THURSDAY, NOVEMBER 9, 1911.

TIDAL ACTION AND COSMOGONY.

The Tides and Kindred Phenomena in the Solar System. The substance of lectures delivered in 1897 at the Lowell Institute, Boston, Massachusetts, by Sir G. H. Darwin, K.C.B. Third edition. Pp. xxiv+437. (London: John Murray, 1911.) Price 7*s.* 6*d.* net.

THE first edition of this book appeared in 1898, and was reviewed in NATURE, vol. lix., p. 219. The work has since taken rank as a classic in its way, and has been translated into several languages. There is no need, therefore, to dwell at any length on its general character and purpose. It aims at giving, with as few technicalities as possible, a summary of the researches on tidal theory, and more especially on the theory of tidal evolution, which have been the principal occupation of the author's long scientific career. It would be misleading to describe it merely as a "popular" book, for it is a valuable guide even to experts who might otherwise be dismayed by the long and intricate calculations in which the original investigations necessarily abound. In this respect it may perhaps be compared with the celebrated "Exposition du Système du Monde" which Laplace added as a supplement to the detailed work of the "Mécanique Céleste." It is true that the subject-matter is in the present case more speculative, but the purpose is the same, and the execution not unworthy of the great exemplar.

In this third edition some additions and alterations have, however, been made which call for notice. These consist in part of supplementary notes to the earlier chapters, in which brief summaries are given of recent work bearing on the various topics. Thus at the end of the first chapter there is an interesting account of deep-sea tide gauges, with a tantalising indication of the valuable results which might be obtained if an extended and systematic use of such appliances were practicable. The appreciative account of Forel's early investigations of the "seiches" of the Lake of Geneva is appropriately supplemented by a reference to Chrystal's recent work on the Scottish lochs. The remarkable observations of Dr. Hecker on the lunar disturbance of gravity, which are the successful realisation of an interprise in which Sir G. Darwin himself led the way, are described with generous enthusiasm. In the absence of any authoritative account in English of these experiments, it is perhaps to be regretted that the description is not still more ample. Their value consists, of course, in the inferences which they justify as to the degree of rigidity of the earth. The other lines of evidence bearing on the same question, viz. those based on observations of the fortnightly tide, and on the free (Eulerian) nutation of the earth's axis, are also explained and discussed, the general conclusion being that the earth's surface yields, under the action of tidal or precessional force, about two-fifths as much as if it were absolutely devoid of rigidity. The more recent work of Love and Larmor, in which a greater degree of precision is given to the inferences which can be drawn from the respective lines of argument, was probably judged to be of too refined a character to admit of elementary treatment.

The views of the author as to the age of the earth, and the scale of geological time, have, as explained in this edition, undergone considerable modification. In 1898 the arguments of Lord Kelvin, which assigned a comparatively moderate age to the solid earth, were in the ascendant; but the rapid and startling succession of discoveries in radio-activity have undermined much of the reasoning based on such considerations as the output of energy from the sun and the secular cooling of the earth. Moreover, the researches of Strutt claim positively to demonstrate an enormous antiquity for certain rocks, far transcending the limits formerly accepted by physicists. On the other hand, an altogether independent estimate by Joly, based on a comparison of the amount of sodium in the ocean with the amount annually carried into it by rivers, would give to the existing ocean an age of about 100 million years at most, a figure which is on the scale of Kelvin's results. The discrepancy is at present unexplained, but we may note an interesting essay on the subject by Joly, in a recent number of the *Phil. Mag.* (September, 1911). Sir G. Darwin inclines, on a review of the whole evidence, to the belief that there is no assignable limit to the fund of time on which biologists may draw for the purpose of their evolutionary theories.

The last three chapters of the book are almost altogether new. The first of these is devoted to a general explanation of the theory of "figures of equilibrium" of rotating fluid, a classical problem with which the names of Maclaurin, Jacobi, Roche, Poincaré, and Darwin will always be associated. The theory of the stability of the various forms is of too technical a character to admit of really elementary treatment, but the summary will be welcome even to mathematicians, as a survey of a somewhat intricate subject. The succeeding chapter, one of the most fascinating in the book, gives a striking application of the theory to the phenomena of variable stars. The evolution of binary stars, a very attractive subject, is also considered, but the intricacy of such speculations is exemplified by the fact that a new source of instability, known as "gravitational instability," comes into play in the case of a gaseous mass. The concluding chapter treats of the nebular hypothesis of Laplace, and of the more important modifications of it which have been proposed by subsequent writers. In particular the "planetesimal" hypothesis of Chamberlin and Moulton, which was suggested by the observed prevalent spiral configuration of many nebulæ, is discussed at some length. Some speculations have an invincible attraction for the mind, but the critical reader will have an uneasy feeling that here at any rate he is making doubtful ventures into a mysterious region, far away from any secure dynamical base.

It would be wrong to end this notice without a word of admiration for the modesty and restraint which the author has shown in setting forth the results of speculations in the origin and development of which he has himself borne a predominant part.

The results of theoretical reasoning are always stated with scrupulous care, and their limitations clearly expressed, and no attempt is made to press conclusions based on idealised premises further than the case will warrant. A striking instance of this is furnished by the way in which, after developing his theory of the evolution of the earth-moon system with justifiable enthusiasm and evident faith, he takes care frankly to point out that other agencies must probably be sought to account for the origin of the satellites of the exterior planets and of the planets themselves.

H. L.

RECENT ADVANCES IN THE GENETICS OF PLANTS.

Einführung in die experimentelle Vererbungslehre By Prof. E. Baur. Pp. vi+293. (Berlin: Gebrüder Borntraeger, 1911.) Price 8.50 marks.

PROF. ERWIN BAUR is well known to students of genetics as a most successful investigator. The fifteen lectures included in the present volume were delivered as a course in Berlin, and they constitute an admirable text-book of the subject, which will do much to familiarise Continental biologists with the methods of Mendelian analysis and the deductions to which it has led. The coloured pictures are exceptionally good. No clearer or better illustrated account of the present state of knowledge of these matters could be desired.

Some years ago Prof. Baur began a series of researches into the nature of variegation in plants, without any special intention of investigating Mendelian phenomena, but, like so many others engaged on special problems, he soon found that a knowledge of heredity was indispensable to a proper understanding of his subject. The breeding experiments then instituted, though begun as a side-issue, have illuminated the whole field. His first success was obtained in a study of the golden-leaved Antirrhinum, which he proved to be a heterozygous form, possessing only one factor for greenness. Self-fertilised, it gives two yellows to one green, the missing term in the series being the homozygous albinos which perish on germination.

This led to a comprehensive examination of the inheritance of flower-colour in *A. majus*, a subject also studied by Miss Wheldale in this country. The series of types is very large, seeming at first sight almost continuous, and the analysis was exceptionally troublesome, but it is satisfactory to know that though working independently, both observers have arrived at practically the same conclusions as to the factorial composition of the several forms. In this book Antirrhinum is naturally taken as the typical example of the effects of combinations of long series of factors, and the reader who masters this example will have encountered most of the complications which ordinary Mendelian inheritance presents.

From this work on the varieties of a single species Baur has gone on to less familiar ground, and in this book he gives the first results of his experiments on the interrelation of forms which are quite distinct species in the systematic sense, especially *A. majus* and *A. molle*. The F_1 plants are fully fertile, and F_2 shows a long series of diverse types resulting from the recombination of segregating factors, but the analysis is still to be completed. One observation of extraordinary interest is announced, namely, that the self-sterility of *A. molle* is a recessive. This announcement must be regarded as preliminary, but if established, the discovery will constitute a striking advance. Self-sterility is one of the greatest paradoxes in nature. If it is true, as we are almost forced to believe, that a self-sterile plant can be fertilised by the pollen of *any* other individual but not by its own, then each individual is differentiated by virtue of its individuality, and there are as many classes as individuals. The notion once suggested by de Vries, which I also had formerly entertained, that there are in reality several *classes* of individuals and that probably fertilisation was inoperative only within each class, is negatived by such experiments as have been made by others and by myself (on a small scale in *Linaria vulgaris*). If self-fertility be a dominant, the main mystery is still unsolved, but we have a new fact of great consequence which may lead to a solution.

The most important chapters are those in which Baur describes his discoveries regarding the inheritance of the several forms of "Chimæra," the term Winkler has introduced to denote patchwork or mosaic individuals. In a variegated Pelargonium, for instance, the albino parts of the vegetative organs may be *sectorial* forming radiating patches of white, or *periclinal*, in which case the external layers of cells may be green and the internal white; or conversely the internal may be green and the external cells white. Baur has shown that the colour of the offspring, whether green or white, depends on the nature of the subepidermal layer of cells from which the parental germ-cells were derived. If in the periclinal chimæra the two peripheral layers of cells are green, the offspring (of self-fertilisation) are all green; if the peripheral layers are albino the offspring are all albino, and, of course, perish. If only the outer cell-layer is white the offspring are green. In either case the particoloured character does not reappear in the offspring. From the sectorial chimæras the inheritance is more complex, and much remains to be cleared up. This discovery of the significance of the subepidermal layer is one of very great importance, and we may anticipate that it will lead to remarkable extensions. It may not improbably lead to a reconsideration of the generally accepted doctrine that segregation takes place in gametogenesis.

Baur has applied these observations to the interpretation of the curious "graft-hybrids" between *Solanum nigrum* and the tomato, first made by Winkler. Some of these were obviously sectorial patchworks of the two species, but Baur suggested that of the others some were actual periclinal chimæras, in which a foundation of tomato was enclosed in one or in two cell-layers of *S. nigrum*, or conversely *S. nigrum* enclosed in an outer sheath of tomato tissue. This conclusion was at first strongly resisted by Winkler, but in a preliminary communication he has since announced the proof that it is correct, having himself by cytological investigation of the growing

points of the periclinal forms been able to prove that some of the layers have the chromosome numbers proper to *S. nigrum*, and others those of *Lycopersicum*. We can scarcely doubt that this remarkable series of observations will pass into the classics of biology.

On similar lines Baur proposes to elucidate the old problem of *Cytisus Adami* and *Crataego-mespilus*, the two traditional examples of "graft-hybrids." The former, for instance, is regarded as a Laburnum enclosed in a sheath of *C. purpureus*. On occasion, as when the exterior is wounded, the Laburnum can come out and develop. Baur's idea is doubtless a part of the truth, but I cannot clearly apply it to all the phenomena which *Adami* presents, especially to the sexual vagaries which it shows in this country at least. In it the *Adami* flowers have good pollen but no good ovules; the *purpureus* flowers have the female parts developed, but the anthers bad; while the *Laburnum* flowers are perfect and set seed in plenty. Nor do I clearly understand the origin of the *purpureus* branches. One can scarcely help suspecting that in the segregation by which these phenomena are produced there is some complex repulsion between the sex-factors and the factors for colour or form, comparable with the distinctions now known to exist between the genetic constitution of pollen and ovules of the same individual in several cases, *e.g.* Stocks and Petunia (Miss Saunders), or Œnothera (de Vries).

The only point in this excellent book which calls for criticism is, in my judgment, the rather crude representation of segregation as effected by chromosomes. These pictures will live in the memory of the reader, and tend to limit his imagination of the possibilities more closely than the known facts at present warrant. W. BATESON.

THE RUSTING OF IRON.

The Corrosion of Iron and Steel. By Dr. J. Newton Friend. Pp. xiv+300. (London: Longmans, Green, and Co., 1911.) Price 6*s.* net.

THE author gives a concise account of all the important work that has been carried out in connection with investigations relating to the causes of corrosion of iron and steel. The book is a model of its kind, since the references to original contributions to knowledge are exhaustive and will serve to direct the investigator to the literature of that branch of the subject in which he is specially interested. After dealing with the action of air, of water and of steam on iron, the various theories which have been advanced to explain corrosion are discussed, and the conclusion is drawn that "the most recent experimental results are entirely in favour of the acid theory of corrosion."

The action of acids and of alkalis, and the influence of solutions of salts of various kinds on iron are next considered, and a short chapter is then devoted to the action of oils on the metal. In dealing with the subject of the passivity of iron the author has failed to make clear the fact that the immersion of the metal in chromic acid must necessarily bring about the removal by oxidation of such impurities as manganese sulphide, which exist on the surface, and form acids on exposure to moist air. The metal by such treatment must in consequence be rendered more resistant to corrosion irrespective of any question of passivity. Nor is attention directed to the fact that the surface of iron immersed in chromic acid must necessarily remain bright whenever the acid is sufficiently concentrated to dissolve any rust which might be formed, and in this connection it may be noted that ferric hydroxide dissolves readily even in dilute solutions of chromic acid. Moreover, H. B. Baker and others have clearly shown that whatever properties are given to iron by immersion in dilute chromic acid immunity from rusting is not one of them, and it is extremely doubtful if previous immersion in chromic acid of any strength is a protection against atmospheric oxidation of iron.

The last three chapters of the book deal respectively with the influence of chemical composition on the corrodibility of iron, with electrical effects and with the relative rate of corrosion of iron and steel. The first of these might with advantage have been considered at an earlier stage—the author states that it is of paramount importance—since an explanation of that troublesome form of corrosion known as pitting in water-tube and other boilers must be sought mainly in the chemical composition of the iron of which they are made. The chapter on electrical action opens with the unfortunate statement that, "as is well known, when an electric current passes through water, the latter is readily split up into its constituent elements, oxygen and hydrogen." This erroneous inclusion of water amongst electrolytes may produce confusion in the minds of some readers, and is greatly to be regretted.

The book is well illustrated throughout, and will appeal to the general reader of scientific literature since it contains matters of interest apart from technical detail. For instance, an account is given of the Iron Pillar of Delhi, dating from 912 B.C., as an example of iron which has for centuries resisted atmospheric attack. There is, however, no record of the very rapid corrosion of the steel pipe line which conveys water from Mundaring to the Kalgoorlie Goldfield in Western Australia, and represents an outlay of upwards of 3,000,000*l.* sterling. Some account of the reports presented to the Government of Western Australia on this matter might with advantage have been cited, and the suggested treatment of the water by deaëration and liming, involving an expenditure for machinery of 187,000*l.*, discussed.

G. T. M.

ASPECTS OF THE EARTH'S STORY.

The Changeful Earth: an Introduction to the Record of the Rocks. (Readable Books in Natural Knowledge.) By Prof. G. A. J. Cole. Pp. x+223. (London: Macmillan and Co., Ltd., 1911.) Price 1*s.* 6*d.*

IT is refreshing to turn from the ordinary text-books of science—useful and necessary as such works undoubtedly are—to a booklet like that now before us. Science manuals in their efforts after inclusion and compression, in order to meet the wants of examination candidates, tend to become dogmatic in their

teachings, and the student is led to rely on the authority of the teacher rather than on any process of reasoning; of such works we must sadly confess "the trail of the examiner is over them all."

But for those who would learn to love geology for itself, Prof. Cole has supplied a charming, and at the same time trustworthy, introduction to the science. He has wisely adopted what may be called "the recapitulation method" of teaching, that is to say, he introduces new facts and ideas in the order and by the reasonings through which they were originally discovered, and by which the present position of the science has been gradually attained; knowledge is made to grow in the individual mind along the same lines as it can be shown to have done, though far more slowly, in the history of our race. It is needless to add that such a mode of presentation must be, to a great extent, biographical.

After some preliminary considerations, the author shows, in the first place, the steps by which William Smith, "the father of English geology," was led to his epoch-making discoveries of a stratigraphical succession, based on the evidence of fossils. Then turning from southern England to the Paris Basin, the labours of Lamarck and Deshayes, of Cuvier and Brongniart are indicated as affording useful aids to Charles Lyell in proving that, in the latest formed geological deposits, life-forms gradually replaced one another, thus lending support to the more general conclusion that the same continuity becomes manifest, as we trace the succession to the remotest past.

In succeeding chapters, the effects of running water, as taught by Hutton, and of moving ice, as shown by Agassiz, are well described, with illustrations drawn from the author's own observations and those of his contemporaries. "The Throat of a Volcano," "The Giant's Causeway," "The Making of Mountains," and "A Year of Earth Storms," are the headings of other chapters of this entertaining and instructive book, in which the labours of the pioneers of research are in all cases described with warm sympathy and just discrimination. The numerous illustrations of the book are, for the most part, from photographs taken by the author, and if any further evidence were needed that his descriptions are based on actual visits to the districts, it will be found in many a picturesque phrase. The hardest working college student, no less than the general reader, will find it an advantage to peruse this bright little book, for he can scarcely fail to catch some sparks of the enthusiasm of the author, which glows on every page.

J. W. J.

BANTU MYSTICISM.

Notes on West African Categories. By R. E. Dennett. Pp. xi+68. (London: Macmillan and Co., Ltd., 1911.) Price 1*s.* net.

IN this small book or enlarged pamphlet, Mr. R. E. Dennett recurs to his theories regarding formulæ, religious categories, and transcendental symbolism which he has believed himself able to trace in the employment of prefixes and word roots, more especially amongst the Bavili, a Congolese tribe of the Loango coast, and also in a lesser degree amongst the Yoruba and Bini peoples of the Niger Delta.

Mr. Dennett cannot fail to write interestingly on any African subject with which he is personally acquainted, since whether one agrees or not with his theories one is certain to find new and true facts in his compilations. But the reviewer is still quite unable to endorse from his own experience the probability that the Bavili (more especially) could have developed such an elaborate mathematical cosmogony and theology as Mr. Dennett places to their credit, and bases on the forms of their prefixes and of their word roots. As happens all too often, to the sorrow of the universal student of Bantu languages, Mr. Dennett has made a study of one particular Bantu dialect and deduces from his study theories which fall to pieces directly one compares that dialect with another of the same group, or one Bantu language with another. He strives to show that in the minds of this particular coast Congo people certain great categories of thought exist. For instance, he would devise a category which should contain four visible and four invisible parts, or another which should range from 0 to 9, and should correspond with certain classes of Bantu prefixes; and again others which correspond with ideas of God, the procreation of the human species, abstract qualities, such as receptivity, originality, order, manner, action, quality, &c.

To anyone who knows the negro as well as the present reviewer may claim to do, much of this appears impossibly fantastic and unreal; and when such theories are based on a misunderstanding (sometimes) of the original form and purport of prefixes in tongues closely related to the Bavili and similar correspondence of word roots, they reduce one to something like despair; for Mr. Dennett, who, as regards his recorded facts, is often so accurate and so helpful to students of Africa, wastes his time and thoughts on prolix theories which seem to be devoid of any scientific foundation. If, as he says in the beginning of his book, he has won over that notable student of the Bantu tongues, Miss Alice Werner, to a belief in, or even a toleration of, his theories given in "At the Back of the Black Man's Mind" and in the present pamphlet, it can only be deeply regretted that both of them should be following a will-o'-the-wisp. This opinion, most regretfully written, does not prevent "Notes on West African Categories" from being a work of considerable interest, and containing many new observations of value which seem to the reviewer perfectly sound as statements of fact.

THE VOICE OF LYELL.

The Student's Lyell: the Principles and Methods of Geology, as applied to the Investigation of the Past History of the Earth and its Inhabitants, with Historical Introduction. Edited by Prof. J. W. Judd, C.B., F.R.S. Second edition, revised and enlarged. Pp. 645. (London: J. Murray, 1911.) Price 7*s.* 6*d.* net.

IT is most fitting that the revision of Lyell's "Students' Elements of Geology" should be again carried out by Prof. J. W. Judd, who brings

to his work such intimate knowledge of Lyell himself, and such broad experience as a geological teacher. Prof. Judd's pupils in many lands will find again in this volume those stimulating memories of Lyell's life and work which they received from their own master in the Royal School of Mines. The "historical introduction" to the present edition, occupying fifty-six pages, is not only a welcome essay on the influence exerted by the doctrine of causes now in action, but also a defence (pp 49–52) of Lyell from the charge of excessive uniformitarianism. Those who have not made themselves acquainted, as Prof. Judd has done, with the extravagant speculations of geological divines and of laymen aspiring to divinity, before the days when the influence of Hutton, von Hoff, and Lyell came to be generally appreciated, can scarcely realise the sense of calm and order that was brought by these authors into a world of controversy. Charles Darwin's admiration for the "Principles of Geology" would alone assure us of Lyell's position as a thinker; and now, in turning the pages of this new issue of his admirable text-book, we are again reminded that here was a man who wrote because, and only because, the spirit moved him.

The refined woodcuts are here that we first knew in 1871. Drawings of such modernities as radiolarian ooze and thin sections of rocks have been introduced, and toothed birds and other American vertebrates are illustrated; but the view of geology remains, in the hands of so sympathetic an editor, essentially that of Lyell in his habit as he lived. We look back into the past from our experience of the present; a pleasant emphasis is laid upon the Tertiary strata throughout Europe; and the work reminds us in so many places of the history of geological thought that it still stands apart from any other text-book.

Supplementary notes have been added (pp. 601 to 610) directing attention to many recent discoveries, and these, in so limited a compass, naturally provide food for thought rather than a complete exposition. We miss a reference to the older glacial epochs; the stratigraphical breaks indicated in the diagram on p. 441 surely exaggerate enormously the imperfection of the European record; and many geologists would like to expand the modest view of contact-metamorphism stated on p. 553. It is easy to comment on details where so wide a range of subjects has been dealt with. The essential feature is that the editor has handed on to us undimmed the lantern lit by Lyell. G. A. J. C.

MODERN KNOWLEDGE HANDBOOKS.

(1) *Polar Exploration.* By Dr. W. S. Bruce. Pp. 256.
(2) *The Evolution of Plants.* By Dr. D. H. Scott, F.R.S. Pp. 256.
(3) *Modern Geography.* By Dr. M. I. Newbigin. Pp. 256.
(Home University Library of Modern Knowledge.) (London: Williams and Norgate, n.d.) Price 1*s.* net each.

THE three volumes the titles of which are given above belong to the Home University Library of Modern Knowledge, published by Messrs. Williams and Norgate under the editorship of Prof. Murray, Mr. Herbert Fisher, and Prof. J. Arthur Thomson. Each is intended to be a concise handbook to the subject with which it deals, and by an acknowledged authority. The object of the series is to place within everyone's reach, at the lowest possible price, authoritative information on any branch of history, science, art, literature, philosophy, or religion with which he desires to become acquainted. Ten volumes will be issued each year. The first on our list, "Polar Exploration," by Dr. Bruce, is what the author has termed a "traveller's sample" of the Arctic and Antarctic warehouses. No one is more competent to present their contents than one who has personally sampled as he has done, more than once, both polar regions, and has besides learned much in regard to them from personal conversations and correspondence during the past twenty years with living polar explorers, including the veteran Sir Joseph Hooker, to whom the volume is dedicated. The personal note predominates, as it needs must, and those parts visited by the author are dealt with in greater detail than those which he has not had an opportunity of visiting. The aspects of the subject dealt with in the present volume are the astronomical features of the polar regions; the ice, both land and sea, its coloration and that of snow; the vegetation, the animal life and the physics of these regions; their meteorology, magnetism, aurora, and tides, with a final chapter on the aims and objects of modern polar exploration. Not the least important addition to the physics of the southern seas made by the Scottish national Antarctic expedition was the discovery of the existence of a long "rise" extending in a curve from Madagascar *via* Bouvet Island, the Sandwich group, the South Orkneys, Graham Land, and the Falklands to South America. "Thus Antarctica, South America, and Madagascar and probably South Africa become connected with one another in a most direct manner by this rise." The volume smacks of a Stevensonian voyage.

(2) "The Evolution of Plants" is a masterly *résumé* of this extremely difficult subject by one of our highest authorities, himself a leading investigator in palæobotany. Dr. Scott's object in this book is to try to trace historically the course which the evolution of plants has actually followed, confining himself to those groups for which the evidence is most satisfactory. The questions here considered are: the evolution of true-flowering plants; that of the seed-plants generally; and, thirdly, that of the great groups of the higher cryptogams, or spore-plants, the ferns, the club mosses, the horsetails and sphenophylls. Dr. Scott's work "needs no bush."

(3) Dr. Marion Newbigin dates the commencement of "modern geography" only from 1859, the year when the celebrated geographers Humboldt and Ritter died and Darwin's "Origin" appeared. The doctrine of evolution has had an enormous effect on geographical science, and its development has been so great that to give a complete survey of the subject would be impossible. Her volume, "Modern Geography," therefore, suggests only some of the

lines along which research is proceeding most actively at the present time, special stress being laid upon those aspects of the subject which are not as yet fully treated in the smaller text-books.

The first four chapters deal with a general survey of the earth's surface, its mountains and ocean depths, the formation of its hills and valleys due to atmospheric agents, running water and ice, and the effects of climate on the distribution of other phenomena on the surface of the globe. In the successive chapters the author describes the three chief zones of vegetation, the Mediterranean scrub land, the temperate forest zone, and the steppe or pasture land, and that as each of these is determined by climate, each again has special types of cultivated plants and domesticated animals.

"It is interesting to note," adds the author, "what cannot be a pure coincidence [and yet may it not be so?], that in Europe three races of men exist, which show a certain rough correspondence to the three zones of vegetation. The Mediterranean type of vegetation and climate is associated" with the Mediterranean race. . . . "The characteristic inhabitants of the temperate forest region of Europe are members of the race called Teutonic or Nordic . . . the steppe and pasture lands . . . tend to be occupied by a third race . . . to which the . . . name of Alpine has been given."

The penultimate chapter is devoted to the races of Europe and their origin, and the last to the distribution of minerals and the localisation of industries and of towns. "Modern Geography" is a suggestive book.

Although the space at our disposal precludes a detailed notice of these volumes, we can warmly and conscientiously recommend them to those interested in the subjects with which they deal. All three are provided with full indexes, and "The Evolution of Plants" has besides an excellent bibliography of the most important works on palæobotany.

OUR BOOK SHELF.

Medical Science of To-day: a Popular Account of the More Recent Developments in Medicine and Surgery. By Dr. Willmott Evans. Pp. 324. (London: Seeley, Service, and Co., Ltd., 1912.) Price 5*s.* net.

THIS is a very delightful book. None of the natural sciences has greater wonders to tell than medical science; none touches more nearly our admiration of good work slowly brought to success. Dr. Willmott Evans is an excellent interpreter; he understands the art of freeing the wonder of the discovery itself from the wrappings of long words put round it by the doctors; he makes the reader feel the intense human significance of the many facts on which the present fabric of medicine and surgery is founded and built; and his book ought to be very widely read and remembered.

Of course, with such an "imperial theme," it was not possible for him to say all that ought to be said. The embarrassment of riches left him only a paragraph or two for methods each deserving a chapter. But he ought to have found room to say more about the tremendous influence of the experimental method in medical science. For instance, his mention of brain-surgery does not do justice to the experimental study of cerebral localisation; and the same fault occurs in his chapter on organo-therapy. And, of course, there are omissions of less importance; thus he speaks of yellow fever without naming Walter Reed, and he describes myxœdema without giving photographs of cases before and after thyroid treatment. He might with advantage have left out the chapters or subchapters on patent medicines, idiosyncrasies, and malingering; the chapters on legal medicine also want thinning.

The one grave defect in the book is the overshadowing of methods by results; he shows us the thing made, not the thing in the making. Still, he has written a book which is excellent reading; he plainly has enjoyed writing it, and it gives a faithful and valuable account of the modern science and art of medicine, surgery, and preventive medicine.

Climatic Control. By L. C. W. Bonacina. Pp. viii+167. (London: A. and C. Black, 1911.) Price 2*s.*

WORKS on climatology and articles in meteorological text-books treating of that subject abound in various forms, but that there is still room for others dealing with different aspects of this important question is shown by the interesting and useful little volume now under review. It is published as one of the series of "Black's School Geography," and, being intended primarily for British students, prominence is given to the climate of this country, but that of other "well-known lands," selected as representative of the various zones and regions, is considered at some length.

In an instructive chapter on the general principles of climatology, the factors which produce variations in different parts of the world—*e.g.* latitude, altitude, prevailing winds, &c.—are separately discussed, and this is followed by chapters (1) on the types of land and the effect of the prime elements of light, heat and moisture, the distribution of vegetation being taken as a rough criterion of the climatic variations; and (2) the influence of climate upon man. The whole of these various aspects are treated in a manner that cannot fail to attract the attention of students, and to induce them to pursue the subject further. The last chapter deals with meteorology and is intended for more advanced students. This chapter, like those preceding it, exhibits an intimate knowledge of the subject, and we regret that it was found necessary, for lack of space, to omit questions relating to atmospheric electricity—*e.g.* thunderstorms, &c.—and to optical phenomena.

The effect of the rotation of the earth on the circulation of the air and on the behaviour of cyclones and anticyclones and many other questions sometimes presenting difficulty to students are clearly explained. A few well-chosen synoptic charts, recently published by the Meteorological Office, are added to explain some of the principal types of weather.

An Introduction to Chemical Theory. By Dr. A. Scott, F.R.S. Second edition. Pp. viii+272. (London: A. and C. Black, 1911.) Price 5*s.* net.

THE first edition of this book was published twenty years ago, just as the "new" physical chemistry was flowing into this country and gaining admission to lecture courses and text-books. It was in a way the last of its race, and it still retains in the new edition a marked mid-Victorian flavour. This is not said in disparagement; indeed, the restraint shown by the author on the more speculative side of theoretical chemistry is a reminder of what in some respects were better days.

The distinction between chemical philosophy, general chemistry, and physical chemistry has become very vague, but Dr. Scott's book may be described as dealing rather with chemical philosophy than physical chemistry, and in that character it has some distinctive features which may give it a place in the

student's armoury. Such, for example, are the two chapters on the classification of compounds.

The treatment throughout is simple and lucid, and there is nothing that is likely to puzzle or mystify a reader. The contents will give him a good, useful store of information relating to the theoretical side of chemistry, though it will be meagre on the topics which have come to the front during the last twenty years, and to which, in a mere revision, it has scarcely been possible to do justice. In some cases the faults pass beyond those of omission, as in the confusion between dissociation and hydrolysis on p. 172, the account of "palladium hydride" on p. 171 and the definition of cryohydrates on p. 255. A. S.

Marvels of the Universe. A Popular Work on the Marvels of the Heavens, the Earth, Plant Life, Animal Life, the Mighty Deep. By various authors. In about twenty-four fortnightly parts. Part i., pp. 48. Part ii., pp. 48. (London: Hutchinson and Co., n.d.) Price 7*d.* net each part.

OF the attractiveness of this serial publication it would be difficult to write too highly. Each part contains four full-page illustrations in colour, remarkable alike for their beauty and accuracy, and a profusion of excellent pictures in black and white, most of which are from photographs.

The contributors are well-qualified authorities on the subjects they have undertaken, and what they have written is appropriate to the work. The selection of topics has been guided entirely by what is likely to arrest the attention of the non-scientific general reader, with the result that instead of an orderly introduction to science, we have a series of short, bright views of some of the wonders of nature, arranged in no logical sequence, but partaking of the character of a scientific scrap-book, using the term to express disjunctiveness rather than depreciation.

Unrelated as the articles are, they may serve a very useful purpose and succeed in attracting readers to the more serious study of some science in which they will be led themselves to observe and record what is happening in the world around them, as well as to take an interest in the explorations of others.

LETTERS TO THE EDITOR.

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

The Scientific Misappropriation of Scientific Terms.

WHILE fully sympathising with Prof. Gregory in his condemnation of the scientific misappropriation of popular terms, and, indeed, objecting to the scientific *appropriation* of such terms where it would be better to employ a universally intelligible technical language, still, it seems to me that even more deserving of condemnation is the misappropriation by one group of scientific workers of the scientific terms used by another group. This procedure is the more objectionable when the two groups of workers are in adjoining fields. It does not greatly hurt anyone that an astronomer should mean by an "asteroid" something quite different from that which a zoologist means; but it does matter when one biologist uses a term in a different sense from another biologist.

Of late years some of us have felt driven to protest against Prof. H. de Vries's use of the term "mutation" in a sense differing in an apparently trivial, yet philosophically important, way from the use of the term by its original inventor—the palæontologist Waagen. Now we find the followers of Prof. de Vries, notably Prof. Johanssen, robbing the systematic biologists of their term "genotype." First proposed by Prof. C. Schuchert in 1897, this term has come into very general use to denote the type-species of a genus. There has been in the past so much confusion between the different senses of the word "type," and this confusion has given rise to so much regrettable confusion of thought, that this latest malappropriation should only need pointing out to be at once stopped. Unfortunately, this simple action has not had the desired effect, and therefore I am impelled to make a protest in your widely read pages. F. A. BATHER.

Wimbledon, November 2.

The Electro-vegetometer.

EXPERIMENTS with electricity as a stimulant to plant growth were made with alleged success 165 years ago, when Mr. Maimbray, of Edinburgh, electrified two myrtles throughout October, 1746, for several hours a day, with the consequence that next summer they blossomed sooner than their neighbours (Priestley's "History of Electricity," part viii., sec. 4).

Shortly after this the Abbé Nollet made similar experiments with electrified seeds in pots, and claimed equally successful results. M. Achard, of Berlin, and other independent observers confirmed the experiments; and the beneficial effect of electrification on plant life was almost an accepted discovery when a Dr. Ingenhousz, after exhaustive experiments, completely refuted all the conclusions hitherto arrived at, and proved that the only effect of electrification was to hinder plant life!

Dr. Carmoy and the Abbé Ormoy later resumed the investigation, and testified to favourable results.

Next the Abbé Berthelon reconciled these divergent conclusions by announcing that electricity in a moderate application was beneficial, but could be applied in excess with harmful results; and he advocated as the safest method the utilisation of atmospheric electricity, which he said rarely rose to a strength injurious to the most delicate plant. He published a suggestion, recently credited by Sir William Ramsay as a new and ingenious theory of Sir Oliver Lodge's, that the pointed leaves of plants acted as conductors of atmospheric electricity, and were an important factor in the prolific vegetation of forests.

The Abbé Berthelon, who utilised both natural and artificial electrification, devised what he called the "electro-vegetometer," which consisted of an insulated series of sharp iron points projecting vertically upwards at a mast-head and connected by chains with similar iron points pointing downwards just over the plants to be experimented on. He states that "the happiest effects were perceived, viz. different plants, herbs, and fruits in greater forwardness than usual, more multiplied, and of better quality."

Until lately all these alleged successes were supposed to have been imaginary; and the question is, Will the recent experiments prove that there was more in the earlier ones than has been supposed, or will the present trials turn out to be, with their predecessors, further examples of myths of science, like the Blondlot rays and Mrs. Somerville's supposed discovery of a magnetising power in solar light? CHARLES E. BENHAM.

Colchester, November 5.

November Meteor-showers.

THE early part of November does not present anything very noteworthy as regards meteoric phenomena, which may be said to begin about November 9, the following being the principal meteor-showers of the month:—

Epoch November 9, 6h. (G.M.T.), first order of magnitude. Principal maximum, November 11, 0h. 30m.; secondary maxima, November 9, 11h. 50m., and November 10, 10h. 40m.

Epoch November 10, 15h. 30m., twenty-second order of magnitude. Principal maximum, November 11, 11h. 30m.; secondary maxima, November 11, 19h. 20m., and November 12, 7h. 40m.

Epoch November 13, 16h., thirtieth order of magnitude. Principal maximum, November 14, 22h. 50m.; secondary maxima, November 15, 9h. 30m., and November 16, 13h. 15m. and 17h. 30m.

Epoch November 16, 10h., thirteenth order of magnitude. Principal maximum, November 15, 21h. 10m.; secondary maximum, November 15, 7h. 15m.

Epoch November 17, 3h. 30m., tenth order of magnitude. Principal maximum, November 17, 17h. 25m.; secondary maxima, November 17, 23h. 30m., and November 18, 5h. 5m.

Epoch November 17, 15h. 30m., approximately sixth order of magnitude. Principal maximum, November 19, 12h. 55m.; secondary maxima, November 18, 15h. 15m., and November 19, 22h. 10m.

Epoch November 24, 2h. 30m., approximately fourth order of magnitude. Principal maximum, November 23, 5h. 30m.; secondary maxima, November 22, 15h. 20m. and 18h. 20m.

Epoch November 25, 4h. 40m., eighteenth order of magnitude. Principal maximum, November 24, 2h. 35m.; secondary maxima, November 24, 12h. 40m. and 23h. 10m.

It is significant that, of the eight principal epochs of the month, no fewer than six fall due during the period of November 9–20. This, therefore, is the part of the month richest in meteoric events. The two remaining epochs of November 24–25, though nominally strong, do not rank in importance with the foregoing six.

Of these six there are three that call for special mention. The first, commencing on November 9, has the highest meteoric intensity of the month; but the epoch of November 17, 3h. 30m., may prove to be the most interesting, as it bears a certain resemblance to the epoch of November 15, 1905, and in the writer's opinion is liable to be associated with auroral phenomena. The small intermediate epoch of November 13, 16h., is the only one that places maxima between 12h. and 18h. on any of the three nights November 14–16, two of its secondary maxima becoming due between these hours on the night of November 16. The general Leonid maximum will therefore probably be best observed on the night of November 16, but late members of this well-known star shower are likely to be strongly in evidence also on the following night.

JOHN R. HENRY.

2 Belgrave Villas, Rathmines, Dublin, November 6.

Tick (Ixodoidea) Generic Names to be included in the "Official List of Zoological Names."

(1) THE international committee invited by the secretary of the International Commission on Zoological Nomenclature to make a detailed study of the nomenclature of ticks (Ixodoidea), and consisting of the following specialists in this group, W. Dönitz (Berlin), Albert Hassall (Washington), L. G. Neumann (Toulouse), G. H. F. Nuttall (Cambridge), and Cecil Warburton (London), has submitted its first report.

(2) Said committee unanimously agrees that the following eight generic names are the correct names for the genera in question, and that the correct genotypes, according to the international rules of zoological nomenclature, are the species cited:—

Amblyomma Koch, 1844a, 223–231, type *cajennense* Fabricius, 1787.

Argas Latreille, 1796a, 178, type *reflexus* Fabricius, 1794.

Dermacentor Koch, 1844a, 235–237, type *reticulatus* Fabricius, 1794.

Haemaphysalis Koch, 1844a, 237, type *concinna* Koch.

Hyalomma Koch, 1844a, 220–223, type *aegyptium* Linnæus.

Ixodes Latreille, 1796a, 179, type *ricinus* Linnæus.

Rhipicentor Nuttall and Warburton, 1908, 398, type *bicornis* Nuttall and Warburton.

Rhipicephalus Koch, 1844a, 238, 239, type *sanguineus* Latreille.

(3) Notice is hereby given that the undersigned will wait until May 1, 1912, for any zoologist to raise any objection to any part of the report of the special committee. If no valid point is raised by the date mentioned, the undersigned will transmit the list to the International Commission with the motion that these names be incorporated in the "Official List of Zoological Names" provided for by the last International Zoological Congress.

All correspondence on this subject should be directed to

C. W. STILES.
(Secretary International Commission on Zoological Nomenclature.)

Hygienic Laboratory, Washington, D.C., October 30.

Localising Minute Leaks in Vacuum Apparatus.

IN view of the fact that in many branches of physical research there has arisen of late years the necessity for complicated apparatus to be kept at a high state of exhaustion, it may interest your readers to hear of a simple method of localising minute leaks.

In the case of leaks in "all glass" apparatus, I have for many years used with success Goldstein's spark method. This consists in disconnecting the kathode lead from the apparatus, putting in a small alternate spark-gap, and exploring over the suspected joints with the loose lead until a brilliant discharge to the inside of the apparatus indicates the position of the leak. The objections to this method are that if parts of the glass are very thin a hole may be made where none previously existed; it obviously cannot be used near a terminal, or at all with a "wax" joint.

An apparatus of mine involving seven distinct and complex sealing-wax joints recently developed a microscopic leak of about 1/100 mm. per hour. Being faced with the alternative of pulling the whole apparatus down and remaking every joint, it occurred to me that the extremely sensitive nature of the discharge in air to change its colour when in the presence of carbon compounds (it is, in fact, by the change from the grey of CO to the crimson of N that leaks are generally first seen) might be used with advantage. I therefore wiped each joint over with a small pad of cotton-wool soaked in petrol, keeping the discharge going meanwhile, and the instant the real offender was reached—a "metal-wax-glass" joint in this case—the discharge turned abruptly from red to blue. The method seems extraordinarily delicate, and should be applicable to all cases of air leak so long as the latter is not so large as to prevent the discharge passing.

F. W. ASTON.

Cavendish Laboratory, Cambridge, October 31.

Multiple Rainbows.

ON Tuesday morning last, October 31, a succession of rainbows of extraordinary brilliance was visible here. The most brilliant appeared at 8.45 a.m., and lasted about five minutes.

The sun was shining brilliantly, and the atmosphere to the east was remarkably clear, while the rain-storms came up from the Bristol Channel, eight miles to the west. At 8.45 a.m. six rainbows were visible, *three* inside the main bow and very close to it, the colours being in the same order as those on the main bow, and two outside, the colours of the first being in reversed order, while the second was faint, and nearly white. Four of the rainbows were quite perfect, but the innermost of the three internal bows was partly broken, only three-quarters being visible. About one-third of the extreme outer bow was visible.

E. NEWBERY.

Sidcot School, Winscombe, Somerset, November 6.

Dangerous Mixtures.

I SHOULD like to direct attention to the dangerous nature of a mixture consisting of magnesium powder and silver nitrate.

When a small quantity (2 to 3 grams) of magnesium powder is mixed with an equal bulk of powdered silver nitrate in a metal dish, and then from the end of a long glass rod a drop of water is allowed to fall on the mixture, a slight explosion occurs, accompanied by a vivid flash.

The unexpected violence of this reaction led to serious burns in my own case.

Mercuric nitrate when substituted for silver nitrate also reacts vigorously with magnesium powder under the same conditions, brown fumes, but no flash, being produced. With barium nitrate the action is slight, heating only appearing to take place.

HAROLD CALAM.

The University, Leeds, October 27.

THE SOLAR PHYSICS OBSERVATORY.

IN last week's NATURE we gave the terms of reference of the departmental committee appointed to consider alternative schemes for transferring this observatory to Fosterdown (Caterham) or to Cambridge.

We are informed that the Treasury has forwarded the report of the committee on this subject to Cambridge, and that it is being considered there; so far we believe no communication has been made to the Solar Physics Committee, the body appointed more than twenty years ago to advise the Government in such matters.

We may summarise now the action taken by the committee and the Board of Education as already recorded in NATURE during the last five years.

(1) In 1906 the Board informed the committee that the land on which the Observatory is situate was required for the Science Museum, and requested them to make inquiries regarding a new site.

(2) The committee formulated the conditions to be fulfilled, and, after inspection of all available Government land in 1907, fixed upon Fosterdown as fully satisfying all the conditions.

(3) The Treasury, in full knowledge of this, proposed Cambridge as an alternative site, although it fulfilled none of the required conditions.

(4) The committee pointed out that this raised questions concerning administration, &c., and asked for more information, and suggested a committee to obtain it, consisting of representatives of the Treasury, the Board of Education, the Solar Physics Observatory, and the Meteorological Office, to consider fully the question of the alternative sites in all its bearing.

(5) Without any communication with the committee, the Treasury requested the War Office to sell the Fosterdown site.

(6) As a result of a memorial to the Prime Minister this proceeding was at once stopped.

(7) The Treasury, thus compelled to hold an inquiry, instead of such a body as that suggested by the committee, with knowledge of the work done in the Solar Physics Observatory and the questions of administration involved, appointed a committee consisting of three fellows of a Cambridge college and the holder of an honorary degree of the University.

(8) The majority of this committee has selected Cambridge as the future site for the observatory.

THE SITES CONTRASTED.

Up to the present time the actual conditions of the two sites as observing stations have not been published, so some trouble has been taken to prepare maps to indicate their relative efficiency.

To illustrate this the accompanying two charts are here reproduced, the first (Fig. 1) representing the Cambridge site and its neighbourhood, and the second (Fig. 2) that at Fosterdown. A study of these two charts will at once demonstrate the respective values of the positions for an observatory to be erected *for all time*.

It is well recognised that the best observations of the sun are made soon after the sun has risen, so that it is essential that the eastern horizon as seen from the observatory should be open and free from a smoky atmosphere. In the plans, lines showing the directions of the sun at sunrise at both the summer and winter solstices have been indicated in order to point out the kind of country (town or fields) over which these observations in the east should be made.

The following comparisons show how the conditions laid down by the Solar Physics Committee are fulfilled or the reverse by the two sites in question :—

"The observatory should be at an elevation of not less than 250 feet, if practicable."

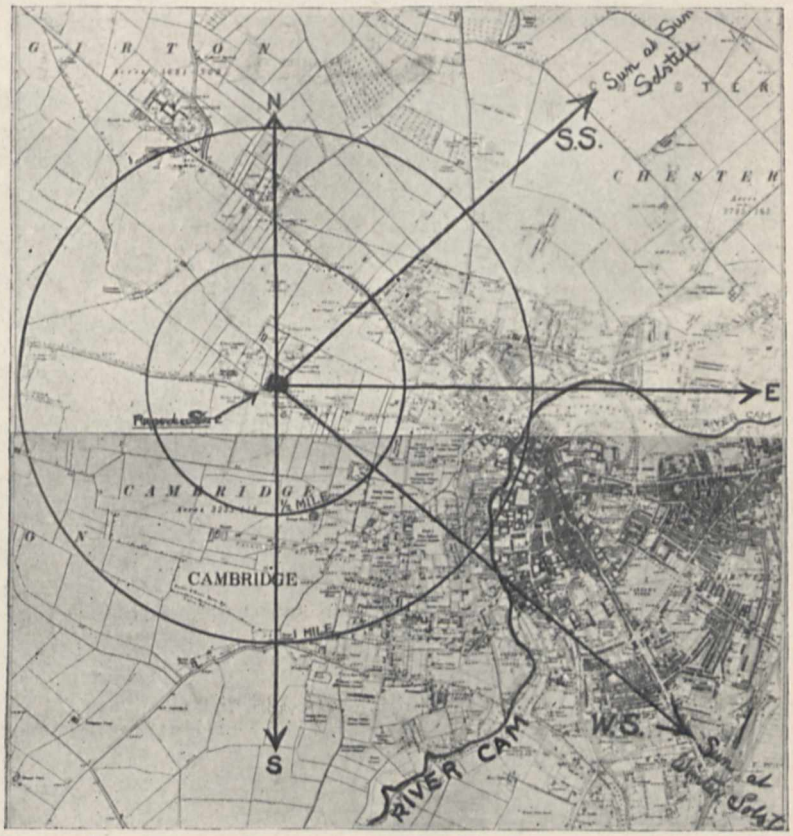


FIG. 1.—Cambridge. The selected site, 70 feet above sea-level, is at the centre of the half-mile and mile circles, and lies 45 feet above the river flats to the eastward. The lines SS and WS represent the directions of sunrise at the summer and winter solstices respectively. Solar observations, which have to be made soon after sunrise, must therefore be made through smoky and misty atmosphere due to the town and river valley respectively.

Cambridge.—75 feet.

Fosterdown.—800 feet.

"In any case it should not be in a smoke area."

Cambridge.—Near a smoke area, namely, the town of Cambridge, and this lies to the east and south-east of the site, and is extending westwards, *i.e.* in the direction of the observatory.

Fosterdown.—No smoke area.

"It should be away from river valley mists and not upon a clay soil (chalk or gravel would be quite satisfactory)."

Cambridge.—River mists and flooded areas by the River Cam—to the east and south-east of the site.

Fosterdown.—No river near the site.

"In the configuration of the ground the important considerations are that the site should not be exposed

to violent winds, and that it should afford as clear horizon as possible, especially to east, south, and west."

Cambridge.—The extension of Cambridge in the direction of the site is increasing, and there is no *natural* guarantee to prevent buildings (which mean smoke) from being erected on any of the sides of the observatory site.

Fosterdown.—The configuration of the site is such that the horizons will be open and clear *for all time.*

It may be further stated that while at Cambridge a main road passes close to the site of the observatory and traffic along it even now shakes the ground, at Fosterdown no such road can be constructed, and therefore no such earth tremors need be feared.

It will therefore be seen that for the work's sake it would be much better to place the observatory in the best position at once, even if it may cost a few hundred pounds more, than to locate it at Cambridge,

At the same time that this report was presented to both Houses of Parliament the third report of the committee appointed to advise the Government on this matter, called the Solar Physics Committee, was also presented. This covers the period 1889–1909 (two previous reports presented in 1882 and 1889 dealt with the period from 1879, when the observatory was founded by the Government).

A perusal of this report enables us to see what work has been done in the past. The report of the departmental committee deals with proposals for its future.

The situation is as follows :—

A Government observatory, more than thirty years old, has to be moved from its present position because the land is wanted for the buildings of the new Science Museum.

When the question of the change of site of the observatory was first brought up a thorough investigation was made by the Solar Physics Committee. They formulated the conditions which had to be secured, and proceeded to search for a suitable site. The conditions which they laid down are given in the departmental committee's report (p. 4)—roughly, the site should be as high as possible to

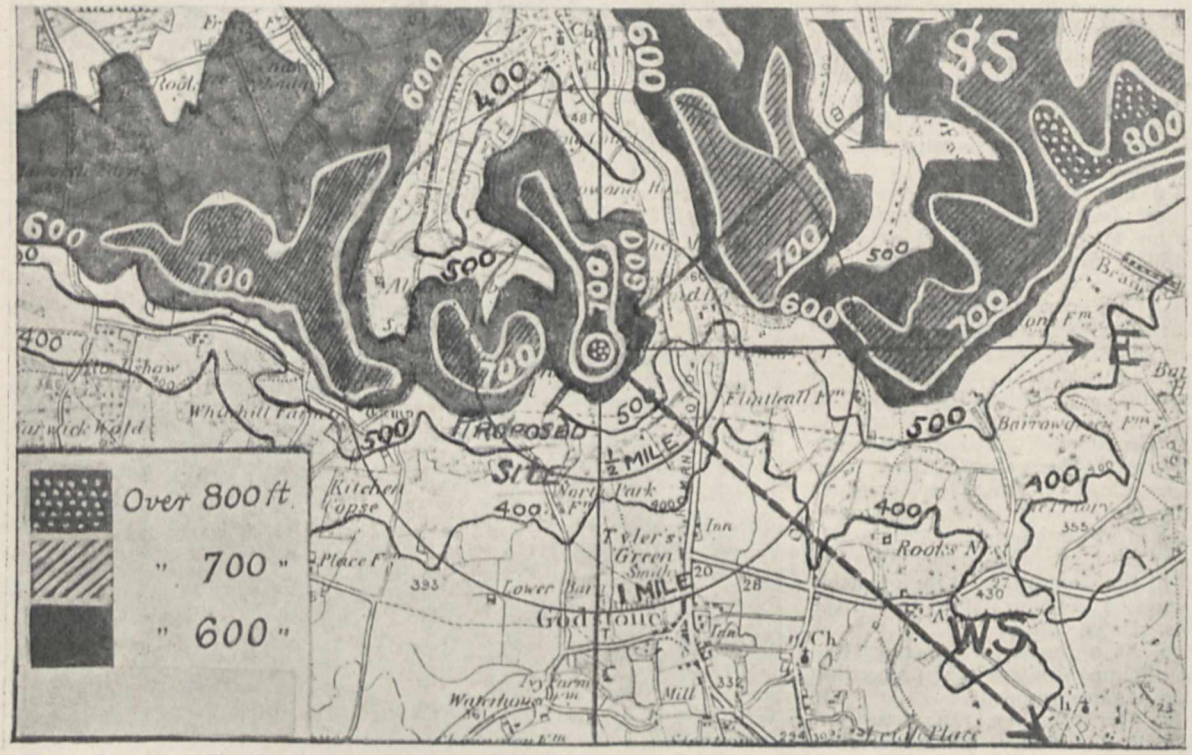


FIG. 2.—Fosterdown. The selected site, 800 feet above sea-level, is at the centre of the half-mile and mile circles, and lies 100 feet above all the neighbouring country with the exception of the small 800-foot area to the north of east, which is on the same level as the site. The lines SS and WS are the directions of sunrise at the summer and winter solstices. The figure shows the open and clear nature of the horizon in all directions.

where at the present time the observing conditions are not good; where year by year they will be getting worse; and where in a short period they will become intolerable for similar reasons which make the present site at Kensington undesirable. The cost of such a removal from Cambridge would entail an additional and unnecessary expense.

"THE TIMES" ON THE SITUATION.

We gave last week two articles from the daily Press—*The Morning Post* and *The Daily Graphic*—giving views as to the committee's report. We now add a letter which appeared in Tuesday's *Times* from an occasional correspondent :—

In your issue of October 27 you published the recommendations of the departmental committee on the Solar Physics Observatory.

secure the least thickness and disturbance of air, and a clear horizon, especially to the east, south, and west; no town smoke or glare at night; proximity to London to facilitate communication with libraries, societies, and men of science.

In choosing a site for a future observatory it was natural that the position should be so selected that in years to come the observing conditions would not be hampered or rendered less efficient by changes in the close surrounding area. When the Solar Physics Committee selected the Fosterdown site they evidently kept this condition well in mind, for an examination of it shows that it is practically impossible for any buildings or roads to be constructed in any direction which will take away from the present efficient observing conditions. Thus the site will probably be as good in 100 years' time as it is now.

Some time ago the Solar Physics Committee was informed that Cambridge had been proposed as an alternative site; the committee hesitated to accept this, pointed out

the necessity for further inquiry, and suggested an inter-departmental committee on which the Treasury, the Board of Education, the Solar Physics Observatory, and the Meteorological Office should be represented.

The committee actually appointed consisted of three persons who are or have been fellows of Trinity College, with the addition of a distinguished honorary graduate of the University of Cambridge. In the terms of reference a condition is assumed that the sum spent in the future upkeep at either place should be approximately the same as that now expended in the present observatory.

Out of the three scientific members of this committee, two, the Astronomer Royal and Dr. Schuster, agreed that the Cambridge site should be preferred, while one, Dr. Glazebrook, the director of the National Physical Laboratory, dissented.

In making a very careful examination of the report of the departmental committee, together with the evidence and appendices, it is really a matter of great difficulty to understand, in the face of the evidence offered, how Messrs. Dyson and Schuster arrived at their conclusion.

The question of site may first be dealt with. The superiority of the Fosterdown site is frankly acknowledged, and evidence is given that some of the present disadvantageous conditions at Cambridge may be much worse in the future. There is no guarantee that the land surrounding the proposed Cambridge site will not be built on, that tram-cars and other heavy traffic will not run along the main road which bounds it. In short, there is no guarantee that this part of the outskirts of Cambridge will not in the near future be an important suburb of Cambridge.

One of the greatest objections to Cambridge is touched on in cavalier fashion. Cambridge, like London, is lighted by electricity; and one of the points in favour of Fosterdown was that town glare at night would be abolished, and that long-exposure photography on the spectra of stars and nebulæ, which is carried on under bad conditions at present at South Kensington, would be rendered more fruitful of results.

As we learn from the solar physics report, this work requires at present the attendance of three assistants on every fine night.

Q. 169.—Is there any interference owing to the town light at the observatory in Cambridge?

Answer.—I do not think anything that would affect solar observations—

is all we can find on this point; and it does not suggest that we are likely to have a continuance of the study of the detailed chemistry of stellar spectra which for many years past has formed part of the routine work of the Solar Physics Observatory, and is not done elsewhere. Town glare naturally does not affect solar observations, because the sun can be observed only by day, while the town is lit only by night. But it does very seriously affect the astrophysical work of the Solar Physics Observatory, which can be carried on only at night. If it is really intended to put an end to a unique investigation of stellar chemistry and physics, the question ought surely to be debated on its merits, and not simply hustled out of sight. There is reason to fear that this is the intention, not only because of the non-recognition of anything beyond solar observation, but also because it is to be gathered from the representative who gave evidence for Cambridge that in the Cambridge view it is not simply a question of transferring the observatory, but of dismissing its staff and putting an end to it as it exists.

Of the ten members of the staff, from Sir Norman Lockyer downwards, not more than two are to be employed (Q. 222), and even none of the existing staff may be of the right "calibre" (Q. 139).

The departmental committee apparently does not accept this (Report, Section 15).

It is understood that the Government desires to relieve itself of the direct control of the Solar Physics Observatory, but that at the same time it acknowledges the value of the work done by that observatory by its willingness to continue the grant at present made for its maintenance. The inducement offered by Cambridge University to transfer control to its hands is that the University undertakes to provide a suitable building for the work, which involves no very serious expenditure. If public money to the amount of 3000*l.* a year is to be handed over to the University on account of certain specified work, then security should be taken that the public shall get value for its money, and that the specified work shall be efficiently carried on. Otherwise the transaction will merely amount to giving the University 3000*l.* a year to spend as it pleases in return for the erection of a building worth 200*l.* or 250*l.* a year.

Now in order that the work shall be carried on efficiently—that is to say, the astrophysical work, which, in spite of its title, is the speciality of the Solar Physics Observatory—it is not enough that a suitable building should be erected, even though it be manned by persons of the "right calibre." It is also necessary that the suitable building should be upon a suitable site, and the only suitable site for an observatory obviously is a site permitting its work of observation and record to be performed in the best conditions attainable. It will not be seriously argued by any responsible person that Cambridge offers the best attainable site for carrying on the astrophysical work of the Solar Physics Observatory. That work involves long exposures of sensitive plates to the light of particular stars. It is necessary that the star should be followed with the utmost accuracy in its diurnal motion, and it is obvious that vibration of the instruments due to heavy traffic in the vicinity cannot conduce to sharpness of definition. If the star has to be photographed through the illuminated haze that hangs over every well-lighted town, another serious difficulty is thrown in the way of the observer, and when spectrographic complications are added the difficulties become indefinitely more formidable.

Thus, while it may be right that the Government should rid itself of direct control of the Solar Physics Observatory, and while it may be right that Cambridge University should assume control, it cannot be right that the University should erect the observatory in Cambridge. For Cambridge is shown by the departmental committee itself to be a bad observing station for this particular work, and to be very likely to become progressively worse. A site can easily be found free from the objections that attach to Cambridge; and if astrophysical work is to be carried on at all with public money, the public have a right to demand that such a site shall be chosen. In placing the observatory at a distance from the University, Cambridge would only be following the practice of other universities, such as those of California and Chicago, which prosecute analogous researches upon the principle that observatories must be placed where the things to be observed can be best observed.

THE ENCYCLOPÆDIA OF SPORT.[1]

AS the third volume commences with hunting and concludes with racing, while it also comprises articles on lawn tennis and polo, it will be obvious that a large portion of its contents does not come within the purview of a journal like NATURE. Nevertheless, there are numerous articles connected with natural history which call for brief mention. As a whole, these articles have been brought well up to date, although in some instances there is a certain amount of repetition, and occasionally discrepancies, when two writers treat of the same subject from different points of view. The illustrations are numerous, and for the most part good (as will be evident from the one here reproduced), but the accompanying legends are in some instances not so full as is desirable. On page 85, for instance, a doe and kid are simply lettered Himalayan Ibex, while there is no indication to show whether the "Caucasian Ibex," figured on the next page, is an example of the western or eastern tur. Misprints seem to be few, although the specific name of the mule-deer is given as *nemionus* in place of *hemionus*, while its alternative

[1] "The Encyclopædia of Sport and Games." Edited by the Earl of Suffolk and Berkshire. Vol. iii., Hunting—Racing. Pp. viii + 448. Vol. iv., Rackets to Zebra. Pp. viii+471. (London: W. Heinemann, 1911.) Price 10*s.* 6*d.* net; abroad 12*s.* 6*d.* net.

generic name, Cariacus, is printed with a small initial letter.

The most valuable of the natural history articles, in our opinion, is the one by Mr. Rothschild on pheasants, in which the number of species of the typical genus Phasianus is reduced from about thirty-five to half a dozen, all the forms allied to *colchicus* being regarded as local races or colour-phases of that species. As these will all interbreed and propagate fertile offspring, the new classification is far preferable to the old. In this connection it may be noted that the author of the article on partridges refers to the red-legged *Caccabis rufa* as a "variety," instead of a species. It is high time that all sportsmen who attempt to write on natural history subjects should make themselves acquainted with the respective significations of the terms species, race, and variety. Before leaving birds, reference may be made to a statement that the smooth surface of the shells of the eggs of North African ostriches is probably brought about by grinding and polishing on the part of the Arabs from whom they are generally procured. It has, however, been pointed out in *The Field* that eggs of North African ostriches laid at Woburn and Tring prove the smooth surface to be natural.

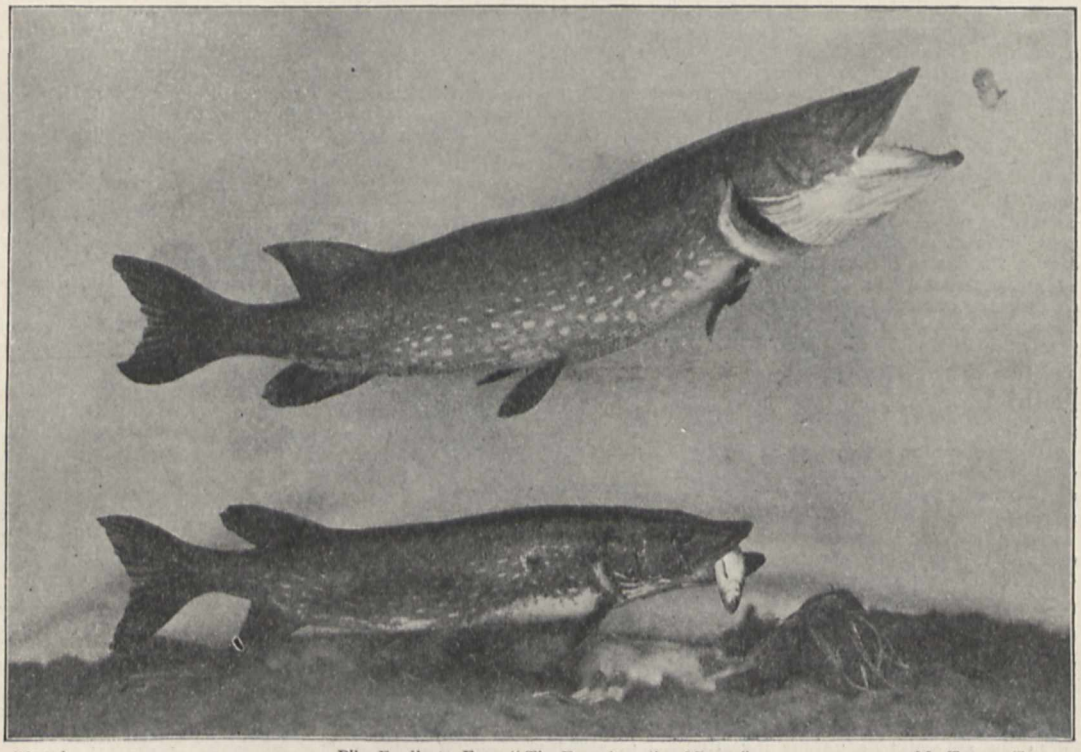
Many of the articles on big game are by Mr. H. A. Bryden, who always writes in a picturesque, if not strictly accurate, style. His worst blunder occurs under the heading Okapi, where it is stated that this animal "may be looked upon as a connecting-link between the giraffe and the antelope, having marked characteristics common to both races." If the okapi is nearly related to any family (not "race") of ruminants other than the giraffe group, it is to the deer, and not the antelopes, the alleged resemblance in bodily form to certain members of the latter group being a feature utterly devoid of systematic value.

Mr. Roosevelt communicates articles in both the third and fourth volumes on American game animals, such as peccari, prairie-chicken, pronghorn, puma, and turkey, all of which are admirable from the sportsman's point of view, although they do not enter deeply into the natural history of the subject.

From Mr R. B. Marston's excellent article on pike and pike-fishing in vol. iii. we reproduce a striking illustration of a pike feeding, other photographs in the fourth volume showing the mode in which salmon take their prey.

Among the zoological articles in vol. iv., it may be noted that the one on red deer appears in much the same form as in the original edition, the Manchurian *Cervus xanthopygus* being still affiliated to the European species instead of to the wapiti, while the Sikhim *C. affinis* is erroneously stated to come close to the latter. The rhinoceros articles, on the other hand, have been well revised, and do full justice to the discovery of the white species in the heart of equatorial Africa. In the article on the rook, Mr. Harting expresses himself as being fully convinced of the value of these birds to the farmer; and the same authority is responsible for the articles on snipe and woodcock, which appear well up to date. Sir Henry Pottinger's article on rype, or ryper (ptarmigan), illustrated (like several of the other bird-articles in this volume) by one of Mr. Thorburn's exquisite paintings, is just what might be expected from such an experienced sportsman, and the same may be said with regard to Sir Herbert Maxwell's account of the salmon. Finally, it may be mentioned that although the author of the article on trout conceals his identity under the pseudonym of "John Bickerdyke," it is satisfactory to find that his view as to the specific unity of all forms of trout is in accord with that adopted by Mr. C. T. Regan in his new book on British fishes.

Without expressing any definite opinion as to the



Photo] Pike Feeding. From "The Encyclopædia of Sport." [*J. Turner-Turner.*

purely sporting articles, we may confidently state that, in spite of a certain number of errors and shortcomings, like those mentioned above, the "Encyclopædia of Sport" supplies in the main exactly the kind of information on natural history subjects the sportsman is likely to require. R. L.

THE PROPAGATION OF EARTHQUAKE WAVES.[1]

"DOS PALABRAS," or "two little words," has a much more friendly sound than the abrupt word "preface." "Preface," standing by itself, is suggestive of a snappy military command, something like "halt" or "quick march," whilst "Dos Palabras" is the kindly invitation of a writer to the public, asking them to read his work. In the "Dos Palabras" we are told that the ordinary person only thinks about earthquake prediction and that which is utilitarian, whilst the principal object of the seismologist is to extend human knowledge about the interior of our planet.

This memoir, which was presented to the American International Congress of Science held in Buenos Ayres in 1910, although dealing especially with the propagation of earthquake waves, gives in an introduction of forty-two pages a rapid review of many problems with which modern seismology deals. From the velocity with which earthquake waves are propagated through our world, we have already learned something new about the constitution of its interior. The conclusions arrived at by these velocities as bearing upon the rigidity of our world, together with investigations made by Lord Kelvin and others on the same subject, are briefly mentioned. References are made to the investigations of Prof. Ricco which indicate a relationship between the value of gravity and the seismic and volcanic phenomena of a district. But the more general relationship between the abnormal movements of magnetic needles, earthquake disturbances, and the value of g in localities characterised by the presence of volcanic rocks, has been overlooked.

Sunspots, unusual movements in bodies of water, the times at which geysers erupt, barisal guns, microphonic disturbances, abnormal earth currents and other phenomena, are pointed to as subjects which should arrest the attention.

Unexpected side issues in the daily work of a seismologist—as, for example, the effect of tidal load, the transpiration of vegetation, which is always wrinkling the face of our globe, the emotional effects produced by earthquakes upon man, their effects on the behaviour of certain animals, and the exploitation of many other byways—have been overlooked. These, however, have nothing to do with Dr. Negri's chief subject, which occupies the next seventy-three pages of his publication. This entirely deals with the velocity with which earthquake motion is propagated. He starts out with the assumption that in a teleseismic record we frequently see many phases, P_1, P_2, &c., and that there are as many corresponding velocities which are distinguished as V_1, V_2, &c. He derived this idea from the publications of Dr. Ōmori. With this assumption V_1 has a velocity of about 12·5 kilometres per second, V_8 would be about 2 kilometres per second, and V_{20}, if there is such a value, would be less than 0·5 per second, *i.e.* if all these phases of earthquake motion started from an origin at the same time. We fear that many seismologists will not readily accept this hypothesis, and to explain the rising and falling in amplitude and changes in period exhibited in teleseismic writings will require some other assumption. P_1, P_2, P_3, and their corresponding velocities, are explicable by the existence of three types of waves, but the lengthening of the caudal appendage of a megaseism as it travels into and sometimes beyond its quadrantal region is a phenomenon about which many explanations have been offered, but the one to be accepted does not appear so far to have been decided on.

In his conclusion to this section, Dr. Negri says that the relation of $\frac{V_1}{V_2}$, $\frac{V_1}{V_{31}}$ (*sic*), $\frac{V_1}{V_5}$, &c., represents a series in increasing arithmetical progression. All that the majority of seismologists at present recognise is that in round numbers V_1 equals 12 kilometres, V_2 equals about 6 kilometres, and V_3 about 3 kilometres per second, and we fear that they are not yet in a position to accept values which might correspond to P_{20} or P_{40}. In an appendix the author shows that his acquaintance with modern seismology is rather one-sided. He gives a bibliography of 176 books and papers, nearly all of which are in the Italian or Spanish language. Japan is credited with thirteen papers, England with five, whilst two or three are in French. The first exhibition of seismological instruments, we are told, was represented by a section in the International Exhibition of 1900 in Paris. The exceedingly popular exhibition of earthquake instruments held in Tokio twenty years earlier is not even mentioned. The author concludes his memoir by two queries: Why do not all the students of seismology in South America combine? Why does not the national authority do something to bring about this union, which would be for the good and progress of science in general? It is my prophecy, says Dr. Negri, that these desires will very soon become realised. JOHN MILNE.

[1] "Velocidad de Propagición de las Ondas Sismicas." By Dr. G. Negri. Traducción de Alfredo Torcelli. Pp. 143. (La Plata: Observatoria Astromomico, 1911.)

PROF. GEORGE CHRYSTAL.

THE lamented death of Prof. George Chrystal, of Edinburgh University, removes an outstanding personality in academic and educational circles. Aberdeen and Cambridge claim him as a distinguished alumnus. In 1875 he was bracketed with Prof. Burnside as Second Wrangler and First Smith's Prizeman. Even then he showed his leaning towards applied rather than pure mathematics; for Prof. Tait, who was one of the examiners, used to say that Chrystal excelled all the others in the way in which he solved physical problems.

After two years as professor of mathematics in St. Andrews University, Prof. Chrystal in November, 1879, began his life's work as occupier of the like chair in Edinburgh. The nature of his work compelled him to give his best mind to the teaching of mathematics and the training of the mathematical teacher. In those days every student of arts had to graduate in the same seven subjects. There were no options. Even the comparatively mild problem-solving mathematics of the old school, of which Kelland had been a shining light, had made many a man of classical and philosophical attainments tremble as he entered the examination hall and sat down to tackle the algebra or the Euclidean geometry paper. But the first year of Chrystal's professoriate struck terror to their hearts. Keen, rapid, logical, full of suggestions as to higher fields of mathematical delights, Chrystal transformed the whole atmosphere of the class-room. Eagerly the mathematical minds followed his fascinating lead; despondingly and despairingly those not so gifted fell hopelessly behind, faintly perceiving, if at all, the finely knit sequence

of ideas which formed the thread of his discussions. These, sad at heart, thought simply of their degree, and wondered how they were going to surmount the mathematical barrier. Chrystal had far other conceptions in his mind; but with all his strenuous and successful labours to raise the standard of mathematical teaching he was essentially just, and knew well that minds of the highest quality are not always able to appreciate the convergency of series or the mysteries of probabilities. When the time for testing came, the really intelligent, hard-working student got full credit for his limited mathematical powers.

It was a great pleasure to see in these early days the enthusiasm of the mathematical students, for whose sakes Chrystal never spared himself. The "coaches," all alive to the necessities of the situation, quickly got hold of the methods; and as the graduates passed out into the schools they carried with them the mind of their master. To Chrystal, more than to any other, the great development of mathematical teaching in the schools may be traced.

From the first, as Tait never failed to remind us, Chrystal's was essentially a physical mind. As a Cambridge undergraduate he had—as some thought—"wasted" his time with Maxwell in the Cavendish Laboratory, fiddling with wires, when he should have been practising the writing out of problems. His careful investigation into the truth of Ohm's law is a standard piece of work showing clear perceptions and careful manipulation. The articles on "Electricity" and "Magnetism" in the ninth edition of the "Encyclopædia Britannica" contain in a wonderfully small compass the very best up-to-date account of these sciences, both theoretical and experimental, ever put together. Had they been printed in book form a few years after their first publication they would have been the *vade mecum* of the advanced student. Their merits are a clear, flowing, forceful style, and a remarkable discrimination in selecting material. The great advances of the last twenty years have been along the lines clearly indicated in these articles. On coming to Edinburgh, Chrystal, though he gave his principal attention to his real class work, did not allow his physical work to fall behind. There was no summer session in those days; and the summer months which most other professors spent in holiday were spent by Chrystal in Tait's laboratory. Here he brought to full fruition his theory of the differential telephone. His paper on the subject is published in the Transactions of the Royal Society of Edinburgh, and constitutes the first truly scientific discussion of the action of the induction-balance.

Outside his own particular experimental work, Chrystal was an ever-present source of inspiration to the students. Several of the investigations which were carried through in Tait's laboratory during the early 'eighties were suggested by Chrystal, who really acted the part of a second professor of natural philosophy. With the increasing care of his own department, he was compelled after a few years to give up his experimenting. Another reason, as he once expressed it, was that he found he was usurping the use of all the best instruments in the place, so that the students were not able to get their best work done.

The personality of Prof. Chrystal soon made itself felt on board and senate. He was elected a vice-president of the Royal Society of Edinburgh in 1887, at the unusually early age of thirty-six. For two terms of six years he filled the same important post, and, in 1901, on Prof. Tait's death, he was chosen general secretary. The duties of this office he performed in a manner which it is impossible to praise too highly. Only a man of Chrystal's alertness of mind, clearness of vision, knowledge of affairs, fair-mindedness, and yet determination to have the society's rights recognised, could have successfully manœuvred the society through the time of strain when its status and efficiency were threatened. The Scottish members of Parliament stood loyally by the society, and by their sympathy more was achieved than was at first hoped for. Through all the cross-currents of opinion, it was Chrystal who was the real steersman. The present habitation of the Royal Society of Edinburgh is a lasting monument to the memory of its general secretary, who secured from the Government of the day a generous recognition of the claims of science.

The same keen personality combined with business faculties of a high order made Chrystal the right man in the right place, when in 1891 his colleagues elected him the dean of the faculty of arts. The new ordinances which came into effect at that time were soon found to be hampering and unworkable in the interests both of teacher and pupil. Strenuously Chrystal applied himself to the reorganisation of the whole arts curriculum, and the reward of his labours he lived to see in the sanctioning of a new ordinance which grants autonomy to each university within reasonable limits.

To these administrative duties he added for some years the chairmanship of the Provincial Committee for the Training of Teachers. He was, in fact, the first chairman, and probably did more than any other single man to mould this committee into a serviceable administrative body. He was also for several years a member of the committee appointed by the War Office to advise the Army Council regarding the preliminary education of officers.

With all this administrative strain, Chrystal continued to develop his department of mathematics to greater and greater effectiveness. His text-books on algebra are well known; but it is not perhaps so well known that he was the inventor of the very appropriate phrases the "freedom equations" and the "constraint equation" of a curve. These show again how his mind moved in dynamical regions.

Chrystal's literary output is perhaps smaller in quantity than that of most men of equal reputation; but the quality is high. He communicated to the Edinburgh Mathematical Society an admirable account of the properties of lenses and doublets, to the study of which he was led in his recreation as a photographer. He was very skilful in all photographic manipulation, his attachment to the art dating from his Cambridge days, when dry plates were unknown.

In addition to several mathematical papers in the Proceedings and Transactions of the Royal Society of Edinburgh, he enriched the science of hydrodynamics by his researches on seiches. His attention was directed to the subject by Sir John Murray, and the whole problem, experimental and theoretical, seized hold of his mind in a marvellous way. This recent work is too well known to need discussion now. Not only did he vastly improve the mathematical theory of these movements in lakes and bays, but he invented instruments and obtained records which shed a new light on the whole set of phenomena. The work is stamped with all the thoroughness and ingenuity of a fine intellect.

What Chrystal undertook to do he did to the utmost of his powers. He left no ragged ends. All was carried through with celerity, yet with thoughtfulness and accuracy. Quick in his apprehension, and impatient of humbug, he was a terror to the student who was not an honest seeker after truth, but to the genuine student he gave of his best, and nothing delighted him more than when a pupil showed originality and power of research. His knowledge of human affairs was wide and deep. He was splendid

company among congenial friends, and in his own home he was the best of hosts. He was remarkably regular in his attendance at the meetings of the Royal Society Club, and there his appreciation of a good story and his own powers as a raconteur were always in evidence. Like most Scotsmen, he was reserved in his expression of the deeper feelings, but his sympathies were true and his friendship staunch.

C. G. KNOTT.

NOTES.

HIS MAJESTY THE KING has been pleased to approve of the following awards this year by the president and council of the Royal Society:—a Royal medal to Prof. George Chrystal, Sec.R.S. Edinburgh, for his researches in mathematics and physics, especially his recent work on seiches and free oscillations in the Scottish lakes; and a Royal medal to Dr. W. M. Bayliss, F.R.S., for his researches in physiology. The following awards have also been made:—the Copley medal to Sir George H. Darwin, K.C.B., F.R.S., for his scientific researches, especially in the domain of astronomical evolution; the Davy medal to Prof. Henry E. Armstrong, F.R.S., for his contributions to chemical science; and the Hughes medal to Mr. C. T. R. Wilson, F.R.S., for his investigations on the formation of cloud and their application to the study of electrical ions.

THE following is a list of those who have been recommended by the president and council of the Royal Society for election into the council for the year 1912 at the anniversary meeting on November 30:—*President*, Sir Archibald Geikie, K.C.B.; *treasurer*, Mr. Alfred Bray Kempe; *secretaries*, Sir Joseph Larmor and Sir John Rose Bradford, K.C.M.G.; *foreign secretary*, Sir William Crookes, O.M.; *other members of the council*, Lieut.-Colonel A. W. Alcock, C.I.E., Prof. W. H. Bragg, Sir A. H. Church, K.C.V.O., Mr. L. Fletcher, Prof. J. S. Gardiner, Mr. W. B. Hardy, Prof. M. J. M. Hill, Prof. F. S. Kipping, Mr. H. R. A. Mallock, the Duke of Northumberland, K.G., Sir Ronald Ross, K.C.B., Prof. E. Rutherford, Prof. S. P. Thompson, Prof. Sir J. J. Thomson, Mr. H. W. T. Wager, and Prof. E. T. Whittaker.

A REUTER message from Stockholm states that the Swedish Academy of Science has decided to award the Nobel prize for chemistry to Mme. Curie. Prof. W. Wien, professor of physics in the University of Würzburg, is to receive the prize for physics. The value of each prize this year is 7773*l*.

WE regret to see the announcement of the death of Mr. John Brown, F.R.S., of Longhurst, Dunmurry, Belfast, on November 1, at sixty-one years of age.

THE Physical Society's annual exhibition will be held on Tuesday, December 19, and will be open both in the afternoon and evening.

THE Berthelot memorial lecture of the Chemical Society will be delivered by Prof. H. B. Dixon, F.R.S., on Thursday, November 23.

THE eighty-sixth Christmas course of juvenile lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Dr. P. Chalmers Mitchell, F.R.S., secretary of the Zoological Society, his subject being "The Childhood of Animals."

THE death is announced of M. E. F. André, whose works in landscape gardening are widely known in the horticultural world. Among various books of which he was the author are "L'Art des Jardins," 1879, with numerous plates and more than 500 illustrations in the text, and a volume on the bromeliaceous plants collected in Colombia, Ecuador, and Venezuela. For nearly thirty years he edited *La Revue Horticole*, which has always held a high place among botanical periodicals.

THE Royal Geological Society of Cornwall at its annual meeting on October 31 presented the Bolitho gold medal to Mr. Clement Reid, F.R.S., in recognition of the able and conscientious manner in which he had superintended, during the past ten years, the geological resurvey of the county, the final memoirs of which are in the press. Mr. Reid, in returning thanks, said that the work done has widened the horizon and opened up new possibilities for Cornish geologists; but there is still a great deal to be done.

THE Royal Society of Arts will begin its 158th session on Wednesday, November 15, with an address from Lord Sanderson, G.C.B., the chairman of the council. Five meetings are announced before Christmas, at which papers will be read on the industrial progress of America, by Prof. James Douglas; the efficiency of the aëroplane, by Mr. A. E. Berriman; British Guiana, by Mr. J. A. J. de Villiers; London transport, by Mr. W. Yorath Lewis; and Bengal fisheries, by Dr. J. Travers Jenkins. Four Cantor lectures on "The Carbonisation of Coal" will be delivered by Prof. Vivian Lewes, and two juvenile lectures on "Soap Bubbles" will be given in January by Mr. C. V. Boys, F.R.S. A long list of papers for the meetings to be held after Christmas is also published.

THE winter session of the British Fire Prevention Committee was commenced on November 1 with a meeting to conduct a series of fire tests dealing with a small hand extinguisher intended to put out electrical and petrol fires. There was a large attendance at the committee's Regent's Park Testing Station, the Earl of Londesborough, K.C.V.O., Mr. Alexander Siemens, and Mr. Edwin O. Sachs, members of council, receiving the visitors, among whom were leading officials concerned in fire matters from the War Office, Board of Trade, and other public departments. There will be another series of tests this month dealing with the flannelette question, which is of such importance to child life; and in December some fire-resisting doors and partitions from the United States will be under investigation.

AUTHENTIC details of the recent Wright gliding experiments are now to hand, from which it appears that the machine used was very similar to a recent type of Wright aëroplane with power. The glider had no front elevator, but an elevating tail placed 12 feet in the rear of the trailing edge of the main planes. The dimensions of the main planes were 32 feet by 5 feet respectively, with a smaller camber than that used in the powered machine. Otherwise the only alterations made were to increase the size of the vertical rudder in the rear and to cut down the length of the skids. With this glider Mr. Orville Wright, starting from one of the sand-hills near Kill Devil Hill, twice succeeded in remaining in the air for rather more than 1m. 25s. The height of the hill from which he started was 75 feet. With regard to the automatic stability device which is stated to have been tried, no details are yet available. The objects of the gliding trials were to decrease the head-resistance of the machine, and incidentally to solve in a practical manner several problems in wind pressure.

BY the death, at the age of seventy-one, of Mr. W. Irvine, a retired member of the Indian Civil Service,

Oriental studies in this country have suffered a grievous loss. Mr. Irvine during a long and distinguished service in India acquired a singularly wide knowledge of the vernacular languages and of Persian. He was one of the few scholars who devoted himself to the history of the later Mogul period. His published work largely consisted of papers contributed to the Journal of the Royal Asiatic Society and other periodicals devoted to Oriental learning. These displayed his wide acquirements in history and philology, and his generous sympathy with India and her people. His more important works were an elaborate account of the armies of the Moguls, and an admirable edition of the famous "Storia do Mogor," or Mogul India between 1653 and 1708, the record of his journeys and experiences by the Venetian traveller, Niccolao Manucci, which was published in four volumes in the Indian Text Series.

THE protest recently made by Lord Curzon against the action of the Indian Government in proposing the suppression of the Central Department of Archæology was strongly supported in these columns and by the numerous scientific bodies and individuals in this country who are interested in the preservation of historical monuments and the excavation of ancient sites. In addition, it has been shown conclusively that the work of the department had commended itself to the native princes and to all classes of the population who look back with pride upon the splendid buildings—the work of vanished races and dynasties. In the course of the debate on the subject, raised by a motion from Lord Curzon on November 3, the Secretary of State, the Marquess of Crewe, announced that while the Government agreed with the contention of the Government of India that the proposed reorganisation would not necessarily put an end to the work of conservation and excavation, he, as representing the Council of India, took the view "that it is necessary to retain the central department for advice, for general supervision, and for the collection of information in connection with archæology." This satisfactory result of the controversy, for which all students of art and history are indebted to Lord Curzon, will be received with general approbation.

THE "Uto" photographic paper of Dr. J. H. Smith, which when exposed under a coloured transparency would furnish a coloured copy of the transparency, was referred to in these columns two or three years ago when it was placed on the market. For some time past it has been unobtainable; and it was known that Dr. Smith was seeking to perfect it. The Société Anonyme Utocolor of La Garenne-Colombes, Paris, is now introducing an improved paper under the name of "Utocolor-paper," which embodies the results of Dr. Smith's investigations. The new paper is stated to be much more rapid than the old, and it is free from the odour of anethol, the sensitiser previously employed. The gelatinous coating of the paper contains three dyes, red, yellow, and blue, which are bleached by exposure to light; and if a coloured light is employed, the dye, or mixture of dyes, that matches the colour of the light survives longer than the other dyes, which absorb the light, and therefore a coloured original is reproduced. The exposure necessary to copy an autochrome is about two hours of direct sunshine, or several hours of good diffused light and one hour of sunshine to finish it. Coloured light-filters are supplied, and one or both of them are placed over the frame during the exposure. They serve to absorb the ultra-violet and adjust the comparative colour intensities. The paper after exposure is desensitised, or "fixed," and the prints may then be kept in a feebly lighted room for a considerable time without obvious change; and in the dark, as in an album, they may be regarded as practically permanent.

THE recently founded Prehistoric Society of East Anglia has issued the first instalment of its Proceedings for 1908–9 and 1909–10. It is mainly devoted to inquiries and speculations regarding certain types of flint implements found by the president, Dr. W. Allen Sturge, and his fellow-members. He remarks that "not only is our district of East Anglia one of the richest in the world for the older Palæolithic remains, but it is probably the richest—I might perhaps go further and say incomparably the richest—in the world in Neolithic remains." The work of such a society will be welcomed by all students of prehistoric man and his culture. Dr. Sturge's essay discusses in detail the peculiarities in the types of implements which he has discovered. These lead him to attribute to them a higher antiquity than is recognised by other authorities. At any rate this essay, which is well provided with illustrations, deserves serious attention.

DR. REDCLIFFE N. SALAMAN contributes to *The Eugenics Review* for October an interesting paper entitled "Heredity and the Jew." Of the ancient race he observes that it is unlikely that any people residing in the centre of the great highway of the Old World, as did the Jews and their neighbours, should have, at any time, maintained a biological purity as we understand it in the animal and plant world. Proceeding to discuss certain cases of mixed marriages between Jews and Gentiles, he arrives at the conclusion that "the Jewish facial type, whether it be considered to rest on a gross anatomical basis or whether it be regarded as the reflection in the facial musculature of a peculiar psychical state, is a character which is subject to the Mendelian law of heredity." The obvious criticism is that the materials are too scanty to warrant this conclusion. The paper, however, suggests an interesting field of inquiry, which the writer might with advantage study on a wider scale.

AT a recent demonstration given by Prof. A. Keith at the Royal College of Surgeons, Lincoln's Inn Fields, a series of preparations were shown which illustrate the remarkable growth changes which occur in the bodies of those suffering from acromegaly. Not only was the skeleton affected by a peculiar form of overgrowth, but so were the muscles, the viscera, the joints, the heart, and the lungs. Even the coats of the appendix were increased. Many of the features of the skeleton recalled those of Neanderthal man. The great enlargement of the ribs, sternum, and clavicles produced a thorax which had many points in common with that of the gorilla. The pituitary body was greatly enlarged. It becomes more evident, as our knowledge of acromegaly is extended, that the pituitary body has a profound influence on the growth of the body. It is generally recognised that it coordinates in some manner the growth of the skeleton and muscles, but it is becoming manifest that it also influences the other systems of the body. A great development of these bones and muscles would be useless to the individual unless there was a corresponding hypertrophy of the heart, lungs, and of the viscera connected with nutrition. The preparations added recently to the College of Surgeons Museum show that all these systems are affected. One of the preparations illustrates a very remarkable structural change. In the subject of the disease, a male, the pelvis had assumed by a process of growth all the characters of the female pelvis

DR. F. NANSEN, G.C.V.O., lectured before the Royal Geographical Society on the Norsemen in America on November 6. The preparation of a short account of Arctic exploration had led him to review the whole of the evidence for the early voyages of the Norsemen, and resulted in views which differ considerably from those that are current. He agrees that the attainment of the shore of America by the Norsemen is certain, but maintains that the accounts of their voyages as we find them in the Icelandic sagas is at least in part legendary. Though Greenland, Helluland, Markland, and Wineland were discovered at the end of the tenth and the beginning of the eleventh centuries, the earliest written saga treating with these voyages was written between 1270 and 1300. He attributes the details of the self-grown vine and the unsown corn (or wheat) to interpolations and additions taken from earlier writings, such as those of Isidor Hispalensis from the seventh century, when writing of the Fortunate Islands in the Atlantic west of Africa. The same ideas in very similar words are seen to occur in the early Irish writings. His conclusion is that the whole narrative of the Wineland voyages is a mosaic of one feature after another gathered from east and west, among which we find many features, however, which indicate a certain knowledge of the real conditions on the north-east coast of America.

AT the conclusion of an article on the habits of the Amazonian ant *Polyergus rufescens*, published in vol. xxxi., p. 695 (October), of *Biologisches Centralblatt*, Prof. C. Emery states that the foundation of a new colony of this species is doubtless due to one or more fertilised females effecting an entrance into a nest of *Formica fusca* or one of its subspecies. The intruding female, unless she be stopped by hostile workers, immediately makes her way to the domicile of the reigning queen, whom, when found, she attacks and eventually kills with her powerful mandibles. During the contest the attendant workers remain stupefied with fright, but at the death of their legitimate queen quickly receive the foreign female in her place. In the second year the new queen lays eggs, from which emerge polyergus-workers, and these eventually obtain the mastery of the nest.

THAT certain fishes, such as salmon, which ascend rivers or streams for spawning assume two, or rarely three, distinct phases has long been known; and in a recent issue (vol. vii., part v.) of *Annotationes Zoologicae Japonenses* Prof. S. Hatta shows that the same thing occurs in the lesser Japanese river-lampern (*Lampetra mitsurikii*). Males and females of this species are readily distinguished by the much greater development of the anal fin in the latter than in the former; and as representatives of each sex are found in both a large phase, which attains a length of about 8 inches, and in a small phase, in which the length is less than half this, it is manifest that the species is dimorphic, especially as the two phases are found in one and the same stream, and do not intergrade.

A SERIES of nine associated human teeth discovered in a stratum of Mousterian age in a cave at St. Brelade's Bay, Jersey, are referred by Messrs. Keith and Knowles, in the October number of *The Journal of Anatomy and Physiology*, to the Neanderthal race. In spite of the slight degree in which the cusps are worn, the pulp-cavities of several of the teeth were found to be filled with secondary dentine. This and the size of the roots the authors regard as characteristic of Neanderthal teeth. Other primitive features are noticeable in the canine and first lower premolar, which (in contrast to what obtains among modern races) is larger than the second, in consequence of having to serve as an opponent to the upper canine.

WITH the view of illustrating normal variations in form and size of chromosomes, Dr. C. E. Walker figures, in a note received as a separate abstract from *Archiv für Zellforschung* (vol. vi., part iv.), certain changes observed during the meiotic division in cells of the generative organ of Triton and Lepidosiren. Arising therefrom, the argument is formulated that if the chromosomes are the bearers of individual variations, the differences in form and size may be correlated with the fluctuating variations recognised by Darwin.

A REPORT on official investigations regarding "beech coccus," *Cryptococcus fagi*, conducted by Mr. L. A. Boodle and Mr. W. Dallimore, is published in the *Kew Bulletin* (No. 8). Personal observations were made in woods in Buckinghamshire and Berkshire. The evidence is not thoroughly conclusive, but the investigators express a definite opinion that the beech coccus is not the destructive agent as generally supposed, and implicate the two fungi *Nectria ditissima* and *Melogramma spiniferum*, both of which were universally found on the unhealthy trees. Another article in the *Bulletin*, of considerable interest to gardeners, is the note on peat-moss litter manure, in which it is stated that the material is neither true peat nor moss, and is extremely undesirable in gardens, being injurious unless it has been allowed to rot for two years at least; the injurious action is attributed to the excess of organic acids contained.

AS a practicable study in the evolution of a land-form and its plant covering, Dr. L. Cockayne describes, in a contribution—of which a separate copy has been received—to the Transactions and Proceedings of the Botanical Society of Edinburgh (vol. xxiv., part iii.), the series of events which have led to the colonisation of the subalpine river-bed of the Rakaia, in the southern Alps of New Zealand. The climatic conditions point to an excess of rain, neutralised by insolation, frost, and high winds, while controlling edaphic factors are supplied by the porous soil and glacial water, so that the early colonists must be able to endure severe ecological changes. The first stages in colonisation are supplied by *Epilobium melanocaulon*, a plant provided with light, rapidly germinating seed, and the mat-forming *Raoulia tenuicaulis*. On situations raised above floods these are reinforced by a crustaceous lichen and other species of Raoulia, notably *R. Haastii*, which serves as a nidus for various less hardy colonists. A steppe association, distinguished by the presence of Raoulia and tussock grasses, and scrub are subsequent stages.

IN all new countries it is necessary to discover new crops in order that the system of agriculture should be diversified as much as possible, and particularly is it desirable to introduce leguminous crops. In a recent issue of *The Agricultural Journal of the Union of South Africa* experiments are reported showing that the soya bean is likely to prove advantageous wherever maize is of great importance. The crop is not only valuable in itself, but it leaves nitrogenous residues in the soil that add materially to the fertility. The seeds are rich in oil, for which there is a considerable demand by soap-makers and others, while the residue left after partial extraction of the oil furnishes useful cattle food.

AS a reply to the statement, formulated in a memorandum issued by the U.S. Weather Bureau, questioning

whether it can be shown that deforestation has augmented droughts and floods, an article is published in *The Indian Forester* (September) citing data and observations to prove that forests do exercise a marked influence on the regulation and maintenance of water supplies. The evidence submitted falls under three heads. First, deforestation produces a diminution or cessation of flow in the streams; most of the examples quoted belong to this category. Testimony from Monroe, Wisconsin, affirms that in seventy years the forest region has been reduced from 83 to 6 per cent.; coincidently, streams have dried up entirely, and mills have ceased to operate. Secondly, reafforestation leads to an increased water supply. An instance from Burma is noted, according to which renewal of the forests on Popa Hill, Myingyan, has averted the periodic drying up of the streams. Thirdly, corroborative conclusions are derived from a comparison of the flow in neighbouring streams, fed in one case from protected, in the other from denuded, catchment areas.

THE Board of Agriculture issues leaflets calculated to serve a very useful purpose by giving information to farmers on such problems as plant diseases, crop management, and manures. The leaflets are short, concisely worded, and where possible illustrated. Some of the recent issues deal with bacteriosis of the potato and tomato; actinomycosis in cattle, a disease caused by the growth on the animal's tongue of the parasitic fungus Actinomyces coming from grasses, cereals, or the soil. Another leaflet deals with the three weed grasses *Triticium repens*, *Agrostis vulgaris*, and *Arrhenatherum avenaceum*, all described by the farmer as couch or twitch; whilst a third gives an account of the composition of seaweed and its use as manure.

THE eleventh annual report of the Midland Agricultural and Dairy College shows that the members of the staff are responding in a splendid manner to the demands made on them by students and farmers. The principal says of one of the departments: "Every use has been made of the time and facilities that are available, and often leisure that ought to have been spent in recreation has been devoted to extra work," a statement fully borne out by the separate reports from the individual members of the staff. The Board of Agriculture has increased the grant to the maximum of 1000*l*., but more space seems to be needed in several departments. Favourable reports were sent by the examiners, except only in one instance, and there a perusal of the examination questions shows that the fault lies with neither students nor staff.

THE summary of the weather for the week ending November 4, issued by the Meteorological Office, shows that the conditions were very stormy throughout the period. Several large and important storm areas arrived from the Atlantic and extended over the British Islands and their neighbourhood. Severe gales were experienced on several days during the week, and on Saturday, November 4, the barometer at Thorshavn fell below 28·0 inches as the central area of the storm traversed Færöe. The rainfall for the week exceeded the average in all districts except in the north-east of England and in the English Channel. In the west of Scotland the measurement was 3·89 inches, which is 2·59 inches more than the average, and in the north of Scotland the excess was 2·29 inches. The aggregate rainfall for the nine weeks of the present autumn is now in excess of the average in the south-east and north-west of England, in the English Channel, and in the south of Ireland, whilst the deficiency in other districts is being greatly lessened by the recent heavy rains. At Greenwich the rainfall for October was 3·29 inches, which is 0·44 inch more than the average of the past sixty years; and October was the wettest month since November of last year.

AMONG several useful papers in the Journal of the Meteorological Society of Japan for August is one, by Mr. Y. Tsuiji, on earth temperature at Taihoku (Formosa), based on eleven years' observations (1897–1907). The surface layer of the ground is clay, and underground water is met with at a depth of about 20 feet. The tables show that the average annual air temperature is 21·54° C., and at the surface of the ground 23·55°; at 0·5 metre the mean is 23·39°, at 1 metre 23·31°, at 3 metres 23·11°. The mean decreases with depth, while the rate of diminution also becomes smaller as the depth increases; the annual range diminishes with increase of depth, while the epoch of extreme temperature is retarded. The author submits the results to harmonic analysis, and remarks that they show that if we are satisfied with a rough determination of the mean values for practical use, there is no need for that laborious process adopted in modern meteorology.

IN *The Cairo Scientific Journal* for September details are given of a slight earthquake shock which was felt in Cairo on August 22 at 10h. 23m. east European time. It was characterised by the very rapid character of the vibrations.

IN *Petermann's Mitteilungen* for October the results of the census of Mexico taken in October, 1910, are discussed and presented in a map which shows the distribution of population density. The northern portion to the north of lat. 25° is scantily peopled, having a population of from one to three to the square kilometre. The most densely peopled region is in the central part by Mexico, where a small portion is shown as having 480 inhabitants per square kilometre.

WE have received a catalogue of surveying and drawing instruments made by Messrs. C. F. Casella and Co., Ltd., of 11 Rochester Row, London, S.W. Besides the usual types of instruments, this firm constructs several of a special character, and full descriptions of some of these are given in the catalogue. Among these we may note Reeves's tangent micrometer for use on sextants and theodolites; Reeves's distance-finder alidade, in which the 3-foot alidade rod can be utilised as a distance finder, so that when used on a plane table the distance of objects can be determined either by intersection or by direct measurement. Hepworth's electric artificial horizon is a simple attachment by which, when a line on the horizon glass is in alignment with the eye of the observer and the natural horizon, the observer is notified by an audible signal, so that the use of the sea-horizon is no longer necessary, and observations can be taken when fog or mist may obscure the horizon.

THE Journal of the Franklin Institute for October contains an abstract of a paper on the *rôle* of water in minerals, by Dr. W. W. Coblentz, of the Bureau of Standards, Washington, which gives an account of a method of investigating the question which seems likely to furnish more definite information than has been available in the past. Dr. Coblentz examines the infra-red absorption spectra of a number of minerals having water of crystallisation by means of a vacuum bolometer and a mirror spectrometer. He finds that in some cases the absorption spectrum of the crystal is not, while in other cases it is,

the superposed spectra of the anhydrous substance and water. The water in crystals of the first class he proposes to call "water of constitution," and in the second "water of crystallisation." The latter term would thus include water which has in the past been known as "water of crystallisation," "dissolved water," and "water of solid solution."

THE diurnal variation of magnetic declination at Kiel is discussed by L. Weber and H. Borchardt in a paper in Heft 1, Bd. xv., of the *Naturwissenschaftlichen Verein* for Schleswig-Holstein. The data, derived from a magnetograph of special construction, extended—with two or three short interruptions—from January, 1902, to September, 1910. The range of the regular diurnal variation in individual months varied from 2·8′ in December, 1905, to 12·8′ in July, 1906; while the range of the mean diurnal inequality for the year varied from 6·63′ in 1909 to 8·46′ in 1905. At the end are curves showing the diurnal variation for the twelve months of the three years 1907 to 1909 treated individually, and for the twelve months of the seven years 1903 to 1909 combined, as well as the mean diurnal variation for the year from the last-mentioned period.

THE recent study of white plumage and hair coloration has led to the interesting conclusion that there are two varieties of white, one of which is dominant and the other recessive. These are indistinguishable to the eye, but exact opposites from the breeder's point of view. Dr. R. A. Gortner, working in the biochemical laboratory of the Carnegie Institution, has shown recently (*Journal of Biological Chemistry*, September) that dominant whites do not contain a melanin which is lacking in the recessive whites; he attributes dominant whites to the presence of a factor which inhibits pigment formation. His experiments prove that the oxidation of tyrosine by tyrosinase is prevented by the presence of aromatic phenols, which contain two hydroxyl groups in the meta position to each other, such as resorcinol, orcinol, or phloroglucinol. These phenols do not inhibit other oxydases than tyrosine. It is supposed that in dominant whites such an inhibiting factor is present, whereas the recessive whites lack enzyme or chromogen or both, and also lack the inhibiting factor.

Engineering for November 3 comments on the report of the commission appointed to inquire into the cause of the *Liberté* explosion, which has now been made public. Briefly, the report states:—(1) That it was not due to an act of malevolence. (2) That it was not due to a fire having occurred in any of the spaces adjoining the magazines. (3) That it was due to the inflammation of a cartridge of service powder in one or other of the forward starboard magazines containing only powder from one lot—namely, lot BM_{13} AM_8 2·06 P.B.—*i.e.* the second lot of powder manufactured in 1906 at the Government powder factory of Pont-de-Buis. The commission hesitates to attribute the cause to "spontaneous combustion" of the powder. Among other recommendations, the report states that the recent order lowering to four years the limit of age allowed for powders stored on board will be, without doubt, for a long time yet one of the most efficacious guarantees of safety against the instability of "B" powders; in foreign navies the limit of age is even lower.

OUR contemporary points out that British cordite is tested as soon as possible after it becomes eight years old, and though inspection is made twice yearly of all cordite, it is clear that it is expected to last at least eight years. Germany and Italy both use nitro-glycerine powders for their navies, which, so far as is known, have been immune from trouble as regards powder. Possibly the United States regulations are referred to, since the U.S. Navy use a nitro-cellulose powder—*i.e.* the same type as the French Navy. *Engineering* holds that the report confirms its already published views that, for naval purposes, the nitro-cellulose type of propellent powder is vastly inferior, both chemically and ballistically, as compared with the nitro-glycerine type. Indications are not wanting that the U.S. Navy may have to deplore a similar disaster, as it has lately adopted the course of "reworking" its "old" powders, some of them only a couple or so years old, with so-called stabilisers. These may have their uses when added to newly made powders; but to add them to powders which have already shown themselves to be unstable, from the fact that they are sentenced to be reworked, is a dangerous expedient which no economic consideration can excuse.

MR. W. MARTINDALE, New Cavendish Street, London, W., has issued a new complete price-list of apparatus, chemicals, and appliances generally suitable for scientific chemists and medical practitioners. The catalogue runs to 182 large pages, is well illustrated, and arranged in a form handy for reference.

MANY valuable works—old and new—are included in a catalogue of second-hand books on meteorology and terrestrial magnetism just issued by Messrs. H. Sotheran and Co., 43 Piccadilly, W. Brief notes are given describing the characters of most of the books. The catalogue includes also a collection of works on airmanship, and a supplement of cognate periodicals and publications of learned societies.

AN illustrated supplement, 1911, to the catalogue of scientific apparatus issued in 1910 by Messrs. Heynes Mathew, Ltd., of Cape Town, serves to show, incidentally, the satisfactory way in which the teaching of science is being developed in South Africa. The science teachers in South African schools are now able to obtain locally the equipment and material necessary for their work. The present list shows that this firm is in a position to undertake the complete furnishing and equipment of laboratories.

THE *Revista Tecnica del Ministerio de Obras Publicas* of Venezuela for September contains a note on the calculation of geographical coordinates and azimuths for a geodetic triangulation on which a physical and political map of the country may be based. The values for Clarke's ellipsoid of 1866 are used, and the Coast and Geodetic Survey of the United States is followed for the logarithms of the different constants involved in the computations.

AMONG notices of forthcoming scientific books which we have received during the week may be mentioned the following:—Messrs. Methuen have in the press a book by Mr. R. Lydekker, F.R.S., entitled "The Ox and its Kindred." Commencing with a discussion as to the proper English name of the domesticated animal, the author gives a sketch of the structure and zoological position of oxen, followed by a history of the extermination of the wild ox, or aurochs. Accounts are also given of park-cattle and the chief domesticated breeds of cattle—British and foreign; the book concludes with brief surveys of the wild and extinct members of the group.—Messrs. Kegan Paul, Trench, Trübner and Co., Ltd., are publishing under the title of "North Sea Fishers and Fighters" a work, by Mr. Walter Wood, on the development of the deep-sea

fisheries. The book deals fully with the men of the North Sea, and is embellished with colour and pencil drawings and photographs.—Mr. William Lewis, of Duke Street, Cardiff, is publishing for the Cardiff Naturalists' Society the first volume of "The Flora of Glamorgan," including the spermaphytes and vascular cryptogams, with index. The work has been prepared under the direction of a committee of the Cardiff Naturalists' Society, and is edited by Prof. A. H. Trow.

OUR ASTRONOMICAL COLUMN.

BROOKS'S COMET, 1911c.—In addition to the ordinary cometary spectrum, M. Bosler finds radiations at λλ 407, 405, 401, and 399 in the spectrum of the head of Brooks's comet. A longer exposure on September 25 showed also the tail radiations, and it was seen that λλ 401, 425, and 456 extended some 1° 30′ into the tail, while the radiation at λ 470 extended for not more than 30′.

Prof. Iniguez, describing the photographs secured at the Madrid Observatory (*Comptes rendus*, No. 17, October 23), records seven condensations in the spectrum, viz. λλ 555, 514, 472, 440, 423, 410, and 388. But the fourth and sixth are multiple, the wave-lengths of their components being 440, 434 and 432 and 410, 407, 405, 404, and 402 respectively; λ 388 is double.

The comet is still visible near the horizon, south of east, just before daybreak; but, as will be seen from the following ephemeris, by Dr. Ebell, the southern declination is increasing, and the comet, receding from both sun and earth, is becoming fainter:—

Ephemeris 12h. M.T. Berlin.

1911	α (true) h. m.	δ (true) ° ′	log r	log Δ	mag.
Nov. 8	12 43·9	− 9 48·9	9·7531	0·0263	3·9
,, 12	12 51·6	−14 10·4	9·7918	0·0558	4·2
,, 16	13 0·3	−18 3·6	9·8317	0·0824	4·5
,, 20	13 9·4	−21 31·7	9·8709	0·1063	4·9

BORRELLY'S COMET, 1911e, AND WOLF'S COMET, 1911a.—A telegram from Dr. Meyermann to the *Astronomische Nachrichten* announces that Borrelly's comet was observed at Tsingtau on October 20. It was elongated, about 2′ in diameter, magnitude 10, had no tail, and was very indistinct.

M. Kamensky gives an ephemeris, extending to January 2, 1912, for Wolf's comet in No. 4528 of the *Astronomische Nachrichten*. Only four observations of this faint object during the present return have yet been recorded; these give corrections of the order of −0·5s. and −6″ to the ephemeris. Taking the magnitude on June 29·5 as 14·6, as determined from Dr. Wolf's plate, M. Kamensky finds that at no time this year will the comet be brighter than the fourteenth magnitude.

MARS.—M. Antoniadi's observations of Mars with the large refractor at the Meudon Observatory commenced on September 18, and a number of changes have already been noted. Modifications of the colours of various parts of the disc, with an abnormal pallor of the "seas," suggests the presence of yellowish cloud in the Martian atmosphere, such as has been noted at previous oppositions. A large mass of white cloud completely veiled the region of M. Cimmerium, M. Tyrrhenum, and Hesperia on October 14. The complete veiling of so dark an area as M. Tyrrhenum has not been seen since 1888, when the series of observations commenced. The whiteness of Libya on October 11 is attributed to overlying mist, which is transparent when viewed normally, but increases in visibility as the line of vision becomes more oblique, *i.e.* as the area approaches the terminator. A very bright terminator projection, probably due to cloud, was a very prominent feature of the regions north of Icaria from 10h. 56m. to 11h. 25m. on October 14; terrestrial clouds then stopped observations (*Astronomische Nachrichten*, No. 4532).

THE SUN'S ENERGY SPECTRUM AND TEMPERATURE.—In No. 3, vol. xxxiv., of *The Astrophysical Journal* Mr. Abbott discusses the distribution of energy in the sun's spectrum as derived from the spectro-bolometric observations made at Mount Wilson, Mount Whitney, and Washington during 1903–10. He discusses at length the various possible errors and the conditions which might modify, more or less, the derived results. The distribution of energy outside the atmosphere is tabulated, and the energy is shown to reach a sharp maximum at about 0·470 μ; a table of atmospheric transmission coefficients is also given. The results appear to be independent of the observing station, but sensitive to the character of the spectroscope used, and little weight must be given to values for wave-lengths beyond 0·40 μ where glass prisms are employed; a quartz-magnalium system was used latterly.

Mr. Abbott also discusses the question of the sun's temperature, and finds that the sun's effective emission is comparable with that of a "black body" at 6000° C. absolute, although he considers this is modified considerably, and that the actual radiating temperature is more of the order of 7000° C. absolute.

A DAYLIGHT METEOR IN SOUTH AFRICA.—Some accounts of a wonderful meteor, which provided a striking spectacle some time before noon on August 24, are recorded by Mr. Innes in Circular 11 of the Transvaal Observatory. The phenomenon was seen by several persons located near Potchefstroom; but the reports are not strictly in accordance. Mr. Innes suggests the possibility of the several observers having seen portions of a broken-up meteor of such brilliancy as to arrest their attention in full sunlight. Mr. Ingham, chief engineer of the Rand Water Board, estimates that when he saw it the meteor was not more than 400 yards distant, had a head 5 or 6 inches in diameter, and a flame, like that of burning sodium, extending some 12 to 15 feet from the head. No "find" is recorded.

THE PERIOD AND EPOCH OF 68 *u* HERCULIS.—In No. 4526 of the *Astronomische Nachrichten* Dr. Hertzsprung discusses the long series of observations of the variations of 68 *u* Herculis made by J. F. J. Schmidt during 1869–79. He finds for the period 2·051027d., which agrees with the spectroscopic results, and for the commencing epoch of chief minimum, taking the mean of Schmidt's and recent observations, J.D. 2410102·321 M.T. Greenwich. The period shows no apparent variation.

THE ASTRONOMICAL SOCIETY OF BARCELONA.—One of the objects of this society, upon which special stress was laid at its foundation in January, 1910, was the provision of a public observatory where members might meet on fine evenings to study celestial phenomena and to discuss points of astronomical interest. It is pleasant to record that the primary object of the promoters has been realised very unexpectedly, and without cost to the society, in such a manner that within the next few weeks the members will be in absolute possession of a well-equipped observatory. Señor Rafael Patxot y Jubert has offered to present his observatory and instruments to the society, and, needless to say, the offer has been accepted. This establishment, the Observatori Catalá, is situated at San Feliu de Guixols, in the province of Gerona, and in importance stands next to the observatories of Madrid and San Fernando. The whole establishment will be removed immediately to Barcelona, where it will be re-erected on the roof of one of the public buildings.

The instruments include a double equatorial by Mailhat, visual and photographic, with apertures of 8¾ inches and focal lengths of 10 feet and 7 feet 9 inches respectively. A complete set of accessories of precision is included in the gift—spectroscope, micrometer, camera, electric pendulum, and azimuthal theodolite. Annexed to the observatory in its new position will be a room for meetings of the society, library, photographic laboratory, &c. Preparations for the public lunar exhibition, which will be held in Barcelona in May, 1912, are being pushed forward rapidly, and already many promises of assistance have been received from all parts of the world. The exhibition will be held in the University buildings, under the honorary presidency of the rector, Baron de Bonet. The executive council of the society invites the cooperation of seleno-

graphers of all classes in order to make this exhibition, the first of its kind, a success. All communications should be addressed to Señor Don Salvador Raurich, Calle Gran Via Diagonal, 462, 2°, Barcelona, Spain.

THE MAGNITUDES OF EIGHTY-EIGHT STARS IN COMA BERENICES.—In No. 43 (vol. iv., 7) of the *Mitteilungen der Nikolai-Hauptsternwarte zu Pulkowa* Herr Beljawsky gives the resulting magnitudes obtained from the measures of two plates exposed in March last on the Coma Berenices group. The magnitudes were determined by comparison with stars of the Pleiades group, taken on the same plates between exposures on the Coma Berenices group. Comparing his final magnitudes with those obtained by Pickering, M. Beljawsky finds that there is a distinct connection between the difference Beljawsky-Pickering and the spectral class of the stars concerned; the difference increases from class A (0·38) to class K (0·84), and the increase is probably due to a difference in the scale of photographic magnitudes.

THE NEW BOTANICAL LABORATORIES OF THE UNIVERSITY OF MANCHESTER.

THE new botanical laboratories of the University of Manchester were opened by Dr. D. H. Scott, F.R.S., on Friday last, November 3. The new block of buildings consists of four main floors with two mezzanines, and is planned so as to give adequate accommodation for the various branches of botanical science.

For palæobotany, the study of which is so closely associated with the name of the late Prof. Williamson, the first professor of botany of the Owens College, a room is set apart on the ground floor, close to the entrance on the south side of the building; while on the north is a well-lighted laboratory for thirty junior students, connected directly with the larger elementary laboratory in the main building, which is capable of seating forty more students. On the first floor is a large research laboratory, opening into the senior laboratory.

The second floor is devoted entirely to the Cryptogamic Department, which owes its endowment to the munificent legacy of the late Prof. Barker. In addition to providing facilities for researches of a purely scientific nature, the Barker Laboratory will be available for inquiries connected with agriculture, such as investigations into diseases of plants caused by fungi and bacteria.

On the third floor the laboratory for plant physiology occupies the gable end of the building, being designed so as to possess both north light for microscope work and south and west light for experiments requiring direct sunlight. Such experiments can be made either in the laboratory itself or in the greenhouses, which occupy the whole extent of the south front of the top floor. The greenhouses are divided so as to have both a hot and moist and also a cooler and drier portion.

The new botanical block is entirely devoted to laboratory accommodation, and does not contain any lecture-rooms or museum galleries. The facilities for botanical work in the University are added to by the experimental grounds and greenhouses on the Behrens Estate, Fallowfield, which supply both the need of economic botany and zoology. Here experiments in plant breeding have been in progress for some time past, as well as investigations on conditions of cultivation as affecting the development or prevention of certain plant diseases, and the testing of varieties of cultivated plants supposed to be immune to disease.

Photo.] New Botanical Laboratories, University of Manchester. [*E. Vincent Ward.*

At the opening ceremony on Friday, November 3, the Vice-Chancellor (Sir Alfred Hopkinson) welcomed the guests, and after referring to the need there had been for securing adequate accommodation for the teaching of botany in the University, and the steps taken by the council of the University to meet the requirements of the growing department, invited Dr. Scott to open the new building. A ceremonial key was presented to Dr. Scott by the architect, Mr. Paul Waterhouse, and, after the door had been unlocked, the building was declared open, and was inspected by the visitors.

Later in the afternoon Dr. Scott delivered a short address to the friends and students of the University, and spoke

in appreciation of the work of the first professor of botany in the Owens College, the late Prof. Williamson. He directed attention to the fact that during the sixty years which had passed since the foundation of the Owens College there had been only two professors of botany there. Williamson was the first, and the second was the present occupant of the chair, Prof. Weiss. Recalling the facts of Dr. Williamson's life, Dr. Scott reminded his audience of the many-sided character of the former professor of botany, and also specified in detail the work done by Williamson. He took a leading part in bringing home to scientific people the importance of those fossil remains which show structure. Fossil plants are preserved in two quite different ways. On one hand we have the more familiar kind of specimens in the form of casts or impressions which show the external form—often very beautiful—or organisation, but not the structure. On the other are specimens, usually very fragmentary, showing little or nothing of external form, but showing the structure, often beautifully preserved. It was upon the latter form of fossils that all Williamson's later work was done. The fine building now completed is a worthy expression of the progress of the study of botany in Manchester, which has now become one of the greatest centres of botanical teaching in the kingdom.

The ceremony concluded with a vote of thanks to Dr. Scott, proposed by Sir Edward Donner and seconded by Prof. Weiss.

PLAGUE IN EAST ANGLIA.

AFTER a period of quiescence lasting for just over a year, plague has again appeared in East Anglia. Between December 12, 1906, and January, 1907, there were several cases of what was supposed to be pneumonia in two adjoining cottages in the parish of Shotley. There were three cases in one house, two of which were fatal, and five cases in the other, of which four were fatal. It is believed now that all these were cases of pneumonic plague. In January, 1910, two persons died at Trimley, exactly opposite Shotley, on the other side of the River Orwell, from a disease now believed to have been plague. In September, 1910, four persons died in two adjoining cottages in the village of Freston, six miles from Shotley. On October 10 last a seaman was admitted to the sick quarters of the Shotley Royal Naval Barracks, Suffolk, and subsequently developed symptoms of pneumonia. His sputum was examined, and plague bacilli were found. Although there is no certain proof of the source of infection, it is believed he caught the plague from a rabbit he skinned, and that in so doing he cut his finger. This event is not altogether unexpected, as it was known some weeks ago that rats in the Samford Hundred—the district enclosed by the Rivers Orwell and Stour—were again plague-infected; and a vigorous campaign against the rats is being pursued. When the epidemic occurred last year competent authorities warned the Local Government Board of the need for concerted and widespread action for the extermination of rats in the infected district and the delimitation of the infected area.

According to the latest report, the authorities in the Samford district are taking every precaution in the way of destroying rats. As the result of the suggestions of the Local Government Board, it is now proposed that rat-catchers shall be employed in a number of parishes. The public will still receive 2*d.* for every rat killed. Returns of rats killed showed that hundreds were being destroyed in some parishes; in others there were very few to kill. The Local Government Board proposes that concerted action in regard to the plague should be taken by all the neighbouring rural and urban authorities, and it also advises the appointment of a special officer to supervise the destruction of rats. It is to be hoped that, in addition, arrangements will be made for a bacteriological examination of a large proportion of the rats captured, for this procedure is required in order to ascertain the prevalence and area of infection. The rabbits and hares also should be subjected to examination.

CONGRESS OF THE UNIVERSITIES OF THE EMPIRE (1912).

AT a meeting of the Home Universities Committee of the congress, consisting of the Vice-Chancellors of the universities of the United Kingdom and other representatives, held on Saturday, November 4, the programme of subjects for discussion at the congress in July, 1912, was settled.

The meetings of the congress will be held on July, 2, 3, 4, and 5, on four mornings and two afternoons. There will be, in addition, a business meeting.

The subjects for discussion fall under two heads, and are as follows:—

I.—*Universities in their Relation to one another.*

(1) Conditions of entrance to universities and the possibility of equivalence and mutual recognition of entrance tests to degree courses.

(2) Interchange of university teachers; conditions of interchange.

(3) Inter-university arrangements for post-graduate and research students.

(4) Question of division of work and specialisation among universities.

(5) The establishment of a central university bureau; its constitution and functions.

II.—*Universities in their Constitutional Aspects and in their Relation to Teachers, Graduates, and Students.*

(1) The relation of universities to technical and professional education and to education for the public services.

(2) Provision of courses of study and examinations for other than degree students, including university extension and tutorial class work, and specialised courses both of a general and technical character for students engaged in professional, commercial, and industrial pursuits.

(3) The representation of teachers and graduates on the governing body of a university.

(4) Action of universities in relation to the after-careers of their students.

(5) The position of women in universities.

(6) The problem of universities in the East in regard to their influence on character and moral ideals.

(7) Residential facilities, including colleges and hostels.

Upon some of these subjects it is hoped that by cooperation between the universities some action may be possible, *e.g.* such subjects as the extent to which universities may recognise each other's entrance examinations, facilities for post-graduate students from other universities, interchange of professors, &c. There are other questions upon which most, if not all, of the universities will have taken some action and obtained some experience, such as the relationship of universities to colleges associated or federated with them, the position of women in universities, provision for students other than degree students, &c. Upon these questions what is wanted is a summary of the experience of each university presented in a way that will be useful for comparison and will furnish a body of information of permanent value. Accordingly, in addition to the subjects for discussion, other subjects have been selected upon which each of the fifty-one universities is asked to prepare a memorandum. These memoranda will be printed beforehand and issued to members of the congress.

It has been decided that, in addition to the delegates, of which each university is entitled to appoint not more than four, invitations to be present, with the right to speak at the meetings of the congress, shall be issued to a certain number of selected persons. It has been decided that no resolutions will be submitted at the ordinary meetings of the congress, but a special business meeting, confined to delegates of the universities, will be held to deal with executive business. In addition, associate membership of the congress will be open to all who may desire to join on payment of a fee of 10*s.* 6*d.*

BOTANY AT THE BRITISH ASSOCIATION.

TO suit the convenience of members of other sections, the president (Prof. F. E. Weiss) delivered his opening address at twelve noon on Thursday, August 31. The address has already been printed in full in NATURE (September 21, p. 395).

In recent years Section K has frequently shown a

tendency to specialise at particular meetings, *e.g.* in physiology at Dublin. This year an international phytogeographical excursion had been arranged to visit the British Isles during August, and to conclude with the British Association week at Portsmouth. The advent of so many eminent foreign phytogeographers predetermined that the bias of this year's meeting should be ecological. Field excursions, therefore, formed a prominent feature of the programme. The localities visited included Kingley Vale (yew woods), the New Forest (heath, valley-moors, and woodland), Southampton Water (Spartina associations), and Ditcham Park (beech-wood, &c.). In addition to the excursions, there were two discussions and a number of individual papers dealing with phytogeographical subjects. These may be taken first.

The Relation of the Present Plant Population of the British Isles to the Glacial Period.

A joint meeting of botanists, geologists, and geographers was arranged for Monday morning, September 4, the subject under discussion being the relation of the present plant population of the British Isles to the Glacial period.

The discussion was opened by Mr. Clement Reid, F.R.S., who first gave a brief historical summary, and then proceeded to discuss some of the problems which particularly need solution. The first question is, "Are any of our plants survivors that managed to live through the cold of the Glacial period in some warm nook in Britain?" This he answered in the negative, except in the case of certain arctic and alpine species, which thus, he believes, form the oldest element of the British flora. Discussing (with the aid of specially prepared maps) the distribution of ice during the period of maximum intensity of cold, he concluded that the whole of the temperate flora must have been swept away as completely as the celebrated volcanic eruption of 1883 destroyed the vegetation of Krakatoa. Dealing now with the question of reimmigration, he could find no evidence for the existence of post-glacial land-bridges connecting the mainland of Great Britain with either the Scilly Isles, Ireland, or the Continent. Mr. Reid then mentioned some of the well-known peculiarities of distribution in our flora, especially the cases of the Pyrenean, Atlantic, and Germanic elements. Most of the species composing these elements are not really maritime plants, though they have a marked coastal distribution. This he explained as due to their comparatively recent introduction from the nearest continental shores, the lapse of time being such that the slow process of spreading inland has only as yet extended a few miles. Mr. Reid strongly urged the view that chance introduction of seeds (*e.g.* by birds driven by exceptionally strong gales) during thousands of years explains the existing peculiarities of geographical distribution in a way that no changes of sea or land or climate will do.

The president then read a letter which Mr. Reid had received from Dr. A. R. Wallace, F.R.S. Dr. Wallace said that he was firmly convinced that plants had great powers of distribution over the sea, in rare cases even for thousands of miles. Referring to the flora of the Azores, he said "there is absolutely no doubt that the whole of its plants have been gradually introduced during the latter half of the Tertiary period, over a width of ocean of about 1000 miles." But he could not accept Mr. Reid's view that the whole of our flora had been exterminated. "Temperature is only one of many, *very many*, factors that determine the distribution of species; and it is also certain that at the *southern limit* of the ice-sheet the winter temperature may have been quite mild enough to support a large number of our species." Dr. Wallace added that the covering of snow during the winter may have been a compensation for the low temperature.

Dr. Scharff discussed the problem from the zoological point of view, dealing principally with the larger mammals living in Ireland in present and past times. From the evidence of animal remains in the Irish turf, marl and cave deposits, Dr. Scharff maintained that many of the larger herbivores, *e.g.* Irish elk, reindeer, &c., survived in Ireland during the Glacial period. As these animals would require an abundant supply of vegetable food, he differed from Mr. Reid as regards the survival of both animals and plants in Ireland during the cold of the Glacial period.

Dr. O. Stapf, F.R.S., expressed his agreement with the opener's view as to the extinction and reimmigration of the temperate flora of the British Isles, but opposed the view that the curious distribution of the American, Atlantic, and limestone elements is due to chance introduction of seeds from great distances. He described the present distribution of the American and Atlantic plants in question, and pointed out that in both cases there existed (if the different species composing the two groups are considered) such gradations of discontinuity as to connect the extreme cases with cases of almost continuous areas. These extreme instances of discontinuous areas, then, would merely represent the last phase of disintegration. Dr. Stapf concluded by emphasising the importance of preserving and coordinating all records (of rare finds, &c.) which bear on the history of the flora of the British Isles.

Prof. C. Schröter dealt with the theories of Nathorst and Brockman with regard to the post-glacial history of the Swiss flora. He also pointed out that new evidence has accumulated showing the great importance of wind as a factor in the dispersal of plants in the Swiss Alps.

Mr. Wright directed attention to the presence of deeply submerged forests and peat-beds in the southern half of the British Isles. This indicates, though it scarcely proves, that a land connection with the Continent existed in post-glacial times. This connection seems to be demanded for the entry of the larger mammals which have found their way into England and Ireland since the Ice age. The evidence as to the total extinction of all life on Krakatoa has been questioned on the ground that seeds may have been preserved in the old surface deposits beneath the mantle of ash, and subsequently exposed for growth by the rapid formation of rain gullies known to have followed the eruption.

Prof. P. F. Kendall[1] entirely agreed with the conclusions of Mr. Reid, and instanced the case of the Isle of Man as indicating on a small scale what has probably happened in the British Isles as a whole. The Isle of Man presents a great variety of topographical, hydrographic, and other features, and thus offers conditions favourable to the maintenance of an equally varied flora and fauna. But the island is remarkably poor in the number of species of both animals and plants. The explanation seems clear that since the departure of the great ice-sheet the island has been repopulated by plants and animals introduced by chance agencies across the Irish Sea.

Dr. J. E. Marr, F.R.S.,[1] said it is generally admitted that after the great Ice age a period occurred which was marked by widespread steppe conditions. It is to be expected that survivals of this period would persist in areas not now under steppe conditions. He suggested that a case of such persistence may be found in a group of xerophytes growing on the Brecklands of North Suffolk and South Norfolk.

Prof. O. Drude pointed out that in attempting to solve a problem of this nature it was necessary to consider, not Great Britain alone, but also the whole of middle Europe. During what is known as the Baltic Ice age, *Picea excelsa*, and even Hymenophyllum, survived in Saxony. It is not impossible, therefore, that temperate forms, mingled with boreal, may have survived in the south of England.

Dr. F. J. Lewis was of opinion that the evidence of submerged peat deposits and buried forests pointed to considerably greater changes of level than those allowed by Mr. Reid. He also thought that the conditions of Krakatoa were so different from those of Britain during post-glacial times that comparisons between the two were unsafe.

Dr. C. H. Ostenfeld thought that the importance of "nunataks" has been overestimated. It is very difficult to be certain of whether a mountain summit has been glaciated or not. Dr. Ostenfeld maintained that the bulk of the temperate British flora had returned by means of a land-bridge, though he admitted that a few of the Atlantic and the two American species had probably arrived by chance.

Mr. E. A. N. Arber believed that land connections existed

[1] Prof. Kendall and Dr. Marr sent written communications, as they were unable to be present.

between England and France, both before and after the main period of glaciation.

Dr. C. E. Moss thought it a mistake to confine attention to the local "Lusitanian" species of west Ireland and south-west England. Belonging to the same distributional type are a number of halophytes, *e.g. Limonium reticulatum*, *Suaeda fruticosa*, &c., which in Britain are limited to the south and east coasts. These probably migrated from south Europe to Britain *via* the west coast of France. Being salt-marsh plants, their seeds are probably carried by ocean drifts. This may explain their absence from the west coast of Britain, as the trend of the currents is in an easterly direction.

Mr. G. Claridge Druce contributed to the discussion a statement of the appearance of species in isolated spots, *e.g. Scirpus maritimus* in Berkshire, and suggested that these were examples of chance dispersal by wind or birds. The same was probably true of the rapid spread of *Crepis taraxacifolia* over Midland England during the last twenty years.

Mr. Clement Reid briefly replied, and still adhered to his main contentions. With regard to the possible survival of plants in Britain, not only was the land itself glaciated, but the surrounding sea was intensely cold. On the subject of post-glacial connections with the Continent we cannot speak with absolute certainty, but he could find no evidence of sufficiently great oscillations of level to allow of their existence. The Irish peat-bog mammals referred to by Dr. Scharff are all good swimmers, and could quite well have crossed a narrow strait. This concluded one of the best discussions which has been held under the auspices of Section K.

The Principles of Constructing Phytogeographical Maps.

A second discussion was arranged for Tuesday morning, September 5, on the principles of constructing phytogeographical maps.

Dr. C. E. Moss, who opened this discussion, briefly traced the history of the recently issued British vegetation maps, and compared them with those produced on the Continent. Dr. Moss pointed out the uses, and also the limitations, of such maps. He emphasised the fact that vegetation maps are just as important as geological maps. Yet the latter are prepared and published by a Government department, while the former are left to the initiative of private individuals, who at present experience great difficulty in securing the publication of their work.

Prof. C. Schröter, who exhibited a fine collection of phytogeographical maps he had brought with him from Switzerland, classified such maps as follows:—(1) autochorological maps, which show the distribution of systematic units (genera, species, &c.); (2) synchorological or formation maps, illustrating the distribution of plant formations; (3) epiontological or historical maps, giving the distribution of floral elements and the history of their immigration; and (4) floristic maps, showing the division of a country into botanical regions.

Prof. O. Drude laid down certain important principles which should be observed in constructing phytogeographical maps. *E.g.* the colour scheme should be such as not to interfere with the general topography, which should be clearly distinguishable even in vegetation maps. Prof. Drude then proceeded to criticise the British maps in respect to certain technical details. He was followed by

Mr. A. G. Tansley, who pointed out that most of Prof. Drude's criticisms had been anticipated by the committee for the survey and study of British vegetation. Many improvements had been adopted in the later maps which, as Dr. Moss had pointed out, still awaited publication.

Dr. E. Rübel distributed copies of his vegetation map of the Bernina district in the Engadine. This map shows what can be done in the way of indicating on a single map such things as, *e.g.* in the case of woodland, not only the distribution of forest, but also the proportion of the more important trees, the types of undergrowth, &c.

Ecological Papers.

Thursday was largely devoted to individual ecological papers.

Prof. F. W. Oliver, F.R.S., read a paper on the life-history of a shingle bank, in which he dealt with the conditions under which plants exist on maritime shingle beaches. Most shingle banks are very mobile. This is due partly to the action of storm waves and partly to undermining by percolating sea water. A passive condition is indicated by the presence of lichens, &c. The origin of the soil occupying the interstices of the shingle was discussed. The most important source of this appears to be the drift on the lee side of the bank. This gradually becomes incorporated with the shingle during the slow landward march of the latter. Considered as a plant habitat, a very remarkable feature of a shingle bank is the rich supply of water with which it is provided, even in its upper zones. This feature requires further investigation.

Prof. C. Schröter next gave an illustrated account of the Swiss National Park and its flora. There are in Switzerland at the present time four organisations working for the preservation of natural and prehistoric monuments. One of the results of this movement has been the establishing of a National Park, or reservation. This is planned to cover an area of 200 square kilometres, about 90 of which have already been acquired.

Prof. J. Massart, in a very interesting paper on phytogeography as an experimental science, strongly urged the necessity for experiment as a method of attacking problems of plant geography. One example mentioned was the case of certain moorland plants (*e.g. Calluna vulgaris*) which flourish in such an unusual habitat as the limestone pavements of west Ireland. Why are these calcifuge species able to grow on limestone in Ireland? Is it because the climate is sufficiently favourable to enable them to withstand the deleterious effects of the calcareous soil? Or because the limestone forms of these species are biologic races, analogous to the cases of some parasitic fungi? Or is it that certain competing species are absent from Ireland? This and many similar problems can only be solved by direct experiment.

The afternoon session was opened by Prof. H. C. Cowles, who gave an illustrated account of a fifteen-year study of the advancing sand-dunes of Lake Michigan. These dunes are frequently 65 metres in height, and travel so rapidly that few of the antecedent plants are able to survive. Curiously enough, those which do so are not the more xerophytic species, but swamp plants and mesophytes, such as Cornus, Salix, Populus, &c. The survival of these plants depends on their capacity to elongate and produce new adventitious roots rapidly.

Miss S. M. Baker, in describing the brown seaweeds of a salt marsh, stated that all the brown seaweeds occurring near high-water level on rocky shores are capable of giving rise to marsh forms. Such marsh forms are frequently characterised by a spiral twisting of the thallus.

Prof. R. H. Yapp next discussed the causes which determine the formation of hairs and palisade cells in plants. The results of many previous experiments show that, in general, palisade tissue and the hairs on aërial shoots are best developed under external conditions which either favour transpiration or hinder absorption. The conclusion was arrived at that the initial stimulus leading to the development of these special cells is connected with a diminished water supply. But turgidity is a necessary condition for the actual growth of the cells. Thus periodic fluctuations in the turgor of the cells concerned, such as will frequently occur during the alternation of day and night, may play an important part.

Dr. F. J. Lewis read a paper on the forest stages represented in the peat underlying the moorlands of Britain. The author's earlier researches on this subject are well known. In this paper he gave some of the results of his more recent work in the Hebrides and elsewhere. The paper was well illustrated by lantern-slides.

A paper was communicated by Miss L. Baker and Mr. B. W. Baker on the plant associations of the district round Macclesfield.

Mr. W. B. Crump, in an interesting paper on the water-content of acidic peats, dealt with the question of the water supply of plants growing on acid soils. Mr. Crump emphasised the importance of considering the humus- as well as the water-content when analysing these soils. He contended that if the results of such analyses be expressed by the ratio water-content/humus-content some indication is obtained of the amount of water available for absorption by the plant.

A further communication by the same author described some experiments on the wilting of moorland plants, in which he attempted to determine directly the physiological water-content of moorland soils.

Palaeobotanical Papers.

Friday morning was chiefly occupied by the communication of palæobotanical papers.

Miss M. Kershaw described the structure and development of the ovule of a cycad, *Bowenia spectabilis*, dealing particularly with the complicated pollen-chamber of this genus. Miss Kershaw, and also several speakers in the discussion which followed, compared the ovule with certain fossil seeds, especially Trigonocarpon.

Dr. M. J. Benson read a paper on a new type of synangium, which she attributed to *Heterangium Grievii*. The author maintained that the discovery of this early synangium affords support to the synangial theory of the seed.

Dr. D. H. Scott, F.R.S., who followed, dealt with the structure and relationships of a rare Palæozoic fern, *Zygopteris Grayi*. This species possesses a five-rayed stellate stele, with internal xylem consisting of narrow tracheides embedded in parenchyma. Dr. Scott is inclined to regard this type of stele as an elaborated protostele rather than a condensation of a more complex vascular system.

Mr. H. Hamshaw Thomas gave a general account of recent researches on the Jurassic plants of Yorkshire. Amongst other things described were several new fossils found by Mr. Thomas himself, *e.g.* a new Bennettitalian "flower" with microsporophylls as well as ovules, and a fruit-like body containing seeds. To the latter he has given the name Caytonia. The discussion which followed centred mainly about the probable nature of this apparent fruit.

Prof. A. C. Seward, F.R.S., gave an account of the structure of a petrified Williamsonia collected by Hugh Millar in north-east Scotland, and figured by him in "The Testimony of the Rocks." The specimen, of which sections have been cut by permission of the director of the Royal Scottish Museum, Edinburgh, consists of a central conical axis bearing immature interseminal scales and seeds, the whole being enclosed by linear bracts bearing numerous unicellular hairs. The structure of the plant will be fully described in a forthcoming paper. In commenting on this paper in the discussion, Dr. Scott remarked that we know nothing at present about the young stages of the ovules in any Bennettitales.

From the examination of serial sections through entire boulders of calciferous sandstone from Pettycur, Miss T. Lockhart was led to results which confirm Dr. Gordon's view that petrifaction of the plant remains in these boulders occurred in thermal pools.

Cytological Papers, &c.

Cytological papers, &c., were taken on Friday afternoon.

The first paper was one contributed by Dr. A. A. Lawson, on nuclear osmosis as a factor in mitosis. The results obtained by the author are at variance in several respects with those of previous observers. He finds that the nuclear membrane does not break down and disappear, but persists as a permeable plasmatic membrane. During mitosis, the nuclear sap diffuses through this membrane, which consequently closes in around the chromosomes, the nuclear cavity becoming much reduced. The author further maintains that the spindle threads are merely a drawing out of the cytoplasmic reticulum by the receding membrane. They thus represent lines of tension in the cytoplasm. They neither invade the nuclear cavity nor aid in drawing the daughter chromosomes to the poles of the spindle.

Dr. H. C. I. Fraser next gave a paper on the longitudinal fission of the meiotic chromosomes in *Vicia Faba*. This paper was a continuation of one communicated at the Sheffield meeting. The chromosomes undergo longitudinal fission during the telophase of the last archesporial division. The V-shaped chromosomes undergo a second longitudinal fission at the poles of the heterotype spindle. Both fissions are recognisable until the chromosomes pass on to the homotype spindle. The second fission disappears during metaphase, but is again visible when the chromosomes come into contact at the poles.

Mr. T. G. B. Osborn gave an account of the life-cycle and affinities of the Plasmodiophoraceæ. A cytological investigation of the life-history of *Spongospora subterranea* showed a very close similarity to that described for certain genera of the Plasmodiophoraceæ by Maire and Tison. The chief difference was that in Spongospora a fusion of nuclei in pairs occurred after the akaryote condition.

Mr. A. S. Horne followed with a paper on somatic nuclear division in *Spongospora Solani*, in which a peculiar form of karyokinesis was described as occurring during the early stages of the life-history.

The proceedings on Friday were terminated by a paper from Mr. A. E. Lechmere, on some West African fungi. Amongst others, a series of interesting forms were isolated which apparently belong to a new genus of Pyrenomycetes. Mr. Lechmere illustrated his paper by photographs and also living cultures.

The Semi-popular Lecture

The semi-popular lecture this year was given by Dr. Francis Darwin, F.R.S., the subject being "The Balance-sheet of a Plant." The lecture was exceedingly interesting and full of apt illustration, and was much appreciated by a crowded audience. Dr. Darwin explained that the "balance-sheet" of the title referred to the water supply of the plant. The lecture cannot be fully noticed here, but it may be mentioned that Dr. Darwin adduced some convincing experiments of his own to show that Lloyd's contention that transpiration is not regulated by movements of the stomata is contrary to fact.

Miscellaneous Papers.

Wednesday morning was occupied by a series of miscellaneous papers and reports of committees.

Mr. Mangham read a paper in which he gave the results of further work on the translocation of sugars by sieve-tubes. The investigation had been extended to Laminaria, and crystalline osazones were found in the cortical cells, sieve-tubes and hyphæ of two species of this genus, especially at the time of formation of the new lamina in *L. digitata*.

Prof. W. B. Bottomley dealt with the structure and functions of the root-nodules of *Myrica Gale*. He concluded that these nodules are concerned with the assimilation of atmospheric nitrogen, as are those of Cycas, Alnus, and other plants.

Another paper by the same author described some experiments on the effect of bacteriotoxins on the growth of plants. An aqueous extract of manure was found to have an injurious effect on the germination of seeds and on the subsequent growth of the seedlings. The harmful effect (which could be prevented by heating the extract) appeared to be due to bacteriotoxins, probably of the nature of toxalbumoses.

Mr. A. S. Horne suggested that the Cornaceæ are polyphyletic. This hypothesis is the result of a comparative study of the flower in the Cornaceæ and allied orders. The uniovular condition and other resemblances in the order are regarded merely as cases of parallelism, the evolutionary history being different in different cases.

Sir Daniel Morris, F.R.S., directed attention to the recent and rapid spread of *Oidium euonymi-japonicae* in southern England, and urged that steps should be taken to prevent the mischief caused by this pest.

Owing to the limited time available, and the absence of the authors, the following papers were taken as read:—the chromosomes of the hybrid *Primula kewensis*, by Miss L. Digby; and a note on the flora of Shetland, with some reference to its ecology, by Mr. W. West.

Reports of Committees.

Reports were presented by five research committees:—(1) The experimental study of heredity. The following summary of the report will indicate the scope of the work carried on. The experiments on the inheritance of double flowers have been continued. In the case of stocks, the results have now shown that this character is inherited in accordance with definite, though somewhat complicated, laws. Similar experiments have also been carried out on several other genera, chiefly biennials (carnation, hollyhock, &c.). These have now been carried to the third

generation. Investigations are being continued on the inheritance of a mutation in the foxglove. Investigations into the inheritance of colour in *Primula sinensis* have been carried further, and attention has been paid to the genetics of parti-coloured and flaked types. The inheritance of an abnormal type of flower in the wallflower is being investigated, and experiments are also being made with a putative hybrid between two species of Taraxacum. Mrs. Thoday has continued her experiments on the nature and inheritance of the yellow tinge in the sweet pea. (2) Botanical photographs. A second list of photographs collected by the committee has been printed and distributed to the botanical members of the association. By this means it is hoped that the collection will become more widely known, and used for teaching and other purposes. (3) A botanical, zoological, and geological survey of Clare Island. It is hoped that the survey will be completed by the end of the present year. (4) The structure of fossil plants. (5) On a national flora.

ANIMAL SANCTUARIES IN LABRADOR.[1]

A SANCTUARY may be defined as a place where man is passive and the rest of nature active. Until quite recently Nature had her own sanctuaries, where man either did not go at all or only as a tool-using animal in comparatively small numbers. But now, in this machinery age, there is no place left where man cannot go with overwhelming forces at his command. He can strangle to death all the nobler wild life in the world to-day. To-morrow he certainly will have done so unless he exercises due foresight and self-control in the meantime. There is not the slightest doubt that birds and mammals are now being killed off much faster than they can breed. And it is always the largest and noblest forms of life that suffer most. The whales and elephants, lions and eagles, go. The rats and flies, and all mean parasites, remain. This is inevitable in certain cases. But it is wanton killing off that I am now describing. Civilised man begins by destroying the very forms of wild life he learns to appreciate most when he becomes still more civilised. The obvious remedy is to begin conservation at an earlier stage, when it is easier and better in every way, by enforcing laws for close seasons, game preserves, the selective protection of certain species, and sanctuaries. The mere fact that man has to protect a sanctuary does away with his purely passive attitude. Then he can be beneficially active by destroying pests and parasites, like bot-flies or mosquitoes, and by finding antidotes for diseases like the epidemic which periodically kills off the rabbits, and thus starves many of the Carnivora to death. But, except in cases where experiment has proved his intervention to be beneficial, the less he upsets the balance of nature the better, even when he tries to be an earthly Providence.

The strongest of all arguments is that sanctuaries, far from conflicting with other interests, actually further them. But unless we make these sanctuaries soon we shall be infamous for ever as the one generation which defrauded posterity of all the preservable wild life that nature took a million years to evolve into its present beautiful perfection. Only a certain amount of animal life can exist in a certain area. The surplus must go outside. So sanctuaries are more than wild "zoos"; they are overflowing reservoirs, fed by their own springs, and feeding streams of life at every outlet. I might mention many instances of successful sanctuaries, permanent or temporary, absolute or modified—the Algonquin, Rocky Mountains, Yoho, Glacier, Jasper and Laurentides in Canada; the Yellowstone, Yosemite, Grand Cañon, Olympus, and Superior in the United States; with the sea-lions of California, the wonderful revival of ibex in Spain and deer in Maine and New Brunswick, the great preserves in Uganda, India, and Ceylon, the selective work of Baron von Berlepsch in Germany, the curious result of taboo protection up the Nelson River, and the effects on seafowl in cases so far apart in time and space as the Guano Islands under the Incas of Peru, Gardiner Island in the United States, or the Bass Rock off the coast of Scotland.

Yet I do not ignore the difficulties. First, there is the universal difficulty of introducing or enforcing laws where there have been no operative laws before. Next, there is the difficulty of arousing public opinion on any subject, however worthy, which requires both insight and foresight. Then we must remember that protected species increasing beyond their special means of subsistence have to seek other kinds of food, sometimes with unfortunate results. And then there are the several special difficulties connected with Labrador.

But in spite of all difficulties, I firmly believe that Labrador is by far the best country in the world for the best kinds of sanctuary. Labrador decidedly improves on acquaintance. The fogs have been grossly exaggerated. The Atlantic seaboard is clearer than the British Isles, which, by the way, lie in exactly the same latitudes. And the Gulf is far clearer than New Brunswick, Nova Scotia, and the Banks. The climate is exceptionally healthy, the air a most invigorating tonic, and the cold no greater than in many a civilised northern land. Besides, there is a considerable range of temperature in a country the extreme north and south of which lie 1000 miles apart, one in the latitude of Greenland, the other in that of Paris.

Most of Labrador is a rocky tableland, still rising from the depths, with some old beaches as much as 1500 feet above the present level of the sea. The St. Lawrence seaboard is famous for its rivers and forests. The Atlantic seaboard has the same myriads of islands, is magnificently bold, is pierced by fiords unexcelled in Norway, and crowned by mountains higher than any others east of the Rockies. This vast country is accessible by sea on three sides, and will soon be accessible by land on the fourth. It lies directly half-way between Great Britain and our own North West, and is 1000 miles nearer London than New York is. Its timber, mines, and water-power will be increasingly exploited. It should also become increasingly attractive to the best type of tourist, naturalist, and sportsman.

The fauna is much more richly varied than people who think of Labrador as nothing but an Arctic barren are inclined to suppose. The fisheries have been known for centuries, especially the cod, which has a prerogative right to the simple word "fish." There are herring and lobsters in the Gulf, plenty of salmon and trout in most of the rivers, winninish in all the tributary waters of the Hamilton, as well as in Lake St. John, whitefish in the lakes, and so forth. Then the stone-carrying chub is one of the most interesting creatures in the world.

Yet I must not forget the "flies"—who that has felt them once can ever forget them? The bot-fly infests the caribou, and will probably infest the reindeer. The black-fly and mosquito attack both man and beast in maddening millions.

Labrador has more than 200 species of birds, from humming-birds and sanderlings to eagles, gannets, loons, and herons.

Both the land and sea mammals are of great importance. Several whales are well known. The right whale is almost exterminated, but the Greenland, or bow-head, is found along the edge of the ice in all Hudsonian waters. The pollock is rare, and the sperm, or cachalot, as nearly exterminated as the right. But the little-piked, or *rostrata*, is found inshore along the north and east, the bottle-nose on the north, the humpback on the east and south, and the finback and sulphur-bottom are common and widely distributed, especially on the east. The little white whale, or "white porpoise," is fairly common all round; the killer is widely distributed, but most numerous on the east, where the narwhal is also found. The harbour and striped porpoises, and the common and bottle-nosed dolphins, are chiefly on the east and south. There are six seals, the harbour, ringed, harp, bearded, grey, and hooded. The walrus, formerly abundant all round, is now rarely seen except in the far north, where he is fast decreasing.

Moose may feel their way in by the south-west to an increasing extent, and might possibly be reinforced by the

[1] From an address presented by Lieut.-Colonel William Wood before the second annual meeting of the Commission on Conservation held at Quebec.

Alaskan variety. Red deer might possibly be induced to enter by the same way in fair numbers over a limited area. The woodland caribou is almost exterminated, but might be resuscitated. The barren-ground caribou is still plentiful in the north. Their tame brother, the reindeer, is being introduced as the chief domestic animal of eastern Labrador, with apparently every prospect of success. Beaver are fairly common and widely distributed in forested areas. Other rodents are frequent—squirrels, musk-rats, mice, voles, lemmings, hares, and porcupines. There are two bats. Black bears are general; polars in the north. Grizzlies have been traded at Fort Chimo in Ungava, but they are probably all killed out. The lynx is common wherever there are woods. There are two wolves, arctic and timber, the latter now rare in the south. The Labrador red fox is very common in the woods, and the "white," or arctic fox, in the barrens and further south on both coasts. The "cross," "silver," and "black" variations of course occur, as they naturally increase towards the northern limits of range. The "blue" is a seasonal change of the "white." The wolverine and otter are common. The skunk is only known in the south-west. The mink ranges through the southern third of the peninsula. The Labrador marten, or "sable," is a subspecies, generally distributed in the forested parts, like the weasel. The "fisher," or Pennant's marten, is much more local, ranging only between the "North Shore" and Mistassini.

When we consider how easily wild life can be preserved in Labrador, and how beneficial its preservation is to all concerned, we can understand how the wanton destruction going on there is quite as idiotic as it is wrong.

Take "egging" as an example. The Indians, Eskimos, and other beasts of prey merely preserved the balance of nature by the toll they used to take. No beast of prey, not even the white man, will destroy his own stock supply of food. But with the nineteenth century came the white-man market "eggers," systematically taking or destroying every egg in every place they visited. Halifax, Quebec, and other towns were centres of the trade. The "eggers" increased in numbers and thoroughness until the eggs decreased in the more accessible spots below paying quantities. But other egging still goes on unchecked. And this is on the St. Lawrence, where there are laws and wardens and fewer fishermen. What about the Atlantic Labrador, where there are no laws, no wardens, many more fishermen, and ruthless competitive egging between the residents and visitors? Of course, where people must egg or starve there is nothing more to be said.

And it is just as bad with the birds as with the eggs. A schooner captain says. "Now, boys, here's your butcher shop: help yourselves!" and this, remember, is in the brooding season. Not long ago the men from a vessel in Cross Harbour landed on an islet full of eiders, and killed every single brooding mother. In the summer of 1907 an American millionaire's yacht landed a party who shot as many brooding birds on St. Mary Island as they chose, and then left the bodies to rot and the broods to perish. That was, presumably, for sport. Deer were literally hacked to pieces by construction gangs on new lines last summer. Dynamiting a stream is quite a common trick wherever it is safe to play it. Harbour seals are wantonly shot in deep fresh water where they cannot be recovered, much as seagulls are shot by blackguards from an ocean liner.

And the worst of it is that all this wanton destruction is not by any means confined to the ignorant or those who have been brought up to it.

We have had our warnings. The great auk and the Labrador duck have both become utterly extinct within living memory. The Eskimo curlew is decreasing to the danger point, and the yellowlegs is following. The lobster fishing is being wastefully conducted along the St. Lawrence; so, indeed, are the other fisheries. Whales are diminishing. The walrus is exterminated everywhere in Labrador except in the north. The seals are diminishing. The woodland caribou has been killed off to such an extent as to cause both Indians and wolves to die off with him. The barren-ground caribou is still plentiful, though decreasing.

All the sound reasons ever given for conserving other natural resources apply to the conservation of wild life—and with threefold power. When wild life is squandered it does not go elsewhere, like squandered money; it cannot possibly be replaced by any substitute, as some inorganic resources are: it is simply an absolute dead loss, gone beyond even the hope of recall. How is Labrador to be brought under conservation, before it is too late, in the best interests of the five chief classes of people who are concerned already, or will be soon? The five great interests are those of (1) food; (2) business; (3) the Indians and Eskimos; (4) sport; and (5) the zoophilists, by which I mean all people interested in wild animal life, from zoologists to tourists.

The resident population is so sparse that there is not one person for every 20,000 acres; and most of these people live on the coast. Consequently, the vast interior could not be used for food supplies in any case.

Business is done in fish, whales, seals, fur, game, plumage, and eggs. The fish are a problem apart. But it is worth noting that uncontrolled exploitation is beginning to affect even the countless numbers in certain places. No one wants his business to be destroyed. But if Labrador is left without control indefinitely every business dealing with the products of wild life will be obliged to play the suicidal game of competitive grab until the last source of supply is exhausted, and capital, income, and employment all go together.

The Eskimos are few, and mostly localised. The Indians stand to gain by anything that will keep the fur trade in full vigour, as they are mostly hunters and trappers. Restriction on the number of skins, if that should prove necessary, and certainly on the sale of all poisons, could be made operative.

Sport should have a great future in Labrador. The extension and enforcement of proper game laws would benefit sport directly, while indirectly benefiting all the other interests.

The zoophilist class seems only in place as an afterthought. But I am convinced that it will soon become of at least equal importance with any other. All the people, from zoologists to tourists, who are drawn to such places by the attraction of seeing animal life in its own surroundings already form an immense class in every community; and it is a rapidly increasing class.

Partly because Quebec has taken the lead in legislation, and partly because an ideal site is ready to hand under its jurisdiction, I would venture to suggest the immediate establishment of an absolute sanctuary for all wild birds and mammals along so much of the coast as possible on either side of Cape Whittle. The best place of all to keep is from Cape Whittle eastward to Cape Mekattina, sixty-four miles in a straight line by sea. Cape Whittle is a great landmark for coasting vessels and for the seal herds as well. A refuge for seals is absolutely necessary to preserve their numbers and the business connected with them. The case of the birds is quite as strong, and the chance of protection by this sanctuary much greater.

There is the further question—affecting all migratory animals, but especially birds—of making international agreements for their protection. There are precedents for this, both in the Old World and in the New; and, so far as the United States is concerned, there should be no great difficulty. Immediate steps should be taken to link our own bird sanctuaries with the splendid American chain of them which runs round the Gulf of Mexico and up the Atlantic coast to within easy reach of the boundary line. Corresponding international chains up the Mississippi and along the Pacific would be of immense benefit to all species, and more particularly to those unfortunate ones which are forced to migrate down along the shore and back by the middle of the continent, thus running the deadly gauntlet both by land and sea.

Inland sanctuaries are more difficult to choose and manage. A deer sanctuary might answer near James Bay. Fur sanctuaries must also be in some fairly accessible places on the seaward sides of the various heights-of-land, and not too far in. The evergreen stretches of the East-main River have several favourable spots. What is needed most is an immediate examination by a trained zoologist. The existing information should be brought together and carefully digested for him in advance.

THE PRESENT POSITION OF ELECTRIC STEEL-MELTING.[1]

THE melting of steel by means of electricity has passed the merely experimental stage and become one of the commercial processes by means of which steel is manufactured for the market. It is not correct to say that it has emerged from the experimental stage, however, as not only this process of steel-making, but most other processes, are being continually experimented with and the results compared with one another by up-to-date and vigorous firms, not only for the new conditions that are always arising, but also for old and well-tried conditions.

A new demand arises or repeat orders come in, and the manufacturer must ask himself what kind of steel will best suit the purpose at the present time. Will Bessemer or open-hearth steel be most suitable to satisfy the demand, price, quality, and all other matters considered, and must it be acid steel or will basic do, or is it necessary or desirable to use crucible steel, or perhaps this new electric steel, to maintain or increase his profit or his reputation for certain goods? These are problems of daily occurrence; and although the difficulties of the manufacture of electric steel by various processes have been fairly well overcome, so far as making it to specification of chemical composition and mechanical tests is concerned, it is in connection with such questions as are indicated in the previous sentence that it is still in the earlier experimental stage. All other processes, however, are more or less under such trials until they become extinct. The point need not be laboured, for many examples will come to the mind at once, such as the comparative merits for various purposes of Swedish-Lancashire and Walloon iron, of mild steel and wrought iron, of acid and basic steel, and so on. The general impression gathered from much conversation with users is that the arc-furnace product from slightly impure materials, purified to Swedish standard, just about takes its place by Swedish open-hearth and Bessemer steels, and that the induction-furnace product skilfully made from pure materials equals anything but the very highest qualities of crucible steels. These are very general statements, but they represent the writer's present more or less intuitive opinions, and only time can determine whether they are correct; for the fact that steels are of certain chemical compositions and give certain mechanical tests is not a final judgment, but the quality and length of service given in actual use. The special feature of the Héroult and Röchling-Rodenhauser types is that with an oxidising purification phosphorus can be eliminated to almost any extent that will pay, and after removing the slag, and forming another, by a reducing purification sulphur can similarly be removed.

The Kjellin induction furnace acts as a melter of materials much after the manner of the crucible, and has one advantage over the crucible in that there is no absorption of sulphur during melting. Recent experiments with covering slags specially calculated by the writer to give a minimum of change in composition during melting show, according to a student's preliminary analysis, compositions in the ingots practically equal to those by calculation from the constituents, a result better than expected, but still requiring thorough checking. The results at least serve as a text for one fact that must never be forgotten. The electric furnace, of whatever design, will not make good steel automatically. The same metallurgical skill required by the older processes must be expended on the proper killing and finishing of the steel by whatever type of electric furnace it is being melted, and the fact that in electric as in other furnaces bad steel may be made from good materials increases the difficulties of finding the exact place of any steel in the world's work. Several cases where the electric steel has been found unsuitable, especially in the earlier days, have been investigated, and it has been found that the steel has been wrongly made. In other cases no such explanation could be given. Recently I had a long talk with a man using large quantities of electric steel; he could get great purity, but no better mechanical tests; yet he found the electric steel gave a better life than his former steel, and so he used it. Here again another difficulty comes in as represented by the fact that I did not think his ordinary steel was specially well made.

One point of importance is that this production of electric steel has introduced a new competitor into the field by giving great impetus to the use of what is sometimes called white coal, namely, the great waterfalls, mostly far removed from coal; and much energy is now being used that formerly ran to waste, whilst the successful application of electric power to the production of charcoal pig-iron allows of a much reduced consumption of charcoal. The rapidly increasing price of charcoal in Sweden, owing, among other causes, to so much of the wood being used for making wood pulp for paper-making, is quite a serious situation, which this application of electric power may help to relieve.

The whole subject of electric iron-smelting and electric steel-melting is attracting much attention. Several books have been published on electric furnaces; and during 1909 and 1910 many interesting articles on the subject have appeared in the technical journals, and many papers have been read before the Iron and Steel Institute. At the autumn meeting of 1909 Mr. C. A. Ljungberg gave a paper on production of iron and steel by electric-smelting processes. He mentioned the Kjellin electric induction furnace at Gysinge, with which the writer had the pleasure of making with Mr. E. C. Ibbotson a full week's trial, as being still in work, making tool steel, special steels, self-hardening and high-speed steels, and others such as nickel and chromium steels. The paper dealt more in detail, however, with the successful experiments on smelting pig-iron at Domnarfvet by electrical means, and the resulting saving in the proportion of charcoal used.

It will be only necessary merely to touch upon the various principles used in the construction of electric furnaces, as these are found in text-books and in the Proceedings of the Iron and Steel Institute. Having obtained an electric current, its energy may be converted into heat by putting a suitable resistance in its path, and the heat may be concentrated at any part of the circuit by making the resistance of other parts small in comparison. If the resistance be a solid or a liquid, then it is called resistance-heating; if a gas, arc-heating. If the liquid through which the current passes is decomposed by the current so that one kind of matter goes to one pole and another kind to the other pole, the liquid is called an electrolyte.

Varieties of Electric Furnaces.

The Stassano furnace is an independent arc furnace. Three carbon electrodes are used, between which arcs play, and the heat from the arc is merely used for heating the charge, partly by direct radiation and partly by reflection from the dome of the furnace.

The Héroult steel-melting furnace is a direct-arc type in which the charge forms one pole of the arc. Two vertical carbon electrodes come through the roof of the furnace and two arcs play, one between each electrode and the molten metal or slag beneath it, the current passing from one electrode through the metal or slag and up through the other electrode.

The Girod furnace, like the Héroult, is a direct-arc furnace, but one or more electrodes of like polarity are maintained above the bath, and soft steel pieces embedded in the hearth of the furnace are in direct contact with the molten metal for the negative electrode. These lower pole-pieces are water-cooled. Large quantities of ferro-silicon, ferro-chrome, &c., as well as of ordinary carbon and special steels, are made in this furnace.

The Keller steel furnace is a direct-arc furnace, very much like the Héroult, only instead of two electrodes coming down into one cavity they come into separate cavities, which are joined by the molten material of the bath.

The Grönwall is of the arc type, and the current enters by two electrodes through the roof; and when once the bath is heated, so that the lining becomes a conductor, the current from both electrodes passes through the lining to a graphite block underneath, and hence to a common wire.

The Nathusius, like the Grönwall, is a combined arc and resistance furnace. It contains three vertical carbon electrodes, arranged at the apices of an equilateral triangle,

[1] Report presented at the Portsmouth meeting of the British Association (Section B) by Prof. Andrew McWilliam.

and three steel electrodes similarly arranged in the bottom of the furnace, but covered by refractory material. Three-phase current is used, and it is claimed that the current flows from one top electrode to the others, from one bottom electrode to the others, and from each top electrode to each bottom electrode.

Kjellin Induction Furnace.—In this furnace, an example of which is in the metallurgical laboratory of the University of Sheffield, and was shown working to the members of the British Association, the metal charge is placed in an annular hearth, almost like a steel-melting crucible in section, but in the form of a ring. The primary coil of twenty-four turns is placed in the centre round a core of laminated iron. The bath or ring of metal acts as a secondary circuit of a single turn, and the heat is thus produced in the charge itself without contact with electrodes. In the Frick furnace the primary coil is above the crucible, and in the Colby round the outside of the crucible.

The Röchling-Rodenhauser furnace is based on the Kjellin principle, but has an important addition. In its simplest form, for single-phase current, there are two grooves, or heating channels, corresponding to the annular crucible of the Kjellin, but these join to a central open-hearth, the whole hearth forming a kind of figure 8. In the central open-hearth all the distinctly metallurgical operations take place, so that this form can be used for refining work, for which the Kjellin is not very suitable. Not only so, but a distinct secondary winding is provided in which a secondary current is induced, and these windings are joined to steel terminal plates which are embedded in the refractory material of the furnace at the ends of the central hearth. At high temperatures the refractory material becomes a conductor of electricity, and thus the currents induced pass through the bath in the central hearth, heating it still further.

There are many others, some only on paper; but these are the principal varieties that have been tried with any considerable degree of success. The loss in melting is an important point, and I am informed that this amounts to about 1½ per cent. in the Kjellin, about 4 to 5 per cent. in the Röchling-Rodenhauser, and 7 to 8 per cent. in arc furnaces.

In considering the present position of the electric steel-melting industry regard must be had to the numbers and capacities of the various types of furnaces in work, not in work, and being built, although a complete survey should also take account of the nature and quality of the materials being made, for a furnace making a ton of high-speed steel should obviously be credited with more importance in the commercial world than one making a ton of steel for rails. The progress in numbers and capacities and in output should also be considered. So far as one could ascertain, about June, 1910, there were about 118 furnaces of all types, of which 70 were in use, 10 not working, and 38 being built. There were 77 of the arc furnaces recorded, of which 29 were credited as Héroult, 17 Girod, 13 Stassano, 6 Keller, and 9 others; besides one furnace at Domnarfvet, Sweden, for the production of 2500 tons of pig-iron per annum, with one in Norway and one at Trollhättan, Sweden, both in course of construction, and each designed to produce about 7500 tons of pig-iron annually. Of the Héroult furnaces, the total capacity per charge of those working was about 80 tons, and of those in course of construction about 50 tons. The Girod furnaces, the great competitors of the Héroult, were recorded at about 38 tons in work and 26 tons being built. Similarly, the figures for the Keller were 13 tons and 5 tons, and for the others 20 tons and 13 tons respectively.

Of the induction furnaces, the Kjellin furnaces erected totalled fourteen, with 35 tons capacity; the Röchling-Rodenhauser fifteen, with 30 tons in work, 1 ton not in work, and 17 tons capacity being built; all others about 18 tons in work. That gave a total capacity of about 250 tons for the arc furnaces and 100 tons for the induction, or a grand total of 350 tons per charge for all electric steel-melting furnaces. Pressure of other work has prevented me from getting the latest figures from all the firms making electric furnaces, but I have obtained these from the two most important firms, viz. the Héroult and the Kjellin and Röchling-Rodenhauser, and in this connection would record my best thanks to Mr. Donald F. Campbell and Mr. E. C. Ibbotson, respectively, for their kind help and trouble in getting me this information. Comparing the Héroult furnaces only, as an example, we have seen that in June, 1910, there were twenty-nine of these furnaces with a capacity of 80 tons in work and 50 tons in course of erection, 130 tons in all; whilst about June, 1911, there were forty-three furnaces, with a total capacity of about 242 tons

The output of electric steel in Germany, the United States, and Austria-Hungary in 1910 amounted to almost 112,000 tons, which is an increase of 63,000 tons over the figures for 1909. These are the only countries for which the exact output of electric steel is published, but there is no doubt that the figures for Sweden, France, Belgium, and Italy would also show large gains. The increase will probably be more than maintained in 1911, as more than thirty new furnaces of various types should be started during the year, and many which only started towards the end of 1910 will put in a full year's work in 1911. England will also for the first time appear as a regular producer. Before the beginning of the present year the Héroult furnace at Edgar Allen's in Sheffield was the only arc one in steady operation. In January three Héroult furnaces were commenced in England: at Vickers' and Thos. Firth and Sons' in Sheffield, and at Lake and Elliott's in Braintree, Essex. A Grönwall furnace, for demonstration and manufacturing purposes, also started at about the same time in Sheffield; and the output of England for 1911 should amount to about 13,000 tons. A 15-ton Héroult furnace is to be erected at Skinningrove shortly, and is expected to turn out 200 tons per day. About the same period Kjellin induction furnaces have been working satisfactorily at Vickers and Jessop's in Sheffield and an experimental furnace at the University of Sheffield.

Great progress will be made in Germany with electric furnaces during the next year, when Héroult furnaces of 25 and 22 tons capacity are to be constructed. At present the largest size are the two 15-ton Héroult furnaces at S. Chicago and Worcester, belonging to the United States Steel Corporation, who have recently acquired the Héroult patents for America, and will probably erect several more furnaces shortly.

The electric furnace can be used either for melting scrap directly or in combination with some other form of furnace, in which case it simply acts as a refiner. The majority of the recent furnaces have been employed in this way, in conjunction either with Bessemer or open-hearth furnaces. The latter are usually of the basic tilting type, part of the charge being removed to the electric furnace after the pig is melted and the bulk of the phosphorus removed, leaving some phosphorus and the oxygen and sulphur to be eliminated by the electric furnace. In this case the time required for the electric furnace is from one hour to two hours, according to the degree of refining required and the original condition of the steel when removed from the basic furnace. The power used varies from 100 to 300 kw. hours per ton. When cold scrap is melted the time required is about six hours, and the power consumption said to be from 650 to 750 kw. hours; but really, all in, more probably 800 to 1000 per ton. Of the forty-four Héroult furnaces in operation or construction twenty-one are to melt scrap, twenty to take molten steel from the basic open-hearth, one from a Talbot furnace, and two from converters.

Electric furnaces are being employed in the following cases:—

(1) To replace crucibles. The gain is then one of cost of production.

(2) For foundries. Electric furnaces are being used in many foundries. At Georg Fischer's and Schaffhausen they are the only furnaces employed, and Lake and Elliott, of Braintree, are now making most of their steel electrically.

(3) To replace Swedish Bessemer steel, and for steel of axle and tyre quality.

(4) For weldless tubes. The Mannesmann Company has Héroult furnaces in Germany and Italy.

(5) In combination with Talbot furnaces. Owing to the fact that the heat need not be sufficiently great for teeming on transference to the electric furnace, the output of the Talbot and the life of the lining and roof are said

to be largely increased. This will be the procedure at Skinningrove for making rails.

(6) For melting turnings, especially high-speed turnings. These make excellent scrap for the electric furnace. Nickel scrap can be melted without any loss of nickel.

There are two aspects of the present position of a comparatively new industry. One is the progress made during the year, and an endeavour has been made to present that point of view. Another aspect is the actual state of the industry at present, and that can best be judged by the following two tables representing the furnaces, capacities, and kind of work done by all the furnaces under the care of the two principal firms already named. A very interesting item in the induction-furnace list is the entry representing the fact that the Kjellin furnace has been adopted for melting the metal for the manufacture of those delightful, though expensive, culinary vessels of pure nickel so much appreciated now.

List of Héroult Furnaces in Construction or Operation.

Country	Firm	Size of Furnace	Method of Melting
		Tons	
England	Edgar Allen and Co., Ltd., Sheffield	2½	Tilting basic open-hearth
	Skinningrove Iron Co., Yorkshire	15	Talbot
	Vickers, Ltd., Sheffield	3	Melting scrap in electric furnace
	Thos. Firth & Sons, Ltd., Sheffield.	2½	,, ,,
	Lake and Elliott, Braintree	2½	,, ,,
Austria	Kaernthner Eisen & Stahl Werke	5	,, ,,
	Gebr. Böhler & Cie. A.G. Kapfenberg	2½	,, ,,
	Brüder Lapp, Rottenmann, Works, Steiermark	4	,, ,,
	Danner & Co., Judenberg	6	,, ,,
Belgium	Société des Usines Métallurgiques du Hainaut, Coultret	2	,, ,,
	Société Anonyme Ougrée-Marihayé, near Liège	5	Basic open-hearth
France	Société Electro-Métallurgique Française, La Praz, Savoie	5	,, ,,
	Aciéries du Saut du Tarn, St. Juéry	2½	Melting scrap in electric furnace
	Usine Métallurgique de la Basse Loire, Trignac	5	,, ,,
Germany	Works of August Thyssen :—	5	Basic open-hearth
	Deutscher Kaiser Stahlwerke, Bruckhausen	7	,, ,,
	Deutscher Kaiser Stahlwerke, Mülheim	6	,, ,,
	Deutscher Kaiser Stahlwerke, Bruckhausen	25	,, ,,
	Stahlwerke Richard Lindenberg, Remscheid-Hasten	2	Tilting basic open-hearth
	Bismarckhütte, Upper Silesia	3	
	Mannesmann Röhren Werke, Saarbrücken, Burbach	1	Melting scrap in electric furnace
	Rombacher Hüttenwerke, Rombach	3	Open-hearth
	Deutsch Luxemburgische, Dortmund	22	,, ,,
		3	,, ,,
		7	,, ,,
Italy	Società Tubi Mannesmann, Dalmine	6	Melting scrap in electric furnace
Russia	Imperial Steel Works, Obuchow, St. Petersburg	6	
	Aktiengesellschaft der Hütten und mechanischen Werke, Ssormovo	3½	Open-hearth
	Société Générale des Hts. Fourneaux & Aciéries en Russie, Makejawka	3	,, ,,
Sweden	Aktiebolaget Héroults Elektriska Stal, Kortfors	6	Melting scrap in electric furnace
Switzerland	Georg Fischer, Schaffhausen	1½	,, ,,
Canada	Electro Metals, Welland	5	,, ,,
United States	United States Steel Corporation, S. Chicago	15	Bessemer
	United States Steel Corporation, Worcester	15	Basic open-hearth
	Firth-Stirling Co., Syracuse, New York	2½	Melting scrap in electric furnace
	Halcomb Steel Co., Syracuse, New York	5	Tilting basic open-hearth
	Crucible Steel Co. of America, Pittsburg, Pa.	5	Basic open-hearth
Mexico	Cie. Mexicano Aciero & Productos Chemicos	4	Melting scrap in electric furnace
	43 Furnaces	242½	

List of Kjellin and Röchling-Rodenhauser Furnaces now in Operation or in Erection.

Type	No.	Country	Firm	In Operation	Not in Operation	In Erection	Kind of Current	Kw.	Notes
				Charge Kg.					
Kjellin	1	GERMANY	Fr. Krupp, A.-G., Essen a.R.	8500			Single phase	750	
Röchling-Rodenhauser	2		Oberschlesische Eisen-ind. A.-G., Gleiwitz	1500			,, ,,	180	
	3		Röchling'sche Eisen- & Stahlwerke Volklingen	7000			Three phase	750	
	4			2000			,, ,,	275	
	5			—		2000	,, ,,	275	
	6			—		2000	,, ,,	275	
	7		Pilgar und Neidhardt, Frankfurt a.M.	—		2000	Single phase	275	
	8		Bergische Stahlindustrie Remscheid	5000			,, ,,	500	
Röchling-Rodenhauser	9	LUXEMBURG	Le Gallais, Metz & Co., Domneldingen	3500			,, ,,	380	
	10			3500			,, ,,	380	
	11			700			,, ,,	100	
	12			1500			Three phase	275	
	13			3500			Single phase	380	
Kjellin	14	AUSTRIA	Poldihütte, Kladno	4000			,, ,,	440	
	15		J. Braun's Söhne, Vocklabruck	400			,, ,,	65	In operation when water available.
Röchling-Rodenhauser	16	FRANCE	Aciéries de la Marine et d'Homecourt, St. Chamond.	—		3000	Three phase	350	
Kjellin	17	GREAT BRITAIN	Vickers, Sons & Maxim, Sheffield	—	1500	—	Single phase	230	Not in operation at present moment.
	18			—		180	,, ,,	100	
	19		W. Jessop & Sons, Sheffield	—		1800	,, ,,	250	
	20		The University of Sheffield	100			,, ,,	60	Experimenting Furnace.
Röchling-Rodenhauser	21	BELGIUM	Aciéries Liégeoises, Bressoux-les-Liége	—	1000	—	Three phase	200	Firm in Liquidation.
Kjellin	22	ITALY	Alti Forni Gregorini, Lovere	—		1500	Single phase	330	
	23	SPAIN	Vidua de Urigeitia é Hija, Araya	1500		—	,, ,,	215	In intermittent operation.
Kjellin	24	SWEDEN	Domnarfvets Jernverk (Gysinge)	1500			,, ,,	175	
	25		Sybry Searls, Ltd., Trollhättan	2000			,, ,,	300	
Röchling-Rodenhauser	26	RUSSIA	Kronwerke Slatoust	—		1000	Three phase	175	In operation when water available.
Kjellin	27	U.S.A	American Electric Furnace Co., Niagara Falls	750		—	Single phase	150	
Colby	28			100		—	,, ,,	60	
Kjellin	29		General Electric Co., Schenectady	60		—	,, ,,	50	
Röchling-Rodenhauser	30	MEXICO	Ricardo Honey, Mexico	—		2500	Three phase	300	

Besides : 1 Furnace at the Berndorfer Metallwarenfabrik, A. Krupp, Berndorf, for treatment of nickel and nickel alloys.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Recent appointments include:—Mr. J. E. Coates, special lecturer in physical chemistry, to succeed Prof. Alex. Findlay; Dr. E. P. Frankland, Mr. P. May, and Mr. Ernest Vanstone assistant lecturers and demonstrators in chemistry; Dr. Thomas Yates, special lecturer in osteology; Dr. J. R. Heath, lecturer in physiology.

The council of the University has decided to increase from 25*l.* to 100*l.* the annual grant to the Workers' Educational Association, which provides classes for working men and women.

PROF. G. E. HALE is prepared to receive applications for the post of assistant in the department of stellar spectroscopy at the Mount Wilson Solar Observatory. Practical experience of observatory work is desirable, and a knowledge of physical optics and spectroscopy is essential.

THE *London University Gazette* announces that a bequest has been made to "the governors for the time being of University College" by the late Mr. A. R. T. Momber of certain shares of his estate. Under the benefaction a sum of 7000*l.* will eventually accrue to the University.

IT is stated in *Science* that President W. H. P. Faunce has announced that 80,000*l.* of the endowment fund of 200,000*l.* which Brown University is endeavouring to secure has already been subscribed. The General Education Board has contributed 30,000*l.*, and eight gifts of 5000*l.*, together with smaller amounts aggregating 10,000*l.*, have been received. From the same source we find that Mr. Charles Scribner has given to Princeton University a completely equipped printing plant, provided at a cost of 25,000*l.*

AN appeal for funds towards the establishment of a modern university in Central China at Hankau-Wuchang has just been made. The scheme is promoted by committees representative of the Universities of Oxford, Cambridge, and London in this country, and of the Universities of Harvard, Columbia, California, and Toronto in Canada and the United States of America. During the three years which have elapsed since its inception the committee has been engaged in settling the lines upon which the University is to be founded, in locating the most advantageous site, in appointing the first president (Mr. W. E. Soothill, late principal of the Imperial University of Shansi), and in other essential preliminaries. An appeal is made for a capital sum of 250,000*l.* for the foundation of the University, the purchase of a site, the erection and equipment of buildings, and the endowment of professorships. It is hoped that one half of this sum, 125,000*l.*, will be the British contribution towards the project, and that the other half will be contributed by America. The general basis of the University will be that of a teaching and examining body working in cooperation with a number of self-governing residential colleges and hostels. The foundation of a university for Central China is desirable on the ground that in this way Great Britain and America can render to China at the present stage a service of incalculable importance and of far-reaching consequence. A seat of learning will thus be established in China which will be inspired by the best traditions of the cooperating Western universities. Donations can be sent to the Most Hon. the Marquess of Salisbury, G.C.V.O., 20 Arlington Street, London, W., or to the honorary treasurer, University for China, 22 Albemarle Street, London, W. Cheques should be drawn in favour of the "University for China." Further particulars can be obtained from the secretary, 22 Albemarle Street, London, W.

THE Education Committee of the London County Council at a recent meeting came to certain important conclusions as to applications from the Senate of the University of London for maintenance grants in aid of incorporated schools and institutions maintained by the University. After reviewing the conditions in the various colleges, the following resolutions were eventually adopted:—"That the Senate of the University of London be invited to prepare and submit to the Council a statement of the policy which it intends to pursue pending the publication of the report of the Royal Commission on University Education in London, together with an estimate of the additional assistance (if any) which may be required from the Council to enable such policy to be carried out." "That, on receipt of the statement and estimate referred to in the foregoing resolution, the Council will be prepared to consider as to the amount of assistance it should give to the University during the academic years 1911–12, 1912–13, and 1913–14; and that the Senate be so informed." "That the Council is not prepared, during the period of three years referred to in the foregoing resolution, to consider any applications for further maintenance grants either for the educational work conducted directly by the University or for the maintenance of the incorporated schools; that the Council does not undertake to continue, after the expiration of the above period of three years, any grant which it may decide to make to the University under the above-mentioned recommendations; and that the Senate be so informed." The committee thinks it is of great importance that it should be clearly laid down that any grant which may be given will be strictly temporary. On the publication of the report of the Royal Commission the whole question of the future government and policy of the University will have to be dealt with, and, among other important questions, that of the relation of the University to the schools which are at present incorporated will come up for discussion. The London County Council, as the authority for higher education in London, should be able, the committee maintains, to impress its views upon these matters upon Parliament and the governing body of the University. The most effective way in which the Council can impress its views is by means of its maintenance grants, and the committee thinks that it must be made clear that the Council will be in no way pledged to continue any grant which it may decide to make to the University at the present time.

THE annual meeting of the Association of Teachers in Technical Institutions was held on November 4. In moving the adoption of the report of the council, Mr. North, the president, directed attention to the evidence which had been given by the association to the Royal Commission on the London University, emphasising the necessity for the formation of an autonomous faculty of technology within the University, and urging that the Imperial College of Science, the London polytechnics, and possibly some provincial technical institutions should form constituent elements of this faculty. In discussing the recent Board of Education circular relating to the new scheme of examinations and grouped courses, he regretted the hasty manner in which the scheme of the Board had been brought into operation. The circular showed a lack of practical knowledge of the actual conditions of the work in technical institutions comparable with that displayed by the Board in the changes introduced last year in the matter of registration. Mr. North referred also to the steps which had been taken by the council in the direction of securing the presence of teachers from technical institutions upon all local advisory committees dealing with juvenile employment. In seconding the adoption of the report, Mr. Abbott, the honorary secretary, pointed out the necessity for the association to continue its efforts for the development of technical education. At the present time technical education in England, if not actually on the downgrade, is stationary. The returns recently published by the Board of Education for the session 1909–10 show that the number of day students in technical institutions is slightly lower than that in the previous session, while the number of evening students is practically the same. After the adoption of the report a discussion was opened by Prof. Schwartz upon the changes recently made by the Board of Education with regard to the abolition of all first-stage examinations and the withdrawal of all examinations in certain subjects. He welcomed this change as one which would lessen the weight of external examinations, which have, up to the present, lessened the real educational work of the technical institutions. He advocated the replacement of the external examinations in Stage i. by internal examinations in the case of the larger institutions, and possibly by groups of institutions for the smaller schools. The president of the association for the year 1911–12 is Dr. J. Clark, rector of the Kilmarnock Academy, and director of technical education for Kilmarnock.

SOCIETIES AND ACADEMIES.

LONDON.

Roval Society, November 2.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir W. de W. **Abney**: Colour-blindness and the trichromatic theory of colour-vision. Part iii.—Incomplete colour-blindness. The first part of the paper shows how, if an equation be formed by rays in known position in the spectrum to match a white, by normal vision and by the colour-blind, the two can be compared together without special reference to the luminosity of the matched white. The luminosities of all the rays are known in the one case, and only two in the second, and from the two matches the unknown deficiency of colour sensation can be calculated. Owing to the fact that large quantities of their white can be mixed with the colours without being detected by those incompletely colour-blind who have a small factor for one of their sensations, a very false interpretation of their colour-blindness might be arrived at by the method described above. If, however, the luminosity of the composite white and the matched white be carefully equalised, a full determination of the colour deficiency can be arrived at by treating the equation somewhat in the manner described in part ii. of this same subject, when a true result is obtained. The latter part of the paper dealt with colour equations made from the rotation of discs; and it is shown that trustworthy results can be obtained from their use so long as the sensations stimulated by the pigments in the light in which they are viewed are known in amount. The method of ascertaining the sensation composition of the pigments, and of the light used for their illumination, is described. When once these are known, no further appeal to the spectrum is required. The author recommends the use of a white light passing through a yellow substance, such as chromate of potash solution, as a viewing light, in which only the red and green pigments are required in the inner disc, the blue not being wanted. The "grey" match becomes thus much brighter and is easier to read.—H. R. A. **Mallock**: Note on the iridescent colours of birds and insects. In this note reasons are given for the view that certain forms of brilliant coloration which occur in the feathers of birds and in the scales and integuments of insects are due to interference, and are of the nature of the colours of thin plates. Walter, in 1895, in Germany, and quite recently Michelson in America, have written on this subject, and, basing their opinions on the behaviour of polarised light when reflected from the colour-producing surfaces, conclude that the colours are due to selective absorption and reflection, and are akin to those reflected from certain anilin dyes and from metals. The reasons against this view and in favour of interference are (1) that when any of these natural colour-producing structures are penetrated by a fluid having the same refractive index as that of the material of which the structure is composed, the colour disappears; (2) when the refractive index of the fluid is less, the colour does not disappear altogether, but changes towards the red; (3) (which is perhaps the most important) under mechanical pressure the colours first change towards the red and then (as the pressure increases) disappear. These results are what might be expected from a structure which produces interference, and it is difficult to reconcile them with any other hypothesis. The note is founded on observations, extending over many years, on examples of this class of colour production taken from a considerable number of orders and genera, both of birds and insects, and the methods of examination employed are shortly described.—K. R. **Lewin**: The behaviour of the infusorian micronucleus in regeneration. When *Stylonychia mytilus* is cut in two, so that each merozoon receives one member of the meganucleus and one micronucleus, both fragments exhibit in favourable circumstances complete regeneration. This involves segmentation of the meganuclear member and division of the micronucleus. If a portion of the cytoplasm be removed from the hind end of the animal without disturbing the nuclei, there may occur during regeneration a division of one, usually the posterior, micronucleus. The result is to furnish the regenerated infusorian with three micronuclei instead of two, *i.e.* the division does not restore, but actually disturbs, the nuclear relations characteristic of the race. When the regenerated individual proceeds to fission, all three micronuclei divide. That an extra division can be introduced into the normal cycle of mitoses shows that the organella is in a fit state to divide before the whole animal is ready for spontaneous fission; that the supernumerary mitosis occurs during regeneration suggests that the stimulus causing the micronucleus to divide may be the condition of the surrounding cytoplasm which obtains during the constructive activities of regeneration. The cases in which regeneration occurs without either of the micronuclei dividing can be supposed to be those in which either the micronuclei were not ripe for mitosis or the stimulus was not sufficiently intense to evoke a division—by reason, *e.g.*, of regeneration occurring slowly, with no great intensity of constructive processes at any time. At the normal fission of the animal, when all the micronuclei present divide, there is a general formation of new parts quite comparable with the localised activity in regeneration, and accomplished, it is natural to suppose, with much the same condition of the cytoplasm. The normally occurring mitoses, and those taking place during regeneration, can thus be brought under one point of view.—A. F. **Hayden** and W. P. **Morgan**: An inquiry into the influence of the constituents of a bacterial emulsion on the opsonic index. These experiments, so far as they have gone, show that in the technique of the estimation of the tubercle opsonic index the quantity and character of the contents of the bacterial emulsion must be taken into account, and that the chief factor influencing the estimation is the finely ground bacterial detritus resulting from the process of triturating the dried culture of the bacillus.—Colonel Sir David **Bruce**: The morphology of *Trypanosoma gambiense* (Dutton).—A. H. **Caulfeild**: (1) Factors in the interpretation of the inhibitive and fixation serum reactions in pulmonary tuberculosis; (2) preliminary report upon the injection of rabbits with protein-free (tuberculo-) antigen and antigen-serum mixtures.

Physical Society, October 27.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Hon. R. J. **Strutt**: Further observations on the afterglow of electric discharge and kindred phenomena. It is shown that ozone prepared by means of the Siemens ozone tube used at atmospheric pressure is able, when mixed with nitric oxide, to give the greenish-yellow afterglow flame. This result is only attained, however, when the ozone has been concentrated by fractional distillation. A blue glow is obtained under the same conditions with sulphuretted hydrogen and ozone. The effect of sulphur compounds in improving the air-glow noticed by the older experimenters is shown to be due, not to any direct intervention of these bodies in the reaction, but to their power of destroying organic matter prejudicial to ozone. When once this is got rid of, the sulphur compounds are of no further advantage. It is found that pure oxygen does not give an afterglow. The afterglow seen in electrodeless bulbs containing oxygen is due to some interaction with water vapour. The luminosity given out when ordinary spring water is shaken with ozone is shown to be due to oxidation of peaty matter contained in it. Brown peat water gives greatly enhanced luminosity.—Prof. C. G. **Barkla** and J. **Nicol**: Homogeneous fluorescent X-radiation of a second series. It was shown by one of the writers that the fluorescent X-radiations emitted by elements exposed to primary Röntgen radiation can be arranged in series, one radiation in a particular series being emitted by each element, and the radiation belonging to that series becoming more penetrating with an increase in the atomic weight of the radiating element (Proc. Camb. Phil. Soc., May, 1909). The homogeneity of radiations of only one series (the K series) was shown by Barkla and Sadler. This paper describes experiments showing the homogeneity of fluorescent X-radiations in the second series (the L series), and exhibiting the homogeneity of radiations of the two series from a number of elements. Details are given of the observations on the radiations from barium. Similar results are recorded in the case of the radiations from iodine, antimony, and silver. The homogeneous fluorescent radiations of different series are emitted simultaneously by an element exposed to Röntgen radiation of more penetrating type than either. The fluorescent X-radiations can

thus be analysed into well-defined radiations widely different in penetrating power, and may be said to give a line spectrum in X-rays. The absorbability of the fluorescent radiations is given by the following values of λ/ρ, where λ is the coefficient of absorption of these radiations in aluminium of density ρ :—

Ag radiation :	(Series K)	[2·5] ;	(Series L)	700
Sb	,,	,,	1·21	,,	435
I	,,	,,	0·92	,,	300
Ba	,,	,,	0·8	,,	224

PARIS.

Academy of Sciences, October 30.—M. Armand Gautier in the chair.—B. **Baillaud** : Presentation of two volumes of the "Annales de l'Observatoire de Paris."—Ch. **André** : The formation of suns. Referring to recent adverse criticisms of Laplace's theory, the author maintains that recent physical researches confirm this theory.—A. **Demoulin** : The R surfaces.—Eugenio Elia **Levi** : Periodic differential equations.—Paul **Dienes** : The summation of Taylor's series.—Henry **Hubert** : The parabolic form of the exposed acid crystalline rocks in western Africa. The water erosion takes place only at the expense of granitic rocks, and is characteristic of certain regions. The effect of the motion of the cutting particles is shown to result in a curved outline.—G. **Millochau** : Contribution to the study of the spectral effects of electric discharges in gases and vapours. The image from a vacuum tube containing the gas under examination at a known pressure is projected on to a circular photographic film rotating at a high known velocity. Seven kinds of simple discharge are described, and three types of mixed discharge. All the results are in accord with hypotheses which connect the production of the spectrum with the temperature of the molecule and the dissociation effects corresponding with that temperature.—Albert **Colson** : The theory of solutions and heats of solution. The author regards the identification of the dissolved particle with the chemical molecule as inadmissible, and considers that the dissolved particle is generally polymolecular. He suggests *dissolecule* as a distinctive name for the dissolved particle. The difference between the heat of solution of a gas and its heat of condensation, which should be zero according to the van 't Hoff hypothesis, represents the heat disengaged by the molecular contraction giving rise to the dissolecule.—MM. **Broniewski** and **Hackspill** : The electrical properties of the alkali metals, of rhodium, and of iridium. Measurements are given of the thermoelectric power of cæsium, rubidium, potassium and sodium, and of rhodium and iridium. The purification of the alkali metals was effected by distillation in a vacuum.—G. D. **Hinrichs** : The atomic weights of the dominant elements.—E. **Chablay** : The use of liquid ammonia in chemical reactions. Researches on the alcoholates. An alcohol dissolved in liquid ammonia immediately decolorises a blue solution of potassammonium or sodammonium, hydrogen, ammonia, and the anhydrous alcoholate RONa being formed. A blue solution of calcium-ammonium reacts similarly, the calcium alcoholate being formed. Barium and strontium ammoniums act similarly.—Maurice **Lanfry** : The oxy-β-methylthiophenes.—MM. **Taffanel** and **Dautriche** : The mode of firing explosives. In blasting in mines one cartridge containing fulminate is usually arranged to explode several cartridges containing safety explosive only. Experiments are described showing the most advantageous arrangement of the fulminating cartridge with respect to the others.—Jean **Friedel** : The effect on vegetation of a more complete darkness than that currently employed in laboratories. A box for growing plants in the dark is described in which the exclusion of light is so perfect that a delicate photographic paper is unaffected after prolonged exposure. The results on the plants are compared with those obtaining under ordinary conditions, in which the exclusion of light is not so perfect.—Pierre **Berthault** : The variations of tuberiferous Solanum.—P. **Desroche** : The action of various light radiations on the motion of the zoospores of Chlamydomonas.—A. **Marie** and A. **Donnadieu** : Leucogenesis and intestinal epithelium.—A. **Magnan** : Human monsters.—Pierre **Georgevitch** : The formation and germination of the spores of *Bacillus thermophilus vragnensis*.—Louis **Gentil** : The country of Zaër, western Morocco.—Maurice **Lugeon** : The existence of two phases of Palæozoic foldings in the western Alps.—Carl **Renz** : The extension of the Palæozoic formations in the islands off the coast of Argos.—Fernand **Meunier** : The Blattidæ of the Commentry Coal-measures. The lake of Commentry would appear to have been inhabited by a fauna of Blattidæ, less rich than in the American deposits, and represented by a very small number of genera, some of which possessed extremely prolific species.—Ch. **Moureu** and A. **Lepape** : The rare gases in fire-damp. Analyses of five specimens of fire-damp collected under conditions excluding air. One striking fact brought out by these analyses is the much higher proportion of helium to nitrogen than that existing in air. The nitrogen from the Mons specimen contained no less than 13 per cent. of helium.

BOOKS RECEIVED.

Die Palaeobotanische Literatur. Bibliographische Übersicht über die Arbeiten aus dem Gebiete der Palaeobotanik. Herausgegeben von W. J. Jongmans. Zweiter Band. Pp. iv+417. (Jena : Fischer.) 18 marks.

Die Bearbeitung des Glases auf dem Blasetische. By D. Djakonow and W. Lermantoff. Zweite Auflage. Pp. xv+196. (Berlin : R. Friedländer & Sohn.) 6 marks.

A Naturalist on Desert Islands. By P. R. Lowe. Pp. xii+300. (Witherby and Co.) 7*s*. 6*d*. net.

Psychology and Pedagogy of Writing : a Résumé of the Researches and Experiments bearing on the History and Pedagogy of Writing. By Dr. M. E. Thompson. Pp. 128. (Baltimore : Warwick and York Inc.)

Mental Fatigue : a Comprehensive Exposition of the Nature of Mental Fatigue, of the Methods of its Measurement and of their Results, with Special Reference to the Problems of Instruction. By Prof. Max Offner. Translated by Prof. G. M. Whipple. Pp. viii+133. (Baltimore : Warwick and York Inc.)

Der Panamakanal. Die Bedeutung des Kanalbaues seine Technik und Wirtschaft. By M. D. Fiegel. Pp. vii+183. (Berlin : D. Reimer.) 4 marks.

Islands of Enchantment : Many-sided Melanesia Seen through many Eyes, and Recorded by F. Coombe. Pp. xxvii+382. (London : Macmillan and Co., Ltd.) 12*s*. net.

Manual of Farm Animals : a Practical Guide to the Choosing, Breeding, and Keep of Horses, Cattle, Sheep, and Swine. By Prof. M. W. Harper. Pp. xxv+545. (London : Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Laughter : an Essay on the Meaning of the Comic. By Prof. H. Bergson. Authorised translation by Cloudesley Brereton and F. Rothwell. Pp. vii+200. (London : Macmillan and Co., Ltd.) 3*s*. 6*d*. net.

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

Die Silicate in Chemischer und Technischer Beziehung. By Drs. W. and D. Asch. Pp. xv+409. (Berlin : Springer.) 16 marks.

Cours de la Faculté des Sciences de Paris. Leçons sur les Hypothèses Cosmogoniques Professées à la Sorbonne. By H. Poincaré. Rédigées par H. Vergne. Pp. xxv+294. (Paris : Hermann.) 12 francs.

Astronomy. By A. R. Hinks. Pp. 256. (London : Williams and Norgate.) 1*s*. net.

Introduction to Science. By Prof. J. A. Thomson. Pp. 256. (London : Williams and Norgate.) 1*s*. net.

Confessions of a Robin. By Lieut.-Col. A. F. Mockler-Ferryman. Pp. 192. (London : S.P.C.K.) 2*s*.

Geometry for Schools. By W. G. Borchardt and the Rev. A. D. Perrott. Vol. i. Pp. viii+52 and Answers. Vol. ii. Pp. viii+53 to 162 and Answers. (London : G. Bell and Sons, Ltd.) 1*s*. and 1*s*. 6*d*.

The Enzyme Treatment of Cancer and its Scientific Basis. By Dr. J. Beard. Pp. xix+290. (London : Chatto and Windus.) 7*s*. 6*d*. net.

Chemistry and Chemical Magic. By V. E. Johnson. Pp. 150. (London : H. Frowde and Hodder and Stoughton.) 1*s*. 6*d*.

Mechanics and some of its Mysteries. By V. E. Johnson. Pp. 120. (London: H. Frowde and Hodder and Stoughton.) 1s. 6d.

Flying and some of its Mysteries. By V. E. Johnson. Pp. 138. (London: H. Frowde and Hodder and Stoughton.) 1s. 6d.

Modern Science Reader, with Special Reference to Chemistry. Edited by Prof. R. M. Bird. Pp. viii+323. (London: Macmillan and Co., Ltd.) 5s. net.

Lehrbuch der Protozoenkunde. By Prof. F. Doflein. Dritte stark vermehrte Auflage. Pp. xii+1043. (Jena: Fischer.) 26 marks.

Geologische Charakterbilder. Herausgegeben von Prof. H. Stille. Heft 2–8. (Berlin: Gebrüder Borntraeger.) Various prices.

The Climate of the Continent of Africa. By A. Knox. Pp. xiv+552. (Cambridge University Press.) 21s. net.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 9.

ROYAL SOCIETY, at 4.30.—The Spectrum of Boron: Sir W. Crookes, O.M., For. Sec. R.S.—A Chemically-active Modification of Nitrogen produced by the Electric Discharge. II.: Hon. R. J. Strutt, F.R.S.—Production of Solid Oxygen by the Evaporation of the Liquid: Prof. Sir J. Dewar, F.R.S.—On the Gaseous Condensable Compound, Explosive at Low Temperatures, produced from Carbon Disulphide Vapour by the Action of the Silent Electric Discharge. II.: Prof. Sir J. Dewar, F.R.S., and Dr. H. O. Jones.—(1) Optical Dispersion: a Comparison of the Maxima of Absorption and Selective Reflection for certain Substances; (2) The Influence of the Solvent on the Position of Absorption Bands in Solutions: Dr. T. H. Havelock.—An Experimental Investigation of Gibbs's Thermodynamical Theory of Interfacial Concentration in the Case of an Air-water Interface: Prof. F. G. Donnan, F.R.S., and J. T. Barker.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Modern High Voltage Power Transformers in Practice with special reference to a "T" Three Unit System: W. T. Taylor.

THE CONCRETE INSTITUTE, at 8.—Presidential Address: Sir Henry Tanner, C.B.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—The Invariants of the Linear Partial Differential Equation of the Second Order in Two Independent Variables: J. E. Campbell.—On Invariants of a Canonical Substitution: H. Hilton.—The System of Lines of a Cubic Surface: C. T. Bennett.—The Relations between Borel's and Cesaro's Methods of Summation: G. H. Hardy and J. E. Littlewood.—A Method of Establishing the 27-line Configuration of a Cubic Surface: W. P. Milne. Mathematical Analogues of Mental Phenomena: H. Bateman.

FRIDAY, NOVEMBER 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Nouvelles étoiles doubles, 6me série: R. Jonckheere.—Empirical Short Period Terms in the Moon's Mean Longitude: F. E. Ross.—(1) Mean Areas and Heliographic Latitudes of Sun-spots in the Year 1910; (2) Observations of Jupiter's 8th Satellite: Royal Observatory, Greenwich.—The Influence of Anomalous Dispersion on Solar Phenomena: P. V. Bevan.—Astrographic Measures of Double Stars: R. W. Wrigley.—On the Errors of Measurements on Photographic Plates: Winifred Gibson.—Fifth Note on the Number of Faint Stars with Large Proper Motions: F. A. Bellamy.—The Spectrum of Nebulium: J. W. Nicholson.—*Probable Paper:* Possible Phase Relations between the Planets and Sun-spot Phenomena: F. J. M. Stratton.

PHYSICAL SOCIETY (at Finsbury Technical College), at 5.—Reflecting Polariscopes for the Study of Optical Stress in Materials: Prof. Silvanus P. Thompson and Prof. E. G. Coker; The Effects of Holes and Semicircular Notches in the Distribution of Stress in Tension Members (demonstrated by polarised light): Prof. E. G. Coker.—(1) A Surface-tension Phenomenon; (2) Temperature Rise in Drops as they Part; (3) Temperatures of Equidensity of Liquids: Mr. C. R. Darling.—(1) Exhibition of a Large Harmonograph; (2) Physiological Effect of an Alternating Magnetic Field; (3) Demonstrations of Acoustical Experiments, New and Old: Prof. S. P. Thompson.

TUESDAY, NOVEMBER 14.

MINERALOGICAL SOCIETY, at 5.30.—On Crystals of Dufrenoysite, Seligmannite and Rathite: R. H. Solly.—A Simple Graphic Method for Determining Extinction-angles in Sections of Biaxial Crystals: H. G. Smith.—On the Meteoric-stone which recently fell in Egypt: Dr. G. T. Prior.—Strüverite from the Federated Malay States: T. Cook and S. T. Johnstone.—On the Temperature at which Gypsum becomes Uniaxial: A. Hutchinson.—On a Total-reflexion Diagram: A. Hutchinson.—The Occurrence of Ankerite in Coal: T. Crook.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Mafulu Mountain People of British New Guinea: R. W. Williamson.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Loch Leven Water-power Works: A. H. Roberts.—The Hydro-electric Plant in the British Aluminium Company's Factory at Kinlochleven: F. B. Sonnenschein.

WEDNESDAY, NOVEMBER 15.

ENTOMOLOGICAL SOCIETY, at 8.—Descriptions of South American Microlepidoptera: E. Meyrick, F.R.S.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Abnormal Summer of 1911: C. Harding.—Notes on Solar Halos: W. Larden.

ROYAL MICROSCOPICAL SOCIETY, at 8.—A Geometric Slide Photo-micrographic Apparatus: J. E. Barnard.—British Enchytræids. II. The Genus Fridericia: Rev. Hilderic Friend.

THURSDAY, NOVEMBER 16.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Discovery of a Novel Type of Flint Implements below the Base of the Red Crag of Suffolk, proving the Existence of Skilled Workers of Flint in the Pliocene Age: Sir Ray Lankester, K.C.B., F.R.S.—The Influence of Ionised Air on Bacteria: Prof. W. M. Thornton.—The Permeability of the Yeast Cell: S. G. Paine.—The Intrinsic Factors in the Act of Progression in the Mammal: Dr. T. G. Brown.—Ventilation of the Lung during Chloroform Narcosis: G. A. Buckmaster and J. A. Gardner.—The Refractive Indices of the Eye Media of some Australian Animals: Dr. J. L. Jona.—Studies in Heredity. I. The Effects of Crossing the Sea-urchins, *Echinus esculentus* and *Echinocardium cordatum*.

INSTITUTION OF MINING AND METALLURGY, at 8.—*Adjourned Discussions:* (1) Fallacies in the Theory of the Organic Origin of Petroleums: Eugene Coste; (2) The Economics of Tube-milling: H. Standish Ball.—*Paper:* The Whim Well Copper Mine, West Pilbara, North-west Australia: H. R. Sleeman.

FRIDAY, NOVEMBER 17.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Endurance of Metals: Experiments on Rotating Beams at University College, London: E. M. Eden, W. N. Rose, and F. L. Cunningham. (*Adjourned Discussion.*)—*Probable Paper:* Double-cutting and High-speed Planing Machines: J. Hartley Wicksteed.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Notes on the Design of Motor-car Headlights: Dr. H. R. B. Hickman.

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