THURSDAY, FEBRUARY 11, 1909.

A NEW ENCYCLOPÆDIA OF AGRICULTURE.

Encyclopaedia of Agriculture by the Most Eminent Authorities. 3 vols. Edited by C. E. Green and D. Young. Vol. i., pp. xii+582. Vol. ii., pp. vii+536. Vol. iii., pp. viii+633. (Edinburgh and London: W. Green and Sons, n.d.) Price 20*s.* net per volume.

THE increasing interest taken in agricultural matters is in no way better shown than by the number of books that have recently been issued. Apart from a host of text-books, at least three large and expensive works of reference have been published within quite a short period. It is a good thing that the demand for such works exists; certainly the present-day farmer stands in need of all the assistance he can get. "There never was a time," say the editors very truly in their preface, "when accurate systematised knowledge regarding the best agricultural methods was more urgently required than now." The increased cost of labour, and the rising charges on land, make it absolutely essential that the farmer should adopt every labour-saving device, and every scheme for reducing the cost of production and for getting the maximum return from his land or his beasts. The object of the volumes before us is "to serve a great use in the way of spreading an accurate knowledge of agricultural science and of the best methods of agricultural practice."

A careful perusal of a number of the articles shows that the work is intended for those taking a general interest in the subject, rather than for the student who is specialising or the expert. The articles are usually too short to allow of much detail, and in some cases the writers have aimed chiefly at showing the bearing of the subject in hand on ordinary farm practice. As a rule, the articles are written in a style that will appeal to the practical man, and they are eminently calculated to arouse his interest in the subject; in some instances a list of standard works is given from which fuller information can be obtained.

The practical matters are in the hands of such capable men as Messrs. Primrose McConnell, John Speir, John Wrightson, W. J. Malden, and others, and are clear, concise, and to the point, giving good accounts of the best practice; we need only mention the articles on ploughs, drainage, forage crops, and potatoes. Live stock receives due attention, and in addition to the ordinary descriptions, we are given admirable reproductions of photographs of good beasts; indeed, these illustrations are quite a feature of the work. The principles of breeding are ably dealt with by Prof. Cossar Ewart, and the bearing of Galton's and Mendel's laws on breeding practice is indicated. There are probably no more skilful stock breeders in the whole world than those of the British Isles, but their success has hitherto been more the result of inborn genius than of education; indeed, the stock breeder will commonly assert that science is of no use for his work. Prof. Ewart shows the fallacy of this position, and gives some illustrations of the value of Mendel's laws in practice. It has long been recognised, he states, that blue Andalusian fowls never breed true. However carefully bred, only about half the offspring are blue, while the other half are pure black or white with black splashes. Yet when the blacks and white splashed are crossed, they yield blue Andalusians. These facts, at one time thought so contradictory, are, of course, in strict accordance with law, and indicate the hybrid nature of the blue Andalusian.

Direct practical application of Mendel's law is suggested in rejuvenating strains showing signs of deterioration. It has hitherto been customary to bring in new blood from a closely related breed, so that the first crosses resemble the parents, *e.g.* in rejuvenating the Chartley herd a Welsh race was used, and the crosses were very like the old Chartleys. A certain number of the Chartleys were also crossed with white Highland cattle, and the first crosses did not resemble Chartleys, so that this method was not regarded favourably by the practical man. However, by mating Highland-Chartley bulls with Highland-Chartley heifers it may be confidently anticipated that a certain proportion of the offspring will resemble the Chartleys but have some of the Highland stamina. Prof. Ewart also goes fully into telegony, and into the persistent hypothesis of "maternal impressions," and shows that no experimental evidence can be adduced in favour of either.

The botanical subjects are dealt with by Prof. Percival, and, needless to say, his treatment is admirable. Insect pests are described by Dr. MacDougall.

On looking down the list of contributors we notice some very curious omissions; it includes no bacteriologist, no chemist except the dairy chemist, and no geologist. The articles on these subjects have been written by practical agriculturists. The experiment was a bold one to make, and has not turned out a success; it has resulted in several poor articles and in a host of errors which greatly mar the value of the work. The general article on bacteriology, for instance, is obviously the work of an amateur who has "got up" the subject from a text-book; there is a good deal of talking round the subject, but we never get anywhere; the reader feels unsatisfied, and if this were a fair presentment of the subject, would be disposed to agree with the statement that "the subject of soil bacteria is not likely to enlist the attention of practical men." The bacteriology of the manure heap has been altogether too much for our author, and after a vain struggle with "aerobic and anaerobic, nitrous, nitric and ammoniacal bacteria, desulphuricans and ferricans," he gives up the unequal contest. We are told that bacteria "multiply with extraordinary rapidity, and occupy the entire bulk of the invaded material in a few hours, or even minutes."

There is an equal lack of treatment about the chemical articles, but the text-book used is older; sulphuric and phosphoric acids are said to "contain

the elements of water, until they combine with a base which supplants the basic water" (vol. i., p. 26). A large number of mistakes are made. "In the process of digestion the carbohydrates are converted by the saliva into cane sugar (maltose, $C_{12}H_{22}O_{11}$) and further into dextrose and levulose," both of which are regarded as varieties of glucose (vol. ii., p. 268). Fish oil is said to be a hydrocarbon. There is a considerable amount of confusion. Dyer's solvent in soil analysis is variously stated to be 1 per cent. nitric acid, 1 per cent. ammonium citrate solution (which is in one place said to be a weak acid and in another an alkali), and 1 per cent. citric acid. The bacterial reduction of nitrates taking place in absence of air, and the evolution of nitrogen from organic matter decomposing in presence of air, get hopelessly confused in the article on denitrification. In describing calcium cyanamide, "the form of lime-nitrogen in which the nitrogen is derived from the air," no distinction whatever is drawn between this substance and the Notodden calcium nitrate; the writer evidently regards them as one and the same thing. Contradictions are not infrequent; under nitrate of soda it is stated that "soda never has been found to be of appreciable manurial value," yet the same writer sixty pages back was insisting on the advantage of manuring mangolds with salt! The author has not much faith in his own chemistry; he impresses on us that there are "forces of vitality which in many cases modify the action of chemical laws and even render them abortive."

It would be easy to multiply instances. The result is all the more regrettable since it conveys an impression of general carelessness and inaccuracy which would not be justified. These unfortunate mistakes make the book an unsafe guide for the student, and prevent it from taking a high place in agricultural literature. It cannot, however, be urged that they are likely to mislead the farmer in his practice. Even with all their errors these articles make interesting reading, and are calculated to show the farmer, if he still needs showing, that there is something in the application of science to practice, and thus to clear the way for the county council lecturer or the agricultural college. E. J. RUSSELL.

THE CAMPAIGN AGAINST TUBERCULOSIS.

The Prevention of Tuberculosis. By Dr. Arthur Newsholme. Pp. ix+429. (London: Methuen and Co., n.d.) Price 10*s.* 6*d.* net.

THE native races of the tropics have their various plagues and pestilences; tuberculosis is generally regarded as the white man's scourge. The incidence of tuberculous diseases among the inhabitants of the British Isles is indeed a heavy one, as shown by the statistical data contained in the opening chapter of the book under review, but it may not be so generally known that tuberculosis has been introduced by the colonising white man among many native races, among whom in some instances it is assuming alarming proportions. On these grounds, therefore, there is ample justification for the publication of this work, which deals first with the causes, and then with the prevention, of this disease.

The first paragraph of the book strikes the keynote of the subsequent matter:—

"Tuberculosis is a disease caused by the destructive lesions set up in the lungs or in other parts of the body by a special bacillus or microbe. The disease is infectious, *i.e.* is communicable from man to man and from animals to man; and it never originates in the body apart from the invasion of the special bacillus."

Tuberculosis, therefore, being placed among the infective diseases, it is natural to compare the death-rate due to it with that of the chief infective diseases—measles, whooping-cough, diarrhœa, enteric, scarlet and typhus fevers, small-pox and diphtheria. We learn that in 1904 the number of deaths in England and Wales from all these were 67,154; from tuberculous diseases there were 60,205, or, in other words, tuberculous diseases in 1904 caused sixty deaths for every sixty-seven caused by the aggregate of the chief acute infectious diseases!

In chapter ii. the magnitude of the evil is discussed from the economic point of view. Thus, taking the statistics of the phthisis (consumption) admissions to the Brighton workhouse infirmary from July 15, 1897, to May 23, 1905, Dr. Newsholme calculates that the cost to the rate-payers amounted to more than 1000*l.* per annum, and on this basis the indoor relief expended on the treatment of consumptives in the workhouse infirmaries of England and Wales amounts to 331,000*l.* per annum. A brief but sufficient sketch of the history, morbid anatomy, and symptoms of phthisis and an account of the tubercle bacillus follows, and then in chapters vii.–ix. the important question of the infectivity of tuberculosis is discussed. Of this the author has no doubt, and the portals and channels of infection are considered in succeeding chapters. It is satisfactory to find that tuberculosis is declining, and in part ii. the causes of the reduction in mortality from phthisis from 281 per 100,000 living in 1850–4 to 123 in 1901–4 are surveyed. The argument and conclusion are that *institutional segregation* is the predominant cause of the decline of phthisis in this country.

Finally, in part iii. the measures for the reduction and annihilation of tuberculosis are discussed. The author favours the view that the diminution of infection outweighs in importance the diminution of the conditions favouring infection, and therefore the early recognition of the disease together with notification are of importance, for then institutional segregation and sanatorium treatment may be secured at that early stage so essential if a cure is to be hoped for, so necessary for the prevention of infection. The various preventive methods are discussed in some detail, and the administrator will gather many valuable hints from a perusal of this portion of the book.

Although, as stated in the preface, written almost entirely from the standpoint of the public health administrator, and intended primarily for medical officers of health, the book is free from technicalities,

and may be commended to the notice of a much wider public, viz. all those interested in the national question of the prevention of tuberculosis and in the public health. The book is light to hold, is printed in pleasant type, and is illustrated with numerous statistical charts and some figures. R. T. H.

TRADITION AND MONUMENTAL REMAINS.

Folk Memory, or the Continuity of British Archaeology. By Walter Johnson. Pp. 416. (Oxford: Clarendon Press, 1908.) Price 12*s.* 6*d.* net.

MR. JOHNSON puts before the student of tradition a study which, whether or not it be accepted in all its details, will be recognised as a valuable addition to our knowledge of the archæological remains of our country. It tells us both of the means by which these remains have often been preserved and of the machinery by which a great mass of tradition has been handed down during the ages. A monument is protected by a custom, superstition or tradition attached to it, while the much frailer life of the custom, superstition or tradition is preserved by the continued existence of the monument. It is obvious that we have here a most fruitful and hitherto largely neglected source of information. Even where tradition has obviously gone wrong, the point where it has gone wrong and the reasons and influence which have caused this deflection are laid bare by Mr. Johnson in many cases, and become a not unimportant part of his inquiry. We frankly confess that, despite objections here and there to conclusions wrongly drawn or drawn from authorities not of the first order, we are impressed by the cumulative value of the evidence which Mr. Johnson adduces. He is sound on most of the scientific problems he deals with, and does not allow his theory to master him.

Mr. Johnson is not always just to his own theory. Thus he directs attention to the important fact that in the Isle of Man it was believed that to pasture sheep on ground which was marked by a stone circle would surely bring disease to the flock, and he goes on to observe that "we call these ideas survivals, and thus hide their true character; in their totality they indicate, not spasmodic survivals, but continuity of development." The introduction of the qualification "spasmodic" is here wholly unwarranted. Survival is not spasmodic, but continuous, and Mr. Johnson not only spoils his own argument, but suggests that he does not understand the true significance of Mr. Tylor's admirable term. Again, he is not always correct in his evidence. His reference to the so-called Boadicea's tomb at Hampstead is to Mr. Read's admirable excavation of it and the suggestion, quite tentative, of its being a tomb of the Bronze age; but further research has been made into this subject, and it is now almost certain that this so-called tomb is a boundary mark of the Roman period, a *botontinus*, in fact, and the legend attaching it to Boadicea is explainable on this origin. We give these examples of faulty research or faulty argument, not for the purpose of discounting Mr. Johnson's work, but merely to show that even after the exhaustive inquiry he has made and the care with which he has marshalled the great mass of facts he has to deal with, there is still much to be done; and the much to be done confirms Mr. Johnson's general conclusions. In these two cases correction would mean additional evidence entirely of the kind that Mr. Johnson advances throughout his work.

The book is usefully, though not elaborately, illustrated, contains full and complete references to authorities, and has a good index. Its scope will be gathered by the following summary of its contents:—the continuity of the ages of Stone and Bronze, racial continuity, links between the prehistoric and protohistoric ages, traces of the ages of Stone and Bronze shown by later implements, stone and bronze in ceremonies and superstitions, the later history of the megaliths, fairies, mound-treasure and barrow superstitions, the reputed virtues of iron, our oldest industry (stone implements), dene holes, linchets, dew ponds, incised figures of our chalk downs, old roads and trackways.

VACCINATION AND OPSONIC ACTION.

Vaccine Therapy and the Opsonic Method of Treatment. By Dr. R. W. Allen. Second edition. Pp xii+244. (London: H. K. Lewis, 1908.) Price 7*s.* 6*d.* net.

THIS book will be found exceedingly useful at the present time, when vaccine therapy has become so popular and in certain fields has achieved such brilliant results. According to the author, the best results are, as a rule, obtained only when vaccination is carried out under the guidance of the opsonic index, but a critical study of his evidence in support of this belief will rather lead one to conclude that good results have been got in spite of the opsonic index and in spite of negative phases. The use of the expression "opsonic method of treatment," forming part of the title of the book, must be strongly deprecated. It is unscientific, and can appeal only to the undiscriminating reader who is unaware of the multiplicity of antibodies elaborated in response to vaccination.

The author commences with a summary review of current opinion on the nature of opsonic action. He believes that the weight of present evidence goes to show that opsonic action, like hæmolytic action, is due to the cooperation of thermostable amboceptor with a thermolabile complement. The practical difficulties in opsonic technique which must yet be overcome in order to do justice to this conception have not, however, been touched upon, nor has the author taken count of this conception in the interpretation of many of the opsonic results tabulated throughout the book. Regarding the site of formation of opsonin, the author concludes from his own experiments that this resides in the muscle tissues. He adduces in support of this view that the opsonic index of muscle plasma from an amputated leg was 1·4 towards various micro-organisms. Further, he mentions that a case of tubercular ulceration which had previously resisted treatment did well when the tuberculin was "injected in a concentric manner round the area of ulceration." We are not told whether the tuberculin was injected intra-

muscularly, but even if it had been, it would not necessarily have supported his claim.

Chapters ii. and iii. deal with the principles involved in vaccine therapy and with the determination of the opsonic index. The author is so strong a believer in the utility of the opsonic index in diagnosis, prognosis, and as a guide in vaccination that a critical review of the subject could not be expected of him, and we do not get it.

The chapters on the methods of obtaining pure cultures of infecting micro-organisms and on the preparation of their corresponding vaccines are well executed. Some micro-organisms, however, like the bacillus of Friedländer and the *Bacillus septus*, receive more attention and consideration than is consistent with our present knowledge as to the *rôle* played by them in disease.

Naturally a large amount of space is devoted to infections caused by the tubercle bacillus. As a result of his own experience the author recommends a mixture of human and bovine tuberculins. The dosage apparently differs enormously according to the guides followed. These may be clinical symptoms, the opsonic index, or common sense. Such multiplication of immunisation systems can only lead to confusion.

The remaining chapters deal with the application of vaccine therapy to many other forms of infection, and the results that have hitherto been achieved.

SCIENCE OUT OF SCHOOL.

Chambers's Wonder Books. (1) *The Wonder Book of Volcanoes and Earthquakes.* By Prof. E. J. Houston. Pp. x+369. (2) *The Wonder Book of the Atmosphere.* By the same author. Pp. ix+326. (3) *Electricity for Young People.* By Tudor Jenks. Pp. viii+317. (4) *Photography for Young People.* By the same author. Pp. x+328. (New York: Frederick A. Stokes Co.; London and Edinburgh: W. and R. Chambers, Ltd., 1908.) Price 3*s.* 6*d.* each.

THE proper function of books of the type under review is to awaken interest in the boys to whom they are addressed. This may be accomplished by appealing to the boy's love of adventure or of animals; or the appeal may be to the constructional instinct, in which case the book should bring science into direct relation with the boy's interests and environment, suggesting to him possibilities of experiment upon his own account. On a higher intellectual level we have to deal with the lad who has reached a more mature stage of mental development and has risen to the height of strictly scientific interests. He now desires *rerum cognoscere causas*, and seeks knowledge in order to obtain intellectual control of natural forces. A valuable stage in his culture will be achieved if at this epoch we can give him an historical survey of the growth of scientific discovery. In such popular histories it is difficult to avoid excess of biography in the earlier portions, and excess of technicality as the present day is approached. Books dealing with boys' hobbies are numerous, and (we are glad to add) often enjoy success. Of the higher type of book—specimens of well-written, untechnical scientific literature—there is an undoubted lack to-day.

The books with which we have now to deal are diverse in character and quality, although appearing in the same series. Even in a short criticism it will be advisable to direct attention to the characteristics of books which are likely to fulfil the function of mental stimulants.

(1) Prof. Houston describes a number of volcanic eruptions and earthquakes. His theme is catastrophe, and he succeeds in producing an impressive compilation of historic disasters due to explosive eruptions or to earthquakes of the first magnitude. He is very precise in stating dates, and the heights—to the nearest foot—of volcanic summits. Our author may be given credit for picturesque descriptions, but it must be regretted that he adopts the cataclysmic geology of Dana. He even puts forward the abandoned theories of "geological revolutions"—with their concomitant exterminations of life—as though such views were generally held by geologists of the present day! We may regard the omission of this or that "important branch of the subject" as no real demerit; but we must condemn writings likely to implant fundamentally wrong ideas, which will provide much for youthful readers to unlearn.

(2) The subject of the second book in the series affords admirable opportunities for suggesting experiments such as would exercise the constructive instinct of his readers. Unfortunately, the opportunity is utilised to an extent which is practically negligible. A very wide range of topics is introduced, and the chapter on the Weather Bureau of the United States may be commended. Many anecdotes are introduced, but they do not suggest, nor would the book as a whole suggest, any steady advance of human knowledge. Exception may fairly be taken to many details, and the style is not calculated to promote accurate thinking. The author's account of Archimedes is regrettable. On such important matters as adiabatic expansion and the rise of clouds he betrays an inability to grip the essentials of the phenomena he sets out to explain.

(3) Mr. Tudor Jenks tells the story of mankind's acquisition of control over electricity, and in so doing gives us a book full of information—probably too full. The first hundred pages contain a considerable amount of biographical matter relating to discoveries from Lucretius to Morse. In books intended for boys it is wise to introduce biography; but this should be done by selecting a few pioneers of science, telling the story of their struggles and achievements with just so much detail as will give a vivid and realistic picture of the men and their surroundings. To do this requires the touch of the artist in words; it is not to be accomplished by relating long strings of events. Still less is it wise to try to tell the story of scientific discovery by snippets of information about a multitude of minor contributors to its progress. Mr. Jenks has been a painstaking student of the history of electricity, and has acquired extensive knowledge; our complaint is that he has compressed too much of this knowledge into a book intended for young people. In the latter half of the work he shows remarkable skill in con-

densing the manifold discoveries of recent years into small compass without sacrifice of accuracy. But he would have produced a more readable, and, we think, more effective book, had he ruthlessly cut out half his information, and expanded the other half so as to supply a series of more carefully graded explanations. A youth who has already made a hobby of electrical-instrument making or who has studied the subject successfully at school might read "Electricity for Young People" with interest, and in that case he would certainly read it with profit.

(4) In the fourth volume of the series, Mr. Jenks had an easier task, since "Photography for Young People" appeals directly to a favourite pursuit. There is a good chance of success for any book of moderate price which tells a boy with sufficient clearness the methods by which he can succeed in his hobby. In this book the young photographer will find good practical instructions, and a particularly clear exposition of the principles of the art he is striving to master. The author is at home alike when dealing with the beginnings of photography and when putting the latest discoveries within reach of the young amateur. Technical terms are properly treated, *i.e.* they are not evaded, but used after explanations have been given in simple language. The acquisition of such terms is enjoyed by a boy, and is good for him provided they are made to become part of his mental possessions—tools in his mental workshop. In each of these volumes a very fair standard is reached as regards illustrations, print, and binding. A plea may be urged for yet more copious illustrations in such books, as the youthful reader is greatly helped thereby. Both (3) and (4) are well indexed. G. F. D.

PHYSICAL ACOUSTICS.

(1) *A Text-book of Sound.* By Prof. E. H. Barton. Pp. xvi+687; illustrations. (London: Macmillan and Co., Ltd., 1908.) Price 10*s.* net.

(2) *Traité de Physique.* By O. D. Chwolson. Translated by E. Davaux. Tome i., fascicule iv. Acoustique. Pp. vii+873–1092. (Paris: A. Hermann, 1908.) Price 8 francs.

(1) PROBABLY no branch of physics is so poorly represented by text-books as that of sound. Between very elementary volumes and Lord Rayleigh's masterly treatise very little exists. The former are too trivial, while the latter is far too severe for the first or second year senior undergraduate. For this reason, amongst others, the present volume will be received gladly by both teacher and student, for it very adequately fills the gap in our expositional literature.

What, then, are the main characteristics of this book which confer superiority upon it? In the first place, the author does not hesitate to employ the elements of the calculus, although in many cases geometrical proofs are given as well. We think the day is now gone in which it was supposed that a student's undergraduate work could be carried on without reference to the calculus. We know that university regulations have in some cases encouraged this belief; but teachers have for a long time ignored these restrictions and have freely employed the calculus in their demonstrations. We hope that the time may come when mathematicians will see their way to give an adequate introduction to such methods in the first collegiate year. It is possible that some matters which are dear to them will need to be postponed until later in order that this may be done. The attempt is made, and satisfactorily so, in some schools; we hope that this practice will become universal. It is true that in some cases an exceedingly quick and convincing proof of a theorem can be obtained by geometrical methods; but, on the other hand, the present writer could lay his finger on pages of proof, partly algebraic, partly graphical, which could all be condensed into a few lines, and which have caused endless bother to the students with whom he has come in contact. Even in the book before us the graphical parts are not those which are clearest, though we have nothing but praise for the thorough way in which those parts are dealt with.

The second main characteristic is the close connection, maintained throughout, between theory and experiment. A treatise on sound is bound to be somewhat mathematical; but the author never misses a chance of introducing an experimental illustration or an account of some experimental verification of a theorem proved.

After a short preliminary survey the book continues with a somewhat long mathematical account of the kinematical and dynamical bases of the subject (including a chapter on elasticity). It is, perhaps, in this part that a curtailment might have been made. The elastic properties of bodies are now usually considered under the head of properties of matter. (By the way, is not the method for calculating the velocity of sound in a gas which starts by superposing an equal but opposite velocity due to Rankine? The author seems to imply that it is Rayleigh's method.) We regret that the part devoted both to the theoretical and experimental side of diffraction should be so short. Dr. Barton probably considers that this should be left to be treated in a text-book on light.

In the third place, we commend this book because it rings true to the spirit of research. The author has himself contributed in some degree to our knowledge of the subject, and he is abreast of the most recent work that has been done in connection with it. This is very notably the case in the large section which deals with musical instruments. Dr. Barton is specially qualified to deal with this side of the subject. The result is that we find here a compendium on the physical side of the qualities of musical instruments such as we believe cannot be found elsewhere.

Of recent work considered, mention may be made of Lord Rayleigh's work on the perception of sound direction, recent considerations in connection with the pressure of radiation, modern work on combination tones (no mention is made, however, of Barrett and Bolas's work on this subject), and the work of Sabine and of Marage on architectural acoustics. The last item is one in connection with which very little is definitely known, and to which research might very well be directed.

Dr. Barton has copied Lord Rayleigh in concluding with a section on electrical oscillations. We have never quite understood why this subject should be treated so fully in a text-book on sound. Some knowledge is, of course, needed in connection with the electrical maintenance of vibrations; but the knowledge so required is very much more than supplied by the theorems given here.

There are twenty-three pages of questions at the end. There are very few misprints in the entire book. We notice *modulus* spelt wrongly twice on p. 131, and we believe that it is to W. König, not A. König, that the explanation of the striated appearance of the dust in a Kundt's tube should be attributed.

(2) The second book which heads this review is a French translation of a Russian text-book. The German translation of the same portion was reviewed by us some time ago, and consequently a very brief notice will now suffice. To the present translation there is a preface by Amagat, and to the eulogistic remarks which he makes on Chwolson's treatise we would add that we consider the entire text-book to be the most satisfactory and complete of any with which we have met. The present part is, perhaps, not the most striking in its superiority; that praise must be reserved for the volume on heat and thermodynamics; but the critical judgment which Chwolson everywhere exhibits has enabled him to deal with the subject of sound in a very masterly way.

OUR BOOK SHELF.

The Zonal-belt Hypothesis. A New Explanation of the Cause of the Ice Ages. By Joseph T. Wheeler. Pp. 402. (Philadelphia and London: J. B. Lippincott Co., 1908.) Price 2.50 dollars net.

THE author of this book has read widely, and the latter two-thirds of it, dealing with comparative mythology, may be useful on account of the quotations. The first third is, as Mr. Wheeler shows in his historical introduction, a development of an idea suggested by Tyndall and by several later authors, to the effect that a thin "canopy" of a gas, capable of transmitting the luminous heat of the sun, but impervious to the dark heat-rays radiated back from the earth, might have a profound effect on the general climate. Such canopies may have arisen from time to time through the fall of rings of matter external to the atmosphere.

The author prefers to regard these rings as planetesimal in origin, and the new point introduced by him is the possibility that the canopies were resolved into belts, thus permitting of strong climatic zones. It is presumed that each ring, as it approached the earth, would divide and spread away as canopies towards both poles, where the centrifugal force was least. Such a time would be a generally warm one, with the production of clouds from evaporated water. These clouds would occur in high levels of the atmosphere, and would assist the rise of temperature. As the canopy aged and became unstable at its edges, it moved back towards the equator, leaving "natural sun-controlled climatic conditions," *i.e.* colder ones, in its wake (p. 103). The regions under the canopy would remain cloudy and warm. Condensation now took place in "the middle ground between the pole and the canopy belt." Here we have all that is needed for the production of a glacial period. Fluctuations in the position of the edges of the canopy would account for interglacial episodes. The final breaking up of the planetesimal belt, and the disappearance of the accompanying atmospheric cloud-belt, caused the glaciation to invade the whole earth (p. 114). Primitive man saw the latest cloud-belts, which originated the myths of serpents twined about the earth.

The gases or planetesimal materials of each original belt are held to have been ultimately deposited as cosmic dust over the globe, after the manner of Mr. H. L. Fairchild's primitive "cosmoclastics" (p. 44). "As a canopy fell a geological age ended, and with it its life conditions" (p. 52). A large number of facts are called in to support the hypothesis, and even the size of Carboniferous insects is said to be an indication of a denser atmosphere. When it is suggested (p. 45) that the earth that has accumulated round the ruins of Nippur "may be in part the wind-blown remnants of cosmical world chaff," we feel inclined to appeal to geology, rather than speculation; and it is with this feeling that we lay down the volume. One of the best things in the unfolding of Mr. Wheeler's hypothesis is the prominence given to the idea that tropical heat is quite compatible with an atmosphere of cloudy darkness. G. A. J. C.

A Monograph of the British Desmidiaceae. By W. West and Dr. G. S. West. Vol. iii. Pp. xv+274; 31 plates (lxv.–xcv., of which 14 coloured). Sixty-fifth year of issue. (London: Printed for the Ray Society, 1908.) Price 25*s.* net.

IN notices of the earlier volumes we have had occasion to speak very highly of this work, which deservedly takes a front rank among monographs devoted to a single family of plants. The merits so conspicuous in these volumes are equally so in this, which is devoted entirely to a part of the great genus Cosmarium. Beginning with species 51, the text closes with species 224; but seven additional species are figured, although exigencies of space require their descriptions to be held over to vol. iv. A very large number of the species have named forms or varieties under them. A considerable proportion of these, and a few of the species, are new to science. The references to the literature under each already known species and variety are very ample. In discussing the distribution of each, the authors are careful to acknowledge the work of others, the names of Roy and Bissett occurring very frequently, and Archer, Cooke, Ralf, and Wills on many pages; but the larger part of the whole is the result of the very extensive researches among fresh-water algæ carried out by the authors themselves in many parts of the British Islands. The distribution beyond our islands is also given, and for some species is extraordinarily wide, *e.g. C. venustum* extends over the northern hemisphere, and has also been found in Java, Australia, and Paraguay, and several others are also dispersed in the fresh waters of almost every part of the world where desmids have been sought for. Under most of the species important notes direct attention to the more distinctive characters, the relations to allied forms, whether British or from other countries, peculiarities of habitat, and other characteristics that cannot be introduced into a systematic description, but which are often exceedingly helpful.

Every species and almost every variety and "form" are figured in the plates, wherever possible in positions to show the forms and markings or sculpture from the different aspects required to give a true conception of these characters. The details of the cell-wall are always shown in uncoloured, and usually the appearance of the living cells in coloured figures, all alike being the work of Dr. G. S. West.

An inspection of the plates and reference to the text show how valuable an aid they afford to the student in the recognition of the species.

The continuation of the work will be looked for with desire and hope by all interested in this beautiful family of microscopic algæ.

Crops, their Characteristics and their Cultivation. By Primrose McConnell. Pp. xii+115. (London: Cassell and Co., Ltd., 1908.) Price 1s. net.

THE author of this little book is one of the few present-day farmers who are also writers, and he has given us an admirable account of the crops commonly cultivated, which cannot fail to be valuable both to the agricultural student and the practical man. The first two chapters are devoted to the general conditions necessary for plant growth, and to those conditions which, though not essential, are favourable, and therefore complied with in practice. Then follow descriptions of the various crops arranged under their agricultural headings, viz. cereals, pulses, forage crops, root crops, and grasses. The last two chapters deal respectively with the manuring of crops and with their common pests.

The book is well up to date in practical matters. The author notes the growing tendency to depart from strict rule in the matter of rotations, and to grow whatever pays best at the moment, provided always there is a change of crop. He also observes that improved methods of cultivation and the use of labour-saving machinery have made it possible to grow wheat at prices impossible thirty years ago, and he anticipates a revival of wheat cultivation in England. Most of those who have studied the problem will agree with the author here.

On the scientific side the author tends to take a rather more definite position than the evidence justifies, *e.g.* in his account of nitrification, of the acid excreted by roots, and of the reason why certain crops require certain manures rather than others; but otherwise the book is very free from errors, and can be cordially recommended to all interested in the subject.

The Moths of the British Isles. By Richard South. Second Series, comprising the Families Noctuidæ to Hepialidæ; with accurately coloured figures of every Species, and many Varieties; also drawings of Eggs, Caterpillars, Chrysalids, and Food-plants. Pp. vi+376; 159 plates, 20 text-figures. (London and New York: Frederick Warne and Co., 1908.) Price 7s. 6d. net.

THE present volume concludes Mr. South's excellent synopsis of the British Macro-lepidoptera, which occupies three volumes, one of butterflies and one of moths having appeared previously. We have already spoken favourably of the earlier volumes, and it is now our pleasing duty to say that there is no falling-off in the execution of the text and plates of the volume before us. Little attempt is made to describe the perfect insects; and indeed a good figure is in many cases sufficient for the identification of many insects; but the range of variation is usually indicated, and caterpillars, habits and localities are usually recorded in detail. As before, we have usually coloured figures of moths on one side of a plate, and plain ones of caterpillars and chrysalids on the other; but sometimes, as in plate 146, which represents Zygænidæ, we have coloured figures of moths on both sides. The figures are usually excellent, but in the case of the emeralds they are unsatisfactory, the figures coming out rather under-coloured, which we suppose is due to some deficiency in the colour-printing. The letterpress is very good and up-to-date, but we do not notice on pp. 55 and 56 any reference to the two specimens of *Thalpochares parva* taken by Dr. Battersby at Torquay in 1859.

In conclusion, we may say that English names for butterflies and moths, which were always reprobated by Stainton, have been coming into general use lately, and most of the popular books now issued give them equal prominence with the Latin names. W. F. K.

Les Stations lacustres d'Europe aux Ages de la Pierre et du Bronze. By Dr. Robert Munro. French edition by Dr. Paul Rodet. Pp. 295. (Paris: Schleicher Frères, 1908.) Price 12 francs.

THIS is an excellent translation into French of the classical work of Dr. Munro on "The Lake Dwellings of Europe," reviewed in NATURE, February 12, 1891. The French edition is not so extensive as the original work. It deals only with lake dwellings of the Stone age and of the Bronze age, the chapters relating to lake dwellings of the Iron age, to the *terramara* of North Italy, to the *terpen* of Holland, and to the *crannogs* of the British Isles being omitted. Several valuable additions have, however, been made to the French edition which make it a very complete, up-to-date compendium of the Stone and Bronze age lake dwellings of Europe. Among these additions we note a map of the lake dwellings surrounding the Alps prepared by M. Adrien de Mortillet, and a map of the lake dwellings of Lake Bienne discriminating between those of the Stone, Copper, Bronze, and Iron age.

Paragraphs are added by the translator giving a description of discoveries that have been made since the date of publication of the original work in 1890. It is to be regretted that the translator has not brought up to date Perrin's statistics of bronze objects from Lake Bourget.

An interesting table is given of the analysis of bronzes from the lake dwellings, and we note that many of them contain small percentages of lead, nickle, cobalt, iron, silver, antimony, and zinc. These foreign substances may be of some value in helping to trace the provenance of the ores used by these prehistoric peoples for their metallurgical operations.

Les Progrès récents de l'Astronomie. By Prof. P. Stroobant. Pp. 98; illustrated. (Brussels: M. Hayez, 112 rue de Louvain, 1908.)

ALL who are interested in the progress of astronomical knowledge should welcome Prof. Stroobant's most useful summary, now issued separately as an extract from "L'Annuaire astronomique de l'Observatoire royal de Belgique."

This small volume is nearly three times the size of its predecessor, and contains a *résumé* of practically all the important astronomical discoveries and advances made during the year 1907. In the first section we get an account of the solar work, including notes on the re-determinations of the sun's rotation period and parallax; then follows a summary of the observations of the transit of Mercury, which is illustrated by a pair of photographs arranged for the stereoscope, a duplicate, detachable plate being included to obviate the necessity of defacing the book.

The observations of the planets, of comets, of variable and double stars, &c., are also discussed, and the book concludes with various notes on such subjects as stellar distances, nebulæ, refraction, and the variation of latitude. The section dealing with comets is illustrated by two excellent photographs of Daniel's comet, taken by Prof. Wolf at Heidelberg.

W. E. ROLSTON.

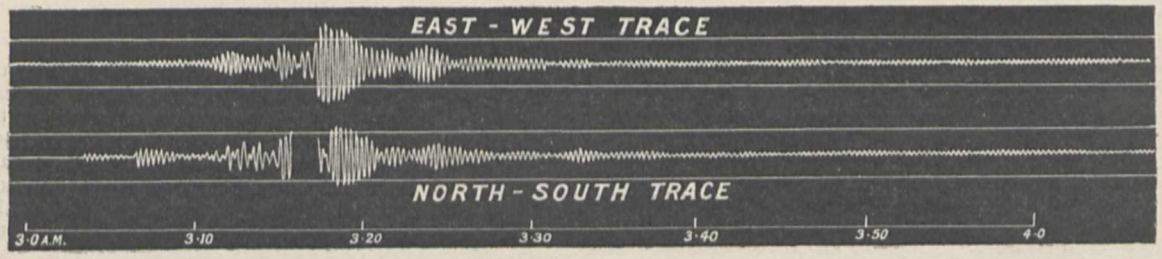
LETTERS TO THE EDITOR.

[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.]*

Seismograms of the Earthquake of January 23.

WITH reference to the article on "Recent Earthquakes" in NATURE of January 28, the accompanying records of the earthquake of January 23 may perhaps be of interest. These are from negatives printed from the original curves taken with the Milne twin-boom seismograph at the new magnetic observatory at Eskdalemuir, Dumfries-shire, of which Mr. G. W. Walker is superintendent.

The interval between the breaks in the curve (not shown in the accompanying reproduction) is one hour, and the hour mark near the commencement of the earthquake



corresponds, as nearly as could be ascertained, to 3h. 5m. a.m., G.M.T., January 23. The natural period of both booms is 18·6s., and the sensitivity is such that 1 mm. = 0″·44.

The east-west is clearer than the north-south trace, and a short piece of the latter is omitted, as it is not possible to reproduce it with certainty from the negative.

R. T. GLAZEBROOK.

The National Physical Laboratory, Teddington, Middlesex, February 1.

The Italian Earthquake.

THE able article in NATURE of January 7 (p. 277) by "R. D. O.," and the useful notes appended thereto, have no doubt been read with interest by students of physical geology all the world over. I should like to add a few remarks, which may perhaps be also found useful.

Thanks to the masterly teaching of the veteran geologist Prof. Suess, of Vienna, as first outlined in his smaller work, "Die Entstehung der Alpen," and to the teaching of the Swiss school, we have learned in the last two decades to trace a clearer causal connection between disturbances of this sort and the local architectonic structure of the lithosphere. The essential factor of such phenomena would seem to be the local weakness of the crust, resulting in its yielding, in this area or in that, to variations of stress in those potentially molten portions of the lithosphere, which, while practically rigid under the rapid rotatory motion of the earth (see my letter to NATURE, May 4, 1905, on "The Rigidity of the Earth's Interior"), exist under planetary pressure at temperatures above the solid-liquid critical temperature of the mineral masses of which they are composed.

The variations referred to (whether from cosmic or terrestrial causes) compel portions of the overlying crust, of course, to adjust themselves under the influence of gravitation to the altered mechanical conditions. Such adjustments may, and generally do, occur on lines of ancient "faulting," and may be classified as positive and negative. The former we should expect to occur as downward movements under the direct action of gravitation where faulting occurs in a synclinal flexure, the tendency of the bed-rock being to sag down, and in such cases we get a slip-fault movement. On the other hand, where any part of the force of gravity is resolved into tangential thrusts on or near axes of anticlinal flexures, the fault-movements are almost bound to be of an overthrust nature. Of these two types we may regard the San Francisco earthquake of 1906 as an instance of a slip-fault movement. The later Valparaiso earthquake, on the other hand, would appear to have been due to movement on planes of overthrust faulting in an anticline, and this alone would account for the greater and more widespread devastation witnessed in that case.

Applying this reasoning to the earthquake of December 28 last, we should expect to find that the movement was of the Valparaiso type, and this receives confirmation from the external fissuring of the ground at the surface. A reference to Prestwich's geological map of Europe throws light at once upon the problem. The Messina Strait is seen to be on the axis of an anticlinal flexure, the sea being there less than 100 fathoms deep. The 100-fathom contour is seen to approach the strait at both ends, and then to double rather sharply back, especially on the Ionian side, while the 1000-fathom contour runs in approximate parallelism to it, and much nearer to it on the Ionian side than on the Tyrrhenian side. The faulting, which Prof. Suess is reported to have sketched in the Vienna papers, seems to cut through the Archæan crystalline mass in the north of Calabria, and then to follow its western boundary for some distance further south, coinciding in part with the shore-line. Under the strait itself it seems to bifurcate "in the direction of Etna," according to Suess, but I would suggest along the southern limit of the exposed crystalline mass, which forms the high promontory of the Peloritan mountains, since Taormina appears to have escaped the effects of the earthquake. The point of bifurcation would be the weakest place, and therefore the locality in which the upthrust would be most perceptible. If this is admitted, we may discern here the true cause of the dual wave which swamped the low-lying portions of both Messina and Reggio.

Further, the steepness of the submarine gradients on the south or Ionian side of the area, as compared with those on the Tyrrhenian side, seems to indicate the existence, on a much smaller scale, of conditions which hold good in Japan, where the bed of the ocean rapidly descends to the greatest oceanic depth known on the Pacific side, the "concave" side of the "mountain-wave" (Suess), as compared with the gradients of the "convex side," the shallow Sea of Japan. Prof. Suess (one of our greatest masters) will therefore perhaps allow me to suggest that the seismic movement in the present instance occurred rather on or just outside the rim of the disc-like area of subsidence which is occupied by the Tyrrhenian Sea, an area of which the Lipari Islands with their volcanoes mark an incidental fracture-feature (as worked out years ago by Judd) rather than the centre.

In the view here put forward the minor earthquake shocks felt a fortnight or so later in the Tuscan region, at Ravenna, and other places, would follow as incidents in the more complete adjustment of the geologically young range of the Apennines to the disturbances of previous mechanical equilibrium, caused by the greater disturbance on the other side of the Tyrrhenian Sea, which has startled the world by its results. The differential results in the Messina-Reggio region would seem, further, to be accounted for by sidelong movements of the ground due to overthrust faulting, so terrible always in its effect upon buildings badly constructed and erected upon such loose and incoherent rock-materials as those which constitute the Quaternary and later Tertiary strata, upon which the low-

lying portions of the ill-fated cities and the Calabrian villages once stood. It is a warning to those who may be in any way responsible for rebuilding them.

A. IRVING.

Bishop's Stortford, January 21.

The Isothermal Layer of the Atmosphere.

MR. DINES makes a happy choice of terms when he writes of the isothermal *column* (NATURE, January 21, p. 341). Each of the unrejected traces is interpreted to show a more or less isothermal column, and it is by mentally piecing together these columns into a sort of honeycomb that the miscalled isothermal *layer* is brought into existence. It must not be forgotten that this hypothetical layer has a very uneven floor, and that each cell in the honeycomb has its own particular temperature. This is a complex structure. I certainly think it more feasible to ascribe the sudden and sustained minimum in the temperature curve, which is the gist of this discussion, to some idiosyncrasy or limit to which all the instruments, foreign as well as native, are subject night and day, and on the down as well as the up journey. In your issue of January 21 I referred to the falling density of the air current, upon which current the whole experiment depends. If the trace shows a uniform temperature during the upper 9 kilometres of an ascent, there is no escape from the conclusion that the temperature of the air has steadily fallen to compensate for its tenuity, and if we assume an adequate compression of the hydrogen before the rubber gives way, there is a further compensation required for loss of speed.

I shall now endeavour to answer Mr. Dines's points by the help of the old-fashioned laws of heat.

"The isothermal column of air shows just as plainly in ascents made after sunset as in those made in the day."

Yes. Radiation is stronger by day, but radiation and convection balance at some point, and the balance, if maintained, means a regular fall of temperature upwards.

"At night the thermograph must receive some heat by radiation from the earth, and lose some by radiation into space, but both amounts must be infinitesimal in comparison with that which would be given to it by the sun."

Being quite close to the hot planet, and being far below the temperature due to such proximity, the balloon, &c., will receive more radiation than they emit. The radiation from the planet, subtending nearly a hemisphere, will be far from infinitesimal compared with that of the sun.

"That solar radiation in the ordinary conditions is not important is proved by the fact that if the balloon bursts, and therefore does not float, it is not possible to say from the trace alone if the ascent was by night or by day."

If solar radiation cannot be detected on the traces it must be because they differ so much *inter se*. Surely if aëration is so good for the thermograph it must be equally good for the balloon, and a perfect torrent of warmed air must waft on to the instrument during the ascent.

"There have been cases in which the balloon did not burst, and the temperature at the top reached the freezing point of water."

This shows an approach to what I call the natural temperature of a body between the sun and a warm planet. Of course, the balloon, instrument, &c., would have been much hotter out of contact with the cold air which was basking in the sunshine at a temperature of about 100° F. *below* freezing. This recalls the question with which I finished my last letter.

"I still believe that radiation at night to and from the bright metal of the thermograph is so trifling that the rate of ascent is of no consequence."

The whole apparatus is admirably contrived—let us try faithfully to decipher the trace it gives us. The thermograph is scores of degrees below its natural temperature. This argues an intake of heat by absorption of rays, which heat is taken by the air current. The current must be colder or more rapid at the 20-kilometre level to give the traces that are now under discussion.

"There is also the fact that the up-trace, where the motion is comparatively slow, is identical with the down-trace where the motion is rapid."

Mr. Dines has dispensed with a timepiece in many cases. Can he speak positively as to the vertical speeds? If it is quite clear that the down-speed is greater I can only suggest that with a parachute the motion is partly lateral, *i.e.* a gliding motion *through the air*, which would tend to interfere with the draught, as would also the parachute acting as a cover to the screen. Perhaps also the parachute subtends a larger angle than the balloon did.

Summarising the matter, I contend that "isothermal layer" is a misleading misnomer.

The basaltic structure of the upper air which is inferred from the traces is intrinsically improbable.

To get the temperature of the air from the trace a curve must be drawn on its low-temperature side and diverging upwards.

The result will be a non-isothermal curve.

The amount of this correction for all currents can be determined on the instrument in the laboratory.

R. F. HUGHES.

The Size of the Leather Turtle.

As trustworthy weights and measurements of large turtles are not often available, the following measurements and weight of a leather-back turtle, Sphargis, are submitted in the hope of eliciting further data regarding this or other species. The total length of the animal, measured along the curve from the nose to tail, was 6 feet 10 inches; the carapace along the curve, 5 feet 2 inches; the circumference at the widest part of the carapace, 7 feet 2 inches; from tip to tip of front flippers, over the shoulders, 8 feet 9 inches. Weight, a little more than 840 lb., for, when on the scales, the tips of the large front flippers rested on the ground. This is one of the largest turtles of this species that has come under my observation. Another specimen that I was able to weigh turned the scales at 740 lb.

F. A. LUCAS.

Museum of the Brooklyn Institute, Eastern Parkway, Brooklyn, N.Y.

Moral Superiority among Birds.

IN NATURE of January 7 Mr. F. C. Constable describes an observation of the moral superiority of the blue-tit over the robin. This is by no means exceptional. I constantly observe the same thing from my dining-room window, where I have a string stretched across with pieces of cocoa-nut and pork-fat attached to it for the tits to feed upon. In the cold weather the robins come too, but they are never allowed to feed in company with the blue-tits; they are attacked at once if they venture to hold their ground. The long-tailed tits and the cole-tits are much less aggressive, and will even give way to the robins.

LAURA D. H. DUKES.

23 Torrs Park, Ilfracombe, February 1.

WOMEN AND THE FELLOWSHIP OF THE CHEMICAL SOCIETY.

IN our issue of July 9, 1908 (vol. lxxviii., p. 226), we directed attention to the fact that an influentially signed memorial had been presented to the council of the Chemical Society stating that, in the opinion of the memorialists, 312 in number, including ten past presidents, twelve vice-presidents, and twenty-nine members of council, among whom were thirty-three Fellows of the Royal Society, and the heads of the chemical departments of nearly all the most important universities and colleges in the kingdom, the time had come when duly qualified women should be admitted to the fellowship of the society, and praying that the council would take the necessary steps to permit of their election.

The council, having taken the memorial into consideration, determined to consult the whole body of the society, and instructed a committee to prepare a statement of reasons for and against the proposal, to be submitted, together with the memorial itself, to

each fellow, with a view to elicit a definite statement of his opinion as to the expediency of acquiescing in the prayer of the memorial.

We had occasion at the time to animadvert on the manner in which certain members of the council, and in particular the executive officers of the society, allowed their declared hostility to the admission of women to the fellowship to get the better of their judgment and sense of fair play, and we commented on the significance of the protest on the part of a large majority of the past presidents, which was sent to every fellow of the society—a protest which lost nothing of its force by the studied moderation of its expression of indignation.

The result of this referendum was that, by a large majority—1094 for and 642 against—the fellows expressed their opinion that the desire of the memorialists should be acceded to, and that duly qualified women should be admitted to the full rights and privileges of fellowship.

After having put the society to the expense and trouble of a referendum on an issue which was definitely stated with all the reasons for and against which could be urged, it might have been assumed that the council, as a representative body and in its fiduciary capacity, would have given heed to the expression of opinion which it had deliberately invited. Certain members of the council were, however, determined that nothing of the kind should be done. No matter what the size of the majority in favour of the admission of women might be, a contumacious and recalcitrant element in the minority —a cabal of London chemists, in fact, in no proper sense representative of the general feeling of the society—set themselves to thwart the wishes of the majority of the fellows. The whole business of the referendum was thereupon deliberately reduced to a fiasco. It was expedient, however, to temporise. The size and character of the majority was too significant and weighty for it to be treated with too great an appearance of contempt, and accordingly it was decided to offer such women as the council should think fit the privilege of attending the society's meetings, of consulting the society's library, and of purchasing the society's publications at cost price, but to deny them the fellowship.

This, of course, was not carrying out the mandate which the council had received. It was, indeed, in flagrant and contumacious opposition to it. It was necessary, therefore, to make some show of justification for such a course, and the result was one of the most remarkable productions in the way of excuse, evasion, partial statement and special pleading which a perverted and not over-scrupulous ingenuity could put together. This *apologia* is published in No. 349 of the society's Proceedings, and will serve to make that issue historical. By way of preamble it recites, with a chastened sobriety, the results of the voting, and then proceeds to state what was perfectly well known to the council before they instituted the referendum, and should have been stated to the fellows on that occasion by those who raised objections to the admission of women, that, having regard to the state of the law affecting women at the time of the granting of the Charter, there might be legal difficulties in its interpretation, and that these difficulties—if they really existed—might not be overcome unless practically the whole of the society was unanimous in praying for a supplementary or amended Charter. It does not state, however, what is the fact, that, whatever may be the difficulty as regards married women, counsel advised that, in the event of the society deciding to admit women, it should make the necessary alteration in its bye-laws. This advice clearly shows that, in the opinion of counsel, the society might certainly admit unmarried women to the fellowship without serious risk to its action being legally challenged, if it were minded to do so, at the trifling cost of amending its bye-laws.

The fact is, there is not a single word in the Charter which either explicitly or implicitly excludes women. It has been held, indeed, by legal authority that by the very wording of the Charter it was clearly contemplated that women might possibly become fellows. Nor is there anything in the nature, functions, or objects of the society as defined by its founders which would preclude the admission of women. These facts were brought to the knowledge of the council on the authority of an eminent lawyer, whose written opinion was laid before them. But no hint of a possible conflict of legal opinion is given in the *apologia* which was put forward on behalf of the council, and only that particular one is referred to, and only so much of it is quoted as serves the purpose of him who drafted the argument. The net result of this conflict of legal opinion on the mind of the council was that it was a case of *tot homines, tot sententiae*.

It is obvious that the whole of the *apologia* put forward on behalf of the council is simply a disingenuous plea of *non possumus*.

Every fair-minded person is now convinced that if the society is determined to admit duly qualified women to its fellowship it can do so without troubling itself about its Charter, and with no risk of an injunction against it so long as such women fulfil the objects of the society and are prepared to comply with its laws. In fact, what it has already done in regard to the election of Madame Curie as an honorary member it can do in regard to any British-born woman as an ordinary fellow.

But now comes the Nemesis. The council having professed their great anxiety concerning the legal difficulties they have conjured up, and which, like so many lions in the path, they say confront them, proceed to disregard the Charter and propose to act in a wholly irregular and unconstitutional way. They enact a resolution, indistinguishable, as has been said, in form and substance from a bye-law, and create a special class called "Subscribers," in no sense differing from that of the associates mentioned in the Charter, except that it is restricted to women, who are not admitted by the ballot of the fellows as are the associates. The difficulty of the council is obvious. Although the women so admitted are, in effect, associates, to call them so would be to give away the whole case. Hence the institution of the new grade. This makes confusion worse confounded. Whilst professing to have regard to the Charter, the council deliberately ignores or sets aside its provisions. No such resolution can take effect until it is sanctioned as a bye-law by a general meeting.

The fact is the council, under the direction of unwise advisers, have bungled in this business from start to finish. The only prudent step they have taken was to elicit the general feeling of the fellows. Having obtained it, they should have acted loyally and in good faith, and have sought to give effect to it. As it is, they have been led by devious and crooked ways from the straight path, with the customary result. The position now is as irregular as it is inequitable, and as illogical as it is unjust. Their plain duty is to retrace their steps and end an unseemly episode by doing what common sense, reason and justice demand.

In the meantime, the women concerned have, with a wiser instinct than that which has actuated the council, declined to accept the invitation to take up a position which, in view of its irregularity, would

have made themselves and the council ridiculous, and would have prejudiced their case as regards the fellowship.

This issue—namely, the position of women chemists in regard to a society which professes to have no other aims than the promotion of chemistry—is one which is bound to be settled in favour of the women. Men have no prerogatives as regards the study and cultivation of natural knowledge. It is open to women, as human beings, to follow its pursuit if they are so minded, and they have the same moral rights as men to benefit by membership of an organisation which has been created to further its interests. We admit women to our colleges and universities; they work in our chemical laboratories; they engage themselves in the business of original chemical inquiry; we publish their scientific communications in our journals; and we confer upon them our degrees in science. Why, then, should the Chemical Society of London be singular in refusing to admit them as fellows? That it is singular is shown by the fact that even a purely professional society—the Institute of Chemistry—admits them. The Society of Chemical Industry places no obstacle in their way, and they are admitted to Continental and American chemical societies.

The small group of London chemists who have set themselves to oppose the wishes of the main body of the society have thereby raised an issue which is even broader than that which they have sought to evade. It is whether, in an essentially democratic institution like that of the Chemical Society, the will of the majority is to prevail, or whether it is to be thwarted by the machinations of a self-constituted oligarchy which abuses its trust and makes use of its opportunities to gratify its personal prejudices. Perhaps the general body of the fellows will have something to say on this matter at the forthcoming general meeting of the society.

PERIODICITY IN THE SUN AND THE RED VARIABLE STARS.[1]

THE mechanisms of the periodicities of the sun and stars are matters still of great obscurity. The cyclic change of the sun's spotted area has long been known, indeed can be traced in the early Chinese observations. In probable association with this are periodicities of facular and floccular areas, and of prominence activity. Coronal forms have been shown to change in type from point to point of this solar cycle, while recent observations of the so-called "solar constant" have shown its intrinsic variability. This last also is likely to be periodic. Such intimate first-hand knowledge is impossible in the case of the stars. Their integrated light changes alone can be examined. For variable stars about or below the solar level, according to the classifications of Secchi, Lockyer, or Pickering, some idea of the details of their variation may be obtained by analogy with the sun. In dealing with the red variable stars this method has been followed in the publication under review. This is an "Essai d'une Explication du Mécanisme de la Périodicité dans le Soleil et les Étoiles rouges variables," by A. Brester, Jz, Docteur ès Sciences, published by the Academy of Science, Amsterdam, 1908. The first accounts of the theory have been already reviewed in NATURE (vol. xxxix., p. 492, and vol. xlvii., pp. 433, 434). Its main features remain unchanged. The present statement gives it in the light of more recent knowledge, amends it in detail, and extends its application, more especially, to the case of red variable stars.

A short preliminary re-statement of the theory is perhaps desirable. In the case of the sun there is postulated a hot fluid globe made up of concentric layers of different substances arranged, more or less, according to their densities, and having angular velocities increasing with the depth in the sun. For the stability of such a stratification a relatively tranquil sun is demanded; such disturbances as are admitted are considered as being of the order of feebleness of terrestrial winds.

Radiation from the outermost solar layers provokes condensation, retarded by exothermic chemical action, which, falling as a torrential rain, forms the photospheric clouds. If the loss of heat above exceeds the gain of heat below the clouds increase in thickness and gradually reach lower and lower levels. In their descent they leave behind the finer condensed material, which serves to explain the loss of solar light at the limbs and the "yellow veil." The extreme brilliance of the photospheric clouds is likened to that of an incandescent mantle, the brightness of which seems to be associated with some subtle chemical activity. The breaks in the photosphere through which the re-vaporised clouds ascend constitute the spots, the vapours of which, though at least equal in temperature to the photospheric clouds, have smaller emissive powers. An upthrusting of faculæ would usually precede a spot, which seems to correspond to the latest observations, while the facular lag and equatorial acceleration of spots would follow from the assumed distribution of angular velocity.

The periodicity of the thickening and sinking of this photospheric cloud and its re-conversion into uprising vapour, which again condenses at a high level, grows in thickness and slowly reaches lower levels once more, is obviously too indefinite for mathematical treatment, so that the eleven-year cycle and the minor periodicities are still only facts of observation. An intensification of this clouding up of radiation and an increased periodic spottiness represent the extension of the theory to the red variable stars.

The tranquility and absence of eruptive phenomena, which the author regards as essential to his theory, are fearlessly imposed. Since the delicately poised strata must not be disturbed, the directly observed velocities, both on the photosphere, as spot and floccular changes, and at the limb, as prominence activities, are discredited as movements of matter. A transference of luminescence serves to explain them. The displacements of some solar lines indicate, on the principle of Döppler, velocities in the line of sight which the author holds as "impossible and absurd." Since line displacements are now known to be produced by other agencies, as well as by line-of-sight velocities, Döppler's principle is held to be untrustworthy. The invariability of the general Fraunhoferic spectrum is adduced as evidence of this photospheric calm, while the outermost different angular velocities of some of the solar layers, as indicated in the recent work of Prof. Hale, show, according to the author, that the "supposed solar eruptions cannot exist."

The above is a very brief sketch of the theory which in the essay is treated in great detail. A wealth of pertinent quotations and references is brought to its support, the collection of which must indeed have been a labour of love.

The parts which exothermic and endothermic chemical actions play in the theory are interesting. Dissociation, a distinctive solar theory of Sir Norman Lockyer, is used in this connection, though the relative temperature and the direction of motion in the umbræ of spots are the opposite of those given in

[1] "Essai d'une Explication du Mécanisme de la Périodicité dans le Soleil et les Étoiles rouges variables." By A. Brester, Jz. Eerste Sectie. Deel ix., No. 6. Pp. 137. (Amsterdam: J. Muller, 1908.)

the sun-spot theory suggested by him. This latter theory recent solar work would seem to support.

While a transference of luminescence might be held as sufficient to account for the direct observations of apparently high velocities in prominences, it would not adequately account for the actual line displacements observed, which are so consistently dealt with by Döppler's principle. It is difficult to see why even a velocity of 300 miles per second in the outer regions of the solar atmosphere is held to be impossible. At the lower levels of the photosphere and reversing layer such enormous velocities are hardly to be expected, though even here the invariability of the spectrum is more apparent than real. Larger solar images and greater dispersion show local movements of the solar lines unobserved under less favourable conditions.

The independent rotation of some of the outermost solar layers is not vital to any theory, and indeed the outermost considered has the *highest* velocity apart from the lack of polar retardation. The existence of extensive magnetic fields in the sun due to the rotation of ions indicates velocities in excess of that which the author's theory would allow. The theory, however, seems a flexible one, and may provide even for these observations. The essay should be found both interesting and suggestive, though it can hardly carry conviction.

For his painstaking compilation of evidence, for his careful discussion of it, and for his daring unorthodoxy and consistency, the author deserves full credit. In the region of solar theory, during this age of subatomic physics, many of the grosser explanations and less subtle analogies, hitherto sufficient, may have to pass. The necessity for an alert and open mind is especially great.

THE INTERNATIONAL CONGRESS OF CHEMISTRY.

THE seventh International Congress of Chemistry will be held in London at the end of May. The congress meets every third year, the last meeting having been in Rome, and the one previous in Berlin. This is the first time that the congress, which is under the patronage of the King and the Prince of Wales, has been held in this country. Some two years ago an organising committee was formed of delegates from twenty societies which have interests in connection with chemistry, and also from the Chambers of Commerce of London and Manchester.

There are very few of the important industries which are not directly or indirectly indebted to technical chemistry for their development and success. Continental nations have long recognised this, and the congresses which have been held in the various cities of Europe have been well attended. It has been felt, also, that the holding of the congresses has materially contributed to the progress of the various countries by bringing the heads of the firms into personal contact with scientific men from all parts of the world.

The congress covers the whole domain of chemistry, and is divided up into eleven sections:—(1) analytical chemistry, (2) inorganic chemistry and allied industries, (3) metallurgy and mining, (4) organic products, (4*a*) colouring substances and their uses, (5) industry and chemistry of sugar, (6) starch industry, (6*a*) fermentation, (7) agricultural chemistry, (8) medical chemistry, (8*a*) pharmaceutical chemistry, (8*b*) bromatology, (9) photochemistry, (10) electrochemistry and physical chemistry, (11) law, political economics, and legislation with reference to chemical industries.

British delegates who have attended these congresses have always been well received and entertained in a most hospitable manner. It is hoped and expected that we in this country will not be behindhand in the welcome which will be extended to our foreign *confrères*.

The congress will be opened at the Albert Hall, and the business part of the proceedings will be held in the buildings of the University of London, the Imperial Institute, and the Imperial College of Science and Technology at South Kensington. The chief aim of the congress is the advancement of scientific knowledge, but beside this, arrangements are being made for various gatherings of a social nature, such as a banquet at the Crystal Palace, a conversazione at the Natural History Museum, and a visit to Windsor Castle by special permission of the King.

In view of the fact that more than 3000 visitors are expected to attend the congress, and that it will last a whole week, the expenses will necessarily be heavy. Substantial sums have already been received, but in order that we may in no way be behind other nations in our hospitality, the committee has appealed for further help.

THE HUTTON MEMORIAL MEDAL AND RESEARCH FUND.

SHORTLY after the death of the late Captain F. W. Hutton in 1905, steps were taken by the Philosophical Institute of Canterbury to establish a research fund as a memorial of his many services to New Zealand science. The New Zealand Government recognised the value of Captain Hutton's work by

subsidising the fund to the amount of 300*l*., and a total sum of about 660*l*. was ultimately handed over to the New Zealand Institute.

Of this amount, 100*l*. was set aside for the expenses of striking a bronze medal to be known as the Hutton memorial medal. This medal, a photograph of which is here reproduced, has been designed by Prof. Lanteri, and bears an excellent portrait of the late Captain Hutton, and on the obverse a design emblematical of the fauna and flora of New Zealand, viz. a tuatara (*Splenodon punctatus*, Gray), prominent in the foreground; a kiwi (Apteryx); a cabbage tree (*Cordyline australis*); New Zealand flax bush (*Phormium tenax*), and other New Zealand plants,

while geology is represented by a geological hammer on some rocks in the foreground, and by a volcano in the distance.

The medal is to be awarded from time to time to persons who have made some notable contribution in connection with the zoology, botany, and geology of New Zealand; save in exceptional circumstances it is not to be awarded oftener than once in three years, and the recipient must have received the greater part of his education in New Zealand, or have resided in New Zealand for not less than ten years.

The remainder of the fund has been invested, and the interest on it may be used by the institute for making grants to persons who require assistance in connection with researches in New Zealand's natural history.

Communications with regard to the fund may be addressed to the secretary of the New Zealand Institute, Wellington, or to Dr. Chas. Chilton, Canterbury College, who acted as hon. treasurer until the fund was handed over to the institute.

W. H. HUDLESTON, F.R.S.

WE have to deplore the death, in his eighty-first year, of Wilfrid Hudleston Hudleston, one of the most distinguished of British geologists, whose combined knowledge of the main branches of the science, palæontological, stratigraphical, petrological and chemical, was unsurpassed.

Born at York, on June 2, 1828, he was the son of Dr. John Simpson, of Knaresborough (who married Elizabeth Ward, heiress of the Hudlestons of Cumberland), and he assumed the name of Hudleston, by letters patent, in 1867.

After receiving education in schools at York and Uppingham, he entered St. John's College, Cambridge, and graduated B.A. in 1850. His attention was directed to geology during his last term at college, when he was present at a course of Sedgwick's lectures, but some years elapsed before his interest was concentrated on that subject. The study of law had engrossed much of his time, and he was called to the Bar in 1853, but never practised.

Possessed of independent means, he spent the earlier years of manhood in travel in various parts of Europe and northern Africa. He was ever a keen sportsman, and the subject of ornithology attracted him, probably through his friendship with the late Alfred Newton, whom he accompanied on a visit to Lapland. Thus it was that he became one of the founders of the British Ornithologists' Union; and on December 9 of last year he attended a special meeting, held in the rooms of the Zoological Society, to celebrate the jubilee of the Union, when a gold medal was presented to him in honour of the occasion.

At the age of thirty-four, Mr. Hudleston decided to qualify himself for research work in natural science by courses of instruction which he undertook at Edinburgh, and afterwards at the Royal College of Chemistry in London. His ultimate career was determined in 1866, when he was introduced to John Morris, professor of geology in University College, London. An absorbing interest in geology was aroused by that enthusiastic and gifted teacher, and Mr. Hudleston became a Fellow of the Geological Society in 1867, and joined the Geologists' Association in 1871. To the latter body he gave energetic service for a number of years, being chosen honorary secretary in 1874, and president in 1881; and he conducted a number of notable excursions, his reports on which contain much original information.

The list of his geological publications commences in 1872, and among the more important are a series of papers on the Yorkshire Oolites, and others on the Gasteropoda of the Oolites, published in the Proceedings of the Geologists' Association and in the *Geological Magazine*.

In 1877, in conjunction with the late J. F. Blake, he communicated to the Geological Society a memoir on "The Corallian Rocks of England," giving full particulars of these fossiliferous strata from Dorset to Yorkshire. It is sufficient to say that this paper is to be regarded as one of the geological classics.

In 1892, with the cooperation of the late Edward Wilson, he published "A Catalogue of British Jurassic Gasteropoda," a work embodying all the critical knowledge of the writers. His chief work, one on which he was engaged for more than twenty years, was his "Monograph on the Gasteropoda of the Inferior Oolite," published by the Palæontographical Society (1887–1896).

Mr. Hudleston, who served for several years as secretary of the Geological Society, was elected president in 1892; and he was awarded the Wollaston medal in 1897, soon after the completion of his great work on the Gasteropoda.

Apart from his detailed investigations, Mr. Hudleston was the author of numerous essays, which afford abundant evidence of his shrewd criticism and sound judgment, with not a little dry humour. Among these articles may be mentioned those on the geology of Palestine, on the Tanganyika problem, on the eastern margin of the North Atlantic Basin, on Indian geology, and on the geological history of iron ores.

Mr. Hudleston was elected a Fellow of the Royal Society in 1884. He was one of the founders of the Malacological Society, was president of Section C of the British Association at Bristol in 1898, and was president at times of several provincial natural history societies. In later years, when he acquired a country residence at West Holme, near Wareham, in Dorset, he took an active part in the proceedings of the Dorset Natural History Field Club. He investigated in detail the structure of Creechbarrow Hill, near Wareham, and only last year published an important paper on some well-sections in connection with the local water-supply. He died at his Dorset home on January 29. A biography of him, to which we are indebted for many of the above particulars, appeared in the *Geological Magazine* for September, 1904, accompanied by an excellent portrait and a list of publications.

H. B. W.

NOTES.

DR. HORACE T. BROWN, F.R.S., and Sir David Bruce, C.B., F.R.S., have been elected members of the Athenæum Club under the provisions of the rule which empowers the election of persons "of distinguished eminence in science, literature, the arts, or for public services."

WE learn from the *Pioneer Mail* that Sir T. H. Holland, F.R.S., director of the Geological Survey of India, may be expected to arrive in England on leave during the coming summer preparatory to retirement, as he proposes to accept the offer of the chair of geology at Manchester University vacated by Prof. Boyd Dawkins, F.R.S.

THE honorary secretaries of the meeting of the British Association to be held in Winnipeg from August 25 to September 1 of this year are Mr. C. N. Bell, Mr. W. Sanford Evans (Mayor), Prof. M. A. Parker, and Prof. Swale Vincent. The office of the secretaries has been organised in the University of Manitoba, Winnipeg, Canada.

SIR DANIEL MORRIS, K.C.M.G., late Imperial Commissioner of Agriculture for the West Indies, has been selected for the newly created office of scientific adviser to the Secretary of State for the Colonies on agricultural matters relating to British possessions in the tropics.

MR. R. R. TATLOCK has been elected president of the Society of Public Analysts for the ensuing year.

MR. O. J. R. HOWARTH has been appointed assistant secretary of the British Association in succession to Mr. A. Silva White, who recently resigned that office.

DR. F. H. HATCH has been appointed by the Government of Natal to make an examination of the mineral resources of the colony, and will shortly proceed to South Africa for that purpose.

A REUTER message from Messina states that a strong earthquake shock was felt there on February 7 at 9.30 p.m., followed by a slighter one half an hour later. Another shock of some violence occurred at 9 a.m. on February 8.

ON Thursday next, February 18, Dr. Hans Gadow, F.R.S., will begin a course of three lectures at the Royal Institution on "Problems of Geographical Distribution in Mexico." The Friday evening discourse on February 19 will be delivered by Sir Henry Cunynghame on "Recent Advances in Means of Saving Life in Coal Mines."

THE Turin Academy of Sciences, says *La Nature*, will award in 1911 a prize of 9300 francs, bequeathed by M. Bressa, to the man of science or the inventor of any nationality, who in the period 1907 to 1910 shall have made, in the judgment of the Turin Academy, the most distinguished and useful discovery, or have produced the most celebrated scientific work in some branch of science.

THE second meeting of the Spanish Association for the Advancement of Science, which was founded on the occasion of the Saragossa Exhibition, will be held at Valence next October. According to the *Revue scientifique*, two meetings will be held in 1910, one in Spain and the other at Toulouse. Particulars of the meetings may be obtained from M. Ricardo Garcia Merat, general secretary of the Royal Spanish Society of Sciences, at Madrid.

THE fifth meeting of the Prehistoric Congress of France will be held at Beauvais on July 26–31 next. The first three days will be devoted to the discussion of papers, and the remaining three to scientific excursions. An exhibition of prehistoric specimens will be held during the meeting. All information may be obtained from M. L. Giraux, the treasurer to the committee, 9 bis, avenue Victor-Hugo, à Saint-Mandé (Seine).

THE death is announced in *Science* of Prof. B. H. Guilbeau, professor of zoology at the Louisiana State University. Since 1906 Prof. Guilbeau had been director of the Gulf Biologic Station. In summer work at Cornell he investigated the froth production of the "spittle insects." At the time of his death he had been engaged for several months investigating the parasites of *Plusia brassica*, confirming the results of French investigators as to the development of many insects from a single egg.

THE gold medal of the Royal Astronomical Society has this year been awarded to Prof. O. Backlund, director of the observatory, Pulkowa, Russia, for his researches on Encke's comet. The medal will be presented at the annual general meeting of the society on Friday, February 12, when the president, Mr. H. F. Newall, F.R.S., will give an address, setting forth the grounds upon which the award has been founded. The Jackson-Gwilt (bronze) medal and gift have been awarded to Mr. P. Melotte, for his discovery of the eighth satellite of Jupiter.

THE following have been elected as officers and council of the Royal Microscopical Society for the ensuing year:—*President*, Sir E. Ray Lankester, K.C.B., F.R.S.; *vice-presidents*, Mr. F. J. Cheshire, Rev. W. H. Dallinger, F.R.S., Sir Ford North, P.C., F.R.S., Mr. E. J. Spitta; *treasurer*, Mr. W. E. Baxter; *secretaries*, Dr. R. G. Hebb, Mr. J. W. Gordon; *ordinary members of council*, Mr. F. W. Watson Baker, Mr. A. N. Disney, Dr. J. W. H. Eyre, Mr. E. Heron-Allen, Mr. H. G. Plimmer, Mr. Thomas H. Powell, Mr. C. Price-Jones, Mr. P. E. Radley, Mr. Julius Rheinberg, Mr. C. F. Rousselet, Mr. F. Shillington Scales, and Mr. D. J. Scourfield.

ON Thursday, February 18, there will be a discussion at the Linnean Society on the subject of alternation of generations in plants. The discussion will be opened by Prof. W. H. Lang, who has just published an article, in the *New Phytologist* for January, on "A Theory of Alternation of Generations in Archegoniate Plants based upon Ontogeny." It is expected that Prof. F. O. Bower, F.R.S., Prof. J. Bretland Farmer, F.R.S., Prof. F. W. Oliver, F.R.S., Dr. D. H. Scott, F.R.S., and Mr. A. G. Tansley will be among those taking part in the discussion, which is likely to be of considerable interest, as the subject is of fundamental importance to botanical morphology, and is one on which botanists have hitherto taken very divergent views.

ONE of the most puzzling features of the reports of the Italian earthquake in the daily papers has been the absence of any news from the interior of Aspromonte. A correspondent to the *Hampshire Chronicle* fills this gap with an account of the medical expedition which was dispatched from Bologna; leaving the coast towns, this struck into the interior, and reached Oppido eight days after the earthquake, to find that they were the first, and only, relief expedition to reach the communes of Oppido, Scido, and Delianuova, where it was found that most of the houses had been destroyed and those still standing were uninhabitable. This district was one of the centres of destructive violence in 1783, and it is interesting to be able to add another to the many analogies between the earthquakes of that year and of 1908.

IN the issue of NATURE for April 20, 1905 (vol. lxxi., p. 595), an account was given of the work of Mr. J. B. Millet, of Boston, Massachusetts, on submarine signalling by sound, which he described at the annual spring meeting of that year of the Institution of Naval Architects. The recent wreck of the *Republic* and the subsequent events, in which use was made of the method, has brought submarine signalling prominently before the public, and it is suggested that the Government should supply our principal lightships with bells. It has been found that the bells can be heard usually at a distance of ten miles, and sometimes of twelve or fifteen miles. Ships fitted with a receiving apparatus can, by using the telephone receiver in the chart room in thick weather, pick up the sound from an ordinary bell-buoy which cannot be heard by the ear alone. We learn from an article in the *Times* that the lightships which already possess bells are the *Royal Sovereign*, *Tongue*, *East Goodwin*, and *Outer Dowsing*. Bells are about to be installed on the *Outer Gubbard*, *Shambles*, *Spurn*, and *Owers* lightships.

MR. QUARITCH has forwarded to us a copy of a catalogue of books on natural history, containing many rare volumes from the library of a naturalist and collector now abroad, and some herbals from that of the late Lord Amherst of Hackney.

COLOUR-VARIATION in some British slugs formed the subject of Mr. W. E. Collinge's presidential address to the Conchological Society in October last, the address, of which we have been favoured with a copy, being published in the *Journal of Conchology*. Colour-variations of a major and a minor type have long been known to occur in the two species forming the subject of the investigation, but the author is of opinion that even the better-marked variations are far less constant than has been hitherto supposed to be the case, while the minor ones are almost endless, and appear of little importance to the naturalist.

To Dr. E. Rey, of Leipzig, we are indebted for a separate copy of a preliminary paper from vol. xxxiv. of the *Ornithologischer Monatschrift*, in which are recorded the results of an examination of the contents of the stomachs of a number of insectivorous birds. The various insects (together with other invertebrates) found therein are tabulated according to their orders, and in the case of the beetles according to their families, those that are harmless being entered in one column and those that are injurious in a second, while such as come under neither of these headings are assigned a third column. The ultimate object of the investigation is to show to what extent insectivorous birds are beneficial to the agriculturist, but further examinations are essential before definite conclusions can be formulated.

BULLETIN No. 136 of the Bureau of Plant Industry of the U.S. Department of Agriculture is devoted to an article, by Mr. O. F. Cook, on methods and causes of evolution. The doctrine of evolution is now being made of practical use in the solution of problems connected with breeding and acclimatisation, and the paper is written to a great extent from this point of view. The author commits himself to the opinion that "evolution is not caused by the struggle for existence, nor limited to characters of environmental fitness. Harmless and even harmful characters may be acquired by species in the same way as beneficial adaptations." This is endorsed by Dr. A. G. Bell, who communicated the following comment quoted in the letter of transmittal:—"I, too, entertain the feeling that natural selection does not, and cannot, produce new species or varieties, or cause modifications of living organisms to come into existence. On the contrary, its sole function is to prevent evolution. In its action it is destructive merely, not constructive—causing death and extinction, not life and progression. Death cannot produce life; and though natural selection may cause the death of the unfit, it cannot produce the fit—far less evolve the fittest. It may permit the fit to survive by not killing them off if they are already in existence; but it does not bring them into existence or cause improvement in them after they have once appeared. We must look to other agencies for the causes of evolution."

THE tenth number, completing the volume for 1908, of the *Kew Bulletin* was issued last month. It contains determinations of new plants, chiefly from Africa and India, also a letter descriptive of a journey in the Nelson district of New Zealand, by Captain A. A. Dorrien-Smith. A note on the poisonous plant *Rhus toxicodendron*, that grows either as a shrub or a climber, is intended to remove the confusion, caused by recent inaccurate descriptions, between the leaves of this plant and of the harmless unrelated plant, *Ampelopsis Veitchii*.

IN the tenth (1908) number of the *Kew Bulletin* an article on the drug *cascara sagrada* furnished by the bark of two American plants, *Rhamnus Purshiana* and *Rhamnus californica*, is published with a view to the possible introduction of these trees into cultivation on the western coasts of the British Isles. The species *Purshiana* has made successful growth at Kew, and a chemical report on the bark pronounces the extract made from it to be indistinguishable from the product of American bark. There is a difficulty in getting fertile seed which has so far been imported, but where plantations are once formed coppice reproduction might be relied on, judging from the abundance of shoots produced from the stump of a tree cut down at Kew. *Rhamnus californica* is not recommended for cultivation in Great Britain.

FOR the inception of the new botanical publication, *Zeitschrift für Botanik*, that has been initiated in circumstances already explained in NATURE, the editors have been fortunate in securing an original article by Dr. H. Fitting on the effect of pollination and other influences on orchid flowers. The experiments carried out in Buitenzorg tend to show that post-floration changes are not the necessary consequence of pollination, although it normally provides the stimulus; thus, premature withering of the flowers and swelling of the gynostemium can be induced by smearing the stigma with dead pollen or an extract of pollen juice, although growth of the ovary does appear to depend upon the formation of the pollen-tube. The number, running to about 100 pages, contains also critical notices of recent publications, and an index to new literature arranged as in the *Botanisches Centralblatt*, which it resembles in form and appearance.

THE phytogeographical account of the littoral and alluvial districts of Belgium by Prof. J. Massart published in the seventh volume of the *Recueil de l'Institut botanique Léo Errera*, provides a remarkably comprehensive and attractive study of the conditions and associations existing there. The author discusses the past history of the region, the action of climate and soil, morphological modifications, the associations of plants, and the origin of the flora. A primary distinction is drawn between the clay soils of the estuaries and of the *polders*—the low-lying lands retained by the system of dykes—and the sandy soils of the dunes. The latter are bound with such typical species as *Ammophila arenaria, Carex arenaria*, and *Eryngium maritimum*, while *Salix repens* and *Hippophae rhamnoides* are dominant in the hollows. Occasionally plantations of alders or Scots pine are attempted, and in parts crops of potatoes and secale are raised. The nature of the associations is well shown in the photographs, which, with several charts and a list of plants, are published in a separate part. The flora differs from the northern littoral floras by the inclusion of calciphilous elements, and resembles the flora of the French littoral, with which it shares a southern origin.

WE learn from the *North British Agriculturalist* of January 21 that a new process for sterilising milk has been tried at Edinburgh under the superintendence of the inventor, Dr. Budde, of Copenhagen. It depends on the presence in milk of an enzyme, catalase, which decomposes hydrogen peroxide with liberation of oxygen. The milk is heated to 120° F., and treated with hydrogen peroxide; after a time the pathogenic organisms are destroyed, and the milk is run into sterilised bottles fitted with air-tight stoppers, and is then ready for delivery.

TEACHERS in agricultural schools and colleges will welcome the set of wall pictures recently issued by Messrs.

Macmillan and Co., Ltd., to illustrate various breeds of farm animals. Text-books containing sufficiently good illustrations to show what is wanted are too costly for class work, and photographs are not altogether suitable. These pictures are of a good size (30 inches by 20 inches), they depict good examples of the breed, and they are coloured. The set of six includes the thoroughbred horse, the Shire horse, the Shorthorn cow, the Ayrshire cow, Lincoln and Southdown sheep, Large White and Berkshire pigs.

THE *Journal of Agriculture of South Australia* for November, 1908, contains a short paper on the poisonous properties of the Cape tulip. Two species of this plant are found in South Australia, both imported from South Africa: *Homeria miniata*, the two-leaved Cape tulip, and *H. collina*, the one-leaved Cape tulip; the latter is the taller and handsomer, and is sometimes cultivated in gardens. The experiments recorded show that the plant is poisonous, but is carefully avoided by animals that regularly graze on land infested with it. There is some danger, however, that animals newly arrived and hungry may eat the plant, with serious consequences.

WE have received from Prof. Potter a copy of a paper recently published by him in the *Journal of Agricultural Science*, in which he suggests a method not hitherto tried for checking parasitic diseases in plants. It is well known that the waste products of metabolism, when permitted to accumulate beyond a certain stage, are inimical to the organism, gradually checking growth and producing results which finally prove fatal. By growing a pathogenic organism (*Pseudomonas destructans*) in a culture medium, he obtained a toxic solution which, on inoculation into a turnip suffering from the disease caused by this organism, completely inhibited further progress of the disease. The method promises to be distinctly useful in dealing with plant diseases.

MR. A. R. HORWOOD has embodied the results of an investigation, ranging over six years, of the fossil flora of the Leicestershire and south Derbyshire coalfield in a paper read before the Leicester Literary and Philosophical Society, and published in vol. xii., part ii., of the Transactions. The main object was to obtain evidence that would fix the position of the local Coal-measures in the British Carboniferous series. In the case of fossil plants such evidence is derived from the general collection rather than from any specific types. A few of the recorded species are rare, such as *Calamocladus lycopodioides* and *Neuropteris callosa*; also it is interesting to learn that Leicestershire provided the type of *Trigonocarpus Parkinsoni*, a seed that has been assigned to the group of fossil plants known as pteridosperms.

A CURIOUS instance of the light which may be thrown by anthropology on the system of Egyptian hieroglyphics is recorded by Mr. A. M. Blackman in the January issue of *Man*. The symbol representing the word *msy*, "to give birth," has been interpreted by Dr. Borchardt in the *Zeitschrift für Ägyptische Sprache* (December, 1907) to be derived from a fly-flap made of fox skins. Mr. Blackman has now found in Nubia that dead foxes are hung over the doors and on the roofs of houses as a charm to protect the women inmates from malignant influences at the time of childbirth. It follows, therefore, that the use of the symbol derived from a fly-flap was a secondary idea, the primitive conception on which it was based being its use as a birth amulet.

THE London County Council is doing useful work in popularising the study of anthropology by the issue of a series of guides to the collections in the Horniman Museum, Forest Hill. The last number, entitled "A Handbook to the Weapons of War and the Chase," is the work of Dr. H. S. Harrison, the curator of the museum, is edited by the advisory curator, Dr. A. C. Haddon, and is published at the modest price of twopence. After a short introduction dealing with the origin and primary characteristics of weapons, we have a series of articles describing the various types, of which those on clubs of various kinds, spear-throwers, and the composite bow may be specially commended. Unfortunately, only two plates are supplied. If the book were issued in a better form, with superior illustrations, it might be a useful addition to the library of the anthropologist.

THE *Journal of Hygiene* dated November last (viii., No. 5), though only just issued, contains an important paper by Miss Chick and Dr. Martin on the process of disinfection, in which a number of factors modifying the velocity of disinfection is discussed and the conditions necessary for determining the germicidal power of disinfectants and their standardisation detailed.

IN a report of the Board of Health, New South Wales, which has recently reached us, Dr. Ashburton Thompson gives details of an outbreak of plague (the seventh) at Sydney in 1907. Forty-seven cases occurred, of which sixteen ended fatally. For some years now the health staff has instituted a crusade against the rats, large numbers of the rodents being systematically destroyed, and a proportion of them examined bacteriologically. As in previous epidemics, numbers of the rats were found to be infected with plague during the epidemic period. In fact, the careful investigations of the Sydney Board of Health have demonstrated in successive epidemics the close connection that exists between plague in rats and plague in man.

THE subject of dangerous trades is one which has rightly attracted the attention of the public, and a hitherto unsuspected source of danger was recently brought to light in relation to the carriage and storage of the substance known as ferro-silicon. This material is manufactured by heating a mixture of iron ore, quartz, coke, and lime in an electric furnace, and is used by steel makers as a convenient method for the addition of silicon to certain grades of steel. A cargo of this material was being conveyed from Antwerp to Grimsby in December last, and five Russian immigrants in the steerage were found dead in the morning, their symptoms suggesting cholera. No suspicion of a dangerous cargo existed, and the necessary measures of precaution were taken by the Grimsby authorities. The viscera were sent to the laboratories of the Royal Institute of Public Health, and no true cholera organisms were discoverable. The subsequent investigations carried out by Dr. Dodd, Dr. Harris, and Prof. W. R. Smith at the laboratory seem to prove beyond question that death resulted from poisonous emanations from the ferro-silicon. When dry this substance emits no fumes, but when powdered and moistened fumes were formed, and proved fatal within a few hours to animals in the immediate neighbourhood. It was proved that arseniuretted hydrogen is produced in small quantities, but the chief gas evolved is phosphoretted hydrogen, a gas which is so poisonous that 0·02 per cent. of it in air is fatal to small animals within half an hour. Now that the source of danger is known, one can only hope that in the future suitable precautions will be taken to prevent the recurrence of fatalities similar to those which have led to the discovery of the danger.

THE Meteorological Office has recently published an English edition of the report of the meeting of the International Meteorological Committee at Paris in September, 1907. The consideration of the classification of meteorological stations, and of the definition in a clear and precise manner of the terms used for frozen aqueous vapour, referred to the committee by the conference at Innsbruck (1905), was postponed. Among the various subjects discussed we may mention a proposal of the Rev. L. Froc (Zi-ka-wei) for a system of signals for communicating to ships the information at present sent to sea-ports, &c. After a long discussion a special commission was appointed to report upon the question; the same commission was requested to report upon a proposal by Dr. Shaw for uniformity in the scale and projection of marine meteorological charts. After an exhaustive discussion of questions raised by Dr. Shaw and Mr. Nakamura relating to mean values of climatological data, the committee decided to request directors of meteorological systems to enumerate the publications containing such information for long periods for their countries. This resulted in the publication in the present report of a very valuable appendix giving references to such data. Special commissions were appointed to consider proposals for the publication of new isothermal charts (Prof. J. Hann) and daily weather reports for the whole globe (M. Teisserenc de Bort). Dr. Hellmann's proposal that a commission should be appointed to deal more especially with the question of wireless telegraphy was adopted. Dr. Shaw and Dr. Hellmann were respectively elected president and secretary of the International Committee in place of MM. Mascart and Hildebrandsson. Reports of commissions on terrestrial magnetism, aëronautics, and solar physics are printed in the appendices.

A PAPER on a practical method for the improvement of existing railway curves was read by Mr. W. H. Shortt at the Institution of Civil Engineers on January 12. The subject-matter comprises methods for the introduction of transition curves for connecting straight lines with circular curves, and also for connecting reversed curves at the reversal of curvature. The paper should be of service in pointing out the scarcity of such relieving curves on existing lines in this country, a defect which leads to damage of both line and rolling stock, and also contributes in no small degree to the discomfort of the travelling public.

THE claims of the propeller problem are advanced by Mr. J. Hamilton Gibson in an article on the efficiency of marine engines and propellers in the *Engineer* of January 29. The power developed by marine turbine machinery is measured by application of a torsionmeter, by means of which the angle of twist of a measured length of the propeller shaft is ascertained and taken as a measure of the torque passing through the shaft. The necessity of calibrating the shaft on which the instrument is to be used is shown from the results of experiments on apparently identical shafts, in which the value of the modulus of rigidity was found to vary from 11,500,000 lb. to 12,500,000 lb. per square inch, a variation which would introduce an error of nearly 9 per cent. had the same value of the modulus been assumed for all. Mr. Gibson has had great experience with torsionmeters, and makes some useful recommendations. Torsionmeter shafts should be periodically re-calibrated. The torque in turbine-driven shafts is found to be remarkably steady, consequently there is but small interference in the torsionmeter readings due to torsional oscillations of such shafts. Methods of obtaining the zero reading are described; this should be done at the commencement of each trial. Data obtained from torsionmeter trials point to a marked inefficiency of the small high-speed turbine-driven propeller as compared with the large low-speed piston-driven screw, and Mr. Gibson suggests the need for a trustworthy thrust indicator which would indicate the amount of compression on the shaft, and thus enable turbine-driven propellers to be compared direct with piston-driven screws. Experiments on multiple-bladed propellers are also suggested, the analogy of modern windmills, fans such as the Sirocco, and many vaned water turbines being cited. Meanwhile, trial-trip data alone are available until some public-spirited firm takes upon itself the responsibility and cost of carrying out experiments on full-sized propellers.

THE *Physikalische Zeitschrift* for January 15 reproduces an address by Prof. M. Planck to the science students at the University of Leyden on the unity of natural philosophy, in which he dealt mainly with the recent tendencies of theoretical physics, and pointed out how marked had been the absorption by electrodynamics of branches of the subject formerly distinct. In his own field of work he dwelt at length on the greater precision which had been introduced into the study of thermodynamics by the reduction by the late Prof. Boltzmann of the idea of entropy to that of probability. From this, since the entropy of two independent systems is the sum of their separate entropies, while the probability of the two systems is the product of their separate probabilities, it follows that the entropy of a system is proportional to the logarithm of its probability. Finally, Prof. Planck pointed out the directions in which future advances will be made, and predicted much discussion of these fundamental questions, for, as he said, "theorists are many and paper is patient." He pleaded above all for conscientiousness in self-criticism and avoidance of personalities in the controversies which must arise.

WE have received from Messrs. W. and J. George a new simplified form of burette stand, which they designate the W.J. Burette Stand. It consists of a stout upright fastened to the usual form of base, both of which are of teak. The upright, of wood, has two permanently fixed arms, which are 9 inches apart. The arms are placed directly above each other, and are slotted so that a burette can easily pass into them. In order to hold the burette in position the wood at the sides of the slots is countersunk in the form of a ring about half-way down its thickness. To fix the burette in position two circular rubber bands are placed over it at such a distance apart that they will just rest upon the counter-sunk part of the arms. There are no screws to turn or get out of order, and by simply slipping the burette between the slots it falls into position without any further adjustment. For elementary students this is certainly a very simple stand, and one which cannot get out of order. The stand was invented and patented by the Rev. A. Wentworth Jones.

MESSRS. JAEGER AND VON STEINWEHR have recently completed at the Physikalisch-Technische Reichsanstalt, Charlottenburg, an exhaustive research on the silver voltameter, in connection with which comparisons of Weston normal cells have also been made (*Zeitschrift für Instrumentenkunde*, November and December, 1908). These two experimenters have arrived at the following conclusions:—(1) The weight of silver deposited in the voltameter does not, within the errors of experiment, depend on whether the Rayleigh form or the Richards modification is employed. The absolute measurements show a difference of 1 part in 10,000, but it was not possible to find a measurable difference in the exact relative measure-

ments. (2) By displacing the air during electrolysis with a neutral gas (nitrogen) no appreciable difference was observed in the weight of silver deposited; this is in agreement with the recent measurements made at the National Physical Laboratory, and contrary to the older measurements of most of the earlier observers. (3) The value found in the course of this research for the Weston normal cell, in terms of the international ohm and international ampere, agrees in a most satisfactory manner with the same results of the Reichsanstalt in 1908, and shows a satisfactory agreement with the recently published results of the National Physical Laboratory.

THE explanation of the electrical and thermal properties of metals as due to the existence of freely moving electrons in the intervals between the molecules of the metal has been a favourite theme with physicists for the last ten years since Prof. Riecke first published his theory. Although most of the theories have succeeded in giving properties for the metals in general agreement with the results of experiment, the quantitative agreement has not been all that could be desired. In particular, the quotient of the electrical and thermal conductivities, which has throughout been a favourite quantity with regard to which theory and experiment were compared, has, according to the theories, been a simpler function of the temperature than experiment has proved it to be. In No. 13 of the *Verhandlungen der deutschen physikalischen Gesellschaft* for 1908 Prof. P. Gruner, of Berne, suggests a modification of the theory of Prof. Lorentz which will do something to remove this objection. The negative electrons alone are supposed to be in motion, and when one impinges on a neutral molecule with sufficient velocity it is supposed to be capable of expelling an electron from the molecule, and when it impinges on a positive molecule with the requisite gentleness it may combine with the molecule. Since the critical velocities can be chosen at will, it is evident that Prof. Gruner's theory admits of a closer fit between theory and experiment than has hitherto been possible.

THE general report on the operations of the Survey of India administered under the Government of India during 1906–7 has been received. The report was prepared under the direction of Colonel F. B. Longe, R.E., Surveyor-General of India. We notice that the scale on which field surveys are to be executed and the larger scale standard maps published has been decided. The general scale of survey is to be 1 inch = 1 mile, but reserved forests and special areas will be surveyed on the scale 2 inches = 1 mile if required. The general scale for publication will be 1 inch = 1 mile. Among special observations carried out during the year under review may be mentioned those in connection with the gravimetric survey. The deflection of the plumb-line was determined at eleven stations in Káthiáwár and round the Gulf of Cambay, and the values obtained were in accordance with the general character of the deflections in Rajputana. Pendulum observations to determine the variation in the value of gravity were made at twelve stations in the neighbourhood of the Himalayas and of the Siwáliks, and on or near the Great Arc. The general character of the variations found was in accordance with expectation, but local anomalies of considerable amount were also disclosed. The results obtained have been found to agree with those obtained by Prof. Hecker in 1905. The magnetic survey was extended during the year into Burma and Assam. The systematic observations of Himalayan peaks in connection with the problem of refraction were continued, and though the results are of great interest many more are required before definite conclusions can be drawn. The total out-turn of detailed topographical and forest surveys on all scales was at the time of the report 25,740 square miles, against 23,312 square miles of similar surveys during the previous year. The total area triangulated and traversed for survey purposes was 31,851 and 1684 square miles respectively, against 27,134 for the previous year.

MESSRS. BOWES AND BOWES, of Cambridge, have just issued their latest catalogue of books on pure and applied mathematics, dealing more particularly with books published in the nineteenth century.

PROF. J. PERRY'S well-known work on "Applied Mechanics" has been translated into German by Herr Rudolf Schick. "Angewandte Mechanik" is published by the firm of Teubner, of Leipzig and Berlin, at the price of 18 marks.

FOUR new volumes in the Philosophische Bibliothek published by the Dürr'schen Buchhandlung, Leipzig, have been received. No. 28 deals with Descartes's principles of philosophy, and is edited by Dr. A. Buchenau; some of the Emperor Julian's philosophical works, translated and explained by Herr R. Asmus, form No. 116; a critical analysis of Schleiermacher's "Weihnachtsfeier," by Herr H. Mulert, appears as No. 117; and No. 118 is an "Einführung in die Erkenntnistheorie," by Prof. A. Messer.

MESSRS. CHAPMAN AND HALL have published a third edition of Mr. Frederick Hovenden's book, "What is Life? or Where are we? What are we? Whence did we come? And whither do we go?" The first issue of the work was reviewed in NATURE for April 7, 1898 (vol. lvii., p. 535), and it is sufficient to say that the present edition has been revised in the light of the progress made since the publication of the last edition, and an appendix has been added.

THE Johns Hopkins University Circular for December, 1908, takes the form of a memorial volume to the late President D. C. Gilman, first president of the Johns Hopkins University, who ruled its destinies from 1876 to 1901. The circular contains the impressive and appreciative addresses, delivered at the *in memoriam* services held last November at the University, by the present president, Dr. Ira Remsen, many of the University administrators and professors, and by Dr. James Bryce, our Ambassador at Washington. Numerous letters eulogising the late president received by President Remsen are included, an article from the *Nation*, and a biographical sketch.

OUR ASTRONOMICAL COLUMN.

WATER-VAPOUR LINES IN THE SUN-SPOT SPECTRUM.—In a paper read before the Dublin meeting of the British Association, and again in No. 5, vol. xxviii., of the *Astrophysical Journal*, Father Cortie directed attention to certain water-vapour lines in the solar spectrum which appear to become intensified in the spot spectrum. Examining ninety-one lines in the region D_1 to λ 5953·386, sixty-four, or 70·3 per cent., of which are due to water vapour, he found that of the sixty-four, twenty-nine, or 45 per cent., are affected in the spectrum of the spot either as widened or darkened lines. An examination of Hale's map showed that sixteen of these twenty-nine lines were also shown there as widened or darkened.

On this evidence Father Cortie suggested that steam may exist in the regions of sun-spots, and supported the suggestion by Mr. E. E. Brook's statement that he found the presence of water vapour essential for the laboratory production of Fowler's magnesium hydride bands, bands which are a prominent feature of the spot spectrum.

In No. 406 of the *Observatory* (p. 101, February) Mr. Evershed discusses the same subject from the observations made at the Kodaikanal Observatory. Dealing with the water-vapour lines of intensity 1 or more given by Rowland between λ 5850 and λ 6000, seventy in all, he finds that thirteen are not shown on his plates, forty-two are absolutely unaffected, seven are weakened, and eight are strengthened. Of the latter, four are only doubtfully strengthened; in two the strengthening is shown to be due to close titanium companions, and two are decidedly darkened. Mr. Evershed concludes that the weight of evidence is against the probability of the existence of steam in sun-spots, but, in commenting on this conclusion, Father Cortie points out that the conditions of observation at Stonyhurst and Kodaikanal were dissimilar, that the water-vapour lines recorded as strengthened at both places still have to be accounted for, and that the collateral evidence from the laboratory must also be taken into account.

THE SPECTRUM AND FORM OF COMET MOREHOUSE.—The *Astrophysical Journal* for January (No. 1, vol. xxix.) contains three papers dealing with Morehouse's comet, 1908*c*. In the first of these Prof. Frost and Mr. Parkhurst describe and discuss two series of spectrograms taken with objective-prism or with slit spectrographs, respectively, at the Yerkes Observatory. As the scale of the spectra is in each case very small, Hβ to Hθ covers about 3 mm., the wave-lengths are only approximate, but comparisons with the hydrogen lines in the spectrum of Vega, taken on the same plate with the "slit" spectra, permitted the recognition of several of the cometary condensations.

The results differ from those previously published by MM. Pluvinel and Baldet in that the Yerkes observers find the third and fourth "carbon" (hydrocarbon?) bands, whilst the Juvisy observers did not. Again, the CN band at λ 4216 could not be detected on the Yerkes spectrograms, whereas the Juvisy observers found that cyanogen was fully represented; both sets of observations agree on the absence of continuous spectrum, but are not in agreement in the matter of the wave-lengths of the bands. On the other hand, the Yerkes wave-lengths agree with those of MM. Deslandres and Bernard, but the latter were unable to identify the "carbon" bands, and they found a continuous spectrum on all their plates.

A study of the relative intensities of the spectra of the head and of the streamers leads to some important results. First, of the monochromatic images of the head, those at λλ 471 and 388 are strong, but no corresponding tail images are shown, or are very weak, thus indicating that the matter producing these radiations is mainly confined to the comet's head. Again, the tails diverging at different angles are shown in the same monochromatic images, thus indicating that they are composed of the same materials.

The second paper is by Prof. Barnard, and in it he describes his latest photographs of the comet. The changes in form which occurred in the tail strengthen his belief that the ejected matter met with resisting media, probably meteor swarms, in space.

Spectrograms, obtained with a slit spectrograph at the Lick Observatory, are described by Prof. Campbell and Dr. S. Albrecht in the third paper. They recognise the different edges of the third and fourth carbon and the first and third cyanogen bands, but the second cyanogen band is missing. Unknown lines at λλ 3913, 4002, 4022, 4255, 4276, 4549, and 4570 are also shown on the spectrograms, and it is suggested that the last six may be related bands, similar to those of cyanogen, due to some substance as yet unknown terrestrially.

PARALLAX OF 23 H CAMELOPARDALIS.—From a photographic investigation, Herr Gustaf Strömberg finds that the parallax of 23 H Camelopardalis is $\pi = +0''\cdot127$, $\chi = -0''\cdot010$, with probable errors of $\pm 0''\cdot053$ and $\pm 0''\cdot057$ respectively, where χ is the relative correction of the aberration constant. These values were obtained by the measurement and discussion of twenty-eight plates taken between October, 1904, and April, 1908, twenty-three being employed for the estimation of the difference in right ascension and twenty-five for that in declination (*Astronomische Nachrichten*, No. 4295, p. 366).

THE STARS OF THE *c* AND *ac* SUBDIVISIONS IN THE MAURY SPECTRAL CLASSIFICATION.—In No. 4296 of the *Astronomische Nachrichten* Herr E. Hertzsprung discusses the distance, distribution, and probable general characteristics of the stars which in Miss Maury's classification of the "Spectra of Bright Stars" (Harvard) are placed in the subdivisions *c* and *ac*. From the discussion of their proper motions, parallaxes, &c., the author finds, among other conclusions, that these stars, among which many of the brightest stars in the heavens are included, are generally at a greater distance and intrinsically brighter than those of the other groups.

THE STARS SURROUNDING 59 CYGNI.—No. 25 of the Contributions from the Observatory of Columbia University contains the measures of the Rutherfurd photographs of stars surrounding 59 Cygni. The measures are discussed by Prof. Jacoby, and in the final catalogue the positions (1875·0), magnitudes, &c., are given for forty-six stars.

ERRORS OF DOUBLE-STAR MEASURES.—In Nos. 4298–9 of the *Astronomische Nachrichten* (pp. 17–39, January 22) Dr. H. E. Lau discusses the systematic errors of double-star measures, and gives in detail the peculiar errors of a large number of well-known observers. In each case a brief note gives the mean probable error at different distances and in position-angle; the magnitude equation of each observer is also discussed.

ELECTRIFICATION OF RAILWAYS.

Present Position.

SINCE the position of railway electrification was last reviewed in these columns, a number of important developments have taken place on the Continent and in America. In England the conversion of steam lines has been slower than was anticipated. On the Continent, however, its spread has been quite as rapid as was expected by any but the too optimistic.

Electrification may be considered under practically the same heads as railways themselves. That is to say, the problem is quite different according to whether the application be to main line, suburban, or purely urban traffic, while the handling of goods traffic introduces an additional consideration.

As regards the advantages of electricity for handling urban traffic there is practically no longer any discussion. Thus most of the purely urban systems in the great capitals of the world, such as the tubes, District, and Metropolitan Railways in London, the Metropolitan in Paris, the subways in New York, and the railways in Berlin and Chicago, so far as they are self-contained, are now electrically worked, steam where previously in use having been replaced.

As regards suburban lines, especially where this is carried over lines which are also used for main-line traffic, the process has not been carried so far. There are, of course, plenty of instances where the conversion has taken place both in the neighbourhood of great capitals and in less populous districts. Thus in London the Harrow extension of the Metropolitan and portions of the Great Western and South-Western now use electricity. In New York the New York Central and the New York, New Haven, and Hartford lines are now working electrically, and the Pennsylvania tunnels are being rapidly equipped. In Chicago the Illinois Central is now considering the electrification of a large number of suburban lines, while an extension of electric working to most of the suburban lines in the Berlin district will probably take place before long. In Melbourne the Railway Commissioners have recently had before them the whole question of converting their suburban system, upwards of 200 miles, to electric working. In London, however, the application of electric working to the suburban sections of the great main lines has made little progress. The Brighton Company has been engaged for some years in converting a portion of its suburban system between Victoria and London Bridge, and the result of that experiment, both financially and technically, will doubtless have its result upon the other companies. A trial trip was made a few days ago.

There are two principal factors, however, which have somewhat lessened the urgency of the electrification problem on London suburban lines.

Suburban Congestion.

A few years ago the principal trouble from which the London suburban railways were suffering was the congestion at their termini, and enormous sums of money were consequently spent on enlarging these termini and increasing the facilities for handling suburban traffic. Since that time, however, suburban traffic has received a setback. Although the provision of new facilities, such as tubes and the conversion of horse tramways to electricity, has undoubtedly created a very large new traffic, it has also abstracted a large amount of traffic from the older railways, and by that much has lessened the congestion at their termini. Now it is a recognised fact that the adoption of electric traction is not, as a rule, justified upon the grounds of reducing working expenses alone. It is true that it usually enables working expenses to be reduced as compared with steam working, but the saving is seldom, if ever, sufficient to pay for the capital charges on the new expenditure involved, and to justify these additional traffic is required. This additional traffic may or may not be obtainable. In the case of the North-Eastern Railway, in that of the Liverpool and Southport lines, and in that of the Metropolitan District Railway additional traffic has been obtained, but it remains to be seen, in view of the growing competition of electric tramways and motor omnibuses, whether sufficient additional traffic can be obtained upon the other London suburban lines, like those now being converted by the Brighton Company, for instance.

Take the North London Railway, the receipts of which show a steady diminution. Electrification has been more than once mooted, and even considered, but never, we believe, seriously investigated by the board; such preliminary and superficial investigations as have been made have, it is believed, pointed to the fact that the cost of converting the lines would not be justified, at least at present, by the extra traffic obtainable; whether a complete investigation by an expert competent to decide upon the commercial as well as the technical aspects would show a different result is a moot point. It may be, of course, done when the Euston to Watford line is completed, and electricity is adopted on a part of the North-Western system, in view of the intimate relations existing between these two companies. Many of those who are most experienced in this question believe that it would materially assist the latter to stem the steady reductions in receipts which have now been taking place for years, while the difficulty of hauling "foreign" trains over the system, which Lord Rathmore has mentioned, is one which has been surmounted without difficulty at the other end of the "Outer Circle," where the North-Western trains were until recently hauled from Earl's Court to the Mansion House by electric locomotives.

Direct Current and Single-phase.

In spite of the differences of opinion between experts as to the relative merits of the different systems of electric traction in use, especially those of the direct-current and single-phase systems, each of which is in reality suited to a different set of conditions, the real problem of electrification at the present time is a commercial one. The fact that in the past the electrical experts have been apt to lay stress upon the technical side, and have in some cases devoted less attention and study to the purely commercial side than it warranted, has undoubtedly made an unfavourable impression upon the railway director and business man. The engineer of the old school was primarily educated with the idea of designing and carrying out undertakings which would *work*. Only since the beginning of the present century has it been fully grasped that the engineer, and more especially the electrical engineer, whose opinion is to be worth paying for is the one who can make a trustworthy report upon whether the undertaking will *pay*.

The growing importance of this aspect of the question is strikingly illustrated in one of the latest reports upon electric traction, that which the Railway Commissioners of Victoria have recently made public. The keynote of this whole report is whether the application of electric traction to the system under discussion is *financially* justified, and, in the second place only, to determine the best means of applying electric traction if it be justifiable.

More and more it is becoming realised in the railway world that a considerable proportion of the traffic which has been diverted from the railways to tramways and omnibuses is traffic which these latter are more fitted to carry. This diversion of traffic can often be stopped, and in some cases, as has happened on the Tyne, for instance, some of it can even be regained; but in the main, electrification, to be justified, must create fresh traffic, usually that of eight to ten or twelve miles, which is rather beyond the profitable radius of a suburban tramway. Given sufficient inducement to the season-ticket holders, the ten- to fifteen-mile suburban traffic in the neighbourhood of provincial towns, and the fifteen- to twenty-five mile traffic in the neighbourhood of London, is capable of very considerable expansion. The movement of the daily bread-winner to even greater distances from his work is a steadily growing one.

There is, of course, in addition to this, usually a considerable saving in operating expenses even with the same train mileage. When, as is always found advisable, the train mileage after electrification is increased, the reduction in the working expenses per train mile is very considerable.

There is another cause lessening the urgency of London suburban electrification, and that is the reduction in main-line trains now being effected as the result of working agreements, which makes suburban working easier.

The Financial Question.

The Victorian report already referred to shows very clearly and typically the kind of financial change which may be expected to be produced by electrification. This system is a considerable one, with a track mileage of more than 200 and a very dense traffic. The expenses per train mile are 18·9*d*. with steam, and would be 11·0*d*. with electric traction. The total operating expenses with electric traction for the whole suburban system is 27,627*l*. per annum less than with steam, but when the interest on the new capital outlay is added, the total cost of operating would be 44,791*l*. more than with steam. Against this, however, is to be put the additional revenue derived from the improved service, and it is shown that the final result would be a balance in favour of electrification. For some reason or other the figures appear to be based upon a traffic increase of only 5 per cent. as the result of electrification. Why such an exceptionally low figure is taken is not explained, for it is pretty certain from the experience of the District Railway, the North-Eastern Railway, the Manhattan Elevated, and, in fact, almost every system which has been converted, that a very much greater increase than this will certainly result.

In addition to the decrease in the suburban traffics, and consequently the terminal congestion, existing a few years ago, the railway companies with termini in London have felt some hesitation owing to the introduction of the single-phase system. The direct-current system which is used on the Underground and for the majority of heavy suburban electric traction schemes is not now the only one possible.

The single-phase system, which is being adopted by the Brighton Company, and which is used on the lines of the New York, New Haven, and Hartford Company, offers certain advantages over direct current, especially where the ultimate extension of electric traction to main lines is possible. It is, however, more expensive to install, assuming the same degree of security and workmanship, needs heavier rolling-stock, and a greater expenditure of current.

These two causes, together with the natural objection to raising money at the present time and to the desire to wait and see whether the Brighton experiment turns out successful, both financially and technically, have made the question of electrification in the London district fall into abeyance at present. At the same time, it must not be

supposed that the single-phase system is untried. There are in Europe more than thirty different railways, portions of which are now in operation or under construction by single-phase current, aggregating in all more than 850 miles, while in America there are nearly 1000 miles of railways being so operated. Some of these, however, are not heavy electric railways, but interurban electric railways laid down for electric working from the start. Hence before long it should be possible to obtain ample experience of the results of single-phase working. Some of these systems are of considerable length. Thus the Prussian State Railway will have 112 miles electrically worked, while the Berlin Stadt and Ring Railway will have 366 miles, and in America the Spokane Inland Railway Company has 115 miles.

Choice of System.

Many engineers and railway men have unfortunately adopted an attitude of partisanship on this, a question which should be considered primarily on its merits in each particular case. It is quite absurd to generalise and say that the single-phase or the direct-current system is the better. Each has its own field, each is excellent and desirable under its own set of conditions, and only those who have studied all the conditions in each particular case can say which is the best scheme to adopt financially.

As regards main-line working pure and simple, engineers have not yet decided quite as to the best systems of doing it, neither are railway men entirely satisfied as to the financial advisability of converting main-line working; but for heavy working under special conditions electrification is being more and more considered. Thus the Grand Trunk Railway has recently equipped the St. Clair Tunnel for electric working, an installation which is notable as being the heaviest railway service in the world handled by electricity. Trains weighing 1000 tons are hauled from one end of the tunnel to the other, about two miles, at a minimum speed of ten miles per hour on a gradient of 1 in 50. The new tunnels under the Hudson River at New York, by which the Pennsylvania Company will obtain access to Manhattan Island itself, are also being electrically equipped for the haulage of main-line Pennsylvania trains, which are naturally of great weight. A project of a somewhat similar character is that which the Great Northern Railroad of America is considering in connection with the electrification of a new section of line over the Rockies, where the three-phase system, which has been a good deal used in Italy and Switzerland, is likely to be adopted.

Thus it will be seen that there is plenty being done in electrification work. It is to be regretted, however, that actual financial results, especially operating costs, have been very sparingly published. While it is known that the North-Eastern Railway Company, for instance, has been well satisfied with the results of the traffic obtained on its Tynemouth lines, and while the traffics on the District and Metropolitan Railways are now beginning to show steady improvement as the result of electrification, the actual balance-sheet of expenses and receipts has not been made public. A number of preliminary figures regarding the New York Central lines have been published, but they were hardly complete enough and the result of too recent work to be of much value. While as regards engineering experience there is a free interchange of ideas between the different makers and the various engineers concerned, there is less of this as regards traffic receipts.

It is to be hoped that ere long it will be possible for those responsible for the management of lines which are being electrically worked in this country to make public some of the results they have obtained for the benefit of those who are still considering the question.

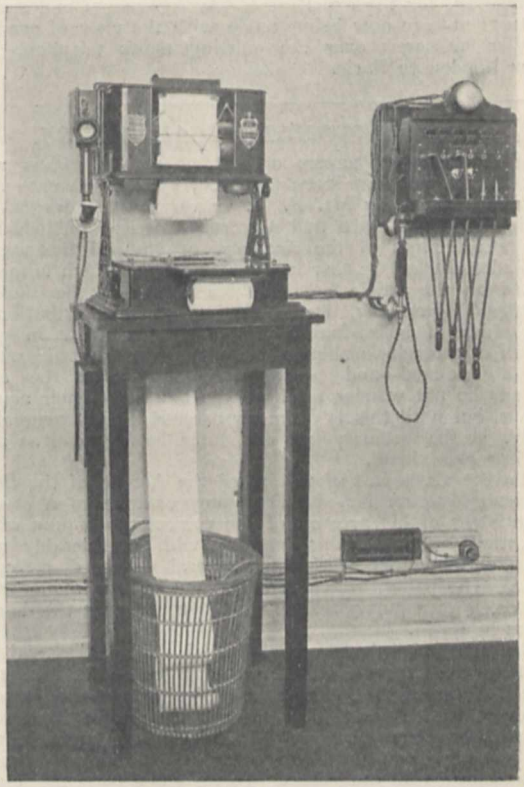
THE TELEGRAPHIC TRANSMISSION OF WRITING.

THE advent of the telewriter should obviate the mistakes and misunderstandings which so commonly occur in business messages transmitted by telephone, and should save the repetition work now necessary owing to messages having to be confirmed by letter.

The telewriter consists of a transmitter and receiver. The message to be sent is written in pencil on a roll of paper attached to the transmitter, and is exactly reproduced in pen and ink on the distant receiver. The pencil at the transmitter is fixed at the junction of two jointed rods, which are connected to each of two shafts, and communicate a rotary movement to them. These shafts in turn move contact pieces, which cause a variation of voltage in two electrical circuits. These circuits control two moving coils suspended in an electromagnetic field in the receiver, and the jointed rods connected to these coils actuate the pen which reproduces the writing—or message—on a roll of paper at the receiver.

Thus any motion of the pencil at the transmitter is resolved into two component movements, which cause a variation of the positions of the moving coils at the receiver. These coils, actuating the two levers to which the receiving pen is attached, reproduce the motions of the pencil at the transmitter.

When the paper available for writing on at the transmitter has been used up, it is fed forward mechanically by pulling a lever, which at the same time causes a current to be sent through both lines and operates a relay which actuates the paper in the receiver proportionately.



Telewriter Transmitter and Receiver arranged with Telephone and Departmental Exchange.

Before starting to send a message, a button is pressed on the transmitter, and this automatically ensures the lever at the receiving end being in the proper position for the instrument to receive a message. The receiving pen—before contact is made by the pencil on the transmitter—reposes in an ink-well, and this ensures that plenty of ink is always obtainable. The telewriter is also fitted with a telephone, and communication can be held by either method over the same lines, but not simultaneously.

An advantage of the telewriter over the telephone is that, should the person rung up be out, the message can be written and will await his return. No operator is necessary to receive the messages, and so long as the roll of paper in the receiver lasts, so long can messages be received.

The ordinary telephone wires are all that is necessary for the operation of the telewriter, the power being

obtained from either batteries or the central station supply. Both direct current and alternating currents can be used, but in the latter case a rectifier must be placed in circuit.

Messages can be sent to practically any number of telewriters from one transmitter, thus assuring the same message being received simultaneously on the various receivers.

The Postmaster-General has granted a licence for twenty-one years to the Telewriter Syndicate, and after 1911, when the National Telephone Company's licence expires, the Telewriter Syndicate will operate its own system and establish telewriter exchanges, paying royalties for the same. These lines will be independent of the Post Office telephones, but will be leased from the Post Office, and telephonic communication in addition is to be a *sine qua non* on all these lines.

At present the telewriter is established chiefly on private lines, and is working satisfactorily in many large warehouses, stores, and offices, but messages and sketches have been successfully sent from London to Manchester over the Post Office telephone trunk lines, which were used, by permission, for the experiment. Arrangements and special instruments are now being made with the view of sending similar messages over the existing trunk telephone line from London to Paris.

SOME ENTOMOLOGICAL PAPERS.

AMONG recent papers on entomology in serials with which we have been favoured, special reference may be made to one by Mr. P. H. Calvert on the dragon-flies (Odonata) of Mexico and Central America, published in the Proceedings of the Academy of Natural Sciences of Philadelphia for October last. This paper, which is mainly based on the article by the same author in the *Biologia Centrali Americana*, forms an important contribution to the study of insect-faunas generally, and treats in great detail of the relationships of the group under consideration. It is assumed—and probably correctly—that the adult insects do not wander far from the haunts of their aquatic larvæ, but until this is definitely ascertained the generalisations, as the author points out, must be regarded as more or less provisional.

To the sixth part of vol. v. of the Annals of the South African Museum Mr. L. Peringuey contributes a seventh instalment of his account of the coleopterous fauna of the country, dealing in this instance with considerably more than one hundred species and several genera described as new. The paper, which is illustrated by two monochrome plates, is of a purely taxonomic character, with the descriptions in Latin.

An addition to our knowledge of the aphides of Japan is furnished by Mr. G. Okajima in vol. viii., No. 1, of the Bulletin of the College of Agriculture of the Imperial University of Tokio. This paper is devoted to the description of three new species of Trichosiphum, a genus founded so recently as 1906 for the reception of another Japanese representative of the group. To the same issue this author contributes a more generally interesting paper, namely, one on the structure of the aphid antennæ. These antennæ are composed of not more than six joints, of which the third and later ones (especially the third) usually bear sensory pits. For their distal portion the name "flagellum" is adopted. It is found that, as regards minor characters, the antennæ present specific differences which harmonise well with the various groups into which the family has been divided.

In a third paper in the serial last cited Mr. T. Miyake gives a list of Japanese Panerpidæ, together with descriptions of ten new species of the type-genus, all of which are illustrated in an accompanying plate. All the new species, which display the general type of colouring characteristic of these elegant insects, agree with the other Japanese members of the group in regard to a peculiarity in one part of the wing-venation.

Under the title of *Indian Forest Memoirs*, the Government of India has commenced the issue of a new quarto serial, intended for the publication of the more important results of the investigations of the Imperial Forest Research Institute. The publication of *Indian Forest Records* is to be continued for minor papers, and the two serials are to constitute the Forest Zoology Series. The first part of the Memoirs is devoted to an account, by Mr. E. P. Stebbing, of some undescribed Scolytidæ of economic importance from the Indian region. Until recently, very little was known with regard to the Indian representatives of this group of bark-boring beetles, and scarcely anything of their life-histories and food-plants. It is now ascertained that the Scolytidæ are of very considerable importance to the Indian forester, this being specially the case as regards the great coniferous forests of the Himalaya. Other species, referable to the genus Sphærotrypes, are, however, detrimental to the sal-forests and other broad-leaved timber-trees. In the present memoir Mr. Stebbing describes three new species of the last-named genus, five of Polygraphus, and two of Dryocetes. Among the species of Sphærotrypes, one, *S. assamensis*, infests the sal-timber of Assam and eastern Bengal, and a second, *S. quercyi*, the oaks of Kumaun.

The Angolese tiger-beetles of the subfamily Cicindelinæ form the subject of an article by Messrs. F. Creighton Wellman and W. Horn in the Proceedings of the Academy of Natural Sciences of Philadelphia for November, 1908. Angola, it appears, is divisible into three distinct physical regions, namely, lowlands, mountainous slopes, and high plateau, the climate of the second of these being cooler and moister than that of the first, although not to the same degree as the third. Each of these areas has its own special tiger-beetle fauna, that of the middle zone possessing the largest number of species.

In this place reference may be made to investigations undertaken in Cornell University by Mr. B. H. Guilbeau, of which the results are published in the *American Naturalist* for December, 1908, as to the mode in which the "cuckoo-spit insects" (Cercopidæ) secrete the foam in which they are enveloped. By cleansing the nymphs from the investing froth, it has been ascertained that the fluid issues from the anal aperture, and is converted into froth by periodical removals of the tip of the abdomen, which is re-introduced holding each time a bubble of air. Viscosity is imparted to the fluid by the secretion of the glands of Batelli.

In conclusion, brief mention may be made of an interesting article, by Mr. A. H. Swinton, on the vocal and instrumental music of insects, the first instalment of which appears in the January number of the *Zoologist*.

THE CHARGES ON IONS.[1]

THE ratio of the charges of ions in liquids to those produced by various methods in gases is a factor that enters into many investigations connected with molecular theories, so that it is of importance that the connection between these charges should be investigated by some accurate method.

The simple relations that hold between the charges of ions in liquids can be easily deduced from the theory of electrolytic conduction. It follows immediately from determinations of the electrochemical equivalents that the charge on any ion in a liquid is either equal to that on a hydrogen atom or an exact multiple of it. No method has been devised for determining this charge directly, but the value of $n \times e$, the product of the number of molecules in a cubic centimetre of a gas at standard pressure and temperature (15° C.) and the charge e expressed in electrostatic units, is accurately known, and is approximately $1{\cdot}23 \times 10^{10}$.

In gases it is possible to obtain a rough estimate of the charge on an ion. The method of determining the charge, which requires a cloud to be formed in the gas, was given by the present writer (Proc. Camb. Phil. Soc., vol. ix., part v., February, 1897), and was first applied to the ions in newly prepared gases. The same principle was subsequently used by Sir J. J. Thomson and Prof. H. A. Wilson in determining the charges on ions produced by Röntgen rays, ultra-violet light, and radio-active substances (J. J. Thomson, "Conduction of Electricity through Gases"). The numbers obtained for e in electrostatic units range from 3×10^{-10} to 9×10^{-10}, but an

[1] Based upon papers by Prof. J. S. Townsend, F.R.S., and Mr. Haselfoot, communicated to the Royal Society January and November, 1908.

accurate estimate of any of the charges has not been obtained owing to the difficulties of experimenting with the clouds. As no trustworthy [1] independent estimates have been made of n, the value of the product $n \times e$ for gaseous ions can only be obtained by this method within wide limits differing by a factor of 10 or 20. It cannot, therefore, be maintained that the direct determination of e in gases leads to any trustworthy information as to the simple relations that hold between the charges on the ions.

A more accurate comparison of the charges on the various kinds of ions can be obtained from determinations of the rate of diffusion of ions in gases and the velocity under an electric force. With this object in view, the rates of diffusion produced by various methods in gases were determined, and it was shown that the value of $n \times e$ for negative ions in gases agreed within 10 per cent. or 15 per cent. with the value for monovalent ions in liquids, and the value for positive ions in gases was somewhat larger (J. S. Townsend, "Diffusion of Ions in Gases," Phil. Trans., vol. cxciii., 1899, and vol. cxcv., 1900). The probable error in the numbers obtained is about 10 per cent. or 12 per cent., so that it is desirable to know more definitely if all these charges are exact multiples of the same atomic quantity, as it is a question of fundamental importance.

The problem of the determination of $n \times e$ for gases has been again undertaken, and a simple experiment has been devised whereby the exact value of $n \times e$ can be immediately deduced from the ratio of the charges acquired by two conductors under special conditions. The method is explained in a paper in the Proceedings of the Royal Society, vol. lxxx., January, 1908, and two papers recently communicated (November, 1908) contain further experiments by the present writer on ions produced by Röntgen rays, and an investigation by Mr. Haselfoot of the ions produced by radio-active substances.

The principle of the method consists in finding the extent to which a uniform stream of ions having a circular cross-sectional area, S, opens out as the ions travel a given distance under a known electromotive force. For this purpose three plates, A, B, and C, are arranged parallel to each other, the middle plate, B, and the lower plate, C, having each a circular aperture cut through its centre. A disc, D, is fixed in the aperture of the plate C, so that the surfaces of the disc and surrounding plate are in the same plane, the disc being a little smaller than aperture in order to insulate it from the plate. The area of the hole S in the middle plate B is equal to the area of the disc *plus* half the air-gap between the disc and the plate C. The plates A and B are connected to suitable numbers of accumulators so as to maintain the same uniform field above and below the middle plate B. The plate C and disc D are insulated, and each maintained at zero potential by a special form of induction balance, which gives the charges acquired simultaneously by the disc D and plate C. The gas in the space between A and B is ionised by Röntgen rays or by radio-active substances, and a uniform stream of ions passes through the aperture in the middle plate. The ions travel to the lower plate under the uniform electric field, and the stream opens out by diffusion, so that some of the ions q_1 arrive on the disc D, and the rest q_2 arrive on the plate C. The ratio q_1/q_2 is found accurately by means of the induction balance, and the value of $n \times e$ may be obtained from the ratio. The equation connecting $n \times e$ and the ratio n_1/n_2 is somewhat complicated, and it would be impossible to explain in a short space how the connection between these quantities is found, but it may be stated that a complete solution of the problem can be obtained in a series of Bessel's functions.

The experiments have been made with different forces and pressures, and it has been found that the value of $n \times e$ for negative ions is in all cases within 3 per cent. or 4 per cent. of the value $1{\cdot}23 \times 10^{10}$; under conditions where the greatest accuracy can be obtained the results are in closer agreement with this number.

For positive ions the value of $n \times e$ depends on the nature of the radiation. With non-penetrating secondary rays from a polished metal surface the value obtained was $1{\cdot}26 \times 10^{10}$, and for penetrating rays from a tarnished surface, or a surface covered with a thin layer of vaseline, larger values were obtained, the greatest being $2{\cdot}4 \times 10^{10}$.

Thus the negative ions have always a charge which is exactly equal to the charge on a monovalent ion in a liquid electrolyte, and the positive ions have either a single or a double charge, the number of either kind in a conducting gas depending on the nature of the radiation.

The values of $n \times e$ for positive and negative ions produced by the α and β rays from radio-active substances are both approximately $1{\cdot}23 \times 10^{10}$.

In addition to the above results, a notable effect of small traces of moisture on the motion of negative ions was observed. When the gas is very dry the negative ions move as if they were very small particles, but when a small amount of moisture is admitted the mass of the negative ion is greatly increased, and obeys the same laws of diffusion as the positive ions. The motion of the positive ions under similar conditions is not affected by the dryness of the gas.

JOHN S. TOWNSEND.

[1] Prof. Perrin has recently announced a new method of determining n, which gives trustworthy results. The number n comes to 3×10^{19} and corresponds to an atomic charge $4{\cdot}1 \times 10^{-10}$. (Jean Perrin, *Comptes rendus*, October 5, 1908).

METEOROLOGICAL CHARTS OF THE INDIAN OCEAN.[1]

THE Indian Ocean is claiming at the present time a large share of the attention of meteorological offices. Recent issues of NATURE have contained notices of meteorological charts for this area issued by the Meteorological Department of the Government of India and by the Meteorological Institute of the Netherlands (NATURE, vol. lxxviii., pp. 169, 487). The present charts are prepared by the Deutsche Seewarte. In area they exceed considerably those referred to above, for they embrace the region between latitudes 30° N. and 50° S., and longitudes 18° E. (Cape Town) and 158° E. The Australian waters and the eastern margin of the Pacific Ocean are thus included, while special inset charts extend the area northwards to include the Yellow Sea and the Sea of Japan. To deal effectively with the results, a scale of approximately 6 mm. to one degree at the equator has been selected, and in consequence an inconveniently large size of page, viz. 36 inches by 27 inches, has had to be adopted.

The preparation of the results has occupied five years. The meteorological information has been abstracted mainly from the log-books of German vessels, but we are glad to note that, in addition, use has been made of all available published information. The arrangement of the data on the charts, of which there is one for each month, is similar to that adopted on the charts for the Atlantic Ocean issued by the Seewarte. Conspicuous blue wind roses show for each square of 5° the percentage frequency of calms and of winds from each of sixteen directions. The mean wind force for each direction, on the Beaufort scale, is indicated by the number of barbs on the wind arrows. Small but distinct black arrows give the directions of surface currents, with the average and the maximum observed displacement in nautical miles per day. Special attention has been devoted to a critical examination of the current data, and several interesting articles on the subject appear on the backs of the charts. A statement of the number of observations on which each wind and current arrow is based would have been welcomed by students.

In addition, each chart gives the tracks for steam and sailing vessels, the normal paths of hurricanes, the frequency of fog and ice, and the lines of equal magnetic declination. The region of easterly variation is distinguished by a special tint. The text printed over the land areas gives, in addition to the necessary explanations, a brief summary of the weather conditions of each month, with special reference to the frequency of hurricanes.

On the back of each chart we find four smaller maps, giving the annual change of magnetic variation, the average air temperature over sea and land, the average temperature of the surface water, and the average barometric pressure. In connection with the latter, we miss

[1] Deutsche Seewarte, Monatskarten für den indischen Ozean. (Hamburg Eckardt und Messtorff, n.d.)

an account of the diurnal variation of pressure, which is so important in the tropics. The only reference to this phenomenon is contained, incidentally, in an article on rules for handling the ship in hurricanes, given on the back of the chart for December.

The remaining space on the backs of the charts is utilised to the full. On several of them detailed information is given of the systems of storm signals used in the area covered by the charts. Others give particulars of the time-signal stations. Numerous fully illustrated articles give particulars of meteorological events of special interest, such as the Hong Kong typhoon of September 18, 1906, and other famous hurricanes. In addition, we have a number of monographs on all manner of subjects of interest to the sailor and the meteorologist. Among them we mention specially one on the prevalence of easterly winds to the south of latitude 50° S.

We congratulate the Seewarte on the completion of so important and arduous a piece of work, which is sure to prove of the utmost value both to sailors and students.

THE FILTRATION AND PURIFICATION OF WATER FOR PUBLIC SUPPLY.[1]

GREAT progress has been made in recent times in the appliances for purifying water. It is no longer necessary to go to distant uplands for a pure and palatable supply. By the methods of treating ordinary river water, carrying possibly hundreds of objectionable germs per c.c., drinking water is now being prepared from the lower reaches of the Thames and of many Continental rivers as wholesome as can be obtained from the mountains of Wales or of Scotland. So great has been the activity of scientific workers in this field that a new and complex branch of technology may be said to have come into existence.

With reference to sources of supply, water companies should not place too much reliance on the innocuousness of supplies drawn from country districts. Water-courses and reservoirs should be protected from the intrusion of harmful matters, and the adjacent ground should be fenced off and planted. Special precautions are needful for preventing the ingress of impurities to wells and bore-holes, and where pollution occurs the origin of the same may be detected by suitable experiments. Storage reservoirs are a useful adjunct to a purifying plant, even when not required for conserving the supply, and it has been proved by the researches of Dr. Houston that the bacteria of enteric practically all disappear from impounded water in two or three days. Still, as it appears that even here the survival of the fittest holds good, and that a few germs live on for weeks, water undertakers are not relieved from the duty of further treating the supply. Sedimentation proceeds more or less rapidly in stagnant reservoirs, but it has been found at the Paris installations that effective precipitation can be secured by running the water in channels, with frequent changes of direction. Thus space is economised.

Discussing the retention of bacteria in filter beds, the lecturer directed particular attention to the functions of the filtering skin. It appears that in the finishing filter at Bedford, which is fed by a sprinkler, no skin is formed at the surface, because the water does not rest there. It sinks at once into the sand, and at a depth of about an inch and a half a slimy growth is easily perceptible on the grains, and this possibly serves the same purpose as the network of algoid growths bedecking the open sand beds. There are five distinct ways in which the sand bed operates in eliminating impurities, but what is most important in the operation of these beds is the circumstance that, after cleaning, a considerable time must elapse before the purifying agencies come into effective action. Water managers should have the means of finding out when the effluent is pure, and in order to do this they must rely on bacteriological analyses. This is the method adopted on the Continent. Unfortunately, it is generally neglected here, and it is a matter of chance in too many cases whether there may or may not be dangerous germs passing through. Chemical analyses alone cannot reveal whether the filtrate is wholesome or not. The amount of nitrogen present as nitrate and nitrite is important enough, but analysts should not rely on this as the chief criterion for determining the purity of a sample.

[1] Abstract of a paper by Mr. John Don selected by the Council of the Institution of Mechanical Engineers for the first award of the "Water Arbitration Prize," 1908, and read before the Institution on January 15.

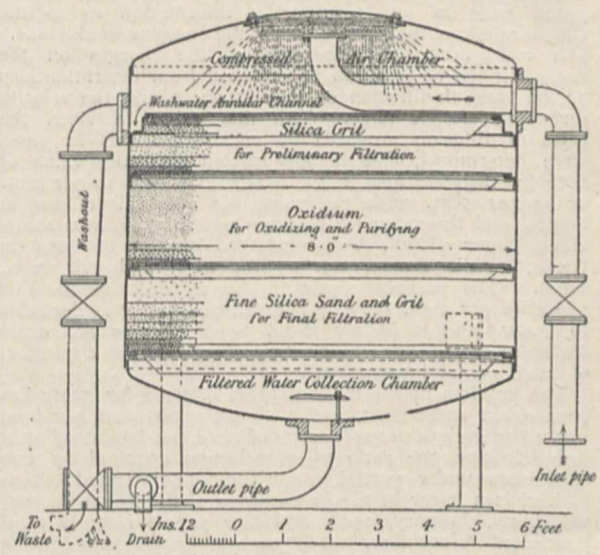


FIG. 1.—Compressed Air and Oxidising Waterworks Filter (Candy).

Recently many mechanical appliances have been brought into use for the purification of water, and among these the Jewell filter is largely used in America. A precipitate of sulphate of alumina forms an efficient skin within a short time after cleaning, and thus there is a great saving of time. The water also passes through the filtering layers forty times more quickly than it does in the open sand filter, but the effluent, subjected to every test, proves to be of a high degree of purity. In Britain, Mather and Platt's and Bell's filters are of similar construction, and

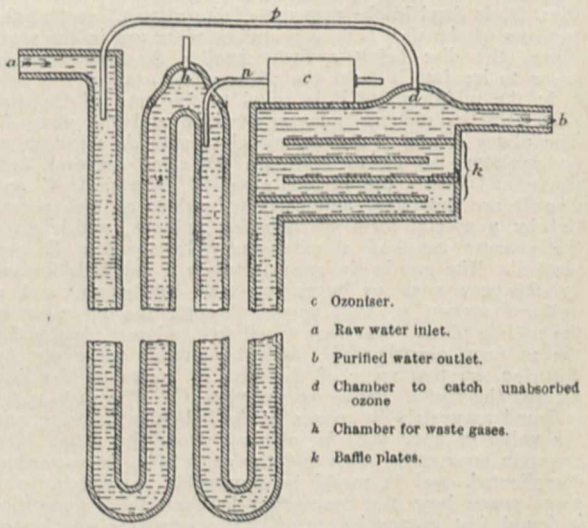


FIG. 2.—Sketch of Ozonising Apparatus (Howard-Bridge) Scale about $\frac{1}{3}$. Action of the Apparatus;—As the raw water passes down the pipe *a* it draws the unabsorbed ozone by way of the tube *p* from the chamber *d*. Freshly ozonised air is also drawn into the current from the ozoniser through the pipe *n*. After traversing the vertical pipes, the water is caused to pass round a series of baffle plates *k*, and finally flowing under the recess at *d* it reaches the outlet.

have like advantages. Very fine work is done by the Candy filter, which dispenses with precipitants, and owes its efficiency to oxidium, a substance with properties akin to those of spongy platinum. Cheapness in working is a feature of this installation (Fig. 1), and the effluent is certified by the highest authority to be excellent.

Great interest has been taken of late in the ozone purification processes, which are in operation at Wiesbaden, Nice, Philadelphia, and elsewhere. The chief difficulty in the meantime is to reduce the cost of working to something approaching the outlay for mechanical filtration by other means. Of the efficiency of ozone treatment there can be no question. The bacteria are practically eradicated. The filtrate is sparkling and palatable, even when the raw water is very bad. Progress has been made in reducing costs, and in particular the Howard-Bridge system effects a saving by collecting the unused ozone (see Fig. 2, *d*) and returning it to the incoming stream.

Many appliances are being tested at Paris for the purification of river water, and notable results are being obtained from the Anderson system. The precipitant in this case is iron oxide. So much as 3 grams per cubic metre is taken up by the raw water in traversing cylinders charged with scrap iron, and the oxide serves to precipitate fine silt and plankton, and finally to form a filtering *couche* on the sand beds (Fig. 3). It is here that the sedimentation by tortuous movements, and by conducting the flow over and under baffles, has been found to give such admirable results.

Another remarkable system which is doing good work in the *banlieue* of Paris is the Puech-Chabal. Here the raw water is first passed through the roughing filters, *dégrossisseurs*, so called, in which it leaves a large part of the suspended matters. The *dégrossisseurs* are composed of grits and pebbles graded from about walnut size to gravel in the last of the series. The rough filtration enables the finishing filter to continue in operation for a much longer period, and there is considerable saving of space and of working expenses.

A necessary adjunct to all filtering appliances is a regulator to control the speed of the flow. Filters in which precipitants are employed also require a regulator for adjusting the dosage to the amount of water passing, and various attempts have been made to perfect an appliance for this end. Variations in the state of the raw water have also to be considered.

In the course of distribution of the filtered water to consumers, impurities creep into the mains and service pipes, the chief being iron oxide and filaments of crenothrix, and in special cases lead and its compounds; but by suitable means all these can be eliminated, and without much outlay. On the whole, the application of scientific method and research to the technicalities of water purification have brought about many valuable improvements, and it may be expected that the future has much in store for the water engineer.

A. Rotating Cylinder.
B¹ B². Bearings for Hollow Trunnions.
C¹ C². Cylinder Supports.
C³. Support of Inlet Pipe.
C⁴. Support of Outlet Pipe.
D D. Curved Beakers.
E. Inlet Pipe.
F. Outlet Pipe.
G. Distributing Pipe.
H. Gear Wheel.
I. Outlet Cover.
J. Valve.
K. Air Inlet
L. Air Outlet.

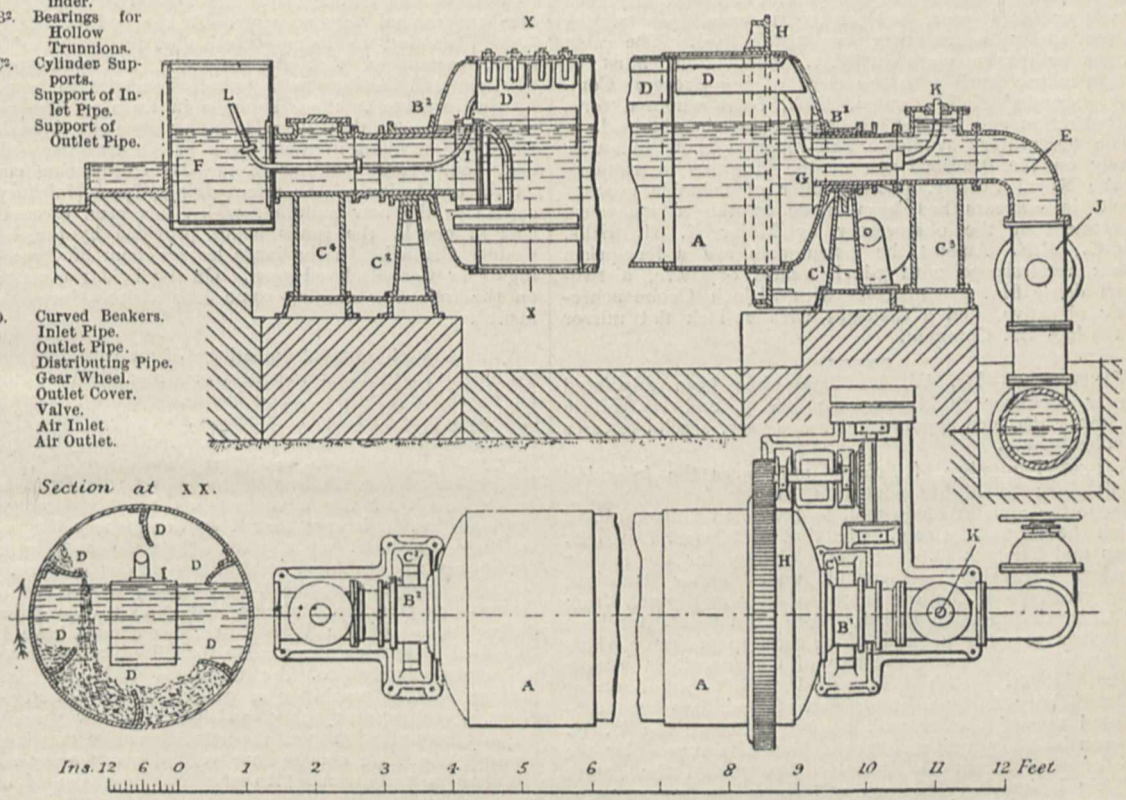


FIG. 3.—Rotating Cylinder containing fragments of Iron (Anderson).

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following have been nominated to serve, for eight years from February 20, on the board of electors to the professorship mentioned before their names:—*Chemistry*, Prof. Wood; *Plumian*, Mr. Mollison; *Anatomy*, Dr. Langley; *Botany*, Prof. I. B. Balfour; *Geology*, Dr. A. S. Woodward; *Jacksonian*, Prof. Larmor; *Medicine* (*Downing*), Dr. Fletcher; *Mineralogy*, Dr. Marr; *Political Economy*, Dr. Marshall; *Zoology and Comparative Anatomy*, Mr. F. Darwin; *Experimental Physics*, Sir W. D. Niven; *Mechanism and Applied Sciences*, Dr. Forsyth; *Physiology*, Prof. Starling; *Surgery*, Dr. Gaskell; *Pathology*, Sir T. Clifford Allbutt; and *Agriculture* (*Drapers*), Prof. Biffen.

Mr. J. B. Peace, of Emmanuel College, has been appointed chairman of examiners for the mechanical sciences tripos, 1909.

Dr. W. H. R. Rivers, of St. John's College, has been nominated to represent the University on the occasion of the celebration in July of the fiftieth aniversary of the foundation of the Anthropological Society of Paris.

Dr. T. G. Longstaff will deliver a lecture in Cambridge on Friday, February 12, on his explorations in the Himalayas. A lecture will be delivered in the Sedgwick Museum at 5 p.m. on Tuesday, February 23, by Dr. Agnes S. Lewis, "On some Deserts that I have Crossed." Dr. Sven Hedin will deliver a lecture before the University on Thursday, March 4.

With the object of encouraging original research in sanitary science, the Grocers' Company offers two scholarships, each of 300*l*. a year, with an allowance to meet the cost of apparatus and other expenses in connection with the work, tenable for one year, but renewable for a second or third year, subject to the conditions of the scheme under which they are established. The next election will take place in May. Applications must be sent in before April 1 to the clerk of the Grocers' Company, Grocers' Hall, London, E.C., from whom a form of application and further information may be obtained.

The observatory syndicate has reported that, following closely on the generous gift of the Huggins instruments by the Royal Society, another offer of valuable spectroscopic instruments has been made to the astrophysical department of the observatory by Major E. H. Hills, C.M.G., R.E. Among the instruments are a four-prism quartz spectroscope with 5-inch quartz objective, a two-prism dense flint spectroscope with 4½-inch Cooke achromatic objective, and a heliostat with 12-inch flat mirror by the late Dr. Common.

MANCHESTER.—Dr. W. H. Lang has been appointed Barker professor in cryptogamic botany, and Dr. Marie C. Stopes has been appointed, for one year, special lecturer in palæobotany.

A RECENT number of *Science* announces the following benefactions to higher education in the United States. Gifts to the amount of 69,300*l*. to Princeton University, of which the largest, 40,000*l*., was that of Messrs. David B. Jones and Thomas D. Jones, of Chicago, for the Palmer Physical Laboratory endowment fund. Other donations were 5100*l*. from the committee of fifty and 7000*l*. from the General Education Board. More than 8000*l*. has been subscribed towards a fund of 20,000*l*. to endow a chair of physiology at the University of Cincinnati, in honour of the late Mr. Joseph Eichberg. President John Thomas, of Middlebury College, states that 18,300*l*. has been contributed toward the 20,000*l*. needed to secure the D. K. Pearson building and endowment fund of 20,000*l*. By the will of Dr. James G. Wheeler, Broughton, the James Millikin University, Decatur, will come into possession of his estate, estimated to be worth from 15,000*l*. to 25,000*l*. The Ohio State University has received 2000*l*. from Mr. Robert T. Scott, Cadiz, the income to be used for the aid of poor students. From the same source we learn that Mr. John D. Rockefeller has made a further gift of 250,000*l*. to the University of Chicago. His gifts to the University now amount to more than 5,000,000*l*. At the last meeting of the board of directors of Bryn Mawr College a gift of 20,000*l*. was presented to the board by the Alumnæ Association of the college, the first instalment of the sum of 200,000*l*. which the alumnæ have undertaken to try to raise for the additional endowment of the college. The alumnæ have made it a condition of their gift that the money shall be used for academic salaries, and they have endowed the chair of mathematics with this first 20,000*l*., and stipulated that the money released by freeing the college from maintaining this professorship shall be used in raising the salary of each full professor in the college.

THE annual prize distribution of the Northampton Polytechnic Institute was held on Friday, February 5, when the prizes were distributed by the Earl of Halsbury, P.C. In the course of his address Lord Halsbury dealt very fully with certain aspects of technical education, particularly with the progress made during the six years since he last officiated at the Northampton Polytechnic Institute in a similar capacity. It appeared to him that the world is somewhat more awake now than it was some time ago, not only in this country, but in other countries, and that people are beginning to think that unless they are to be outstripped in the battle of the industries they must look to themselves and consider in these battles, as well as in battles of another sort, that the people who sleep on what they have got are very likely to lose it, and that we in England are in danger of being left behind in the race. The need for high scientific training was emphasised by reference to the discovery of the part played by fleas on rats in the dissemination of disease, and the "Ca Canny" principle was severely condemned. The liberality of the County Council towards the institute was suitably emphasised in connection with the new buildings which were opened during the evening. The need of such institutes in view of the decadence of the system of apprenticeship was emphasised very strongly. At the end of his speech Lord Halsbury, as Prime Warden of the Saddlers' Company, announced that the company has entrusted the Northampton Institute with certain bursaries to be applied by the institute to those students in training who require such assistance, the bursaries being specially intended to assist the students in their work in the workshops during their four years' training in the day engineering courses. At the conclusion of the prize giving, Lord Halsbury proceeded to the new building, which has been erected at a cost of 9000*l*., the funds being provided by the London County Council. In the large lecture-room of these buildings they were declared open. On the Friday evening and on the following evening some 6000 visitors inspected the institute.

THE annual general meeting of the Association of Technical Institutions was held at Grocers' Hall, London, on February 5 and 6. The business meeting on the first day was preceded by a luncheon, at which members of the association were entertained by the Grocers' Company. In proposing the toast of "The Association of Technical Institutions," Sir William White said he does not believe in the truth of the statements as to the decadence of England, but he is sure that if we are to keep the position we hold we must as a nation lose no opportunity of developing the technical institutions of the country. Sir Norman Lockyer responded, and during the course of his remarks said if Mr. Haldane had gone to the Education Office instead of the War Office, we should have had a Board of Education responsible for all education from top to bottom, instead of the truncated body we have at present. There would be a general staff, full of knowledge, directing everything, so that in a few years' time by this organisation and the administrative conditions it brought about we should have such a peace army as Mr. Haldane is endeavouring to give in the shape of a war army. At the subsequent meeting Dr. George T. Beilby, F.R.S., was elected president for 1909, and proceeded to deliver his address. If, he said, the members of the association are possessed by the belief that the industrial future of the nation must largely depend on the spread of education in science and in the application of its laws to the affairs of daily life, then they cannot escape from the conclusion that it is their particular duty to see to it that they are taking a leading part in this vitally important work. If, he pointed out, the training in technical institutions is to be modelled on the lines of the best professional standards, it is necessary to secure the active cooperation of representative men from those industries for which it is proposed to train the students. With the help of such representatives courses of instruction, practical as well as theoretical, must be organised. The same kind of reality must be given to the practical side of the work as is found in the clinical teaching of medical students, and it must be made compulsory for all who desire to obtain the full diploma of the college. On the second day Principal F. C. Forth, of Belfast, read a paper on the management of the entrance examinations giving admission to the evening classes of a technical institute, and Mr. Sidney Webb opened a discussion on compulsory attendance at evening classes.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 10, 1908.—"Potential Gradient in Glow Discharges from a Point to a Plane." By J. W. **Bispham.** Communicated by Sir J. J. Thomson, F.R.S.

Three types of discharge were examined; for very small currents (type A) the glow was limited to the immediate neighbourhood of the point. For larger currents (type B) the luminous glow spread out in a conical form from point to plate, and the current, as indicated by a telephone in circuit, became intermittent. The oscillations of current amplitude could be augmented and decreased in frequency by capacity and inductance, and striæ then began to appear. The striæ were absolutely steady to the eye, in spite of the intermittent nature of the current. When the current was still further increased the flow became continuous, and the glow (type C) was limited to the neighbourhood of the axis of discharge. In this condition the point appeared to be exerting no peculiar effect—the discharge was simply that between two small electrodes.

An exploring electrode was inserted between the point and the plane, and by means of flotation on mercury it could be made to take up any position on the axis relative to the point and plane. The electrode took up the potential of the gas, and in this way potential curves were obtained and the electric force at various points calculated from them.

Electric-force curves were obtained for the A type which indicated that it only possessed a limited range of stability, not being obtained at all for pressures less than 11·3 mm. (point negative) and 3 mm. (point positive) in discharges in hydrogen. Current increase led to the production of the B type of discharge. For the B type of discharge it was observed that the kathode dark space was abnormally large, and also that the kathode glow was a doublet consisting of two bright layers separated by a layer of very low luminosity.

Apparent reversals of field were observed near the electrodes, but it was found that these apparent reversals varied with the capacity of the electroscope used to measure the potential, and they were interpreted to indicate local excesses of positive and negative electrification rather than reversals of field. The distortion of the potential curve was increased by increasing the capacity of the electroscope. No distortion was observed in the case of the C type of discharge, and the capacity of the electroscope did not affect the readings. Evidently the distortion of the curve was to be associated with the intermittent character of the discharge in type B.

It was concluded (for type B) that the Crookes dark space was positively electrified, while negative ions were in excess at a point further away from the kathode. Similarly, when striæ were obtained the anode side of a stria was positively electrified, while the kathode side was negatively electrified, as indicated by the potential curves. In the C type of discharge a constant and normal kathode fall was obtained for wide ranges of pressure and current variation, and the curves were of the same type as has been obtained by Prof. H. A. Wilson for discharges between small plane electrodes. They afforded testimony as to the efficient working of the explorer. In this type of discharge, also, the kathode dark space was observed to be unusually large, and the negative glow resembled rather a large stria embedded in a pale blue halo. Some of the curves obtained for the point glow (A type of discharge) indicated that the discharge proceeded in two stages, a discharge from the point to the neighbouring gas, succeeded by a discharge from this gas to the plate.

Royal Microscopical Society, January 20.—Anniversary meeting.—Lord Avebury, F.R.S., president, in the chair.—Presidential address, entitled "On Seeds, with Special Reference to British Plants": Lord **Avebury.** In this the president more particularly dealt with the seeds of gymnosperms and monocotyledons, in continuation of the address of the previous year, in which the seeds of dicotyledons were considered.

Physical Society, January 22.—Dr. C. Chree, F.R.S., president, in the chair.—Effective resistance and inductance of a concentric main, and methods of computing the Ber and Bei and allied functions: Dr. A. **Russell.** The following simple formula for the effective resistance R, per centimetre length, of the inner conductor of a concentric main for high-frequency currents is obtained:—

$$R=(\rho m/2\pi a)\,(0{\cdot}7071+1/2ma+0{\cdot}265/m^2a^2-0{\cdot}35/m^4a^4),$$

where ρ is the volume resistivity of the conductor, a its radius, $m^2=8\pi^2\mu f/\rho$, μ the permeability of the conductor, and f the frequency of the alternating current. This formula may be used in wireless telegraphy for calculating the resistance of a conductor when other conductors carrying high-frequency currents are not too close. For values of ma greater than 6 the maximum inaccuracy of the formula is less than 1 in 10,000. In obtaining the solution, exact formulæ are obtained for the density of the current at all points on the inner and outer conductors.—Note on the luminous efficiency of a black body: Dr. C. V. **Drysdale.** The importance of efficient methods of light production renders it of interest to ascertain the possibilities of a black body as a light radiator at various temperatures, and the author has attempted to obtain these from the radiation formula of Wien. The energy radiated between any two wave-lengths is written down, and the total radiation calculated. This, in conjunction with Kurlbaum's determination of the radiation constant, and Lummer and Pringsheim's results, gives rise to the formulæ given in the paper. A table and curves calculated from these formulæ have been worked out by Mr. A. F. Burgess, and show the relation of the total and luminous radiation and luminous efficiency for various temperatures. The comparison of the luminous energy so calculated with the intensity of light radiation found by Prof. Féry leads to a mechanical equivalent of light of about 0·075 watt per candle, which is a fairly probable figure. The results show the enormous extent to which the luminous efficiency is dependent upon the temperature, and how extremely low it is at ordinary temperatures. At 1500° C. the efficiency is only of the order of 1 per cent. or less, while at 2000° C. it is about 3 per cent. The highest efficiency is obtained at a temperature of about 6500° C., and is then only between 40 per cent. and 50 per cent. This strongly points to the necessity for working in the direction of selective radiation or luminescence.—The use of the potentiometer on alternate current circuits: Dr. C. V. **Drysdale.** The great difficulty in alternate current measurement lies in the shortness of the range of the instruments available, and there is therefore a great need for some instrument which, like the direct potentiometer, should be capable of measuring P.Ds. and currents of any range with accuracy. By interposing an ammeter on the dynamometer principle in the main circuit of a potentiometer and deriving the current from the secondary of a phase-shifting transformer, it is possible to check the instrument with direct current against the standard cell in the ordinary way, and then to reproduce the same current in the potentiometer circuit and to bring it into coincidence of phase with the P.D. to be measured. Experiments have been made with this device by Mr. A. C. Jolley and the author, first as to the accuracy of current measurement using an ordinary low-resistance standard, and have been found to give very good agreement with a Kelvin balance. Other tests have been made to obtain the vector difference of potential across a resistance coil and a choking coil connected in series, and the triangle of voltages so formed was found to be very nearly closed. The tests so far made seem to indicate that an alternate current P.D. of 0·1 volt can be measured to an accuracy of 0·2 per cent. or closer. The author has also designed a universal potentiometer on this principle which serves both for direct- and alternate-current measurements, and for testing P.D., current, phase, power, inductance, capacity, &c.

Royal Anthropological Institute, January 26.—Annual general meeting.—Prof. W. Ridgeway, president, in the chair.—Anniversary address, the relation of anthropology to classical studies: Prof. **Ridgeway.** The results that had followed from the use of the anthropological method in the study of the classics were pointed out. Subjects which had long been obscure or had given rise to wild speculations, in the light of anthropology took upon themselves a clear meaning. For example, Aristotle's account of the origins of Greek society, an account which had for long

perplexed scholars, can be explained by comparing it with institutions still surviving amongst primitive peoples; but it is only of recent years that any such comparison has been made, or such an explanation given. It is not only in the domain of sociology or religion that such a comparative method is of service. The art of the Greeks, for example, can be shown to have been at one time in a stage comparable to that of the modern savage, from which it has directly developed. Again, a knowledge of anthropology will be of great service to an intelligent understanding of classical literature. The attacks which have been made on classical studies, and especially on the teaching of Greek, are in great measure due to the classical scholars themselves, who by their pedantry and indifference to scientific method have caused the reaction which has set in against these studies.

Mineralogical Society, January 26.—Dr. A. E. H. Tutton, F.R.S., vice-president, in the chair.—The identity of poonahlite with mesolite: Dr. H. L. **Bowman.** Small colourless prisms, associated with stilbite and pale green apophyllite from Poonah, which appear to be identical with the mineral described by H. J. Brooke in 1831 as poonahlite, are shown by analysis to be mesolite, having a composition corresponding to a mixture of two molecules of scolecite with one of natrolite. The optical characters are similar to those recently observed by Görgay in mesolite from the Færöe Islands.—Cross-planes in twin-crystals: Dr. J. W. **Evans.** A twin-plane is composed of two equivalent planes, one from each component crystal, and every line in it is composed of two equivalent lines. A cross-plane is also composed of two equivalent planes, but there are only two, four, or six lines (at right angles in pairs) composed of equivalent lines. A plane of composition is always a twin-plane or a cross-plane. In the former molecular distances are the same in all directions in the plane, in the latter in two, four, or six directions only.—Comparison of the refractive indices of adjoining crystals in a rock slice which have their directions of vibration oblique to one another: Dr. J. W. **Evans.** The Nicols are placed with their directions of vibration parallel and bisecting the angle θ between the directions of the vibrations the refractive indices of which are to be compared. The light received from these directions will (apart from interference) be proportional to $\cos^2\theta/2$, and that from those at right angles to them $\sin^2\theta/2$, so that the former will bear to the latter the ratio $\cot^2\theta/2$. If θ be less than 35° this will be greater than ten, and the light from the directions at right angles may be neglected both in respect of its direct effects on the Becke phenomena and its indirect action in producing interference.—Note on the spontaneous crystallisation of solutions as spherulites: J. **Chevalier.** Experiments on solutions of potash-alum, sodium, ammonium and lithium sulphates, &c., made at the suggestion of Prof. Miers in the Oxford Mineralogical Laboratory, show that spherulites and sphero-crystals are characteristic of the spontaneous crystallisation of many solutions in thin drops. When other crystals grow first, it is probably because they have been introduced, the drop in that case appearing to be metastable. The spherulites mark the passage of the solution to the labile state.—A method for studying the optical properties of crystals: the late Dr. H. C. **Sorby.** The author gives complete details of his work on the determination of refractive indices in thin plates, of which preliminary accounts have been published in the first two volumes of the *Mineralogical Magazine*. The method he describes in the case of doubly refractive minerals is identical in principle (though devised quite independently) with that given by the Duc de Chaulnes for singly refractive substances, but is worked out in far greater detail.—Some additional localities for idocrase in Cornwall: G. **Barrow** and H. H. **Thomas.** During the mapping of the metamorphic area round the Bodmin Moor granite, further occurrences of idocrase have been found in the altered limestones. Well-shaped crystals of the mineral, up to 6 mm. in length, are fairly common in drusy cavities. They are perfectly uniaxial, but show in thin sections considerable variation in the double refraction, especially in the outer layers of the crystals. The idocrase is associated with pale pink to pinkish-brown garnet (often in regular intergrowth with the idocrase), pale green diopside, and epidote approximating to clinozoisite in its low extinction and birefringence.—Detrital andalusite in Tertiary and Post-Tertiary sands: H. H. **Thomas.** Occurrences of detrital andalusite are described in sands from various localities in West Wales. In no sedimentary rock of greater antiquity than the Pliocene has detrital andalusite been found. In the sands of West Wales the mineral occurs as slightly elongated, somewhat angular grains, often showing very intense pleochroism from blood-red to pale greenish-blue. It is associated in these sands with pink garnet, greenish-brown augite, cyanite, zircon, rutile, tabular anatase, staurolite, brown and more rarely blue tourmaline, green hornblende, bright green epidote, cordierite, iron ores, and in some cases glaucophane.—The energy of twin-crystals: H. **Hilton.** The author determines in a simple case the conditions according to which a twin-crystal may be a more stable form, or, in other words, may have less surface energy than a simple crystal of the same volume.

Geological Society, January 27.—Prof. W. J. Sollas, F.R.S., president, in the chair.—The Conway succession: Dr. Gertrude L. **Elles.** In this area the author found a complete succession of strata, from Llandeilian up to Salopian date. A table of the divisions proposed is given. The beds are described in ascending order, lists of fossils being given from the more important exposures. There is no break in the sequence between the Ordovician and the Silurian rocks in the district. A detailed comparison is established between the rocks of this area and those of South Wales, the Rhayader and Tarannon districts, Lakeland, the south of Scotland, and Pomeroy. The Conway Mountain volcanic series appears to be equivalent to the Borrowdale volcanic rocks of the Lake District, and the Cadnant Slates and Bodeidda Mudstones equivalent to the Upper Dicranograptus Shales, Trinucleus beds, and Sholeshook Limestone of South Wales, the Sleddale and Roman Fell groups of Lakeland, and the Upper Glenkiln and Lower Hartfell of the south of Scotland. The Deganwy Mudstones are paralleled with the Redhill beds and the Ashgill Shales. Close comparison is possible between the graptolitic zones of the Gyffin Shales and corresponding beds at Rhayader, Tarannon, in the Lake District, and the south of Scotland.—The depth and succession of the Bovey deposits: A. J. **Jukes-Browne.** The total thickness of the Tertiary beds in the Bovey basin has never yet been ascertained. Some years ago a boring, which reached a depth of 526 feet from the surface, was put down. Particulars concerning the beds traversed by this boring have led to a discussion of the succession of the Bovey deposits, so far as they have been explored. A generalised description of the strata seen in the Heathfield pit, and penetrated by the boring from the bottom of that excavation, is given. The conclusion arrived at by Pengelly in 1861 with regard to the relative age of the beds exposed in the "old coal-pit" south-east of Bovey Tracey, and those proved in a boring to the east of it, is confirmed. The total thickness of the "Eocene" beds is estimated to be about 613 feet. The Bovey basin itself is regarded as a tectonic basin or post-Eocene pericline, and not as a lake-basin. Heer's view of the manner in which the lignites were formed is dissented from, and the identification of some of the plants discussed, and it is concluded that the lignites, which form the mass of the lower beds, represent the growth and decay of successive swamp-forests. Assuming these lower beds to be of Eocene age, and contemporaneous with the Bournemouth beds of the Hampshire basin, it is pointed out that nothing has yet been proved with regard to the higher beds, which may be of Bartonian or even of Oligocene age.

MANCHESTER.

Literary and Philosophical Society, January 26.—Prof H. B. Dixon, F.R.S., president, in the chair.—The dowels of some Egyptian coffins of the twelfth dynasty: T. G. B. **Osborn.** An examination was made of various wooden coffins of the twelfth dynasty in the Manchester Museum, using microscopic methods with the view of determining the timber employed in their construction. The wood used in making the body of the coffins was found to be sycamore (*Ficus sycomorus*), while the dowels or wooden pins, with

which they were joined, were of acacia, a harder and tougher wood.—The diatomaceous deposit of the Lower Bann Valley, N. Ireland, and prehistoric implements found therein: J. W. **Jackson.** The diatom deposit occupies a considerable area on both sides of the river Bann, and varies in thickness from 6 feet at Culbane to 18 inches near Lough Beg. At Toome and the Ferry near Lough Beg the clay is cut out in brick form, dried, milled, and put up in sacks for export. The prepared material, known as "Kieselgühr," is used in about fifty manufactures as varied as "polishing powder," "filtering material," "insulating medium," and "tooth and face powders." The prehistoric implements found in working the clay were collected by the late Mr. R. D. Darbishire and Mr. Bell, of Belfast. They comprise large numbers of worked flint flakes, viz. knives, borers, and scrapers, a few flint celts and arrow-heads, a number of implements made of coarse clay-slate, and several others. Other objects described were grind-stones, found near Culbane; clay-slate whetstones, one being of peculiar interest from bearing on its face a number of rune-like characters, possibly inscribed thereon to convey a message; and a large saddle-quern, weighing 62 lb., also found at Culbane. Some Oghamic scribings from other parts were referred to. The tools probably range from the Neolithic to the Bronze age.

DUBLIN.

Royal Irish Academy, January 25.—Dr. F. A. Tarleton, president, in the chair.—The Irish horse and its early history: Dr. R. F. **Scharff.** That the modern Irish horse shows remarkable traces of an eastern strain is well known, and has been alluded to by many writers. This is currently believed to be due to human introduction of Spanish horses possessing eastern characteristics. Prof. Ridgeway contended that a superior class of horses resembling the Libyan race had been sent to Ireland even since pre-Christian times. The author exhibited Irish horse remains from crannogs, bogs, marls, and caves, and showed that all these were quite as Arab-like as any modern Irish horse, even more so. He expressed the view that, as some of these bones belonged to wild horses, the eastern features in the modern races were not altogether the result of artificial introduction, but due to inheritance from the original wild stock of the country.—A supplementary list of the spiders of Ireland: Denis R. **Pack-Beresford.** The list contains the record of fifty-eight species of spiders taken in Ireland since the publication of Prof. Carpenter's "List of the Spiders of Ireland" in 1898. Only one species—*Lophocarenum stramineum*, Menge—has not yet occurred in Great Britain, though it has been taken in two localities in the south of Ireland. A single specimen of the rare *Eugnatha striata*, L. Koch, is recorded from Sligo, and *Gongylidiellum paganum*, Sim., *Lophomma stationum*, Sim., and *Wideria melanocephala*, Camb., have been taken in Co. Carlow, having only previously been found in single localities in England. An exotic species—*Triaeris stenaspis*, Sim.—a native of Venezuela, has been taken in the Botanic Gardens, Glasnevin, in the hot-houses. A second list contains a few corrections in nomenclature of species in Prof. Carpenter's list, and a third gives all the records available at present of new localities for some of the rarer species inhabiting Ireland.—Contributions towards a monograph of the British and Irish Oligochæta: R. **Southern.** Ten new species were described, and twenty-one additions to the fauna of the British Isles were recorded. The total number of species and subspecies now known to occur in the British Isles is 135. A consideration of the distribution of the Irish earthworms leads to the conclusion that the Lusitanian species, at least, are part of a pre-Glacial fauna. This is opposed to the "glacial" theory advanced by Prof. Michaelsen to explain the present distribution of the Lumbricidæ.

PARIS.

Academy of Sciences, February 1.—M. Bouchard in the chair.—The diffusion of saline manures in the soil: A. **Muntz** and H. **Gaudechon.** A patch of soil containing a salt such as potassium chloride or nitrate attracts moisture from the surrounding earth, giving a damp patch. This explains why it is not advisable to use such manures at the time the seeds are planted, since if the seed is in a saline patch it is killed by the strong solution, and outside such a patch the soil is rendered too dry for germination. Even in moist soils diffusion of the salt horizontally takes place with extreme slowness.—A fructification of a Lycopodinium found in the Trias: P. **Fliche.**—Results of micrometric measurements made at the Observatory of Lyons during the eclipse of the sun of June 28, 1908: J. **Merlin.**—The comparative activity of the Leonid and Geminid swarms of November 14, 1907: Maurice **Farman** and Em. **Touchet.**—New researches on the selective absorption and diffusion of light in interstellar space: G. A. **Tikhoff.** Photographs of the Pleiades were made through four screens allowing the passage of the ultra-violet, indigo-violet, yellow-green, and orange rays respectively. The proofs thus obtained showed very clearly that, with a few exceptions, the difference of brightness of the brilliant and feeble stars of the Pleiades increases in an unexpected manner in passing from the orange rays to the ultra-violet. The general results are in accordance with the predictions of Prof. Turner in a recent note on the diminution of light in its passage through interstellar space, based on the supposition of the scattering of light by particles disseminated through space.—Families of Lamé composed of Dupin cyclids: A. **Demoulin.**—Some remarks on geodesic lines, with reference to a recent note by M. Drach: M. **Hadamard.**—The integrals of an algebraical differential equation of the first order: Pierre **Boutroux.**—The application of a generalised theorem of Jacobi to the problem of S. Lie-Mayer: W. **Stekloff.**—The approximate representation of continuous functions by a multiple integral: M. **Fréchet.**—The diminution of phosphorescence at low temperatures: J. **de Kowalski.** Various derivatives of benzene cooled to the temperature of liquid air were exposed to the rays of a mercury arc lamp. The phosphorescence was then observed through different screens, and the time during which the light was visible noted. It was found that the diminution of intensity was more rapid with the long wave-lengths than with the short wave-lengths.—Some new reactions of dioxyacetone: G. **Denigès.** A solution containing dioxyacetone, sulphuric acid, and potassium bromide gives definite colour reactions with gallic and salicylic acids and other organic compounds.—The action of air and other oxidising agents on coals: O. **Boudouard.** In contact with air, coals absorb oxygen, especially at high temperatures. Coking coals, oxidised at 100° C., lose their power of coking, and after such treatment contain humic acid.—The formation of hydrocyanic acid in the action of nitric acid on phenols and quinones: A. **Seyewetz** and L. **Poizat.** Hydrocyanic acid is formed by the action of a boiling solution of nitric acid (20 per cent.) on numerous organic compounds, especially those containing a phenolic or quinonic group. This is due to the presence of nitrous acid, since if urea or aniline be present no hydrocyanic acid is formed, and a theory based on this fact is suggested.—The action of nitrosobenzene on the secondary amines: P. **Freundler** and M. **Juillard.**—Some reactions of the 9: 10-dihydride of anthracene and of anthranol: R. **Padova.** A condensation product with benzophenone chloride is described.—The combustion of gases without flame and on the conditions of lighting by incandescence: Jean **Meunier.**—The extension of the notion of solubility to colloids: M. **Duclaux.** The ordinary definition of solubility is inapplicable to colloids. If a colloid solution is placed in a vessel permeable to the solvent, the latter will escape through the walls, and the concentration of the colloid will increase up to a certain limit, which defines the solubility at the temperature of the experiment. The classification of colloids is considered from this point of view.—The action of acids on peroxydiastase: Gabriel **Bertrand** and Mlle. M. **Rozenband.**—The maltase of maize: R. **Huerre.** Different species of maize contain maltases differing in their temperatures of maximum activity, and also in the range of temperature over which hydrolysis of starch takes place.—The use of ferrous arseniate against the parasitic insects of plants: MM. **Vermorel** and **Dantony.** This insecticide possesses the advantages of adhering well to the plants, strong insecticidal powers, little or no damage to the plant, and less

dangerous to man than other arsenical compounds previously proposed.—Concerning the anatomy of the human thymus: René **Cruchet.** The results recently published by MM. Henri Rieffel and Jacques Le Mée confirm the results published by the author seven years ago.—New cytological researches on the aseptic autolysis of the liver: L. **Launoy.**—Researches on the contagion of tuberculosis by air: M. **Le Noir** and Jean **Camus.** Experiments made with the air of a hospital ward filled with tuberculous patients showed that while no bacilli could be detected in the air, the dust was infected.—The duration of the hypotensive effects resulting from high-frequency currents: E. **Doumer.** The good effects are in general durable. In cases where there was a tendency to relapse, a very short course of the original treatment was sufficient again to lower the blood pressure.—The immediate and ultimate results of arterio-venous suture: Albert **Frouin.**—The various types of stolon in Syllidians, especially a new species (*Syllis cirropunctata*): Aug. **Michel.**—The evolutive cycles of a Scyphistome: Edgard **Hérouard.**—The existence of coal at Gironcourt-sur-Vraine (Vosges): René **Nicklès.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 11.

ROYAL SOCIETY, at 4.30.—The Nerves of the Atrio-ventricular Bundle: J. Gordon Wilson.—An Experimental Estimation of the Theory of Ancestral Contributions in Heredity: A. D. Darbishire.—On the Determination of a Coefficient by which the Rate of Diffusion of Stain and other Substances into Living Cells can be measured, and by which Bacteria and other Cells may be Differentiated: H. C. Ross.—The Origin and Destiny of Cholesterol in the Animal Organism. Part III., The Absorption of Cholesterol from the Food and its Appearance in the Blood: C. Dorée and J. A. Gardner.—On the Origin and Destiny of Cholesterol in the Animal Organism. Part IV., The Cholesterol Contents of Eggs and Chicks: G. W. Ellis and J. A. Gardner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Use of Large Gas Engines for Generating Power: L. Andrews and R. Porter.

MATHEMATICAL SOCIETY, at 5.30.—On the Relation between Pfaff's Problem and the Calculus of Variations: Prof. A. C. Dixon.—On Implicit Functions and their Differentials: Dr. W. H. Young.—On a Certain Family of Cubic Surfaces: W. H. Salmon.—Some Fundamental Properties of Lebesgue Integrals in a Two-dimensional Domain: Dr. E. W. Hobson.—Modular Invariants of a General System of Linear Forms: Prof. L. E. Dickson.—The Conformal Transformations of a Space of Four Dimensions and the Generalisation of the Lorentz Einstein Principle: H. Bateman and E. Cunningham.—On Indeterminate Forms: Dr. W. H. Young.

FRIDAY, FEBRUARY 12.

ROYAL INSTITUTION, at 9.—The Electrical Properties of Flame: Prof. H. A. Wilson, F.R.S.

PHYSICAL SOCIETY, at 8.—Annual General Meeting.—Presidential Address.

MALACOLOGICAL SOCIETY, at 8.—Annual General Meeting.—Presidential Address: Darwinism and Malacology: B. B. Woodward.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Construction of Docks: Sir Whately Eliot.

MONDAY, FEBRUARY 15.

ROYAL SOCIETY OF ARTS, at 8.—Modern Methods of Artificial Illumination: Leon Gaster.

VICTORIA INSTITUTE, at 4.30.—Discoveries in Babylonia and Neighbouring Lands: Dr. T. G. Pinches.

TUESDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 3.—The Architectural and Sculptural Antiquities of India: Prof. A. A. Macdonell.

ZOOLOGICAL SOCIETY, at 8.30.—The Fauna of the Cocos-Keeling Atoll: F. Wood-Jones.—Contributions to the Anatomy of certain Ungulata, including Tapirus, Hyrax, and Antilocapra: F. E. Beddard, F.R.S.—Le Rhinocéros Blanc du Soudan: Prof. E. L. Trouessart.

ROYAL STATISTICAL SOCIETY, at 5.—Forestry in Some of its Economic Aspects: Prof. W. Somerville.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design of Marine Steam-Turbines: S. J. Reed.

ROYAL SOCIETY OF ARTS, at 8.—The Commercial Relations of France and Great Britain: Yves Guyot.

WEDNESDAY, FEBRUARY 17.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On a German Silver Powell Portable Microscope, made in 1850: A. A. C. E. Merlin: The "Red Snow" Plant, *Sphaerella nivalis*: G. S. West.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1908: E. Mawley.—The Cold Spell at the End of December, 1908: W. Marriott.

THURSDAY, FEBRUARY 18.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Osmotic Pressures of Calcium Ferrocyanide Solutions, Part II., Weak Solutions: Earl of Berkeley, F.R.S., E. G. J. Hartley and J. Stephenson.—On the Spontaneous Crystallisation of Monochloracetic Acid and its Mixtures with Naphthalene: Prof. H. A. Miers, F.R.S., and Miss F. Isaac.—An Apparatus for Measurements of the Defining Power of Objectives: J. de G. Hunter.—On Best Conditions for Photographic Enlargement of Small Solid Objects: A. Mallock, F.R.S.

ROYAL INSTITUTION, at 3.—Problems of Geographical Distribution in Mexico: Dr. Hans Gadow, F.R.S.

LINNEAN SOCIETY, at 8.—Discussion on Alternation of Generations: opened by Dr. W. H. Lang.

FRIDAY, FEBRUARY 19.

ROYAL INSTITUTION, at 9.—Recent Advances in Means of Saving Life in Coal Mines: Sir Henry Cunynghame, K.C.B.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.—*Further discussion*: The Filtration and Purification of Water for Public Supply: John Don.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Standardisation in Engineering Practice: Dr. W. C. Unwin, F.R.S.

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