium by which authoritative advice and direction may be given in the form of answers to questions upon matters of general interest relating to problems of cattle, cereal and plant breeding."

More than one-third of the number is taken up by an address by Mr. G. P. Mudge, entitled "Biological Iconoclasm, Mendelian Inheritance and Human Society," delivered to the Mendel Society and to the Eugenics Education Society in June, 1908.

Like many lecturers on eugenics, Mr. Mudge realised that in order to convince people of the supremely important part played by heredity in determining physical

[1] (1) "Essays in Eugenics." By Sir Francis Galton, F.R.S. Pp. vi+109. (London: The Eugenics Education Society, 1909.)
(2) *The Mendel Journal*, No. 1, October, 1909. Pp. 216. (London and Manchester: Published for the Mendel Society by Taylor, Garnett, Evans, and Co.) Price 2*s.* 6*d.* net.
(3) *Biometrika*, vol. vii., parts i. and ii., July and October, 1909. Pp. 236. (Cambridge: University Press.) Price 20*s.* net.

and mental characters in man, it was necessary to free their minds from common error that the predominant determining factor is environment. His method of attempting to do this is vigorous assertion, unsupported by any direct evidence. That improved bodily conditions and suitable education can effect a great improvement in even the least promising human material is a belief widely and probably correctly held; yet Mr. Mudge tries to shake it by arguments such as the following:—"From the fertilised ovum of a fish there is developed a fish, not a bird. Transference of the bird to water, or the fish to the skies, will not convert the one to the other." He complains of others "setting up a dogma that rushes in where biological philosophy fears to tread," but his own biological philosophy is none too diffident, and indeed bears a striking resemblance to dogma. His failure to produce direct evidence as to the relative effects of heredity and environment in man is no doubt due to the fact that very little evidence is available, but this should be frankly acknowledged.

Mr. Mudge then goes on to describe very fully and clearly a simple case of Mendelian inheritance in rabbits, and mentions certain phenomena of inheritance in man which are explicable on a Mendelian hypothesis. He concludes with what is in effect a plea for eugenics, which for him seems to follow as a corollary to Mendelism. To us it appears that he would be more likely to win proselytes if he had rested his case on the broader basis of the generally admitted facts of human inheritance. For although in certain cases these may bear a Mendelian interpretation, it cannot be argued that Mendel's laws have been demonstrated at all widely for man; and it is certain that they have not been demonstrated for any of the characters which constitute civic worth.

Two other papers read to the Mendel Society are included in the journal, namely, J. T. Cunningham, "The Evolution of Man," and C. C. Hurst, "Mendelism and Sex." Original research is represented by "Parthenogenesis in Nicotiana," by Mrs. R. Haig Thomas. Among other contributions from G. P. Mudge are three family histories described in careful detail. These are the first of "Mendelian Collection of Human Pedigrees," which appears as a sort of rival to the "Treasury of Human Inheritance," issued by the Galton Research Laboratory in National Eugenics.

Under the heading "Methods and Results" are included three papers by "Ardent Mendelian"; of these the first calls for special comment. It purports to deal with the "present position of Mendelians and Biometricians." Its meaning looms a little vaguely from a cloud of martial imagery, in which biometricians are represented as an army unsuccessfully resisting the encroachments of Mendelians. The author appears to us completely to misunderstand the position of biometricians, which is simply this, namely, that statistical methods may be applied with advantage to the study of many biological problems, including that of heredity; they do not hold that these methods should be applied to the exclusion of others, such as the Mendelian; and the validity of the statistical descriptions obtained by the correct application of their methods would be in no way impaired, even if Mendel's laws were proved to be universally true. We regret to note that the tone of this article is calculated to be offensive to biometricians; as an instance the following sentence may be taken:—"We may further infer, therefore, that the discipline of the army is very severe, and perhaps this may throw some light upon the constant reappearance of the figure 0·5 in relation to the size of some of its artillery equipment." Since 0·5 is the value obtained very frequently as a fraternal correlation coefficient, it must be assumed that "Ardent Mendelian" means that this agreement is, to put it crudely, the result of "faking." If serious charges of this kind are to be made, they should be made in plain English, and supported by strong evidence. We do not know whether the *Mendel Journal* has an editor; if it has, we venture to suggest to him that it will not lose in dignity or influence by adopting a more courteous tone. It starts with a clean sheet, and need not perpetuate the bitterness engendered by old controversies.

We regret that space does not permit us to deal with the many interesting papers published in this double number of *Biometrika*, but will make reference to two only selected from them. Dr. Galloway gives an account of his seventeen years' experience of canary breeding, with a partial analysis of the results. His conclusions, valuable in themselves, together with the clear descriptions and figures which he gives of the different points of the various breeds of canaries, should be of the utmost assistance to anyone proposing to breed these birds, either as a fancier or for the purpose of studying the problems of heredity.

Dr. Jenkinson deals with the relation between the symmetry of the egg, the symmetry of segmentation, and the symmetry of the embryo in the frog; he finds that "the position of the symmetry plane of the egg is determined, in the absence of external factors, by the path of entrance of the spermatozoon, and the point of the entrance is nearly always opposite to the grey crescent. The position of the first furrow is determined by the second part of the sperm path, the line of union of the male and female pronuclei. Thus the internal factors which determine differentiation and the direction of cell-division are not the same, although they may coincide (when the two parts of the path lie in the same meridional plane). They are also influenced differently by different external factors." It appears that there is always a closer relation between the plane of symmetry of the unsegmented egg and the sagittal plane of the embryo than between the first furrow and either of them. E. H. J. S.

DR. SHELFORD BIDWELL, F.R.S.

SHELFORD BIDWELL was a distinguished member of that class of men to whom English science owes so much, the amateur, who, holding no post as a professional scientific man or teacher, by voluntary devotion enriches science with investigations of permanent value.

Born at Thetford in 1848, and trained at Caius College, Cambridge, he was placed among the Junior Optimes in the Mathematical Tripos of 1870, and in the following year he obtained second-class honours in the Law and History Tripos. He read for the profession of law at Lincoln's Inn and was called to the bar in 1874. While he was practising as a barrister he cultivated his taste for physical science, and was attracted to the meetings of the then newly founded Physical Society, which he joined in the spring of 1877. Years afterwards, in his presidential address of 1898 to that society, he referred to the matter in the following terms:—

"One of the most useful functions of these institutions (the Physical and other kindred societies) is to bring together and promote friendly intercourse among fellow-workers in a particular branch of science. In this connection, I myself (if you will pardon me for referring to personal matters) owe a heavy debt of gratitude to the Physical Society. At the time when I was desirous of becoming a member, I was not personally known to a single man who was in a position to support my candidature. After some preliminary correspondence, I introduced myself to

Prof. Roberts-Austen, then one of the secretaries; he kindly gave me an introduction to Prof. Adams, the president, and the two were good enough to sign my recommendation form. Who furnished the third signature I never ascertained. In spite of this somewhat inauspicious *début*, it was my good fortune after, and solely as the result of, a few years' more or less regular attendance at the meetings to have made a large number of acquaintances, and, I may say, very good friends, among the leaders and workers in science. I have long regarded my connection with the Physical Society as the source of one of the chief interests of my life; and for the highly valued honour you have done me in electing me to be your president, I cannot sufficiently express my thanks."

Bidwell's first communication to the Physical Society was read on March 13, 1880; it was entitled "On the Influence of Friction upon the Generation of a Voltaic Current," and was a simple investigation into the causes of the operation of the Edison "motograph" or chalk-cylinder telephone receiver. He considered his experiments to show conclusively that the explanation of the changes of friction in that instrument is the electrolytic liberation of a film of hydrogen gas. For the next three or four years he was chiefly occupied which the photo-electric properties of selenium. He invented a method of telegraphic photography based on the use of selenium. In the course of his work he did much to clear up the obscurities and contradictions which until then had hung over the behaviour of selenium. Being himself an excellent mechanic, and having equipped for himself a workshop in his house, he constructed, with his own hands, many simple and beautiful experimental appliances. His method of constructing selenium cells with copper wires wound upon a slip of slate or of mica brought selenium cells within the reach of all experimenters. He investigated the effects of temperature and of moisture upon selenium cells. He also investigated the kindred properties of cells made with mixtures of sulphur and carbon. The next subject to claim his attention was the alleged change in the resistance of carbon under pressure, which led him to a careful investigation of the whole question of microphonic contacts. In an article communicated to the Royal Society, he considered the methods of measuring the electrical resistance of contacts, and found that though the moment before the measurement is made the resistance may be sensibly infinite, the very act of measurement reduces it to a few hundred ohms. Here he touched the question of the coherer, which was destined in a short space to become, in the hands of Branly and of Sir Oliver Lodge, so vastly important for the study of radio-telegraphy.

Bidwell was always a most conscientious worker, never satisfied to publish until he had convinced himself of the reality of his results, and of their originality. He took endless pains to discover what might have been previously published on any subject at which he was working. He had a curious distrust of himself while at work, coupled with a singular confidence in the results when they were once established. He had a profound dissatisfaction with half-knowledge, but yet those subjects as to which knowledge was in an imperfect stage possessed for him a singular fascination. Most of his work consisted in unravelling paradoxical facts or obscure phenomena. Thus he investigated the magnetic expansion of iron, and cleared away the obscurity involved in the case of straight rods by the action of their poles, by showing that an iron ring (which possesses no poles) also expands on being magnetised. In connection with this subject, he re-examined the law of magnetic traction. He was the discoverer, too, of the paradoxical fact that an iron electromagnet, if its core is made of an iron tube with short plugs fitting loosely into its ends, when it is magnetised grows longer by pushing the plugs out, instead of attracting them in. Later, and by a beautifully refined piece of home-made apparatus, he showed that the impact of light is able to affect directly the magnetic state of a carefully demagnetised soft iron rod.

His attention was then directed to the subjective phenomena of vision, and he made innumerable experiments on the "ghosts" that are seen following in the train of a luminous body moving across a dark field. He produced some very extraordinary and paradoxical illustrations of colour-vision by intermittent illumination and vision of coloured objects, which he caused to appear of tints complementary to their actual pigments. The result of these investigations he embodied in a most interesting book, written in a popular style, but essentially scientific throughout, called "Curiosities of Light and Sight," published in 1899. He lectured more than once on these matters at the Royal Institution. Unhappily, in his experiments his eyesight became seriously impaired, and he was threatened with blindness. Fortunately, however, after many months he recovered, and was able to read without pain. In 1900, Bidwell received from his own University of Cambridge the degree of D.Sc. He had been elected a Fellow of the Royal Society in May, 1886; and he served on the council of that society from 1904 to 1906. His presidency of the Physical Society in 1897-9 has already been alluded to. Amongst his later work was the writing of the article on magnetism for the new volumes of the "Encyclopædia Britannica." In consequence of troubles arising from an affection of the heart, Shelford Bidwell had not been able to attend any scientific meetings for more than eighteen months, his last visit to the Royal Society being in May, 1908. He died on December 18 at his residence, "Beechmead," Oaklands Chase, Weybridge, at the age of sixty-one.

DR. R. BOWDLER SHARPE.

IT is with great regret that we have to record the death of Dr. Richard Bowdler Sharpe, at his residence in Chiswick, on December 25. Although Dr. Sharpe had been in indifferent health for some considerable time, he was on duty at the Natural History Museum at least as late as December 14, so that the fatal attack was of comparatively short duration.

Born in November, 1847, and therefore just over sixty-two years of age at the time of his death, Dr. Sharpe was the son of T. B. Sharpe, a publisher, of Cookham and Malvern Link. Educated at Brighton and at Peterborough and Loughborough grammar schools, he entered the service of Messrs. W. H. Smith and Son at the early age of sixteen, and after remaining two years with that firm, migrated in 1865 to the establishment of Mr. Quaritch. Two years later he was appointed to the newly-founded librarianship of the Zoological Society of London, a position which brought him into contact with Dr. P. L. Sclater, and thus no doubt tended to foster that taste for ornithology with which he had been imbued from very early years. Be this as it may, by 1872 Dr. Sharpe had become an accomplished ornithologist, and he was appointed in that year to a senior assistantship in the zoological department of the British Museum, a position from which he was promoted to an assistant-keepership in the vertebrate section in 1895, this latter post being held by him at the time of his death.

Dr. Sharpe was a Fellow of the Linnean and Zoological Societies, an LL.D. of Aberdeen University,

and holder of the Emperor of Austria's gold medal for distinction in science; in 1905 he was president of the fourth Ornithological Congress, which met in London.

In addition to being joint author of the earlier portion of the "Birds of Europe" and sole author of various bird-monographs such as those of the kingfishers and birds-of-paradise, Dr. Sharpe compiled 13 out of the 27 volumes of the invaluable British Museum "Catalogue of Birds," and was responsible for the whole of the 5 volumes of the companion work, the "Hand-list of Birds," of which the last volume was completed only a short time before his death. As regards his knowledge of the external features of birds, and his capacity for identifying species, Dr. Sharpe was, if not unrivalled, at all events unsurpassed; and his preeminence in these respects received world-wide recognition. Unfortunately, he knew little of the anatomy of birds, so that in his address on "Attempts to Classify Birds," read before the second Ornithological Congress at Budapest, in 1891, he had to depend for this portion of his subject on information borrowed from Seebohm, who had in turn been mainly dependent upon Kitchen Parker. Under Dr. Sharpe's supervision, the collection of bird-skins in the British Museum increased by leaps and bounds, and has now attained vast dimensions, while it is specially valuable on account of the number of "types" it contains.

As a relaxation from his ornithological studies, Dr. Sharpe devoted, during the later years of his life, a considerable amount of time to the natural history and antiquities of Selborne, where he owned a cottage in which he spent much of his holidays. As the result of these leisure-time studies, he brought out a beautifully illustrated edition of "White's Selborne" in two thick volumes.

THE NATURAL HISTORY MUSEUM.

THE *Times* of December 28 includes further correspondence upon the question of the separation of the Natural History Museum from the British Museum. In the two letters subjoined, Prof. A. Sedgwick and Sir Ray Lankester reply to the letter of Sir Archibald Geikie, published in that journal on December 13, and reprinted in NATURE of December 16.

I much regret that it should be necessary for me to address you again on the subject of the Natural History Museum, but the publication of the correspondence between Mr. Lowther and Sir Archibald Geikie in your issue of December 13 last leaves me no alternative. The only satisfactory thing about the correspondence is the admission by Mr. Lowther that the Trustees are uneasy in their own minds as to the satisfactoriness of the present arrangements. They "are anxious to be reassured," Mr. Lowther writes, "that the management of the Natural History Museum is adequate." This is a sign of grace, if only a small one, but such as it is we are thankful to have obtained it.

Before proceeding to deal with Sir Archibald Geikie's letter, there are two small points to which I desire to call the attention of your readers. The first of these concerns the views of the Trustees as to the proper person to call in for judgment in a matter directly concerning the administration of the Museum. They call in one of their own body. This seems to me to constitute a new departure in judicial procedure. The second is the fact that the President of the Royal Society, in his capacity as Trustee, has allowed himself to be nominated public censor of those of his colleagues who in the last forty years have expressed objections to the system which is under discussion. I also desire to emphasise the following points:—(1) In this prolonged agitation it has always been the system of administration, and not the persons administering the system, which has been impugned. (2) The living protagonists of the agitation hold that a system of control by Trustees is the best, provided that their number is small and that the scientific element, whether professional or other, is not represented as such (see NATURE, April 29, 1909, p. 254).

I now proceed to the consideration of Sir Archibald's letter. It is painful to me to have to call in question the deliberate statement of a much respected friend, and one who holds the high and honoured position of President of the Royal Society. It is hard to be certain of one's motives, but I believe that my sole motive in the present case is that of the interests of science. I also wish to say that I have the same belief as to the reasons which have induced Sir A. Geikie to write his remarkable letter. The issue between us, therefore, is simply one of fact, and can only be decided by an inquiry. I had hoped, especially after Mr. Montagu's letter to you of November 19, that the Trustees might be willing to set their own house in order, and that an inquiry might be avoided. I have not always held this view, and for two years, acting in conjunction with my colleagues, I pressed for an inquiry; but I came to see that there were many difficulties in the way of an inquiry and objections to the possible legislation which might result therefrom, and that the essential points in which we deemed the museum administration defective might be remedied by the action of the Trustees themselves. I therefore welcomed the suggestion in Mr. Montagu's letter, and wrote to you to say so. But so long as Sir Archibald's statements are accepted as authoritative, and so long as the Trustees think along the lines of Mr. Lowther's letter, it is clear that reform from within is impossible, and that an inquiry by impartial outsiders is a necessity.

As Sir Archibald Geikie says that he has made a "careful investigation of the facts of the case," we may presume that all his statements, particularly those which can be tested without any inquiry, will be accurate. Let us submit his letter to that test. His first statement is that the "agitation has been carried on fitfully but persistently in the public Press for many years, and has been supported by *some* well-known men of science" (the italics are mine). That Sir Archibald should have made this statement shows that his investigation has been, to say the least of it, superficial. The recent (during the last half-century) history of the agitation is as follows. In the year 1866 there was a memorial to the Chancellor of the Exchequer, signed by all the most famous biologists of the time (I will enumerate them when I deal with the word *some*), stating that they were "of opinion that it is of fundamental importance to the progress of Natural Sciences in this country that the administration of the national Natural History Collections should be separated from that of the Library and Art Collections, and placed under one officer, who should be immediately responsible to one of the Queen's Ministers." In the year 1874 the Royal Commission on Scientific Instruction and the Advancement of Science, having fully considered the state of the Natural History Departments in the British Museum and taken evidence thereon from the principal scientific authorities of the country, came to the same conclusion. In 1879 the Council of the British Association for the Advancement of Science prepared a memorial to the Prime Minister pointing out that the views of scientific men on this subject, as embodied in the recommendations of the Royal Commissioners, had been entirely overlooked, and that "the question of the administration of the Natural History Collections is one of the utmost importance as regards the future progress of Natural History in this country," and urging upon the Government to take the opportunity afforded by the removal to South Kensington "of effecting the alterations in the mode of administration of the Collections recommended by the Royal Commission." Now ensued a lull in the agitation for twenty years. The cause of this lull is highly instructive, and must be mentioned here. Hitherto the head of the Natural History Collections had been entitled Superintendent, and had been subordinate to the Principal Librarian. In 1885, on the recommendation of the Principal Librarian, Sir E. Bond, the office of Superintendent was replaced by a new office, that of Director, with new duties, new responsibili-

ties, and new salary. The Director was made entirely independent of the Principal Librarian, except in financial matters. Financial independence was offered him, but declined. This meant that the Trustees had accepted the recommendations of the Duke of Devonshire's Commission so far as concerned the independence of the Museum. In 1898, on Sir W. Flower's retirement, it became known that the Trustees had in contemplation the revocation of the position of comparative independence assigned in 1885 to the Director of the Natural History Museum. Accordingly, a memorial was presented to the Trustees stating that, in the opinion of the memorialists, it was "of great importance to the welfare of Natural History that the principal officer in charge of the national collections relating to the subject should not be subordinate in authority to any other officer of the Museum." This memorial was published in the *Times* on July 9, 1898, and on the following day a letter appeared from the Principal Librarian stating that the petitioners had been misinformed, and that no change in the status of the Director was in contemplation. In spite of that public statement the fears of the memorialists were realised, for either in July or August of that year the position of comparative independence assigned to the Director of the Natural History Museum in 1885 was revoked, and the new Director who was appointed shortly after found himself—quite unexpectedly in view of the letter just referred to—in a position very different from that of his predecessor. In September, 1907, a memorial praying that advantage might be taken of the approaching vacancy in the Directorship to hold an inquiry into the administration of the Museum was sent to the Prime Minister, who in July, 1908, received a deputation on the same subject. As nothing resulted from this last effort, a letter was addressed to the *Times* on April 19 of this year calling the attention of the public to the matter. So much for the suggestion that the agitation on this matter has been a Press agitation.

I must now pass to consider the suggestion contained in the words "supported by *some* well-known men of science." The memorial of 1866 was signed by G. Bentham, W. B. Carpenter, W. S. Dallas, Charles Darwin, F. D. Godman, Joseph Hooker, T. H. Huxley, John Kirk, Lord Lilford, A. Newton, W. K. Porter, O. Salvin, P. L. Sclater, S. J. A. Salter, H. B. Tristram, A. R. Wallace and others. The Report of the Royal Commission was signed by the Duke of Devonshire, Sir J. Lubbock, Sir J. P. Kay-Shuttleworth, Dr. Sharpey, T. H. Huxley, G. G. Stokes, Prof. Henry Smith, Mr. B. Samuelson, Sir Norman Lockyer being Secretary. The memorial of the Council of the British Association was signed by W. Spottiswoode, Douglas Galton, P. L. Sclater, on behalf of the Council. The memorial to the Trustees in 1898 was signed by Lord Kelvin, G. G. Stokes, M. Foster, A. Rücker, John Murray, Francis Galton, Henry Thompson, W. Turner, Benjamin Baker, A. R. Wallace, W. F. R. Weldon, amongst others—I have not access to a complete list. The memorial of 1907 was signed by all the Professors of Zoology in the United Kingdom except two, and was supported by all of them. The deputation to the Prime Minister of 1908 consisted of some of these Professors, supported by Mr. Francis Darwin and Dr. Marr. From these lists it is clear that, although it would not be correct to say that this long-continued agitation has received the support of all well-known men of science, yet it would have been nearer the truth if Sir Archibald Geikie had used the word *most* instead of *some* in referring to the support it has received, for the cream of certainly two, and perhaps three, generations of English men of science have taken part in the agitation. Having thus shown that Sir A. Geikie has been inaccurate, not to say loose, in two of his statements of fact, what weight can be attached to any opinion that he formulates in his letter on the subject under discussion? He says that the result of his inquiry has been to convince him "that the agitation has no substantial justification, but has arisen from misapprehension and ignorance," and he goes on to reprove those who have taken part in it in these words:—"If the actual state of the matter had been realised no agitation ought ever to have been started." This is Sir Archibald Geikie's opinion. Let us try to realise for a moment what an extraordinary state of mind it reveals! What a contempt for his colleagues, some of them among the greatest naturalists of the world's history, not to mention great names in other branches of science, some of whom had made a special and prolonged inquiry as members of a Royal Commission specially deputed to deal with this matter, and were masters of administrative methods! His contempt for the knowledge and judgment of his most distinguished scientific contemporaries is so colossal that it almost touches the infinite. But I need not labour this point, nor need I refer to his estimate of the knowledge of those of his zoological colleagues now living, all of whom by their avocations have a special interest in the Museum.

We now come to the last and most important point of all. Sir Archibald says that "the allegation so constantly made, that the Director of the Natural History Museum is under much more than merely nominal control of the Director and Principal Librarian at Bloomsbury is without any real foundation." This, of course, is his opinion on the question which has always been at issue. We, that is my colleagues and myself, traverse it absolutely. Can it be supposed that all the distinguished men in the past whom I have mentioned, and all the biologists now living who have paid special attention to the matter, have undergone the labour and expenditure of time and money which this prolonged agitation has involved without convincing themselves of the reality of this basal element in the question? It is true they may be wrong and Sir Archibald right, but what, I ask all unprejudiced men, are the probabilities? It may be said in reply, "Yes, but what are your reasons for holding this view? You must at least state them." A most reasonable request, with which we are only too anxious to comply if the opportunity is given us. Unsupported statements are worth little, and may easily be turned into personal attacks and lead to useless and hurtful recriminations. An inquiry must be held before a proper tribunal which can receive and sift evidence on this question so important to biological science in England.

At the end of his letter Sir Archibald Geikie draws a red herring across the scent by referring to a matter which, however deeply we may feel it, we have always avoided. It is not the question at issue. That question existed long before the recent circumstances to which he refers arose, and will, unless dealt with, continue long after they are forgotten.

ADAM SEDGWICK.

Imperial College of Science and Technology,
December 20.

I am sure that everyone connected with natural history or with the Royal Society recognises the amiable tactfulness and discretion of our worthy President. These qualities explain the opinion which he has expressed in reply to an inquiry from the Speaker as to the government of the Natural History Museum. They do not, however, give any weight to it. The essential qualification for expressing an opinion of value on this subject is a knowledge of the facts. Of that, I am sorry to be obliged to say, Sir Archibald Geikie is entirely innocent. The Speaker says in his letter that he understands that Sir Archibald Geikie "has recently made special inquiries on this subject." Sir Archibald himself says he has "had occasion to make a careful investigation of the facts of the case."

Sir Archibald, though he has recently become a Trustee of the British Museum, has not become one of the inner circle of the standing committee. No doubt he supposes that he has acquired some knowledge of the "facts of the case." He has been permitted to see the Red Book of Regulations! But he does not duly estimate the secrecy with which the business of the Trustees is conducted by the standing committee. He knows so little of the matter that he is unaware of his own ignorance. There are only three people who really know the facts as to the proceedings of the Trustees of the British Museum in regard to the Natural History Departments during the last twelve years. The Trustees themselves, even those of the inner circle, do not understand what has been done in their name. Sir Archibald Geikie has not sought information from any one of the three persons who could (were they willing) give it. The individual who really knows every

detail as to the actual government of the Natural History Museum by the Trustees of the British Museum during the last twelve years—whether good or bad in their tendency and result—is the late Director of the Natural History Departments. He is in frequent personal relations with Sir Archibald Geikie, but has never been consulted or questioned in any way whatever by that gentleman during his "careful investigation" of the utility or inutility of the present relations of the Trustees of the British Museum to the Natural History Museum.

I am able to state, categorically, that Sir Archibald's opinion is not based upon a knowledge of the facts, and that he has not (for reasons perhaps known to the Speaker and to himself, but not to me) taken the obvious means of ascertaining the facts—since I am the late Director in question. I have always maintained very friendly relations with Sir Archibald and should have been quite willing to assist him in his inquiry. He has not, however, approached me on the subject, and has not received either from me or from others authorised by me any statement on the matter. It will, I think, be obvious to your readers that no one, not even a member of the committee itself, which varies in consequence of absences, replacements by death, inattention, and incapacity to understand the matters discussed, can have such a knowledge of the acts and tendency of the body in question as the official (in this case the Director of the Natural History Departments) who during many successive years attended every meeting (held once a month) as secretary, prepared their agenda, took the minutes of their proceedings, and conducted their correspondence. He necessarily endeavoured to obtain their support for certain lines of policy, and knows, as he alone can know, what they accepted, what they rejected, and the motives and influences at work in determining their assent and their dissent. He cannot make a full statement of his knowledge on these matters except under very special authority and guarantee of immunity. For this he asks.

E. RAY LANKESTER.

Hôtel Ritz, Paris, December 16.

NOTES.

WE regret to announce the death, at eighty-two years of age, of M. Bouquet de la Grye, member of the Paris Academy of Sciences, and distinguished by his work in astronomy and hydrographic engineering.

THE death is announced, in his seventy-fourth year, of Prof. L. Lortet, honorary dean of the medical faculty in the University of Lyons and director of the Natural History Museum in that city. Prof. Lortet was the author of a number of original works, and also of translations of works by Prof. Tyndall and other British scientific writers.

THE juvenile lectures at the Royal Society of Arts will be delivered by Prof. Harold B. Dixon, F.R.S., on January 5 and 12, his subject being the chemistry of flame. The subject is one that lends itself to experiments, and the nature of flame, the properties of oxygen, the nature of various combinations of air and gas, will all be fully illustrated and explained.

THE Paris correspondent of the *Times* announces the death of Dr. L. Malassez, assistant director of the École des Hautes Études, and president of the French Biological Society, in his sixty-eighth year. Dr. Malassez was distinguished by his numerous works on normal and pathological histology and his research work on questions relating to blood tuberculosis and the genesis and nature of tumours.

BY the assassination, on December 22, of Mr. A. M. T. Jackson, Collector of Násik, the Bombay Civil Service has lost one of its most learned members. Educated at Winchester and Brasenose College, Oxford, where he gained the Boden Sanskrit scholarship, he commenced his Indian service in 1888. He was the contributor of many papers on subjects connected with the religion, history, and ethnology of western India, and he collaborated with the late Sir James Campbell in the valuable series of volumes constituting the "Bombay Gazetteer." It was mainly owing to his researches published in the *Indian Antiquary*, Journal of the Royal Asiatic Society, and articles in the "Bombay Gazetteer" that the origin of the Rájput tribes from the Scythian and Hun invaders was established. His untimely death removes one of the most eminent scholars in the ranks of the Indian Civil Service.

THE Research Defence Society desires to direct the attention of all Parliamentary candidates to its work. The society was founded in January, 1908, to make generally known the facts as to experiments on animals in this country, and the regulations under which they are conducted; the immense importance of such experiments to the welfare of mankind; and the great saving of human life and health which is already due to them. It is hoped that all candidates for Parliament, who may desire to acquaint themselves with these facts, will communicate with the hon. secretary, Research Defence Society, 70 Harley Street, W.

THE following appointments have been made at the National Physical Laboratory:—Dr. G. W. C. Kaye has been appointed an assistant in the metrology division. Dr. Kaye holds the degree of D.Sc. of London University, the B.A. research degree of Cambridge, and is an associate of the Royal College of Science and an associate member of the Institution of Electrical Engineers. He was formerly demonstrator in physics at the Royal College of Science, and a sub-lector in physics at Trinity College, Cambridge. Mr. Harris Booth has been appointed a junior assistant in the aëronautics division. Mr. Booth took the degree of B.A. at Cambridge, obtaining honours in mathematics and mechanical sciences. Mr. J. H. Hyde has been appointed a junior assistant in the aëronautics division. Mr. Hyde obtained in 1907 a Whitworth exhibition for engineering, and has had five years' experience at the works of the Great Eastern Railway Company.

SIR HENRY TRUEMAN WOOD, the secretary of the society, has edited a "Directory of the Royal Society of Arts," which has been published by Messrs. George Bell and Sons at the price of 2*s*. The pamphlet, which runs to seventy-six pages, contains a short sketch of the society's history, an account of the trust and prize funds which it administers, a history of the examinations which it has carried on for the past fifty years, a description and pictures of its medals, lists of the Albert medallists and of past and present officials, the charter and by-laws, and other general information, including a list of the proceedings of the past session, and a financial statement for the past year. The pamphlet provides abundant evidence of the honourable part taken by the Royal Society of Arts in the improvement and development of the scientific and technical education of the country. The work of the society is, and has been, at once scientific, technical, industrial, commercial, and artistic. For many years—for it must be remembered the society was founded in 1754—it alone filled the place which is now occupied by the numerous modern scientific and technical associations, the Royal Society and the Society of Antiquaries alone being in existence when the society was inaugurated. It was the Society of Arts that first directed public attention to the national need for technical education, and by its efforts aroused the public feeling which led to the appointment of the Royal Commission of 1881. The whole of the society's work has been carried on without Government aid, or, indeed, without any endowment. It is practically

dependent entirely upon the annual subscriptions of its members. We welcome the new directory as likely to direct prominent attention to the excellent work the society is doing.

DR. FRANCIS WARD, who has been very successful in the photography of marine animals, described his methods, and showed the apparatus that he uses, at a recent lecture before the Royal Photographic Society. In a general sense, the apparatus is similar to the usual type of horizontal photomicrographic camera, but it is so hinged that the camera proper, including that portion of the base-board that carries the microscope, can be raised into a vertical position. The microscope can be easily unclamped and removed, an ordinary photographic lens screwed into the flange of the camera, and the apparatus is then ready for photographing objects in horizontal or vertical tanks, 6 inches or 8 inches square. To facilitate manipulation the camera has an internal mirror and a hood, as in ordinary "reflex" cameras, so that focussing and adjustment may be done on either the horizontal or the vertical focussing screen. It is thus possible to work rapidly, and to adjust the apparatus in a very short time to the photography of specimens natural size or smaller, up to a magnification of about two thousand diameters. These high magnifications are obtained with a high-power projecting eye-piece and the longest camera extension—about 30 inches. For low magnifications, up to about twenty-five diameters, Dr. Ward prefers Zeiss's micro-planar lenses. By the use of a small arc-lamp as made for microscopic illumination, "instantaneous" work is possible, and Dr. Ward showed, by way of illustration, a photograph of living and moving oyster spat, magnified sixty diameters, taken in the tenth of a second. One special advantage of colour photographs, as on autochrome plates, was mentioned, namely, that specimens which will only take a quickly fugitive stain can be photographed while at their best, and so a permanent record obtained.

ALCYONARIAN and madreporarian corals from the Irish coast are discussed by Miss J. Stephens, of the Dublin Museum, in "Fisheries, Ireland, Sci. Invest., 1907, No. 5 (1909)," the paper including the description by Prof. Hickson of a new species of the genus Stachyodes.

PICTURES of Arctic and Antarctic scenery, by Mr. F. W. Stokes, form some of the latest additions to the museums of the Brooklyn Institute. According to the December number of the *Museum News*, Mr. Stokes is absolutely the first to represent the scenery of the Antarctic in painting, while he has had but one predecessor in depicting that of the Arctic.

AMONG the additions to the Bristol Museum and Art Gallery recorded in the report for the year ending in September last are living specimens of Polypterus and Protopterus collected by the late Mr. J. S. Budgett, which have proved a source of interest to visitors. Numerous misprints of names, such as Myopotomus, *Procyon lator*, and Spizoetus, are apparent in the list of additions.

Naturen for December opens with a memoir and portrait of Mikal Heggelund Foslie, for many years conservator of the botanical collection at Trondhjem, who died on November 9, in the fifty-fourth year of his age. Prof. Foslie, who was well known in this country, devoted special attention to the calcareous algæ, of which he described the collection brought home by the Percy Sladen expedition to the Indian Ocean. In 1892 he paid a visit to the Isle of Wight for the purpose of collecting these organisms, and he also made a trip to Ireland seven years later with the same object.

WE have hitherto omitted to mention that in the October number of the *American Naturalist* Miss Dederer comes to the conclusion, from a careful study of the skull and dentition, that the South American marsupials of the genus Cœnolestes appear to be more nearly related to the polyprotodonts than to the diprotodonts, among which they have hitherto been placed. In fact, the large pair of lower incisors, which may well be an adaptive feature, forms practically the only diprotodont character, the dentition in other respects being essentially polyprotodont.

To the *Field* of December 18 Mr. Douglas Carruthers communicates an article on the big game of Syria, Palestine, and the Sinaitic Peninsula, in regard to which our information has hitherto been defective. He adds the wild goat to the fauna of the district, and confirms Mr. Lydekker's statement as to the absence of the bubal hartebeest, the white oryx, and the addax. Particulars are given with regard to the horn-characters of *Gazella merrilli*, which is shown to be allied to *G. cuvieri* of the Atlas.

A CORRESPONDENT of the *Yorkshire Weekly Post* of December 11 directs attention to the scheduling by the Westmorland County Council of the hawfinch as a protected bird. This he regards as a grave mistake, seeing that the hawfinch is one of the most mischievous birds against which the gardener has to contend. Reference is also made to the northern extension of the British range of this species, which was formerly unknown in Yorkshire. The writer also directs attention to the danger to birds caused by the ringing system, as it seems that specimens of various species are shot in order to ascertain whether or no their legs are ringed.

IN the second and concluding part of his account of the life-history of the American toad, published in the December number of the *American Naturalist*, Mr. N. Miller asks the question why, in spite of the great fertility of the female, the numbers of the species remain practically stationary. Taking the low figure of 8000 eggs as the number in one spawn, it appears that with the exception of two, all these, as well as the whole of the eggs in the other spawns of the same female, must perish if the species remain, as appears to be the case, at the same numerical level. Various water animals, such as dragon-flies, water-beetles and water-bugs, together with their larvæ, newts, and crayfish, appear to be the chief agents in carrying on the work of destruction.

GREAT interest attaches to the description by Dr. E. L. Trouessart, in the October number of the *Annals and Magazine of Natural History*, of a new representative of the gymnuras, from Sze-chuen, for which the name *Neotetracus sinensis* is proposed. It will be remembered that until recently these remarkable Insectivora were known only by the Burmo-Malay genera Gymnura and Hylomys. A few years ago, however, a third genus, Podogymnura, was described on the evidence of a single specimen from Mount Abou, in the Philippines, and now comes the new Sze-chuen form, which is the smallest of all, and serves to connect the other Gymnurinæ with the Erenaceinæ. It has, in fact, the general appearance of Podogymnura coupled with the dentition of a hedgehog. The genus has been named from the apparent resemblance of the lower jaw to the one from the French Miocene on which was founded the genus Tetracus.

IN the *Journal of Hygiene* for November (ix., No. 3) Prof. Hewlett, Mr. Villar, and Mr. Revis discuss the nature of the cellular elements present in milk. They conclude that the majority are not leucocytes, as has generally

been supposed, but are derived from the secreting epithelium of the udder. Moreover, vast numbers of these cells may occur in the milk of perfectly healthy cows. Some have considered that these cells (so-called leucocytes or pus-cells), when present in any number, indicate inflammation and suppuration of the udder, but in view of this work such a conclusion does not appear justifiable.

THE growing interest in India among Americans is shown by the fact that the *National Geographic Magazine* for November is largely devoted to a series of excellent photographs illustrating the temples, tombs, and people of the country, by Mr. W. M. Zumbro. It is unfortunate, however, that the titles of the plates and the letterpress were not submitted to the revision of someone more familiar with Indian life and architecture.

"TIDE Tables for the Eastern Coasts of Canada for the Year 1910," by Dr. W. Bell Dawson, have been issued by the Tidal and Current Survey in the Department of Marine and Fisheries, Ottawa. The tables are based upon observations obtained by means of self-registering tide-gauges kept in continuous operation, and, owing to the length of the series of observations, can lay claim to considerable accuracy. The records are reduced by the latest methods of analysis, by which the tidal constants are arrived at, and from these the tables are calculated by the Nautical Almanac Office in London. The paper also includes useful summaries of the more important results of investigations regarding the currents in various regions contained in the reports issued by the Survey; copies of these full reports, illustrated by charts and plates, may be had on application to the department.

A REPORT on the rainfall of the Exe Valley, by Dr. H. R. Mill, forming part of the report of progress in the investigation of rivers, by Dr. A. Strahan and others, is contained in the *Geographical Journal* for December. Owing to the scarcity of long records, Dr. Mill found it necessary to construct maps for four decades between 1868 and 1907 from the data which are summarised in the tables, and to combine these four maps into one of forty years' average by a somewhat laborious process, fully explained in the paper. This map shows that the heaviest rainfall occurs on Dartmoor, where a wide area has more than 70 inches per annum, but that this amount diminishes rapidly in all directions. The general rainfall of the whole of the Exe Valley is shown to be about 42 inches, and nowhere less than 30 inches. Roughly speaking, the Culm and Creedy receive an equal volume of rainfall over their basins, and the Exe three times as much as either. The four ten-year groups of the mean annual rainfall over the whole area show 107, 103, 95, and 95 per cent. of the average; with regard to this, Dr. Mill remarks that he sees no reason for supposing that there is a progressive diminution of the annual amount, though a comparatively dry spell has succeeded a comparatively wet one.

THE geological section of the Belfast Naturalists' Field Club held its first meeting of the winter session on November 24, when one of the members, Mr. James Strachan, delivered a lecture on petrological types of basalt in County Antrim. The chief portion of the lecture was devoted to a suggested rational classification of the basaltic rocks of Co. Antrim according to their varying basicity. Three main classes were recognised, and subdivided as follows:—(1) Basalts without olivine (basaltic andesites): (*a*) flow type, basalt of Spanish Bay, Giant's Causeway; (*b*) intrusive type, dolerite of the Neck at Carnmoney Hill. (2) Olivine basalts: (*a*) flow type, the common olivine-basalt of the district, with olivine increasing from occasional grains to plentiful porphyritic crystals; (*b*) intrusive type, the common olivine-dolerite of the district with varying amount of olivine, *e.g.* dolerite of the Neck at Scawt Hill, and that of Ballygalley Head. (3) Basalts rich in olivine: (*a*) flow type, containing excess of olivine in large phenocrysts, minimum of felspar and augite and colourless interstitial glass; north side of Carnmoney Hill; (*b*) intrusive type, dolerite rich in olivine; Slieve Mish. These types of basaltic rocks were all illustrated by hand-specimens and numerous microscopic sections. In conclusion, the lecturer referred to several peculiar features of the local basalts, such as the fairly common occurrence of "tube-amygdaloid" at the basal portion of many of the Co. Antrim flows, and the complete inclusion of primary minerals, such as felspar and augite, in natrolite and other zeolites.

THE Bausch and Lomb Optical Company, 19 Thavies Inn, E.C., have submitted an improved Störmer viscosimeter for our inspection. In this apparatus a weight falling from rest causes a paddle to rotate in the oil or other liquid to be tested, and a dial registers the number of revolutions made. The time required for a given number of rotations is taken with a stop-watch; it varies with the viscosity of the liquid. Thus, when the apparatus is so adjusted that 100 revolutions in water take 12 seconds, with ether the time is 9·8 seconds, and with glycerine 36·8. The viscosities are reckoned as proportional to the time, that of water being taken as unity. To obviate "spinning" of the liquid a square receptacle is used. Some of the advantages claimed over other types of apparatus are:—(1) Only a small volume of liquid (50 c.c.) is necessary; (2) a determination is made in a few seconds, and can be easily repeated upon the same identical quantity of liquid; (3) the variation due to change of temperature during the operation is practically negligible, since the time is so short; and (4) given spare cups, a series of tests can be made without any waste of time in cleaning the instrument after each experiment. The apparatus is compact, and appears quite easy to manipulate.

THE *Verhandlungen der deutschen physikalischen Gesellschaft* for November 15 contains a critical examination, by Dr. Karl Kurz, of the theories which have been advanced to account for the existence of the penetrating radiation of the nature of γ rays in the atmosphere, and even in vessels hermetically sealed. There are three possible sources of this radiation. It must come either from an extra-terrestrial source, from the earth's atmosphere, or from the material of the earth itself. The author shows that the extra-terrestrial source must be excluded, owing to its leading to consequences in the upper atmosphere which are not in agreement with observations. The atmospheric source he shows to be quite inadequate, the quantity of radio-active matter present being much too small. The radio-active matter present in the soil is, however, not only sufficient to account for the radiation, but gives its intensity correctly as that necessary to produce nine or ten ions per cubic centimetre per second. The semi-diurnal period observed in the amount of radiation the author ascribes to the radio-active matter present in the atmosphere.

THE belief that areas of seismic and volcanic activity move slowly to the west is given a precise form in a paper, by Mr. H. Wehner, which appears in the *Physikalische Zeitschrift* for December 1. He assumes that within the solid crust of the earth, and separated from it by a thin layer of liquid, is a solid nucleus which rotates about the same axis as the outer shell and in the same direc-

tion, but with a velocity slightly less than that of the shell, the result being that, with respect to the shell, the nucleus makes one revolution to the west in 952 years. On this revolving nucleus the author assumes there are projecting or "active" spots which in their motion come under weak portions of the crust and cause earthquakes and volcanic disturbances. On this basis he calculates the positions of the active spots on the nucleus which have during the last sixty years produced disturbances notified by ships at sea in the tropical parts of the Atlantic. According to the calculation, these active spots are now nearly all collected under the region between longitude 35° and 41° W., and latitude 1° N. and 1° S., which should therefore be a danger zone. It will be interesting to see if further statistics support this theory.

WE have received from Lu-kia-pang, China—which now serves as the magnetic observatory of the Jesuit fathers of Zi-ka-wei—an interesting copy of the record of the great magnetic storm of September 25, with some notes thereon. The storm in China was of similar duration to that experienced in this country, and presented many similar features, but the oscillations were of a much less striking character. The ranges of the declination and vertical force disturbances—about 50′ and 0·002 C.G.S. respectively—were much less than in Europe. The range in horizontal force, however, exceeded 0·005 C.G.S., and the excess may have been large, as the trace was off the sheet during the greater part of the storm. About three hours before the large disturbance began there was a curious little movement, seen in all the elements, which is described in the "Notes" as a precursor of the storm. We understand that movements corresponding to the supposed precursor are distinctly shown on the Kew curves, so that whether related or not to the great storm they seem to have been, like it, experienced all over the world.

THE dissociation of hydrobromic and hydriodic acids at high temperatures is the subject of a paper by K. V. v. Falckenstein in the current number of the *Zeitschrift für physikalische Chemie*. The method used is the statical one, first employed by Löwenstein, and is based on the fact that at a high temperature platinum permits the passage of hydrogen, but of no other gas. The action of the red-hot metal may be roughly regarded as a filter, the pores of which are so small that only the very small hydrogen molecules can pass through. The gaseous hydrogen compound, contained in a fused quartz tube and heated in an electric resistance furnace, passes over a platinum bulb, the inside of the latter being connected to a manometer. The pressure of the hydrogen inside the bulb is in equilibrium with the hydrogen outside the bulb arising from the dissociation. Data are given for three temperatures, 1024°, 1108°, and 1222°, in the case of hydrobromic acid, and for two, 1022° and 1217°, for hydriodic acid. Bodenstein and Geiger have measured the E.M.F. at 30° of the cell Br_2—HBr—H_2, and Haber has deduced a formula for the relation between the amount of dissociation of the hydrobromic acid and the temperature. It is interesting to note that the dissociation calculated from this formula, in spite of the large temperature difference between 30° and 1200°, is in very fair agreement with the experimental results described in this paper.

THE sixty-sixth annual issue of the Medical Directory, for 1910, published by Messrs. J. and A. Churchill (price 14*s*. net), includes several new features. It appears from the numerical summary that there are 40,558 members of the medical profession, the increase from 1909 to 1910 being 566. The directory includes, for the first time, a section on the principal British spas and climatic health resorts, by Mr. N. H. Forbes. Improvements have also been made in the list of hospitals and other institutions printed at the end of the London section of the directory.

MESSRS. CHARLES GRIFFIN AND CO., LTD., have published a sixth edition of Prof. Grenville A. J. Cole's "Aids in Practical Geology." Alterations have been made in more than a hundred places, and the subject-matter has in this way been brought up to date. While certain modern restrictions in nomenclature have been introduced, the limits of the names of rocks and fossil genera have, as in previous editions, been kept as wide as possible. Prof. Cole's book has been of signal service to very many practical geologists since its first publication in 1890, and in its latest revised form we have no doubt its sphere of usefulness will be extended.

OUR ASTRONOMICAL COLUMN.

HALLEY'S COMET, 1909*c*.—As was briefly stated on p. 239 of our issue of last week, M. Deslandres has added to the large reflector at Meudon a finder, fitted with a moving reticle, which enables the instrument to be used for photographing any faint object moving in relation to the surrounding guiding stars. The aperture of the large reflector is 1 metre, the focal length 3 metres, and an exposure of five minutes, on December 6, 7, and 8, was sufficient to give a sharp image of the comet's central portion. With an hour's exposure the comet was seen, on the negative, as a nebulosity, elongated in the direction opposed to the sun. The finder now in use has an aperture of 15 cm. (6 inches) and a focal length of 2·3 metres, and may be placed on either side of the telescope to suit the convenience of the observer, a suitable counterpoise of the same form being employed on the opposite side.

In conjunction with M. Bernard, M. Deslandres also describes two spectra of the comet secured on December 6 and 8 with exposures of two hours and three hours respectively. That the comet, on December 6, was already emitting its own radiations is shown by the appearance of bright condensations at λ 388 and λ 391·45, as in Morehouse's comet last year. In addition to the nearly circular nucleus, several curved rays, fainter than the nucleus and having the appearance of antennæ, were seen; from their direction it is difficult to account for these rays solely on the assumption that they are produced by solar repulsion. A spectrum taken on December 13 shows the continuous spectrum of the nucleus stronger and the condensations in the ultra-violet larger, the latter radiations evidently emanating from the nebulosity surrounding the nucleus. There is also some evidence for the oscillations of brightness observed at Greenwich (*Comptes rendus*, No. 24, December 13).

Other visual observations of the comet are recorded in No. 4377 of the *Astronomische Nachrichten*, where Prof. A. A. Iwanow also has a paper describing his calculations of the perturbations of the comet's path between 1835 and 1910. His final elements give April 23, 1910, as the probable date of perihelion passage.

AN INTERESTING SUN-SPOT.—In No. 4377 of the *Astronomische Nachrichten* M. Amaftounsky describes the changes in detail which took place in a sun-spot first seen on the sun's eastern limb on September 27 (September 15 O.S.). Six drawings which accompany the paper show how enormous were the changes, and M. Amaftounsky directs special attention to a marked yellowish-green tint which pervaded the bright tongues, or bridges, over the nucleus and the bright edges of the penumbra. This was not an optical coloration, and, according to the observer, is a very rare phenomenon.

PERIODS IN THE VARIATION OF LATITUDE.—No. 8 of the *Bulletin International de l'Académie des Sciences de Cracovie* (October, p. 543) contains a *résumé*, in French, of a memoir by M. Jan Krassowski, in which the author briefly discusses the results obtained by him in an analysis, by Schuster's "periodogram" method, of the motion of the pole. The data employed consisted of all the results

published by the International Latitude Service since 1908. Periods of one-fortieth of a year (9·125 days) were taken, and the values for x and y analysed independently, special attention being paid to the possible demonstration of a yearly period.

The resulting maxima show no trace of an annual period, but there is a weak maximum at thirteen months. A very strongly marked period, of 419·750 days for the x, and 410·625 days for the y, coordinate, was found, and agrees fairly well with the period (428 days) found by Chandler. Another less marked period of 438·0 days also results from M. Krassowski's investigation, and agrees with that found by Mr. Kimura.

THE PLANET VENUS.—In a very interesting lecture, now published in the December number of the *Popular Science Monthly* (vol. lxxv., No. 6, p. 521), Prof. Lowell describes the observations which have been made of the planet Venus, at present so prominent an object in our evening skies. Not only are the observations described, but the results accruing from them are discussed in popular language. Thus the spectroscopic and visual observations are held to have proved that the rotation and revolution of Venus are synchronous, the period being 225 days. A number of drawings accompanying the paper show the permanent markings recorded, and illustrate the unanimity of the observers working under good conditions. The main feature is a number of dark markings which, leaving the limb at different points, converge to the centre, thus giving the planet's disc a cart-wheel appearance.

SUGGESTED OBSERVATIONS OF HALLEY'S COMET.

THE Astronomical and Astrophysical Society of America, through its comet committee, is soliciting cooperation in the observation of Halley's comet at the present return, and has prepared a circular letter of advice that has been widely distributed among observatories with regard to such observations. A copy of this circular will be sent to any astronomer who may desire to use it upon request being made to the chairman of the committee, Prof. G. C. Comstock, Washburn Observatory, Madison, Wisconsin. As many astronomers and other observers of Halley's comet will be interested in the suggestion made by the committee, the circular is here reprinted in a slightly abridged form.

It is desirable that the position of the comet be well observed during the entire period of its visibility, and it seems probable that extra-meridian observations will be secured in sufficient number without especial solicitation. In view, however, of possible large perturbations arising from the close approach of the comet to Venus on May 1, and to the earth on May 18, meridian observations are especially desired during the period in which the comet is sufficiently bright for that purpose. An examination of the amount and character of these comet perturbations and their adaptability to a determination of the mass of the planets producing them has been undertaken by Profs. Leuschner and Crawford, and in case the conditions prove favourable, the meridian determinations may well be supplemented by heliometer observations of the positions of the inner planets with the view of a possible determination of the mass of the comet itself.

The close approach of the comet to the earth promises unusual opportunity for a study of the physical conditions that obtain in such a body, and, as an indispensable basis for such study, the committee recommends a photographic campaign as long and as nearly continuous as possible. The comet's close proximity to the sun's direction at the time of maximum brilliance imposes serious limitations upon this programme, and widely extended cooperation will be required throughout the whole circuit of the earth if this ideal of a continuous photographic record is to be even remotely realised.

About one-third of the earth's circumference in longitude is covered by the Pacific Ocean, within which there is known to exist no observatory with proper facilities for celestial photography. To fill this gap, at least partially, the committee, aided by a grant from the National Academy of Sciences, proposes to send to the Hawaiian Islands an expedition to photograph the comet during the period of its greatest brilliance.

The ends to be served by these photographs, and others obtained elsewhere, are as follows:—

To give a permanent record, as continuous as possible, of the phenomena and changes (1) in the tail of the comet, with special reference to outgoing masses; (2) in the head and nucleus of the comet, particularly as to the formation of envelopes and jets.

The following suggestions as to procedure and precaution in making the photographs have been formulated by Prof. Barnard.

Photography of Comets.

One of the greatest difficulties in photographing the average bright comet is its proximity to the horizon, and consequent projection on a more or less dawn or twilight sky. The effect of this illuminated background with any considerable exposure is to fog the plate to such an extent as either to ruin it or to prevent a proper development of the image of the comet. A difference of three or four minutes in the duration of exposure when the sky is brightest may make a success or a failure of the picture. It is impossible to establish fixed rules as to when the exposure should stop or begin; so much will depend upon the condition of the sky, the position of the comet, the kind of lens, the rapidity of the plates, &c. The best rule is that of the judgment of the observer at the time, and this can only be derived from actual experience in the work.

The plates should be backed with the following to prevent halation. Cook two pounds of white sugar in a saucepan without water until nearly in the caramel stage, then add one pound of burnt sienna. Cook a little more (but not to the candy stage), stirring well. Finally, add about one-half an ounce of alcohol to each pint of backing as a dryer. This backing will keep indefinitely. When it is too hard, moisten it with a little water. This is to be applied to the back of the plate as a stiff paste with a broad camel's-hair brush, and should be applied just before using. A piece of old newspaper pressed upon this will prevent its being rubbed. The face of the plate should be very carefully dusted with a broad camel's-hair brush after it has been placed in the plate-holder. The camera tube should also be frequently wiped out with a damp cloth to avoid dust. Before developing, remove the backing with moist absorbent cotton. If a little remains on the plate it will not injure the developer. In removing the backing be careful to shield the plate from the dark-room light. Do not wet the surface of the plate before pouring on the developer, as it may cause air bubbles on the film; swab it carefully with absorbent cotton at the beginning of development. Develop until the plate is almost opaque to the ordinary developing light. Fix for twenty minutes or more in the ordinary fixing bath (frequently made new), to which has been added a teaspoonful of sodium bisulphite to prevent discoloration.

Lumière Sigma dry plates are recommended, because of their rapidity. Seed 27 Gilt Edge and Cramer Crown are both beautiful plates, but are not now so rapid as the Sigma.

Hydrochinon developer gives a good strong negative, and for astronomical work is excellent. Rodinal in a weakened form, say 1/60 or 1/70 of water, with a longer development, will give a soft and more transparent negative, especially suited for showing the details of the head of the comet on large-scale photographs.

The doublet, or portrait lens, such as is made in America by the Brashear Optical Company and the Alvan Clark Corporation, on account of its wide field, is the best form of instrument for showing the general features of the comet and its tail, and especially for following any outgoing masses that may appear in the tail. One of about 6 inches (15 cm.) aperture will be the most generally used, because of the expense of such instruments. It should be supplemented by several smaller lenses. A "lantern" lens of 1½ inches (4 cm.) aperture and about 6 inches (15 cm.) focus, made by McAllister, of New York, is recommended for showing the extent of the tail. The cost of one of these lantern lenses is seven dollars. It gives a good field of twenty to thirty degrees, especially when diaphragmed

down to 1 inch. It is extremely quick for comet work. Its focus should be carefully determined by star trails.

In comet work it is important in all these lenses that the camera should be so adjusted on the mounting with respect to the guiding telescope that the head of the comet can be displaced to one side of the field to secure a greater extension of the tail. Two of the small lenses may be so arranged by a mutual adjustment as to cover the full length of the tail, even though it should be fifty degrees long or more. Although it would thus be in two sections—the head and part of the tail on one plate, and the rest of the tail on the other—there would be no serious objection if the whole tail could thus be secured. The large reflectors will be of the utmost importance in dealing with the detail and structure of the head and envelopes, as has been recently shown at Greenwich.

Until something further is known of the spectrum of the comet, it would be unwise to attempt to give any specific directions as to the duration of exposure required with any telescope. Daniel's comet of 1907, and Morehouse's of 1908, were very different in respect to their photographic activity. The latter was relatively many times more actinic in its light, and hence required much shorter exposures to show the same strength of tail. This information must come from actual experience with the comet. It would seem, however, that the circumstances of the comet's visibility when brightest will make short exposures necessary.

The committee will be pleased to receive from every astronomer who may cooperate in the matter copies (glass positives) of his negatives of Halley's comet, and it will undertake the comparison and discussion of the material thus collected.

Spectroscopic Observations.

For spectroscopic observations of the comet the committee makes the following suggestions, formulated by Prof. Frost. While it may be possible to make visual observations of the comet's spectrum with ocular spectroscopes attached to large telescopes, it is likely that most of the photographic records of the spectrum will be obtained by the objective prism or the slit spectrograph, and reference will be made in what follows to the use of these two types of instrument.

These methods of observation are mutually complementary; for the accurate measurement of wave-length, effect of motion in the line of sight, and analysis of structure of lines or bands (if sufficiently sharp), the slit spectrograph has all the advantages, but for study of distribution of elements in different parts of the comet, and for reaching faint details, the prismatic camera, or objective prism, with its much greater light-power, is essential. The prismatic camera may be employed, with a fair possibility of success, when the comet's brightness is equivalent to that of a ninth- or tenth-magnitude star; the slit spectrograph cannot be hopefully applied before the comet is two or three magnitudes brighter. The size and kind of telescope employed, of course, make such statements relative rather than absolute, and uncertain at best. Too much here depends upon the comet; if its light is chiefly reflected rather than intrinsic, and the continuous spectrum is predominant, then the comet will have to be much brighter for satisfactory spectroscopic analysis than if the light is largely intrinsic and concentrated at half a dozen points in the spectrum. Comets showing sudden and marked fluctuation in size or brightness are likely to exhibit changes in the bright band spectrum.

(1) Prismatic camera or objective prism.

The camera should be a doublet of large angular aperture, 1/4 or 1/5. Useful observations could be secured if the linear aperture is as small as 4 or 5 inches (10 or 12 cm.). The objective prism should be of small angle, perhaps 10° or 15°; if an additional prism is available for the period of the comet's greatest brightness, its angle should be about three times that of the smaller prism. If the doublet is of comparatively short focus, as is likely to be the case, it will be found to be quite sensitive to focus, and separate exposures will be needed for the blue-violet region and the yellow-green region. Optical parts transparent to ultra-violet would be useful, as there may be some important bands of shorter wave-length than λ 3883.

It is very desirable to photograph the spectrum of a star before or after the comet, placing the star at such a point on the reticle of the guiding telescope that the stellar lines may serve for comparison.

Prof. Pickering suggests that an interesting observation would be to photograph the spectrum of a star when seen through the bright portion of the tail, to see if dark absorption lines could be detected.

(2) Slit spectrograph.

A small spectrograph will be a very useful attachment to a photographic doublet as described above. It need not be complicated, and its dispersion may be small. Apparatus for producing a comparison spectrum is not essential, for a neighbouring star of the first type may be brought upon the slit, and its spectrum impressed above and below that of the comet. With one thread of the guiding telescope, or finder, movable, the star can be placed so that its spectrum will fall on the slit as desired. The identity of the cometary band can be thus established better than with the objective prism. After spectrograms of the comet have thus been obtained, it will also be desirable to obtain plates with the slit as narrow as feasible, in order to detect duplicity or complexity of the lines or bands.

Observations with powerful stellar spectrographs of the types in use for determining radial velocities will doubtless be made as soon as the comet's brightness permits, but this is likely to be disappointingly late on account of the heavy loss of light in such instruments. The fixed equipment of these instruments will determine their operation by their regular observers.

Photometric and Polariscopic Observations.

Photometric and polariscopic observations of the comet should certainly be made, although they will doubtless occupy a position of subordinate importance. The suggestions of the committee in this respect are formulated by Prof. Pickering, as follows:—

A great variety of methods may be employed for measuring the light or amount of polarisation of the comet. It is suggested that astronomers undertaking this problem should correspond with the chairman of the committee, in order that uniform methods may be employed throughout by different observers. The plans proposed below may require modification, according to the instruments available.

A direct estimate, by Argelander's method, of the entire light of the comet, as seen by the naked eye, or in the smallest telescope with which it is visible, may have a certain value to observers in the future, although large systematic errors are to be expected in such estimates.

It is doubtful if photometric measures of the nucleus of the comet will have much value, as the results will probably be greatly affected by the coma, and will differ with different photometers and telescopes. If the nucleus be distinctly stellar it may be compared directly with an adjacent star, by means of a double-image photometer. The effect of background would thus be eliminated. Direct measures with a Zöllner photometer, or similar instrument, would probably have but little value, owing to the effect of the coma. Any series by the same observer with the same instrument would be valuable by itself, and the observations by different persons and different instruments might be subsequently adjusted for systematic differences.

The measures described in Harvard Circular 68 showed that the absorption of light by the tail of comet 1902*b* was certainly less than a tenth of a magnitude. Similar measures should be made of Halley's comet. A double-image photometer is indispensable for these measures also, to eliminate the effect of background.

The light of different portions of the tail of the comet may best be measured by the following method. Take two photographs at the same time with similar instruments, using the same kind of plate and developer, and giving equal exposures, taking one in focus and the other out of focus, so that the images of the stars shall appear as circles two or three millimetres in diameter. Make similar enlargements of the two plates, interposing screens of perforated brass. Measures of the opacity of the resulting circular images of different portions of the comet on one plate may be compared with the images of stars the magnitudes of which are known as photographed on the

other plate. The effect of the light of the sky or of twilight may thus be eliminated, and the light of the comet compared with that of a star of known magnitude spread over a standard area. The two photographs may also be compared directly with a suitable photometer.

Messrs. Barnard and Frost, having also the benefit of Mr. Parkhurst's opinion, suggest as an alternative and possibly better method the extra focal use of a single camera. The intensity of the extra-focal cometary image could be reduced to the focal plane as accurately as for the star images. The relative values on different nights would always be correct.

Useful suggestions for the photometric observations of the comet may be derived from a paper by Dr. Rosenberg upon photometric observations of the Morehouse comet, contained in the *Astrophysical Journal* for November.

The polarisation, if any, of the comet's tail may best be studied by photographs taken with a camera having a double-image prism placed over the lens. The prism should be turned so that the two images are perpendicular to the direction of the sun. The two images of an unpolarised object should be alike if the correction for colour is the same for both, otherwise it will be necessary to take a second photograph, turning the prism 180°. If the light is polarised, one image may be fainter than the other, as in similar photographs of the solar corona. Measures may be made as described in the preceding paragraph.

Bands will doubtless be seen if the comet is examined by means of a Savart's polariscope or similar instrument, but it is, in that case, difficult to distinguish between slight polarisation of the comet and the strong polarisation of faint sky-light.

Minor Notes.

The following titles may be specified as minor matters not included above, but which may in some circumstances become of importance, viz. :—

The head of the comet should be carefully examined for traces of phase. Possible disturbances may be found in the comet, due to its close approach to Venus on May 1 and to the earth on May 18. A transit of the earth through the comet's tail is possible at or near the latter date, and, if such should occur, a meteoric shower should be looked for and observed with reference to a determination of the meteoritic particles, their frequence, size, &c. Resultant disturbances of the electric potential of the earth's atmosphere are possible, and the cooperation of meteorological observers, and especially of national weather bureaus, is earnestly desired in this connection.

Although the amount of refraction experienced by light in transit through a comet is known to be very small, it seems desirable to make investigation of the matter photographically with long-focus telescopes. The position of a sufficiently bright star near the nucleus, or in the brightest part of the edge of the tail, should be referred to a group of more distant ones, and the resulting position of the star compared with that resulting from another plate exposed after the comet has left the star.

THE HEADMASTERS' CONFERENCE.

THE headmasters of sixty of the leading public schools met at the Leys School, Cambridge, on December 22 and 23. On the first day the chief matter discussed was the work of the Public Schools' League for Imperial Land Settlement in the Overseas Dominions, which was strongly supported by the Rev. Dr. Gray (warden of Bradfield College). Under the auspices of the committee, approved boys are to be sent to a Canadian farm after completing their school career. A course at an agricultural college is to follow a year's practical training on the farm, and it is hoped that the public schools will assist the supply to the dominion of "men of character, intelligence, and energy, possessed of a little capital, who will settle down seriously and will assist in bringing under cultivation the immense areas of land at present untouched." The conference pledged its support to the establishment of a central office in London for the permanent work of the league. Later in the day the meeting asked for fuller recognition of English in the university examinations for admission. All the speakers emphasised the importance of the subject, which was no longer regarded as something for a spare hour; not a few were of opinion that to add English to the entrance examinations would be the worst service they could do to the cause. Fear was expressed lest a set period or figure in literature might be made compulsory, and the comments of some speakers upon the university examinations were decidedly caustic.

On the second day the meeting debated the report of the curriculum committee as to a scheme of studies for schoolboys from the age of nine to about sixteen. The conference passed, practically unanimously, the three following resolutions :—

That this conference approves the principle laid down in the curriculum report of the committee that a boy should not be allowed to begin Greek until the foundations of Latin and French have been securely laid and he has received systematic training in English.

That it is essential to give such a definite position to English and French in the entrance scholarship examinations that these subjects may not be sacrificed to a premature study of Greek; that this meeting be urged to take such steps as will ensure full consideration of the nature and results of the mathematical teaching of boys from nine to sixteen; and that it be referred to a subcommittee to consider and report to this meeting.

That a special meeting of those headmasters who are in favour of the recommendations of the committee be summoned in the early part of next year to take steps to give practical effect in their own schools to the proposals made by the committee, and with this object in view that the secretary be instructed to send a circular to the members of the conference in the third week of January asking whether they are generally in favour of the recommendations of the committee, and, if so, whether they will be prepared to meet in London on a certain date in February or March.

There were several points in the report which were not dealt with in the resolutions, *e.g.* the committee is convinced that German should be excluded from the preparatory school. At the present time the two languages must be Latin and French, in order to provide a basis of education preparatory to classical and modern sides. Dealing with mathematics, the committee reports that in some cases the attempt is made to cover too much ground for the average boy, yet in others there is a danger that mathematics may be sacrificed entirely.

Although reformers will wish that the headmasters had gone further, it is a matter for congratulation that this year's conference exhibited a progressive spirit alike in resolutions and in individual speeches. Not only did the meeting recognise the relation of the public schools to the Empire, but it deprecated early specialisation in Greek, encouraged the advance of English studies, and adopted the principle of differentiating curricula to suit varying capacity. Above all, the headmasters acknowledged the obligation to give practical effect to the opinions which they expressed in conference. Perhaps we may not have to wait many years before drawing, nature-study, music, and handwork are accorded the status of essential subjects in the preparatory curriculum. G. F. D.

WATER SUPPLY IN THE UNITED STATES.[1]

IT is an obvious truism that water is the commonest and most plentiful substance in nature. Oceans, seas, lakes, rivers, floods, and streams innumerable testify to its universality, and its indispensability is no less manifest. Whenever man penetrates into virgin territory, his first care is to find water; wherever civilisation sets up her ultimate standard of health and comfort, she establishes and secures an efficient water supply. Water is the embodi-

1 Water Supply Papers: No. 224. Some Desert Watering Places in South-eastern California and South-western Nevada. By Walter C. Mendenhall. Pp. 98.

No. 228. Water Supply Investigations in the Yukon-Tanana Region, Alaska, 1907 and 1908. By C. C. Covert and C. E. Ellsworth. Pp. 108.

No. 230. Surface Water Supply of Nebraska. By J. C. Stevens. Pp. 251.

No. 231. Geology and Water Resources of the Harvey Basin Region, Oregon. By Gerald A. Waring. Pp. 93.

No. 234. Papers on the Conservation of Water Resources. Pp. 96. (United States Geological Survey. Washington: Government Printing Office 1909.)

ment of all that is delightful in art, useful in industry, valuable to commerce, and essential to existence.

Hence the interest attaching to these publications of the United States Geological Survey, dry (paradoxical term!), statistical records for the most part, but none the less engrossing in their importance, and even entertaining at not infrequent intervals. Amid a voluminous mass of data, carefully and patiently collected from day to day and year to year, it is surely worthy a passing glance to note that the mean annual rainfall over the United States is 29·4 inches, that the heaviest precipitation occurs upon the North Pacific Coast, where, at several points in the States of Washington and Oregon, it exceeds 100 inches, while at the back of the coastal mountain ranges the rainfall diminishes rapidly southward, so that in the State of Nevada it ceases altogether, or is negligibly small. From another paper comes corroborative evidence on the value of afforestation, in that the data obtained clearly demonstrate the fact that an increase in floods is directly associated with the denudation of forest areas. Again, it is of considerable industrial importance to have an estimate of the total available water horse-power throughout the country. This is stated to lie between 200 and 250 millions, of which only 5½ millions have as yet been utilised. Yet again, from a geological point of view it is instructive to learn that the whole surface of the United States is being denuded at the rate of 1 inch in 760 years, representing an annual transportation of 270 million tons of dissolved matter and 513 million tons of suspended matter to tidal waters.

But the volumes are not merely academically and statistically interesting. They have a human side, which at times is forcible in its suggestiveness. Here and there are touches of the grim reality of things, allusions at once startling and tragic, pictures which bring us face to face with the deadly antagonism to humankind of nature in her more savage aspects. Take, for instance, the pamphlet entitled "Some Desert Watering Places in California and Nebraska." Here are no descriptions of well-watered plains and fertile valleys, but vivid sketches of an arid, desolate region, comprising an area of 68,000 square miles, where "the scarcity of water and the importance of a knowledge of its whereabouts are indicated by the frequency with which the Press records instances of death from thirst in the more remote parts of the desert." The Death Valley region comprises plains which are absolute deserts, totally destitute of water and treeless for a space representing many days' journey. The following extract, under the head of "Getting Lost," gives a vivid sketch of the possibilities of a desert tragedy:—

"The inexperienced traveller often gets at once into a panic on losing his way, and wastes his remaining energy in frantic rushes in one direction and another. This tendency to become panic-stricken should be controlled, if possible. Sit down, get out your map and compass—if you are provided with them, as you should be—and study the situation carefully before acting. At least, rest a little and think it over. If it is hot and you are far from camp, get your head into the shade of a bush or rock, and wait till night. Thirst will be less intolerable then and endurance greater. If you have camp companions who are likely to look for you, start a signal fire by night or a smoke by day from some little eminence, and then stay by it till help comes. If you must depend on your own exertions, think carefully over all the possibilities and adopt a plan of action and adhere to it."

Excellent advice! but it is one thing to read it amid the bustle of a crowded city and another to act upon it in the lonely and fearful silence of the illimitable desert.

B. C.

Death Valley, looking north toward the Black Mountains.

SOME RECENT WORK ON TROPICAL MEDICINE.

TWO recent numbers of the *Annals of Tropical Medicine and Parasitology* (vol. iii., No. 2, October 20, and No. 3, November 1) contain six memoirs, of which four deal with problems relating to trypanosomes and the diseases caused by them. Messrs. Kinghorn and Montgomery discuss the important and difficult question of the flagellates found in the intestine and proboscis of tsetse-flies caught wild, on the basis of observations made by them during their expedition to the Zambezi, 1907–9. In *Glossina palpalis* collected by them on Matondwi Island, at the southern extremity of Lake Tanganyika, an island that has been uninhabited for twenty years, they found, out of 185 flies dissected, no fewer than seventy-eight, or 42·1 per cent., harbouring flagellates in the intestine, a percentage which far surpasses all previous records from other places; no parasites were found, however, in the proboscis. In *Glossina morsitans* collected near Kambole, about fifty miles west of Abercorn, nine out of 113 flies examined, or 7·8 per cent., were found infected with flagellates in the intestine, and seven out of thirty-one flies examined, or 21·2 per cent., were found to contain flagellates in the proboscis.

The authors give a detailed description of the parasites, but, unfortunately, without any figures; they consider that the flagellates observed in *G. palpalis* are to be referred to the type of *Trypanosoma grayi*, Novy, but they did not observe the encystment described by Minchin. The parasites observed in *G. morsitans* only differed slightly from those observed in *G. palpalis*. Feeding experiments were undertaken in order to trace, if possible, a development of the flagellates found in *G. palpalis*, and with rather surprising results, for while 42 per cent. of flies not fed artificially contained trypanosomes, in those fed only a very small proportion were found to harbour these parasites. It was also found that the percentage of intestinal infections tended to decrease when flies were kept in captivity, while, on the other hand, the percentage of infections of the proboscis tended to increase; but the number of cases examined is scarcely sufficient to support these conclusions.

The origin of the trypanosomes occurring in "wild" tsetse-flies is discussed, but without reaching very definite conclusions. The authors agree with Stuhlmann that the parasites in the proboscis are derived from those in the intestine, and they suggest the possibility that the trypanosomes found in "wild" tsetses "may be derived from pathogenic trypanosomes which lose for some unknown reason their infectivity when ingested," and also that they represent a mixed infection.

In two other memoirs the same authors report at length

on human trypanosomiasis in north-eastern Rhodesia and Nyasaland, and on trypanosomiasis of domestic stock in north-eastern Rhodesia. The reports contain much valuable information concerning the habits and occurrence of the species of Glossina and other biting flies, the various types of trypanosomes (illustrated by photomicrographs) met with in the blood of diseased domestic animals, and other important points, and the question of prophylactic measures against trypanosomiasis is discussed both for human beings and animals.

In another memoir Messrs. Breinl and Nierenstein give an account of their biochemical and therapeutical studies on trypanosomiasis. After a detailed account of their "observations on experimental trypanosomiasis, the treatment of infections with different pathogenic trypanosomes, and the mechanism of the therapeutical action of various trypanocidal compounds," they raise the question, "When can an animal be considered to be cured?" No very definite answer is given, however, to this question, and it is concluded that "the general condition of experimental animals influences to a large extent the results obtained in therapeutical experiments." The memoir ends with a brief discussion on the comparative value of experiments on different laboratory animals.

The two remaining memoirs are by Prof. John Cardamatis, on sanitary measures and malaria epidemics of Athens, and by H. B. Day and Prof. A. R. Ferguson, on a form of splenomegaly, with hepatic cirrhosis, endemic in Egypt. Both memoirs are illustrated by photographs.

In the *Annals of Tropical Medicine and Parasitology*, vol. iv., part iv., are published two reports of the expedition of the Liverpool School of Tropical Medicine to Jamaica. The first of these reports is by Mr. Robert Newstead, on the ticks and other blood-sucking Arthropoda of Jamaica. The author gives most interesting bionomical notes, as well as systematic descriptions, of these pests, and suggests measures to be taken for the extermination of ticks. The most active enemies of ticks were found to be birds, especially the tinkling grackle (*Quiscalus crassirostris*), the parrot-billed blackbird (*Crotophaga ani*), and the domestic fowl. In the stomach of Crotophaga there were also found specimens of the "green stink-bug" (*Loxa flavicollis*), an observation of great bionomical interest, since this insect, though possessed of an odour which is "horribly offensive," has a protective green coloration. The second report is by Dr. W. T. Prout, on malaria. After discussing the nature and etiology of the disease and its occurrence in Jamaica, the author gives an account of anti-malarial measures and their effects in Jamaica and elsewhere, and suggests practical means for combating the disease.

PRODUCTION AND UTILISATION OF MOLASSES.

THE production of molasses is an important factor in the cane-sugar industry, and has received a good deal of attention in sugar-growing countries. Molasses constitute the thick mother liquor left after the sucrose has crystallised out, and, no matter what artifice be adopted, there is a point beyond which it seems impossible to obtain any more crystals, the sugar being held back by the foreign bodies present. Hertzfeld has shown that the formation of beet-sugar molasses is due to the mineral matter originally present in the juice, or added in the liming process, reacting with the sucrose to form non-crystallisable compounds. Prinsen Geerligs has proved that similar compounds are formed in working up cane sugar. The problem is complicated here by the presence of glucose, which reacts more readily with the mineral substances than does sucrose. In this way is explained the definitely established fact that, the larger the proportion of glucose to mineral matter, the greater the recovery of sugar is likely to be. There appears also to be a physical factor involved; gummy matter is always present, which apparently coats the small crystals and prevents their growth.

The whole subject is discussed very fully in an illuminating article in a recent issue of the *Agricultural News*, one of the publications of the West Indian Department of Agriculture. It is further pointed out that during the past season the muscovado molasses of Antigua and Barbadoes, and to a lesser extent of other West Indian islands, has obtained a remarkably high market price, higher, indeed, than the value of the sucrose present. The chief consumers seem to have been the fishermen and lumbermen on the North American continent. There has been a simultaneous rise in the market value of the exhausted vacuum-pan molasses of Antigua. The problem of storage, therefore, assumes considerable importance; it is complicated by certain bacterial changes which are very liable to set in. But these changes are not inevitable, and with greater care in the manufacture the "souring" which so greatly reduces the market value can be to a large extent avoided. The composition of the various grades of molasses is given as follows:—

	Muscovado molasses (Antigua) per cent.	Centrifugalled first molasses per cent.	Centrifugalled second molasses (exhausted) per cent.
Sucrose ...	50 to 55	40 to 60	20 to 40
Glucose ...	5 ,, 15	7 ,, 20	15 ,, 40
Non-sugar ...	3 ,, 8	—	—
Ash	3 ,, 5	3 ,, 6	3 ,, 10
Water	24 ,, 30	25 ,, 28	17 ,, 28

The first molasses can be made to yield a further crop of cane sugar by re-boiling, but the second molasses cannot, and are therefore said to be exhausted.

The problem in Hawaii is very different in character. The molasses obtained there are not of the muscovado type, and consequently have no commercial value as human food. It is estimated that something like fifteen million gallons are obtained annually, of which about ten millions are used as food for stock. There is little doubt that this would be the most economical way of utilising the remainder, but, unfortunately, the number of stock kept on the islands is insufficient for the purpose. Of the other twenty million gallons some is burnt as fuel, some is put on the land as fertiliser, and some is run into the sea and wasted. Decided benefit has followed the use of molasses as fertiliser in Mauritius, and there is some reason to suppose that the sugar increased the amount of nitrogen fixation in the soil; in consequence, the manurial value is higher than one would expect from a consideration merely of the amount of nitrogen and mineral matter present. These favourable results, however, are not obtained in Hawaii, and experiments have been instituted at the Experiment Station of the Hawaiian Sugar-planters' Association to find out whether molasses could profitably be converted into alcohol. Something more than 50 per cent. of sugar is present, of which 83 per cent. can be converted by fermentation into alcohol. The effect of varying conditions has been investigated and the native yeasts described.

THE AUSTRALIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE Australian Association for the Advancement of Science held its inaugural meeting in Sydney in September, 1888, and met there again in 1898; in January, 1890, it visited Melbourne, and again in 1901; since then sessions have been twice held at Adelaide, Hobart, and Brisbane, and once at Christchurch and once at Dunedin, in New Zealand; its next meeting will be held in Sydney in 1911.

As a rule, the meetings have been held in the capitals of the Australian States at intervals of ten years; as the inland towns like Bathurst and Ballarat become larger and better able to provide the requisite meeting-rooms and other accommodation, they will also be visited.

One great disadvantage under which the association suffers is the very great distances which the members have to travel; the nearest meeting-places are between 500 and 600 miles apart, so that members living in Brisbane, Melbourne, and Hobart have to travel those distances to attend a meeting in Sydney, and members from South Australia and New Zealand have to travel about 1200 miles, and those from Western Australia nearly 2500 miles; when the meeting is in New Zealand all the Australian members have to undergo a sea voyage of about five days at least, and some a longer one, with perhaps some hundreds of miles of railway travelling in addition.

People in England do not generally realise these great distances; the above towns appear to be quite close on an ordinary map, especially as the maps of Australia are usually on a much smaller scale than those of Europe and America.

It is partly on account of these great distances that the meetings are no longer held annually, but in alternate years; the yearly expenditure of time and money was too great a tax upon the working members, for, to their credit, it is they who, in spite of these disadvantages, attend the most regularly. The association has, so far, not had funds placed at its disposal to reduce the travelling and other expenses of its members (the British Association has received considerable sums for this purpose when visiting Canada and South Africa); the members, however, are granted return railway tickets for a single fare by the Government railways, and certain of the steamship companies allow a reduction of 20 per cent. off their ordinary fares. The attendance of members and associates has varied from about 600 to nearly 1200.

The Australian Association was founded with the same aims and objects as the British Association, and its rules are very similar; the subscription is lower, viz. 1*l.* for members and 10*s.* for associates (ladies and students) for each session, and there is no longer an entrance fee. The sessions last about a week, and the work is distributed over various sections.

Lectures to working men and others form a popular feature; also garden-parties, conversaziones, and similar social gatherings, which greatly help to bring the members together and afford opportunities to make and renew acquaintances. Local excursions to places of interest and to engineering and other works are also much appreciated, as well as the longer botanical and geological excursions.

The association does a good deal of work by means of special committees for investigation and research; money grants are made to these where necessary from the interest of the research fund (now nearly 3000*l.*), which has been slowly built up from the savings from members' subscriptions, but this has only been rendered possible by the fact that the Australian and New Zealand Governments have liberally provided for the printing of the volume of reports and proceedings. All other expenses are paid for out of the subscriptions, and the excursions are made self-supporting; no funds are provided by the towns visited for the entertainment of the members, as is done for the British Association, but private hospitality is gladly offered to visiting members.

The principal working members are naturally the scientific members of the Australasian universities, societies, museums, Government departments, and other institutions, although, as is seen from the association's publications, many others contribute valuable papers.

There is no doubt that the peripatetic meetings of the association have done much to cause many of the residents in the districts in which it has met to take an interest in scientific matters and do much for its advancement; the effect is also noticeable in the increased output of the original work of the local universities and similar institutions.

One of the greatest benefits of the meetings of the association is that it enables workers to meet and discuss matters of mutual interest, and there is no doubt that this acts as a stimulus of immensely greater value than the reading of even hundreds of pages of printed reports.

The association has one medal to award, viz. that founded in memory of the late Baron von Mueller.

The association has published eleven volumes of reports; these are of about the same size as the annual volumes of the British Association; they are well illustrated by maps, plans, and numerous reproductions of photographs. These volumes are distributed gratuitously to about 300 scientific societies and institutions throughout the world, so that they are fairly accessible to anyone interested in Australasian science, even in places so widely separated as Bucharest, Monte Video, Seoul, Port Louis, and Pietermaritzburg.

As an example of the contents of the volumes, the last report published, viz. that of the Adelaide meeting for 1907 (the report of this year's meeting, held at Brisbane, is now being printed), may be referred to; after the list of officers, sections, committees, and other preliminary matters (thirty-two pages) there is the interesting address by the president, the late Dr. A. W. Howitt, C.M.G., upon personal reminiscences of Central Australia and the Burke and Wills' expedition, which affords a good deal of hitherto unpublished information upon this disastrous expedition; this is followed by the addresses of the presidents of the sections, beginning with Section A, for mathematics, astronomy, and physics, by E. F. J. Love, on the theory of the Voltaic cell; Section B, chemistry and metallurgy, by R. C. Stiehl, on progress in rapid oxidation processes applied to copper smelting, a most important subject in Australia; Section C, geology, by A. Gibb Maitland, Government geologist of Western Australia, on recent advances in the knowledge of the geology of Western Australia; Section D, biology, a century of botanical endeavour in South Australia, by J. H. Maiden, Government botanist of New South Wales; Section E, geography, by Thomas Walker Fowler, upon Australasian geography; Section F, anthropology and philology, by R. Parkinson, of Ralum, Bismarck Archipelago, on totemism and its possible origin; Section G, I., social and statistical science; Section G, II., agriculture, by F. Anderson, professor of mental philosophy, Sydney University, on Liberalism and Socialism, and the outlook of agriculture in Australia, by T. Cherry, Director of Agriculture, Victoria; Section H, engineering and architecture, no address; Section I, sanitary science and hygiene, by Dr. R. Greig-Smith, on air infection; Section J, mental science and education, by Dr. Henry Laurie, professor of mental philosophy, Melbourne University, on materialism and evolution.

Next, on p. 263, follow the reports of committees:—

(1) For the investigation of glacial phenomena in Australasia. This contains the most recent results of the investigations into the Cambrian (?) and Permo-Carboniferous glacial history of South Australia, Victoria, Tasmania, West Australia, and New Zealand, and is supplementary to reports by this committee published in several of the association's previous volumes. (2) For the biological and hydrographical study of the New Zealand coast. (3) On New Zealand food fishes. (4) On terrestrial magnetism in Australia and New Zealand. (5) On seismological phenomena in Australasia. This committee has worked continuously for several years, and has issued several valuable reports. (6) On a uniform system for the nomenclature of igneous rocks in Australasia.

Previous volumes contain other valuable reports from committees upon other subjects; amongst them the following may be mentioned, as they give a general idea of the matters which have engaged, and are still engaging, the attention of the association:—

(1) Upon a uniform system of spelling native names. (2) To inquire into and report upon the teaching of science in primary and secondary schools, technical colleges, and universities. (3) To investigate and report upon the best method of utilising diamond-drill bores for the determination of underground temperatures. Deep bores are being put down in many parts of Australia by the Governments and by private individuals for ordinary water supplies and for irrigation. (4) For collecting and cataloguing geological photographs and surveys. (5) For cataloguing marine Mollusca. (6) For cataloguing the minerals of Australia. (7) To investigate the tides of South Australia. (8) The movements of New Zealand glaciers. (9) The fertilisation of the fig in Australia. (10) On rust in wheat. (11) On Antarctic exploration. (12) On the protection of native birds and animals. (13) On improvements in museums as a means of popular education. (14) On the Adulteration of Food Acts of the Australian Governments. (15) On the chemical compositions and properties of the mineral waters of New Zealand. (16) On the vernacular names of Australian birds.

Next follow the papers read before the sections; several of these, in common with papers in previous volumes, are of a high order, and will be of permanent value. It would be rather difficult to make a selection of these papers, and much space would be occupied by even their titles, but it may perhaps be mentioned that in astronomy, mathematics, and physics there are eleven papers; in chemistry, &c., ten; geology, twenty; biology, eleven;

geography, seven; anthropology and philology, four; social science and statistics, six; agriculture, eight; engineering and architecture, seven; sanitary science and hygiene, nine; and in mental science and education, four; this section is a very popular one with teachers and others interested in education, and the attendance is usually very large.

The association has made several recommendations to the various Australasian Governments and other authorities, and in the majority of cases these have been sympathetically received, and in certain cases carried out. One of the first recommendations was to the British Admiralty, suggesting that the ocean between Australia, New Zealand, and Tasmania should be named the Tasman Sea; this was agreed to, and the name was at once ordered by the Admiralty to be printed on all charts; previous to this there was some difficulty in speaking of this hitherto nameless part of the Pacific.

The association has also made requests for the reservation of certain areas in Australia and New Zealand for the preservation of the native flora and fauna, some of these have been agreed to; a notable one is the reservation of the island upon which the Tuatara lizard is found. Another smaller reservation was that of a sandstone quarry at Bondi, near Sydney, showing a remarkable columnar or prismatic structure.

Amongst other recommendations made at various meetings to the Australian and New Zealand Governments are the following, some of which have been given effect to:—

(1) That the Federal Government should endeavour to obtain data in the Indian Ocean for long-distance weather forecasting.

(2) The installation at Perth, Western Australia, of a complete set of magnetographs for the continuous registration of magnetic variations; also installations at Brisbane, Port Darwin, and Hobart similar to those at Sydney, Melbourne, &c. One has recently been installed at Adelaide in response to the association's suggestions.

(3) That the Australian and New Zealand Governments should adopt additional measures to prevent the further extension of tuberculosis amongst cattle and swine.

(4) Recommending the teaching of hygiene and the medical inspection of school children.

(5) That the New Zealand Government should undertake the magnetic survey of the Macquarie Islands now that the survey of the main islands has been completed.

(6) The Australian Governments were urged to take more effective steps for the conservation of forest areas.

The Federal Government was requested in 1902, before determining upon the site of the Federal capital, to appoint a board, consisting of architects, engineers, surveyors, medical and business men, to inquire and report upon the sites proposed; also to reserve a site for a national museum and for the housing of scientific societies and institutions in the proposed Federal capital. In 1898 successful recommendations were made to the New South Wales Government to proceed with the boring at Funafuti.

So that members may come prepared for the discussions, it has been agreed to arrange for the preparation of papers on subjects of which notice had been given at a previous meeting. Arrangements are being made for the preparation and publication of bibliographies which would be beyond the powers of an unaided individual.

Some of the papers of permanent value might usefully be reproduced in English publications, for in spite of the volumes of reports being widely distributed, a paper published at the Antipodes finds very few readers elsewhere, because on receipt of the volumes by an institution they are usually put on the library shelves, and there they remain.

The desirability of inviting the British Association to visit Australia has been considered and warmly advocated at different times since 1885; a reference to the proposed invitation will be found on p. xxiii of the present volume, in which it was suggested at the Adelaide meeting in 1907 that a sum of 10,000*l.* to 20,000*l.* should be provided to defray part of the travelling expenses of the visitors, and that the invitation should be issued for not earlier than 1913, so as to leave plenty of time to make proper arrangements.

The permanent offices of the Australian Association are in the house of the Royal Society of New South Wales, which has recently provided accommodation for other scientific societies, so as in a small way to afford some of the advantages which Burlington House provides for certain of the English societies; the Sydney societies thus housed have already found much mutual advantage from being under one roof. A. LIVERSIDGE.

EPIDEMIC DISEASE AMONG THE NORTH AMERICAN INDIANS.

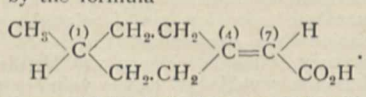
IN the Bulletin of the Johns Hopkins Hospital for November Dr. H. U. Williams discusses the origin of epidemic diseases among the North American Indians.

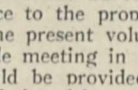
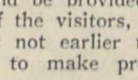
He believes that these American races developed an extremely small number of infectious maladies. Many of the most deadly kind—small-pox, leprosy, bubonic plague, glanders, anthrax, rabies—were the result of the introduction of infection from Europe. With regard to tuberculosis, diphtheria, influenza, gonorrhœa, beri beri, and malaria, the case is more doubtful; but these maladies do not seem to have been noticed among the native tribes by the earlier explorers. The origin of syphilis and yellow fever alone can with some degree of certainty be assigned to American soil. As contributory causes to this immunity from infection, the dispersion of the tribes in isolated camps, and the lack of domestic animals (the horse being connected with glanders, the cow with tuberculosis, and the goat with Malta fever), may have prevented the spread of disease.

Dr. Williams further attempts to identify the serious epidemic which prevailed on the western coast about 1612–20. When the Puritans appeared on the scene they found this region almost entirely depopulated, and they regarded the epidemic as a dispensation of Providence which had removed the savages to make room for the Europeans. It seems probable that this terrible malady was introduced by foreign settlers. It is very generally supposed to have been an outbreak of small-pox or yellow fever; if this be the case, it is remarkable that the early travellers should not have described it under those names. It is significant that in 1614 that ruffian, Hunt, kidnapped several natives, who were carried to Europe, and after a time those who survived were brought back to their native country. Bubonic plague prevailed in London from 1603 to 1611, and sporadic cases were reported in the following years. The European settlers in America seem to have escaped the disease; and if, as seems most probable, the terrible mortality among the Indians was due to plague, the settlers may have been protected, as in the recent epidemic in India, by the fact that they were cleanlier in their habits and better shod than the native population, and that they were thus less liable to contagion through wounds or insect bites.

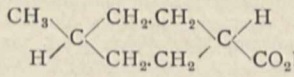
OPTICAL ACTIVITY WITH NO ASYMMETRIC ATOM.

AN important paper by Profs. Perkin, Pope and Wallach on optically active substances containing no asymmetric atom appears in the Chemical Society's Journal for November. The substance described is 1-methyl*cyclo*hexylidene-4-acetic acid, and its structure is represented by the formula



The carbon atom (1) is linked to two identical chains of atoms, and is therefore not asymmetric. The optical activity of the compound depends on the fact that the plane of the  group is at right angles to the plane of the  group, the former being perpendicular to the plane of the hexagonal ring and the latter identical with it; the dissimilarity of the —H and —CH_3 radicles

destroys the symmetry on either side of the plane of the ring, whilst the dissimilarity of the —H and —CO_2H groups destroys the symmetry about the perpendicular plane. The compound therefore fulfils the fundamental condition for enantiomorphism, namely, that no plane of symmetry shall exist. By way of contrast it may be noted that the compound



could not exist in enantiomorphous forms or exhibit optical activity, because the four radicles are all situated in a plane (perpendicular to that of the ring) which would thus form a plane of symmetry of the molecule.

Extraordinary difficulties were encountered in effecting the resolution of the acid. Owing to its weak basicity the salts were very ill-defined, and the brucine salt by means of which the resolution was finally accomplished separated from its solutions as an oil which only slowly became crystalline. Again, the brucine salts of the enantiomorphous acids were so similar that an exceedingly tedious process of re-crystallisation was required before they could be obtained with a constant rotatory power, and even then the acids separated from them were not homogeneous, but proved to be capable of further resolution. Evidently the salts are not only similar, but partially isomorphous. Finally, however, both acids were obtained in a pure state, the *l*-acid giving $[\alpha]_D - 81{\cdot}1°$ and the *d*-acid $[\alpha]_D + 81{\cdot}4°$ in absolute alcohol (0·145 gr. in 20 c.c.).

TECHNICAL EDUCATION IN MANCHESTER.

THE sixth annual report of the Manchester Education Committee, dealing with the work of the year 1907–8, has now been published, and provides an excellent example of the way in which an educational authority can build up a complete and duly correlated system of education to meet the precise needs of the area under its charge. The report deals fully with higher, secondary, and elementary education.

The section dealing with higher education is concerned with the year ending in October, 1908, and deals chiefly with technical education. The number of individual day and evening students enrolled at the Municipal School of Technology for the session ending July 31 was 5299, as compared with 5149 for the previous session. The number of individual students enrolled in the day departments was 661, as compared with 651 for the session 1906–7. The class entries for the session were 11,379, against 10,979 for the session 1906–7. These figures do not, however, include the class entries in respect of students in the day departments of the school. Computing the total volume of work of the evening departments in student-hours—that is, by multiplying the number of students enrolled by the total number of hours' instruction given during the session—it was found to be 459,805. The actual volume of work, namely, the total number of hours of instruction multiplied by the actual attendances, was 302,162 student-hours, or 60 per cent. of the total volume of work. Whichever method of computation is adopted, the result obtained shows a marked increase on the previous session.

The imperial grant received year by year increases steadily, amounting during 1906–7 to 9773*l*. The capitation grant paid by the Lancashire County Council in respect of students outside the Manchester area was, for 1907–8, 1226*l*. The Cheshire County Council compounds, so far as its students are concerned, and from this source the school received 400*l*.

It is interesting to notice that a certificate has been instituted this year for students attending the engineering apprentices' course, held on Mondays from 9 a.m. to 6 p.m. throughout the session. To satisfy the conditions of award, students must pass all the prescribed examinations upon completion of the two years' course of study. The certificate has now been awarded to thirty-seven students, who have attended the course during the past four sessions. A similar day course for apprentice painters and decorators has also been inaugurated. The committee of the school has had under consideration the question of extending the facilities to apprentices in other industries for instruction and training during one whole day a week, so as to relieve them from attendance at the evening classes, and at the same time to give additional time and opportunity for homework and study in the evening. After consultation with the Master Plumbers' Association of the Manchester and Salford district, a scheme has been drawn up for apprentice plumbers on the same lines as the course for apprentice engineers.

During the past year opportunity has been taken to improve and develop the organised courses of instruction in several of the evening departments in order more thoroughly to systematise the training given, and to bring the various subjects of the respective evening courses into closer organic relation. The courses in the departments of mechanical engineering, electrical engineering, architecture and builders' work, municipal and sanitary engineering, and textile manufacture, are thus graduated and organised to cover a period of three or five years, leading up to the evening certificate or diploma of the school, as the case may be.

A large number of tests has been carried out during the year for various firms in Manchester and district, and the facilities which the school offers for mechanical and electrical tests, and tests and analyses of a chemical nature, are taken advantage of increasingly, as shown by the fees received, which have increased from 119*l*. in 1904–5 to 319*l*. in 1906–7, and 352*l*. in 1907–8. The members of the staff have been responsible during the session for a considerable amount of original research, a large portion of which has been embodied in papers read before various scientific societies, and published in the journals of the scientific and technical Press.

Not only does the committee govern the Municipal School of Technology, but aids higher education in other ways. It recommended to the City Council the grant of 4000*l*. received by the Victoria University of Manchester, and is responsible for the grants received from the council by the secondary schools of the district.

ON THE INVENTION OF THE SLIDE RULE.[1]

SOME modern writers attribute the invention of the rectilinear slide rule to Edmund Gunter, others to William Oughtred, but most of them to Edmund Wingate. This disagreement is due mainly to lack of opportunity to consult original sources. It is the purpose of this paper to demonstrate that Wingate never wrote on the slide rule, and that Oughtred is the inventor of the rectilinear as well as the circular type.

It was pointed out by Prof. De Morgan that Gunter invented Gunter's line or scale, but that he did not invent the slide rule. As Gunter's works are found in most large libraries, the correctness of this statement can be readily verified. This scale was not a slide rule, for it had no sliding parts.

No one denies that William Forster published in London in 1632 a book entitled "The Circles of Proportion," which described the circular slide rule invented by William Oughtred. In the dedication it is said that Oughtred invented also the straight-edge type; but this was not described until 1633, when Forster brought out an "Addition unto the Use of the Instrument," with an appendix entitled "The Declaration of the Two Rulers for Calculation," which described the rectilinear slide rule.[2]

The question remains, Did Wingate invent the straight-edge slide rule, and is he entitled to priority over Oughtred? De Morgan maintained that Wingate never wrote on the slide rule,[3] but he had not seen all of Wingate's books. Thus he admits[4] that he had not examined Wingate's "Of Naturall and Artificiall Arithmetique," 1630, yet this very book is quoted by several recent writers as describing the slide rule[5]; but these and all writers who name Wingate as the inventor invariably fail to give

[1] Abstract of a paper, by Prof. F. Cajori, read before the Section of Mathematical and Physical Science of the British Association, Winnipeg, August 27.

[2] For extracts see Cajori, "History of the Logarithmic Slide Rule." (New York: *Engineering News* Publishing Co., 1909.)

[3] "Penny Cyclop.," Art. "Slide Rule," and Wingate, Edmund, "Arithm. Books." Pp. 38, 42. (London, 1847.)

[4] "Arithm. Books," p. 48.

[5] A. Favaro in "Veneto Istituto Atti" (5), 5, 1878–9, p. 500; Mehmke in "Encyklop. d. Math. Wiss.," vol. i., p. 1054. (Leipzig, 1898–1904.)

evidence which would show that they had actually seen the book to which they refer. We have gathered information about all Wingate's mathematical books which De Morgan did not examine. We shall state where copies can be found, so that the data given here can be verified by those who are near the libraries named. We take up Wingate's books, one after the other, and show that none contains the slide rule.

(1) "L'Usage de la Règle de Proportion," Paris, 1624. De Morgan's assertion that this book describes nothing more than Gunter's scale[1] is corroborated by P. M. N. Benoit,[2] who examined copies in the Bibliothèque nationale and the Bibliothèque Mazarine in Paris. There is a copy in the Bodleian Library.

Wingate brought out in 1626 in London a translation under the title "Use of the Rule of Proportion." Later editions appeared in 1628, 1645, 1658, and 1683. De Morgan saw the 1645 edition, a copy of which is in the British Museum. Wingate died in 1656.

(2) "Arithmétique logarithmique," Paris, 1626. De Morgan described this book.[3] He saw also the "Logarithmeticall Table," London, 1635, which is anonymous, but is attributed to Wingate.[4]

(3) "Construction and Use of the Line of Proportion," London, 1628. Copy in the British Museum. The "line of proportion" here described is merely a mechanical table of logarithms. There are no sliding parts.

(4) "Of Naturall and Artificiall Arithmetique," London, 1630. Copy in the Bodleian Library. Describes only the instrument named in the preceding text. The first part of this book was enlarged by John Kersey the elder in 1650 under the new title "Arithmetique Made Easie." De Morgan saw the editions of 1673 and 1760.[5] The second part was re-edited by Wingate in 1652. Copy in the British Museum. The instrument described here is still the "line of proportion."

(5) "Ludus Mathematicus," London, 1654, 1681. De Morgan[6] inspected the first edition.

(6) "Use of the Gauge-rod," London, 1658 (second edition).

(7) "The Clarks Tutor for Arithmetick and Writing . . . being the Remains of Edmund Wingate," London, 1671. Copies of both books in the Bodleian Library. Neither contains an account of the slide rule.

MASONRY ARCHES.

A MEMOIR dealing with a subject of great interest to the engineer has recently been issued as a Drapers' Company Research Memoir.[1] It must be admitted that the ordinary treatment of the masonry arch is by no means satisfactory, and therefore any solution of the problem which would give more accurate and trustworthy results without involving excessive labour in the necessary calculations would be welcomed by every engineer who may in the course of his professional duties have to deal with the design and erection of masonry or brick arches.

After discussing the ideal arches for different load conditions, the authors show that for the fairly flat arches of modern practice designed to carry (1) a uniform load per foot run of the rib, or (2) a vertical load rising to a horizontal at a height $l^2/8r+r/6$ above the central line at the crown, the elliptic arch is the proper design.

The rest of the memoir is devoted to an investigation of the extent of the applicability of the elliptic arch. It is shown that for the loads usual in masonry arches the elliptic arch is only closely approximate to the ideal if the ratio of rise to span be small, this latter condition involving large horizontal thrusts and great compressive stresses.

The authors then show that a close approximation to the arch the line of pressure of which coincides with its central line can be obtained with no great labour of calculation, and such an arch they term a pseudo-elliptic arch. The necessary equations to give the required solution are obtained, and an example is worked out in detail to show the application of the method and to prove that the labour of the necessary calculation is not a serious obstacle to the employment of this method. The memoir is illustrated by six plates reproduced from actual drawings.

The applied mathematics department of University College is to be congratulated on this valuable addition to the series of research memoirs dealing with difficult engineering problems for which Prof. Karl Pearson and his students have been responsible. T. H. B.

1 "Arithm. Books," p. 42.
2 "La Règle à Calcul expliquée," p. vi. (Paris, 1853.)
3 "Penny Cyclop.," Art. "Tables," p. 497.
4 *Loc. cit.*, p. 498.
5 "Arithm. Books," pp. 48, 73.
6 *Op. cit.*, p. 44.
7 "On a Practical Theory of Elliptic and Pseudo-elliptic Arches, with Special Reference to the Ideal Masonry Arch." By Prof. Karl Pearson, W. D. Reynolds, and W. F. Stanton. Pp. 23+6 plates. Drapers' Company Research Memoirs, Technical Series, VI. (London: Dulau and Co., 1909.) Price 4s.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GRADUATES of the late Royal University of Ireland who desire to be registered as graduates of the Queen's University of Belfast, or enrolled as members of Convocation, should communicate as early as possible with the secretary of the latter University. The first meeting of Convocation must be held within the next four months.

WE learn from *Science* that, according to figures available in the office of the auditor, the University of Chicago holds investments representing permanent endowment that amount to 2,974,000*l.* In addition, its buildings and grounds devoted entirely to university use represent 1,783,540*l.*; equipment, scientific apparatus, furniture, &c., being put at 383,260*l.* additional. These figures do not include the funds destined for the erection of the Harper Memorial Library, estimated in round figures to cost 180,000*l.*, nor the cost of the classical building, the construction of which is in contemplation, and on which about 50,000*l.* will be expended.

DR. CHARLES GRAHAM, at one time professor of chemistry at University College, London, and a prominent member of the Society of Chemical Industry, who died on November 13, has left the residue of his estate for medical research. The amount available will probably be 35,000*l.*, and it is left to the Senate of the University of London to found a fund, to be known as the Charles Graham Medical Research Fund. The fund is to be applied in aid of any research carried on by a teacher or student of the school of advanced medical studies of the University College Hospital for the prevention, cure, or alleviation of human disease or suffering. If any student or teacher conducts a research which is considered of sufficient merit a gold medal of appropriate value is to be awarded to him. The committee of the school is also to pay to such teacher or student conducting the research an annual sum not exceeding 200*l.* per annum for two years, such person to be known as the "Charles Graham Student in Pathology."

THE Department of Agriculture and Technical Instruction for Ireland has issued a syllabus (Circular 70) of the examination which it proposes to hold in the principles, methods, and history of education, with special reference to science teaching. The examination will be held in June of each year. The examination is provided for candidates seeking recognition of qualification to teach science. Among the subjects included in the syllabus are:—The general characteristics of the curriculum and methods of instruction in science as determined by the laws of general development; the correlation of science with other subjects of the curriculum. The methodology of instruction in science as determined by the laws of development of knowledge; the functions and relations of laboratory work and class-teaching. The critical study of the history of a special branch of science so far as it bears upon the teaching of the subject. The use of note-books and text-books in science teaching; methods of recording and treating observational data. The construction and use of pictorial illustrations, diagrams, and models; the construction of apparatus. Laboratory organisation and management.

THE "Regulations for Secondary Schools" of the Board of Education lays it down that in all fee-charging secondary schools free places must be offered, under certain conditions, at the beginning of each school year to pupils entering from public elementary schools. The number of such places offered must ordinarily be 25 per cent. of the total number of pupils admitted to the school during the previous

year, or, in the case of a new school, at its opening, but this percentage may be reduced or varied by the Board on sufficient grounds in the case of any particular school. A return has just been issued showing the number and names of the fee-charging secondary schools receiving the Board's full grant in which the 25 per cent. of free places has been reduced or varied on grounds deemed sufficient by the Board of Education. The return shows there are 865 secondary schools receiving from the Board the full scale of grant of 5*l.* for each registered pupil between twelve and eighteen years of age. At two of these schools no fees are charged, 746 are required to offer 25 per cent. of free places, and in the remaining 117 a lower percentage is required. The grounds for variation or reduction of the normal percentage of free places fall roughly under three heads, viz. financial circumstances, the fact that there is an adequate provision of free places in neighbouring schools, and the existence of a large percentage of boarders in the school. In fifty-three cases the number of free places has been reduced from 25 per cent. to 10 per cent., in twenty-nine cases to 12·5 per cent., in thirteen cases to 15 per cent., and in all other cases where a reduction has been allowed to 20 per cent.

THE eighth annual report, which deals with the work of the year 1908–9, of the executive committee of the Carnegie Trust for the Universities of Scotland has now been issued. The committee states that reports of the independent authorities who have examined the records of the year's work under the research scheme of the trust give evidence that its past success is being well maintained. The committee acknowledges the assistance rendered by the universities in providing the scheme with so many able workers and in affording accommodation and supervision in their various laboratories. We notice that applications for fellowships, scholarships, and grants for 1910–11 must be lodged on or before April 1 next with the secretary of the trust, from whom application forms and regulations can be obtained. The expenditure for 1908–9 upon the scheme of fellowships, scholarships, and grants, and upon the laboratory, was respectively 686*l.* and 199*2l.*, towards the latter of which the Royal College of Physicians and the Royal College of Surgeons together contributed 102*5l.* The second quinquennial scheme of distribution, which opened with the year under review, besides making contributions of 65,250*l.* to buildings and permanent equipment, and 20,500*l.* to libraries, will at the close of the period of five years have increased the resources of teaching in the four university centres by permanent endowments amounting to 87,500*l.*, while it will at the same time have afforded during the five years an annual income of some 4150*l.* to meet ordinary expenditure. Statistics of the payment of class fees for 1908–9 give the total number of beneficiaries as 3553, the total amount of fees paid as 47,071*l.*, and the average amount of fees paid per beneficiary as 13*l.* 4*s.* 11*d.*, an increase as compared with the preceding academic year of 284 beneficiaries, of 381*5l.* in the total expenditure, and of threepence in the average amount per beneficiary. During the year 257*l.* 10*s.* 6*d.* was refunded voluntarily on behalf of eleven beneficiaries for whom class fees had been paid by the trust.

THE recommendations, made jointly by several of its subcommittees, to the London Education Committee for the organisation of a system of central schools in London have been adopted by the Education Committee, with the exception of a few relating to certain points concerning the teaching staff, and the consideration of these has been deferred. A system of schools is to be established giving an educational course not provided in existing elementary or secondary schools, and the new schools, which will be known as central schools, will have either an industrial or a commercial bias, or both. These schools will take the place of the existing higher elementary and higher grade schools, and will be fed by contributions from surrounding schools, as most of the higher grade schools are at present. The curriculum will provide in all cases for manual and practical work, and, in the case of girls, for instruction in domestic subjects. The curriculum of each school will be considered specially, and be determined with the view of meeting the needs of the district. Pupils will be selected between the ages of eleven and twelve, and parents will be given the opportunity of choosing either a secondary school or a central school for these children. The schools will be organised on a four years' course, and provision will be made for bursaries to be held by pupils on their attaining the age of fourteen. These bursaries will not exceed 500 in number, and will consist of maintenance grants from the age of fourteen at the rate of 10*l.* a year. The total annual cost of this arrangement is estimated at 7500*l.* It is intended that the number of central schools shall be fewer than the present higher elementary and higher grade schools, and shall be carried on under the ordinary regulations of the Board of Education, and in this way be free from the restrictions imposed by the higher elementary schools' regulations. In order that the parents of candidates for admission may be given an opportunity of realising the advantages afforded by the new schools, it is intended to issue a short descriptive pamphlet, and the parents are to be encouraged to seek personal interviews with the school managers and head teachers.

THE eighth annual meeting of the North of England Education Conference will be held at Leeds, in the University buildings, on January 6–8, under the presidency of Sir Nathan Bodington, Vice-Chancellor of the University. The general conference on Friday morning will be devoted to a discussion on the relation of elementary schools to technical schools (day and evening), which will be introduced by papers by Prof. M. E. Sadler, of Manchester, and Mr. James Baker. Mr. J. H. Reynolds and Mr. A. C. Coffin will open the discussion. The subject for the general conference on Saturday morning will be education abroad and in England—a comparison, introduced by papers by Mr. J. C. Medd and Mr. Otto Siepmann, head of the modern languages department, Clifton College. Mr. Cloudesley Brereton and Dr. R. M. Walmsley will open the discussion. The sectional meetings on Friday afternoon will be devoted to the following four topics:—(1) independent study and self-help in schools; (2) co-operation between employers and education authorities; (3) colour-study in relation to general art and to trade, and modern developments of applied art instruction; and (4) the teaching of geography and history in relation to one another. The sectional meetings on Saturday afternoon will be devoted to the four subjects:—(1) physical training in schools, with special reference to the new scheme of the Board of Education; (2) do we teach too many subjects in the primary schools? (3) modern ideas on general art instruction; and (4) the relation of the State to the training of teachers of domestic science, and their relation to the university. The last subject will be introduced by Prof. Smithells, F.R.S., and Miss M. Atkinson. It will be seen that the organising committee has selected a series of topics of wide interest and importance. The principal speakers are experts in their subjects. As a good attendance is already guaranteed, the conference should be one of particular interest and utility. The social side of the conference will be promoted by a conversazione at the University on Thursday evening, January 6, and by a reception by the Lord Mayor in the City Art Gallery on Friday evening, January 7. The usual publishers' exhibition will be liberally accommodated in the large physics laboratory at the University, and the comfort of delegates has been carefully considered in the provision of writing, smoking, and conversation rooms. The technological departments of the University will be open to delegates throughout the conference.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, December 14.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—Dr. F. D. **Welch**: (1) Change of colour in a specimen of *Mellivora ratel* living in the society's gardens; (2) a comparative examination of three living specimens of *Felis tigris sondaica*, with notes on an old Javan male.—Dr. W. E. **Agar**: The nesting habits of the tree-frog, *Phyllomedusa sauvagii*. This frog makes a nest suspended from bushes overhanging a pool, into which the tadpoles drop when they are hatched. The nest is constructed from a number of leaves, the lower ends of which are drawn

together and held so by a deposit of empty gelatinous egg-capsules, forming together a thick jelly. After oviposition the nest is closed with a similar mass of empty capsules, so that in a well-made nest not a single egg is exposed to the light and air.—Miss Ruth M. **Harrison** and Miss Margaret **Poole**: Madreporaria collected by Jas. J. Simpson and R. N. Rudmose-Brown from the Mergui Archipelago, Lower Burma, and from the Kerimba Archipelago, Portuguese East Africa.—F. E. **Beddard**: (1) Some notes upon *Boa occidentalis* and *Boa* (*Pelophilus*) *madagascariensis*; (2) notes upon the anatomy of monkeys of the genus Pithecia.—G. A. **Boulenger**: The ophidian genus Grayia. A contribution to the revision of the genus made necessary by an increased knowledge of African snakes.

Linnean Society, December 16.—Prof. E. B. Poulton, F.R.S., vice-president, in the chair.—Rev. T. R. R. **Stebbing**: (1) Report on the Crustacea Isopoda and Tanaidacea collected by Mr. Crossland in the Sudanese Red Sea; (2) Isopoda from the Indian Ocean and British East Africa. Among the Red Sea species, the most interesting novelty is one named *Lanocira latifrons*, in allusion to the peculiar widening of the frontal process. In British East Africa, Wasin has yielded a new genus and species meriting the significant appellation *Kalliapseudes makrothrix*, which may be rendered in the vulgar tongue as the "long-haired beauty of the Apseudidæ." The species is remarkable for the extensive fringes of feathered setæ on the mandibles, maxillipeds, and first gnathopods, as well as for the short, round-ended finger of its second gnathopods. In the Stanley Gardiner collection the new species *Apanthura xenocheir* is unique within its own family in the structure of the hand and finger of the first gnathopods. The new genus and species *Pontógelos aselgókeros*, of the family Eurydicidæ, from Mauritius, displays a prolongation of the first antennæ hitherto unexampled in that family. Several new species and a new genus of Epicaridea, isopods parasitic on other crustaceans, are described from specimens transmitted by Miss M. J. Rathbun, who had extracted them with great care from the crabs of the Stanley Gardiner Expedition. In one instance it proved that the maternal pouch of the parasite was occupied, not by the usual enormous mass of eggs, but by another parasite, probably itself an epicaridean, though strangely metamorphosed.—Prof. G. H. **Carpenter**: Pycnogonida from the Red Sea and Indian Ocean, collected by Mr. Cyril Crossland.—R. **Shelford**: A collection of Blattidæ preserved in amber, from Prussia.—A. W. **Waters**: The Bryozoa from collections made by Mr. C. Crossland, part ii., Cyclostomata, Ctenostomata, and Endoprocta. The collections dealt with only contain sixteen species, and these are nearly all known from the Mediterranean, while nine are British. In this and the previous paper ninety-nine Red Sea species and varieties are referred to; of these, thirty-four are known from the Atlantic, twenty-six from British seas, thirty-nine from the Mediterranean, thirty-four from Indian and neighbouring seas, seventeen from Crossland's Zanzibar collection, eight from Japan, thirty-five from Australia. The classification of the Ctenostomata is examined, and it is considered that the group Stolonifera of Ehlers must be divided into Vesicularina and Stolonifera. In the first there is usually a moderately thick, erect stem from which the zoœcia arise directly, and they all have gizzards, an organ not general in the Ctenostomata and probably confined to this group. In the Stolonifera as now reduced there is a delicate creeping rhizome expanding at intervals, and from these places the zoœcia arise, usually in pairs. There is no gizzard. The gizzards of the Vesicularina usually have a large number of sharp and irregular teeth surrounded by a band of strong muscles, but in Cryptopolyzoon the gizzard has but two teeth with nearly flat edges, called grindstone teeth.

DUBLIN.

Royal Irish Academy, December 13.—Dr. F. A. Tarleton, president, in the chair.—Prof. G. A. J. **Cole**: The "Picture Rock" or "Scribed Rock" near Rathmullan, in the county of Donegal. Attention has been directed to this rock on account of the supposed resemblance of the markings on its surface to casts of the footprints of animals. It proves to be a weathered face of spheroidal diabase (epidiorite), in which prisms of hornblende have developed from the two primary series of joints, and have spread inwards into the rock on either side. The portions of the rock which are thus strengthened to resist denudation stand up like the walls of boxes round about the residual cores of the spheroids, with a deeply weathered interval between them and the spheroids.—Prof. A. W. **Conway**: The motion of an electrified sphere. The problem of the distribution of electricity on a moving spherical conductor was treated, the velocity varying in any manner and the sphere having rotation. Two types of functions, called harmonicoid functions, were introduced, and by their aid a method of approximation to any degree of accuracy was obtained. The stability of the charge was found to be decreased. In quasi-stationary motion with a uniform field of force the distribution remains uniform if there is no Newtonian mass, but, if there is, a "cosine" distribution is produced, the extent depending on the Newtonian mass. In *all cases* the total masses transverse and longitudinal are the same as if the charge were uniform and rigidly attached to the sphere. A conducting electron will have the same dynamical properties as an Abraham electron of the same size and charge.

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