THURSDAY, NOVEMBER 29, 1906.

ALTERNATING CURRENTS.

Alternating Currents: a Text-book for Students of Engineering. By C. G. Lamb. Pp. vi+325. (London: Edward Arnold, n.d.) Price 10*s.* 6*d.* net.

THIS book is designed to be a text-book for students of engineering, more particularly for those who are going through a course at the engineering laboratory at Cambridge. In any attempt to write an account of alternating currents for such a purpose, the question arises at once, Out of all the materials at the disposal of the author, what should be selected as being most suitable, or on what principle should such a selection be made? The answer to this question may perhaps be best given by considering the requirements of engineering students. Chiefly, perhaps, the mind must be trained to accurate thought; but, apart from this, which is common to all scientific education, a student should acquire a thorough knowledge of fundamental principles in such a way that he may have confidence in himself when he is faced with the various problems that constantly arise in the course of his professional career. Beyond this, he should be taught sufficient of the methods of procedure in common use, so that when he takes up his first appointment in a subordinate position he will be able to follow with intelligence the methods of practice used by his superiors. As Mr. Lamb remarks in his preface, details of actual practice are unsuitable in such a book, and are best learned by actual contact with drawing-office work.

If the book in question be examined in the light of these principles, it will be seen that the statements of the fundamental ideas are very clear, and are logically followed up. It might, perhaps, be suggested that there is a tendency to explain various actions by means of equations rather than by physical conceptions. One is somewhat reminded of the mathematical coach lecturing on optics, who introduced the subject of optical instruments with the remark that a telescope is defined by the equation K=0. Many students are naturally inclined to view physical problems in this way, and such a tendency should be checked, especially among intending engineers.

With regard to the methods of procedure in common use, it cannot be said that this book is irreproachable. In particular, practically no mention is made of the necessity of designing apparatus to meet a given temperature specification. This necessity makes itself felt throughout almost the entire range of electrical apparatus, and yet with the exception of one brief paragraph the subject of temperature rise is not mentioned. A student reading this book with no other source of information at his disposal might be excused for imagining that apparatus was usually designed without any definite ideas as to its capacity, and was only rated after it had been manufactured and tested to see what it would stand. This must be regarded as an unfortunate omission.

Turning now to the consideration of the book in detail, it should be remarked that a certain extent of previous acquaintance with elementary theory is assumed, chiefly the theory of magnetism, including hysteresis and eddy currents, and a knowledge of vectors. The author has not attempted to introduce any symbolic treatment, no doubt very wisely.

The first seven chapters cover the preliminary statements of the usual methods of treating alternate-current problems in general, also of measuring instruments, and discuss the theory of the single-phase transformer. This piece of apparatus is regarded first of all in the light of a choking coil, for which the fundamental vector diagrams are obtained. Following this the analytical expressions for an actual transformer are worked out, and methods are described whereby the regulation can be calculated. The fifth chapter concludes with a paragraph giving a few constants for a modern type, which might have been more valuable if some indication had been given as to how such constants vary over a range of transformers for different outputs and frequencies, and with different load factors. Special types of transformer occupy the sixth chapter, in which mention might have been made of sucking—or booster—transformers, to be quite up to date; while the seventh chapter is devoted to efficiencies.

Apart from the points mentioned, which are not important, the foregoing chapters may be said to be excellent both in matter and in manner. Unfortunately, the same cannot be said of the very brief mention of single-phase commutator motors which occupies the eighth chapter. This part gives one the impression of having been put in as an afterthought; neither the repulsion motor nor the compensated repulsion motor is mentioned, and the type of series motor illustrated is already antiquated; moreover, the self-induction of the whole motor cannot be reduced to that of the field coils alone (p. 95).

The rest of the book is devoted to the consideration of alternators both as generators and motors, and of induction motors. Without following the treatment too closely, it may be remarked that wave forms are considered with reference to the presence of harmonics, the properties of concentrated and distributed windings are set out, and towards the end of the book armature reaction is considered in detail.

The treatment of the latter subject is based chiefly on the method of synchronous reactance, in which the whole reaction is considered simply as due to a single internal self-induction. This method has several drawbacks, and for practical work it is better to look upon the action of the armature as partly a demagnetising effect and partly a self-induction. This treatment is very simple, and sufficiently accurate if proper constants are taken. In chapter xxi. of Mr. Lamb's work the armature reaction is dealt with in greater detail, and is split up into three components, viz. stray field reactance, cross and back reactances, each of which has its own magnitude and its own phase. It is stated that this method leads to very good results, but it is more cumbersome, and seems to contain as much liability to error as the method above alluded to.

Space will not permit of more than a brief reference to many of the subjects dealt with. Induction motors are discussed with reference to the well-known Hey-

land circle diagram, and emphasis is laid on the necessity for proper phase relations being maintained between the applied voltages. A short chapter is devoted to induction meters, the principles of which are explained analytically and graphically.

Compound alternators are referred to somewhat scantily, only two types being described, both of which are manufactured by the Westinghouse Company. The parallel running of alternators is examined by the aid of synchronous reactance, and various methods of synchronising such machines are described.

The operation of synchronous motors is treated in the same way at considerable length, and an interesting graphical method is given for finding the value of the motor E.M.F. for any given load, due, we understand, to Mr. G. T. Bennett, of Emmanuel College, Cambridge. There is a short reference to the hunting of such motors, and to the action of the amortisseur. The book concludes with a chapter on the rotary converter, with special paragraphs on the E.M.F. relations, current relations and ohmic loss, starting, pressure regulation, efficiency and hunting.

It may be remarked that no mention whatever is made of transmission lines, a subject which would naturally be included in a book such as this; but possibly the author may have adequate reasons for the omission.

Apart from criticism of the contents of the book, it is necessary to direct attention to one point referred to in the preface, viz. the question of references to previous writers whose works have been requisitioned. It is quite true that such references are not of great value to the student, and would be unnecessary for others if no original matter were introduced. This, however, is not the case, and it is unreasonable to assume that the learned persons, mentioned by Mr. Lamb, who read the book will be acquainted with the authorship of this original matter. The number of engineers who are practically familiar with all branches of alternating-current science must be very small, and anyone wishing to study a particular branch from Mr. Lamb's book would naturally ascribe to him the credit for some of the original matter contained therein. In a few places, contributions have been abstracted from the proceedings of learned societies without a word of acknowledgment. Rather than adopt such a course it would be better to adhere to the system in vogue in Germany, where a man who writes a book on any subject without supplying with it a complete bibliography is considered a hopeless amateur.

THE CELL AND HEREDITY.

Die stofflichen Grundlagen der Vererbung im organischen Reich. Versuch einer gemeinverständlichen Darstellung von Eduard Strasburger. Pp. viii+68. (Jena: Gustav Fischer, 1905.) Price 2 marks.

THIS little sketch of the cell as the bearer of the hereditary qualities of the organism is full of interest, like everything that springs from Prof. Strasburger's pen. It is written in somewhat popular style, but is nevertheless a thoughtful and real contribution to the literature of the subject.

The book opens with a brief but sufficient account of the processes associated with the formation of the sexual elements, and with the outlines of nuclear division in so far as they are necessary for the understanding of the main problem.

The author follows current opinion in laying great stress on the qualitatively equal division of the chromosome secured by the mode of longitudinal fission of the chromatic thread, and he regards the chromosomes themselves as permanent elements of the cell nucleus. He explains in detail what is meant by "reduction-divisions," whereby the number of chromosomes in the sexual cells becomes reduced to one-half that characteristic of the nuclei of the body cells of the animal or plant. This reduction is dependent on the circumstance that the paternal and maternal chromosomes, which at sexual fusion are contributed to the fertilised ovum, remain distinct in the nucleus of that and the succeeding cells which originate from it. But at some period in the life-cycle certain cells, all or some of the descendants of which are destined to give rise again to sexual elements, exhibit two well-marked nuclear divisions that follow rapidly upon each other. In this way a definite phase (termed by some writers the maiotic phase) is intercalated in the cellular life-cycle of the organism, and it marks the transition from the cells with "unreduced" to those in which the nuclei possess the "reduced" number of chromosomes.

The essential feature connected with the maiotic phase lies in the manner in which the reduction in the number of the chromosomes is effected. Instead of a distribution to each nucleus of respective moieties of every chromosome taking place, as in the ordinary nuclear divisions, *entire* chromosomes first become temporarily united in pairs, and then the two members of each pair diverge from each other, and, aggregating into two groups, give rise to two nuclei each of which thus respectively contains half the whole complement of chromosomes present in the original nucleus.

There is some divergence of opinion as to the exact method by which the association and subsequent distribution of the chromosomes is effected during the maiotic phase, and perhaps it may vary somewhat in different organisms, but there is a general agreement as to the final result.

There exists a considerable weight of evidence tending to prove that the different chromosomes are responsible for different characters or groups of characters in the organism as a whole, and this circumstance is to be correlated with the fact that an equal number of these bodies is normally furnished to the fertilised ovum by each parent. Each chromosome, therefore, which is derived from the one parent will have its homologue or duplicate originating from the other. The importance of this becomes manifest when the facts of reduction are considered in relation to the behaviour of hybrids or crosses, in which a given character or group of characters (allelomorphs of Bateson) differs in the two parents. When such

varieties are crossed, the character of one of the parents is commonly alone visible, but the (different) character of the other is really present, though latent, in the offspring. On again crossing the latter these latent characters reappear, and often in a very definite proportion, in this second generation.

This fact was discovered many years ago by Mendel, and has formed the basis of most of the recent experimental work that has thrown so much light on the problems of heredity. But although it harmonises, in a large number of cases, with the expectation based on a study of nuclear division, there are many things which still require explanation. Prof. Strasburger has touched on some of these; thus, for instance, the proportion of the sexes in many unisexual plants and animals is an almost invariable one, and appears to be inexplicable on the view of the chromosomes above indicated. On the other hand, we know, especially amongst animals, of cases in which the sex of the offspring can be definitely affected by conditions that are under control, although further study is necessary for their thorough elucidation. The assumption of entirely new characters again provides a field of research that as yet can hardly be said to have been explored at all except statistically, and it is at the same time one that is certain to yield most profitable fruit.

These and many other points are raised in the pages of a booklet which, while of small dimensions, is replete with material for thought. Prof. Strasburger has shown that a popular exposition does not necessarily connote a superficial treatment of a difficult subject. J. B. F.

DISEASE AND ITS PREVENTION.

(1) *Immunity in Infective Diseases.* By Prof. Élie Metchnikoff. Translated from the French by Francis G. Binnie. Pp. xvi+591. (Cambridge: University Press, 1905.) Price 18*s.* net.

(2) *The Inflammation Idea in General Pathology.* By Dr. W. H. Ransom, F.R.S. Pp. vi+354. (London: Williams and Norgate, 1905.) Price 7*s.* 6*d.*

(3) *The Milroy Lectures on Epidemic Disease in England. The Evidence of Variability and of Persistency of Type.* By Dr. W. H. Hamer. Pp. 72. (London: Printed at the Bedford Press, 20 and 21 Bedfordbury, W.C., 1906.)

(4) *Microbiologie Agricole.* By Dr. Edmond Kayser. Pp. xii+439. (Paris: Librairie J. B. Baillière et Fils.) Price 5 francs.

(1) PATHOLOGISTS will welcome this translation of Prof. Metchnikoff's great work on immunity, containing as it does the results of twenty years' work devoted to the subject. Commencing with some introductory remarks on the importance of immunity, the author passes on to review the phenomena of immunity in unicellular animals and in multicellular plants, the resorption of formed elements and of albumenoid fluids in animals, instances and mechanism of natural immunity against micro-organisms, the problems of acquired immunity against micro-organisms and of natural and artificial immunity against toxins, and the comparative immunity of the skin and mucous membranes to microbial attacks. A chapter on protective vaccinations, and another giving a useful summary of the whole subject and an historical sketch of our knowledge of immunity conclude the volume.

The dominant idea running through the whole book, and supported with the greatest ability and ingenuity, is that the means of defence of the organism against the invasion of micro-organisms lie principally, if not entirely, with certain of the wandering cells of the body, "phagocytes," which comprise some of the leucocytes, and probably also certain endothelial and fixed connective tissue cells. These phagocytes either directly attack the invaders, enveloping and digesting them (phagocytosis), or, in the case of toxins, unite with these and prevent their toxic action, or secrete, or produce as a result of their disintegration, substances which are bacteriolytic and bactericidal for micro-organisms, and occasionally antitoxic for toxins. Under natural conditions it is chiefly against the microbes, and not against their toxins, that the organism has to defend itself, and hence phagocytosis normally is all-important. It used to be supposed that the body fluids were bactericidal, and the blood serum *in vitro* frequently possesses marked bactericidal properties, but Metchnikoff and his co-workers, particularly Gengou, have shown that the blood *plasma* in such cases before coagulation has occurred is almost devoid of bactericidal power, but after coagulation the breaking down of leucocytes which accompanies this phenomenon apparently gives rise to the bactericidal substances in the *serum*.

There is little to criticise in the book. It is somewhat difficult to grasp exactly what cells Prof. Metchnikoff regards as phagocytic, as his nomenclature of the leucocytes differs essentially from that used by most pathologists. In the chapter on preventive inoculation Haffkine's anti-choleraic inoculation is criticised in a manner hardly justified in view of the excellent results shown by the statistics of Simpson and others. In certain places the statements are not quite up to date, since the book in the original was published in 1901.

The volume is fascinating reading, and anyone who first dips into it will in all probability do more, and study it deeply. It forms a complete statement of the phagocytic hypothesis, and a masterly summary of the whole subject of immunity up to 1902.

(2) It is somewhat difficult to grasp exactly what the author of this book wishes to impart to his reader. Apparently it is his desire to formulate a conception of inflammation which shall be applicable to all organisms, animal and vegetable. The author believes that pathologists have always considered that inflammation is the first stage towards repair after an injury. But this is hardly so; it would be more correct to say that pathologists hold that the phenomena of inflammation *generally tend towards repair*, which is a conception distinctly different from that assumed by Dr. Ransom. According to him, an

injury in any organism is followed by responses misdirected and always damaging; "these misdirected perturbed responses are inflammation." . . . "It is distinguished from repair, for it is a perturbation thereof." This theme is supported by a number of examples, principally derived from injuries, &c., in vegetable organisms.

(3) In these Milroy lectures Dr. Hamer gives a brief but fascinating account of some of the plagues and pestilences that ravaged England and Europe during the early and Middle Ages, and attempts to unravel the nature of some of these. That principally dealt with is the "sweating sickness," a mysterious disease which appeared in England in 1485, and recurred again and again. By careful analysis this disease is proved to be epidemic influenza. A consideration of the records of measles and of small-pox leads to the conclusion that these two diseases have maintained a wonderful fixity of character.

(4) This book should usefully serve the purpose for which it is intended, viz. to give an account of microbial activity in relation to agriculture. The introduction on the morphology and classification of the bacteria is perhaps not altogether satisfactory, but the succeeding portions of the book successfully epitomise the subjects of nitrification and denitrification, the fixation of atmospheric nitrogen by the agency of various micro-organisms, and the various industries dependent on microbial activity. Under the last heading the alcoholic, acetic, and lactic fermentations are dealt with at length, also bread and sugar making, ensilage, flax and tobacco manufacture, and tanning. The book thus gives a very complete account of fermentation processes, is illustrated with a number of figures, and can be cordially recommended.

R. T. HEWLETT.

CAPTAINS OF CHEMICAL INDUSTRY.

Some Founders of the Chemical Industry: Men to be remembered. By T. Fenwick Allen. Pp. xxiii+289. (Manchester and London: Sherratt and Hughes, 1906.) Price 5*s.* net.

THIS book consists of a series of biographical sketches of men whose claim to remembrance is mainly based on their connection with the development of the great chemical industry of Lancashire and the North, viz., the manufacture of alkali and of the other chemical products which are directly associated with that industry. These sketches originally appeared in the *Chemical Trade Journal,* and Mr. Allen has done wisely in putting them together and republishing them in book-form, and thereby rendering them more readily accessible to all who are interested in the personal history of technology.

The book deserves to be in the library of every polytechnic and technical school in the country. Although it deals with only a special branch of chemical industry, that branch, in point of magnitude and commercial value, is by far the most important of our chemical manufactures. The story of its rise and progress, as illustrated by the biographies of its founders, is one of the most interesting and fascinating chapters in the history of industry in this country. Dr. Smiles has done much by biographical narrative to popularise what may be called the romance of industry, and it cannot be doubted that his works have served to fire the ambitions and to stimulate the endeavours of hundreds of earnest, thoughtful young men. But the life-history of his heroes, and the story of their struggles, their disappointments and successes, is not a whit more marvellous or more enthralling than the stories of such men as Gossage, Gamble, Muspratt, Andreas Kurtz, or Henry Deacon. No chemical technologist—be he young or old—can rise from the perusal of even the most meagre account of their life-work without realising that genius in chemistry is to be found as much in its applications to the material benefit of mankind as in the elucidation of its scientific truths.

The men who collectively founded and developed in this country the several manufactures which are comprehended under what is known as the alkali trade sprang, for the most part, from the lower middle class. They were persons of very small means, imperfectly educated, and with very little knowledge, to begin with, of chemistry. It is difficult, indeed, in some cases to discover why they should have turned their attention to chemical pursuits. Gossage was born in a small Lincolnshire town; Gamble was an ordained minister of the Presbyterian kirk in Enniskillen; Muspratt was also an Irishman—a rolling stone, who tried the army and then the navy, before he settled down to chemical manufacture; Deacon was a Londoner, and apprenticed to an engineering firm; Allhusen started life in the grain trade; and Peter Spence's father was a hand-loom weaver in Brechin, who apprenticed him to a grocer. Not one of them was predisposed by the circumstances of his origin or home-life to take up chemistry, of which science, indeed, he could have no knowledge until long after the age at which most young men nowadays begin their life-work. Deacon's bent may possibly have been determined by his association, as a boy, with Faraday, but it is more than likely that it was the failure of the engineering firm to which he was apprenticed that changed the current of his life and made him a glass-maker at St. Helens.

However different they might be in temperament, in habits of mind, and in intellectual tendencies—it is impossible to conceive, for example, two more sharply contrasted characters than James Muspratt and Peter Spence—all the men had certain gifts in common, chief among which were imagination and invention, pertinacity and resource, courage and self-reliance. Some of them, and not always the most talented, became wealthy; others, greatly daring, brought themselves to the verge of ruin in what seemed at the time heroic but hopeless struggles with the vagaries of a chemical process. These men pursued chemical manufacturing with all the keenness of scientific investigation, and wrestled with difficulties for the pure love of conquest.

Mr. Allen tells the story of their hopes and disappointments, their failures and triumphs, and tells it very well. We heartily commend his book to all who are interested in industrial progress, and in particular to chemical students who desire to know some-

thing of the personal history of those pioneers in technology who have been so largely instrumental in bringing one of our staple industries to its present pitch of development. T. E. THORPE.

AIDS TO PHOTOGRAPHY.

(1) *The Year-book of Photography for* 1906–7. Edited by F. J. Mortimer. Pp. 618. (London: The *Photographic News*, 1906.) Price 1*s.* paper, 1*s.* 6*d.* cloth.

(2) *The Photographic Picture Post-card.* By E. J. Wall and H. Snowden Ward. Pp. 104. (London: Dawbarn and Ward, Ltd., 1906.) Price 1*s.* net.

(3) *Magnesium Light Photography.* By E. J. Mortimer. Pp. 88. (London: Dawbarn and Ward, Ltd., 1906.) Price 1*s.* net.

(1) THE present number is the forty-seventh issue of this hardy annual, and the amateur or professional photographer will not have much to complain about when he has entirely digested its contents. In its present form it is a mine of photographic information, and contains data which are indispensable to every worker. Thus there are useful hints for negative making and finishing, complete and up-to-date directories of the photographic societies of the United Kingdom, a collection of useful recipes, formulæ, and reference tables of general use for every kind of work.

In addition to these and many other data which are valuable to the working photographer, there is a series of very interesting and helpful articles. These have been written by such well-known men as Robert Demachy, Walter Benington, George E. Brown, E. J. Wall, and others, and are on those particular subjects which have brought their names in the front rank. Two full and very practical articles on bromide and gas-light printing are contributed by the editor, and these contain much that is new and useful to the practical worker.

In fact, the volume should naturally find itself in the hands of every photographer, and is an indispensable book of reference. Sixteen full-page illustrations on art paper accompany the text, and an excellent index completes the volume.

(2) In this book the authors describe the making of picture post-cards from the initial sizing of the card down to the finished article. The beginner should find no trouble in following the instructions laid out, for the authors have described the various manipulations in clear and concise language.

Chapters are devoted also to photomechanical processes of producing a number of cards of one subject and to colouring post-cards, while part ii. of the book deals with such information as how to publish the cards, how to sell rights of reproduction, &c. Those who have a fancy for printing their negatives in this manner will gain some useful wrinkles by carefully reading this guide.

(3) Mr. Mortimer describes another phase of camera work which is as useful to the amateur as the professional. Mr. Mortimer does not let the worker take much for granted, for in these pages he refers to nearly every kind of subject that may be met with, from a flower study in a studio to the stoke-hold of a warship. The value of the text is very much enhanced by some excellent illustrations indicating not only the relative positions of camera, subject, and flash-lamp, but the actual results produced in these circumstances.

Beginners and others will do well to read this book, which embodies the results of one who has had a very wide and successful practical experience in this branch of the subject.

OUR BOOK SHELF.

The Rusts of Australia; their Structure, Nature, and Classification. By D. McAlpine. Pp. vii+349; plates, 55. (Melbourne: R. S. Brain, Government Printer, 1906.)

THIS book is published by the Department of Agriculture of Victoria, and represents the labour of many years on the part of the Government pathologist (vegetable). The first part, up to p. 75, contains much useful matter, although, of course, only a summary of the work of others. The second part is also necessary and useful, but contains some serious blemishes.

The author records sixty-three new species, the majority of which are more or less unsound, being simply forms of the same fungus growing on different hosts; and when, as on pp. 160, 165, the hosts have been incorrectly determined, the fungi have been given incorrect names. The author does not err alone in this matter, but the better botanists set their faces strongly against this practice of naming parasites according to their hosts without any experimental inquiry as to whether the same fungus might not infest many hosts, as in fact they do in many cases, and can probably be caused to do in still more. The seventy-two rusts recorded in Cooke's "Handbook to the Fungus Flora of Australia" are now increased to 161, but it is difficult to say to what extent this merely represents records of previously known species on new hosts. In some cases the new species are supposed to be distinguished by minute differences in the shape and character of the spores. Yet on Plate xl., p. 320, are figures of abnormal spores of one species giving a greater range than that which in others makes new species. A good instance of the confusion which arises from the system of naming is given on p. 169, where four names are inextricably entangled, and the author solves this difficulty by creating a name of his own, and so making matters worse for subsequent investigators.

The coloured plates are good, with the exception of Plate i., which is useless for fungal diagnosis. There are far too many photomicrographs; a few give verisimilitude to a paper and confirm the *bona fides* of the author, but good hand drawings are always better for reference if they can be relied on.

On the whole, there can be no doubt that the book is a useful one. A few typographical errors, such as Schelhammera for Schelhammeria, are unavoidable in a work of this kind, but our author is mistaken in supposing that the Kew index is an infallible guide in questions of synonymy and in the naming of species. It would have been better, both from the scientific and economic points of view, if the work on which the book is based had been more experimental and less taxonomic in character. Probably the author felt that owing to the amount of ground to be covered only a general review of it

could be attempted, which should serve as a foundation for further detailed investigations of the important questions connected with these plant parasites.

The Dissociation of a Personality, a Biographical Study in Abnormal Psychology. By Dr. Morton Prince. Pp. x+569. (London: Longmans, Green and Co., 1906.) Price 10*s.* 6*d.* net.

Of all the problems raised by the investigations of that section of modern psychology which deals with the abnormal and neurasthenic, those concerned with what is called multiple personality are perhaps the most interesting for psychology and philosophy as a whole. Cases of multiple personality are comparatively rare, and this book is of great value as being a very full and careful account of quite the most remarkable of such cases known to us. Dr. Prince had "Miss Beauchamp" under his care from the time when a second personality first manifested itself until "the real Miss Beauchamp" was at length discovered and restored. It is the great merit of the book that the author abstains almost altogether from theories. These he promises us in a further volume. In this he contents himself with a careful history of the details of the extraordinary case. Extraordinary it certainly is. There were three distinct and entirely different personalities. Of these, two known as B I and B IV, were alternating, and only knew of each other by inference. Dr. Prince evidently considers that they were caused by "the splitting up the original personality" and loss of memory due to an intense mental shock. Not the least interesting part of the book is an account of the striking oppositions in what we should be inclined to call bodily characteristics, manifested by those two personalities. But the personality known as B II, or "Sally," is most interesting of all. Not only did she exist as an alternating personality with B I and B IV, but she went on being conscious all the time, while B I and B IV were in possession of the body, with the difference that in the one case she was conscious, not only of outside events, but of B I's thoughts, while in the other she was aware always of what B IV said and did, but not of what she thought. The consequence is that the study of Sally throws light on many questions concerning subconscious personality, and such phenomena as dreams, hallucinations, &c. The questions raised by the whole story in regard to how a personality is constituted, and what either an associated or a dissociated personality can mean, are many and important, but a discussion of the philosophical importance of the facts recorded here had better be postponed until the appearance of Dr. Prince's promised second volume. Meanwhile, the book can be recommended to all interested in questions of abnormal psychology. The facts of the case are told in a very direct and interesting way.

A. D. L.

The "Lloyd" Guide to Australasia. Edited by A. G. Plate for the Norddeutscher Lloyd, Bremen. Pp. 469+ix. (London: Edward Stanford, 1906.) Price 6*s.*

This compact handbook on Australia should prove of great service to tourists visiting the Antipodes. The volume is profusely illustrated, and generously provided with maps and plans. Great care appears to have been taken in making the information up to date. The volume may not only be commended to travellers, but also to teachers of geography in secondary schools, who will find it useful as a supplement to their class-books.

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.*]

Presence of Neon in Radio-active Minerals.

I have for some time been engaged in a search for the rare gases, along with helium, in the radio-active minerals. The earlier results were negative, but I have just found a trace of neon in two minerals—zircon and cyrtolite. I cannot give definite quantities, but should guess that the neon is not so much as 1/300th part of the helium.

The separations have been made by Sir James Dewar's charcoal method. He suggested this application of the method in his original publication of it.

I cannot yet state positively whether or not the presence of neon with helium is general. The manipulation has been progressively improved, and it may be that on repeating the earlier experiments on other helium-bearing minerals neon will be detected. On the other hand, it may be that the presence of neon is connected with zirconia, for both of the above minerals contain it.

R. J. Strutt.

Sunnyside, Cambridge.

Radium and Helium.

In Nature of October 25 Prof. E. Rutherford has briefly restated the arguments for considering that radio-active phenomena are probably associated with atomic degradation, and that, as a rule, the loss of an atom of helium accompanies such changes, the atomic weight of the substance undergoing transformation being diminished by 4, the atomic weight of helium.

With this assumption, the transformation of the uranium atom (238·5) into radium (225) occurs owing to the loss of *three* helium atoms, whilst the change of radium into lead (206·5) is due to the loss of *five* such atoms. The numbers are not, however, in strict agreement with this view, for $238{\cdot}5-3\times4=226{\cdot}5$ instead of 225, and $225-5\times4=205$ instead of 206·5.

This objection can, however, be removed by assuming that the atomic weight of radium is not 225, but 226·5, for we then have

$$238{\cdot}5-3\times4=226{\cdot}5$$

and

$$226{\cdot}5-5\times4=206{\cdot}5.$$

The above assumption, that the atomic weight of radium is slightly higher than that obtained by Madame Curie in her latest determination, does not, indeed, appear improbable when it is remembered that the first determination of the atomic weight of radium by Madame Curie gave a value of 146, and that the atomic weight has become greater and greater as the material used has been more and more purified. Madame Curie now considers that her latest value is correct to within a single unit, but she states that the material she employed contained a minute quantity of barium.

B. Walter.

Hamburg, physikalisches Staatslaboratorium,
November 6.

Magnetostriction.

In your issue of March 24, 1904, Mr. Nagaoka gives an account of a lecture experiment on magnetostriction; a few weeks later Prof. W. S. Franklin describes an experiment of the same kind. Both experimenters use a vertical solenoid, along the axis of which is fixed at its upper extremity an iron wire. When a current is sent through wire and solenoid, the wire is twisted. The explanation given is that the wire is magnetised helically, the expansion along the lines of magnetisation resulting in a twist of the free lower extremity.

May not the result of the experiment be accounted for in the following way? When a current enters at a pole and passes out at the centre of a freely suspended magnet, the magnet rotates about its axis. If, then, the current enters at one pole and passes out at the other—as both halves tend to rotate in opposite directions—one end of the magnet should be twisted relatively to the other.

D. O. S. Davies.

138 Earlham Road, Norwich, November 16.

Photography in Natural Colours.

IN NATURE of October 4 (p. 571) you referred to the fact that the new method of photography in natural colours described by Prof. Lippmann in the *Comptes rendus* of July 30 had been forestalled by myself and published in the *British Journal of Photography*, January 1, 1904. It is now my turn to disclaim priority, for Mr. F. Cheshire, who wrote you on the subject before, has just found, and kindly brought to my notice, a patent taken out by Mr. F. W. Lanchester, of Alvechurch, dated 1895, which describes to all intents and purposes the same arrangement. Not less curious is the fact that between the times of my own and Prof. Lippmann's publications, another French investigator, M. A. Cheron, devised the same method and obtained a French patent for the same early this year, and another French worker, M. Raymond, has, according to M. Cheron's communication to this month's number of *La Photographie des Couleurs*, been apparently working on the same lines.

We have here, therefore, the strange coincidence of five different people quite independently inventing the same method. JULIUS RHEINBERG.

16 Coolhurst Road, Crouch End, N., November 24.

ANTARCTIC EXPLORATION.[1]

THE story of the Antarctic is longer in time than in materials, for the necessary existence of lands around the South Pole was affirmed by some of the earliest geographers. There was abundant speculation about the character of these South Polar lands and the impossibility of reaching them before Bouvet found his islet and Cook was convinced of the existence of a great southern continent. The Antarctic regions have furnished less dramatic incident and fewer commercial returns than the Arctic, but they have probably given, in proportion to the efforts devoted to them, more wide-reaching scientific results. Dr. Mill's book gives a full and graphic sketch of the whole subject. It summarises the classical and mediæval speculations, tells the narratives, and explains the results of all the expeditions that have worked in the Antarctic. It handles the many branches of the subject—oceanography, terrestrial magnetism, topography, and bibliography—with expert knowledge, an intimate acquaintance with the scattered literature, and high literary skill. The story is enlivened by pithy anecdotes, and gives lucid explanations of the scientific problems, so that the book is as interesting as it is instructive. It tells us, for example, of the cost of various expeditions. Thus Cook's great results were achieved for 20,000*l*., and the *Belgica* Expedition gained its rich harvest for only 12,000*l*. It helps us to place the explorers, by other incidents in their lives, such as Dumont d'Urville's discovery of the Venus of Milo, Maury's service in the Confederate Navy, Wilkes's achievements on behalf of the Northern States in the same war, and his famous arrest of the *Trent*. The literary history is enlivened by many items of bibliographic interest, such as the mythical author "H. M. S. Slaney," the recovery of the remarkable appeal to the Geographical Society in 1837 on behalf of Antarctic research by "A. L.," from a French translation, and the loss of Enderberg's MS. in one of the London Society's libraries.

The siege of the South Pole has been conducted by campaigns at three periods. The first period began in the time of Drake, who reached 57° S. lat., and of de Quiros, who proclaimed his annexation "in the name of the Holy Trinity of all islands and lands which I have recently discovered and will discover even to the Pole." The great achievement of this period was the voyage of Cook, whom Dr. Mill regards as the hero of Antarctic work. He describes him as "the greatest of British maritime explorers, the one man who could be compared with Columbus and Magellan." He deplores that the only reward he received after his Antarctic voyage for "his stupendous service to science and his country, was a step in naval rank"; and he reminds us of the almost incredible fact that "Cook's own log was actually left unpublished for 130 years, while, incredible as it may seem, the description of some of the scientific collections of the voyage with the plates engraved at the time are only now appearing in the twentieth century." Cook's work showed that the Antarctic continent was confined within narrower limits than had previously been thought, but Cook, though he did not actually land on Antarctica, was emphatic as to its existence. More definite knowledge of the Antarctic continent was obtained by the explorers of the second period, that of Bellingshausen, Weddell, Biscoe, Wilkes, and Ross. It is to the work of that period that we owe most of the data that enabled Sir John Murray, after the dredging of the *Challenger* had given the geological proof of the continental structure of the Antarctic lands, to prepare the outline map of Antarctica, which, as Dr. Mill tells us, "subsequent discovery has not as yet materially modified." The active research of the second period was brought to a sudden and complete stop; the siege was raised for sixty years. The abandonment of the work was perhaps partly due to the disgust at the quarrels in America over the Wilkes Expedition, and at the feud between Wilkes and Ross; but Dr. Mill attributes it mainly to the concentration of attention in the Arctic, in consequence of the Franklin tragedy. Ross's voyage naturally receives the fullest treatment, owing to its important results. Great though they were, they might easily have been greater, for Dr. Mill, who has had personal experience of scientific research in naval vessels, remarks that "the average naval officer understands something of physical observations, but the collection of geological and natural history specimens is a mystery to him, and he abhors such mysteries"; and he describes how McCormick was hampered in his attempts to make zoological collections, and the misleading influence of Ross's theories, based on his mistaking records of pressure for deep-sea temperatures. Had Ross's expedition, says the author, "been organised on the lines subsequently followed on that of the *Challenger* the gain to science would have been enormous."

The third period includes the Antarctic research of recent years. The long agitation for the renewal of the work is fully told by Dr. Mill, from the appeal by Maury to the Geographical Society in 1860, and the persistent efforts of Neumayr, who was promised the leadership of an expedition from Hamburg in 1870, which was stopped by the Franco-German War; he records the "snubbed proposals" of the Australian colonies, the suggested Australian-Swedish expedition, and the resumption of Antarctic research by the whalers, by Dallmann in 1873, the *Balaena* with W. S. Bruce in 1892, the *Jason* under Larsen, and especially the *Antarctic*, sent by Sven Foyn in 1894 to the Ross Sea. These commercial enterprises rearoused the public interest in the Antarctic, and led to the despatch of the British, German, Belgian, Swedish, and French expeditions of the opening of this century, the results of which are now in course

[1] "The Siege of the South Pole, the Story of Antarctic Exploration." By Dr. Hugh Robert Mill. Pp. xvi+455; with maps and illustrations. (London: Alston Rivers, Ltd., 1905.)

"The Voyage of the *Scotia*. Being the Record of a Voyage of Exploration in Antarctic Seas." By Three of the Staff. Pp. xxiv+375; with three maps and numerous illustrations. (Edinburgh and London: Wm. Blackwood and Sons, 1906.) Price 21*s*. net.

of publication. Dr. Mill closes his volume with proposals for an international scheme of Antarctic research, to be undertaken with the help of an international committee, the functions of which he proposes should be advisory. He recommends the use of three or four whalers and light motor-cars, but no balloons, the uselessness of which has been twice proved. The actual organisation of the expeditions should be left to those responsible for the money, and he holds that "the price of a battleship would conquer all the secrets of the South, . . . not without risk, but still with far less risk than in say ten years of football." The book is illustrated with an excellent map of the Antarctic regions by Bartholomew, by many photographs of the scenery and ice-forms, and an excellent series of portraits of the chief actors in the Antarctic field. The frontispiece, an instructive picture of Antarctic ice, has been contributed by Prof. von Drygalski.

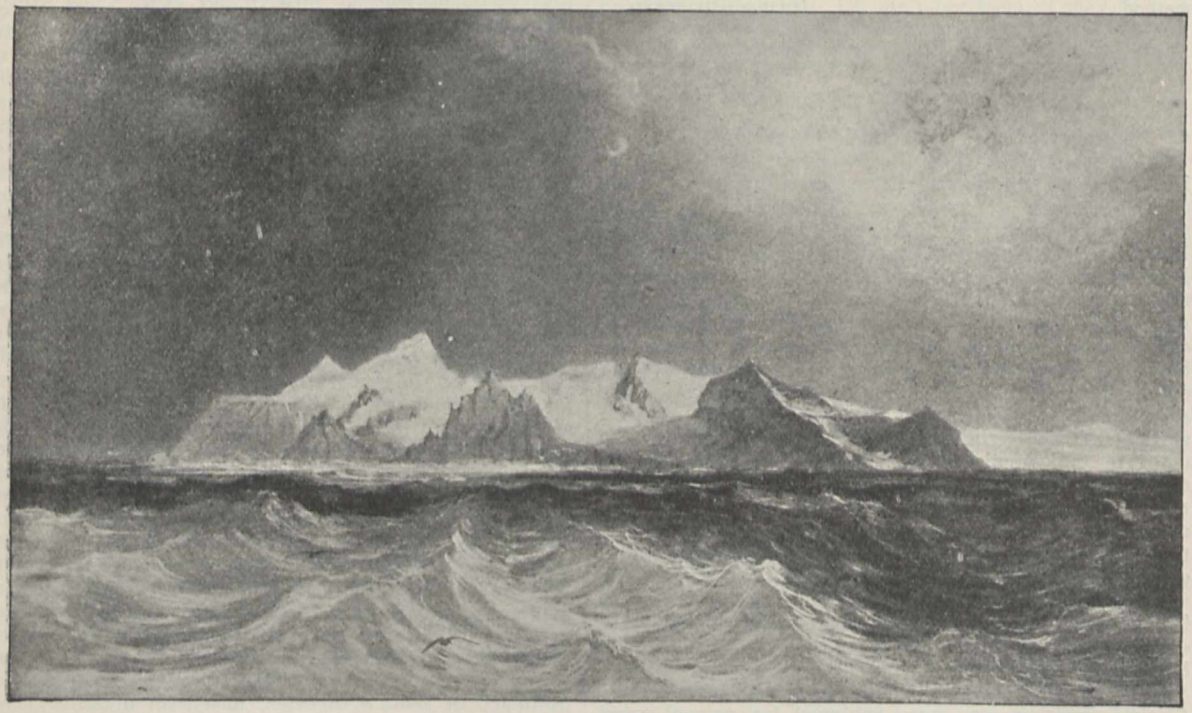

FIG. 1.—View of Elephant Island, one of the South Shetlands, in d'Urville's "Atlas." From "The Siege of the South Pole."

The latest original contribution to Antarctic literature is "The Voyage of the *Scotia*," the narrative of the Scottish National Antarctic Expedition. The expedition was organised and commanded by Mr. W. S. Bruce, who after a voyage to the Antarctic in a Dundee whaler in 1892–3 had persistently advocated the despatch of an expedition to the Weddell Sea, and by careful training had rendered himself fit for its command. He had made several visits to the Arctic, and from 1894 to 1896 had been in charge of the Ben Nevis Observatory, so that he was an expert in meteorological observation. The funds available for the expedition were comparatively small, and were mainly due to the generosity of Mr. Jas. Coats, of Paisley. The expedition left the Clyde on November 2, 1902, and the Falkland Islands on January 26, 1903. It was already late in the season, and the ice appears that summer to have been unusually thick in the Weddell Sea; but the *Scotia*, commanded by an experienced Arctic navigator, forced its way through the pack to the latitude of 70° 25′ S., and though several times beset, it escaped and returned to the South Orkneys. Suitable winter quarters were found in Scotia Bay, on Laurie Island; a house and magnetic observatory were built ashore, and the winter spent in active work. On the return of spring sledging expeditions explored the island and determined the Ordovician age of its rocks by Dr. Pirie's discovery of Pleurograptus and Discinocaris in the slates of Graptolite Island.

As soon as the *Scotia* could be freed from the ice it sailed for Buenos Aires for stores, &c., while Mr. Mossman, with five men, remained at the station to continue the meteorological work. The *Scotia* returned on February 14, bringing with it a party of observers sent by the Argentine Government, which had wisely undertaken to maintain the meteorological station; Mr. Mossman remained to help the Argentine party during its first winter, and the *Scotia* left on February 21 with the rest of the Scotch expedition for its second cruise in the Weddell Sea.

Here the expedition achieved its two great geographical successes. It discovered a new land, Coats Land, which, judging from the boulders dredged off it, is composed of continental rocks, granite, gneiss, schist, sandstone, slate, and limestone. This land is probably the edge of Antarctica, which therefore occurs 400 miles farther north than the position suggested for it on Sir John Murray's sketch map. Murray had extended the Weddell Sea thus far to the south, as the natural inference from the reported soundings, which had been greatly exaggerated by Ross's primitive appliances. Where Ross reported no bottom at 4000 fathoms, the *Scotia* found blue mud at the depth of only 2660 fathoms. The *Scotia* has removed Ross's Deep from the chart. During the return voyage the *Scotia* visited Gough Island, which was found to be volcanic, and after calling at Cape Town, Saldanha Bay, and various

Atlantic islands, it arrived back in the Clyde in July, 1904.

The narrative of the expedition is told by three members of the staff, Mr. R. C. Mossman, the meteorologist and magnetic observer; Dr. J. H. H. Pirie, the medical officer and geologist; and Mr. R. N. Rudmose Brown, the botanist. Each author contributes the chapters describing the work with which he was most concerned. The book perhaps suffers as literature from the difference in treatment of successive chapters, but it has the advantage of describing the whole expedition by the first-hand accounts of men concerned in all the different sections of the work.

The narrative is of great interest. It tells the story of long, thoughtful preparation, of the setting forth of a band of determined men, each well trained in his own line of work, and of their quiet, successful achievement of their purpose. The expedition must be regarded, especially in view of its low cost, as remarkably successful. Its discovery of Coats Land

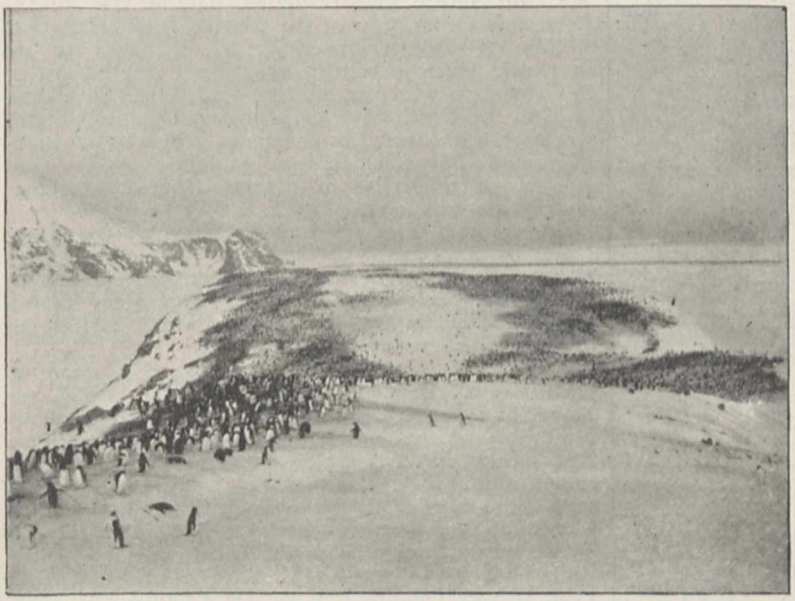

FIG. 2.—Penguin rookery on Graptolite Island. From "The Voyage of the *Scotia*."

determined the hitherto quite unknown southern limit of the Weddell Sea, and has broken the longest unknown line in the coast of Antarctica. As far as can be judged from published information, the *Scotia* will probably be found to have contributed more to Antarctic oceanography and biology than any of the expeditions in the field at the same time. Its deep-sea equipment was excellent, and was fully used, and the description of the quantities of material obtained in the deep-sea hauls justifies the hope that the biological collections will yield most important contributions to our knowledge of the Antarctic fauna.

J. W. G.

SYNTONIC WIRELESS TELEGRAPHY.

ON Tuesday evening, at a reception given by Lord Armstrong at the Queen's Hall, Sir William H. Preece, K.C.B., F.R.S., being in the chair, a very important and interesting demonstration was given by Mr. Valdemar Poulsen before a large audience, which included, among others, H.R.H. the Duchess of Argyll, the Duke of Argyll, and the Danish Ambassador, of a new development of wireless telegraphy which affords grounds for hoping that the problem of syntonic signalling is at last nearing practical solution.

Mr. Poulsen will be familiar to readers of NATURE as the inventor of the telegraphone (see NATURE, vol. lxii., p. 371, and vol. lxiv., p. 183). Before describing the experiments shown at the Queen's Hall, it will be advisable to give a short account of the principles on which the new method is based. It has often been pointed out in NATURE that all attempts hitherto made with regard to selective signalling are of a very unsatisfactory nature, and it has been suggested (NATURE, vol. lxviii., p. 249) that the solution is likely to be found in the application of the principle discovered by Mr. Duddell in the "musical" or "singing" arc. It is precisely that principle that Mr. Poulsen has adopted. The reason for this is sufficiently clear when it is considered that syntony, or tuning between transmitter and receiver, means the emission by the transmitter of sustained vibrations of definite frequency. Only when these are produced is it possible to employ in the receiver a circuit tuned or resonating to this particular frequency.

The main difficulty with all methods of spark transmission is to produce these sustained vibrations. The signal produced by a spark discharge consists of a series of violent pulses each consisting of a short train of strongly damped vibrations of definite frequency. Such tuning as can be done is accomplished by making the natural period of vibration of the receiving circuit the same as the vibration period of the individual pulses, but as the effect of the pulse itself as such is practically as great as that of its component vibrations, it will be readily seen that the tuning is only partial. To make the syntonisation effectual, the effect of the pulse must be diminished and that of the vibrations increased. In order to do this, the damping of the vibrations must be lessened until the signal is no longer a series of rapidly damped waves, but becomes a continuous succession of undamped, or, at the worst, very slightly damped vibrations, and the culminative effect of the continuous succession of waves will be far greater.

The problem, therefore, reduces itself to the production of a train of undamped waves, and the manner of its solution was indicated by Mr. Duddell when he discovered the phenomenon of the singing arc (NATURE, vol. lxiii., p. 182). Mr. Duddell showed that if a continuous current arc, burning under such conditions that a small rise in the current is attended by a small fall of potential—or in symbols for which dv/dA is negative and numerically greater than the resistance of the shunt circuit—is shunted by a circuit containing self-induction and capacity, there is spontaneously set up in that shunt circuit an alternating current the frequency of which is determined by the "natural" frequency of the circuit. By the use of different inductions and capacities Mr. Duddell produced alternating currents of various frequencies causing the arc to emit a musical note. The frequency of these vibrations was, however, low—as is shown by the fact of the arc emitting a note—and in wireless telegraphy the frequency must be high. Mr. Poulsen has found that by burning the arc in an atmosphere containing hydrogen, by lengthening the

arc and by placing it in a strong magnetic field, the frequency can be enormously increased, and as many as a million vibrations a second may be obtained. Mr. Poulsen also finds that it is advantageous to have the anode of copper and the kathode of carbon, but when high currents are used the anode must be cooled by water running through tubes arranged for this purpose.

Mr. Poulsen showed several interesting experiments, illustrating the delicacy of the receiving circuit, in that on the slightest variation of frequency the activity of the receiving circuit ceases. Another experiment with a generator the oscillation circuit of which was connected directly to a resonator the frequency of which was in agreement with that of the generator circuit (about one hundred and seventy thousand oscillations per second), showed stationary oscillations with maximum tension at the top of the coil, and gave a peculiar soundless flame. As indicating the enormous amount of energy produced, Mr. Poulsen showed several experiments—lighting six incandescent lamps which were simply connected to a coil of wire which was brought near the oscillation circuit; destruction of a copper ring of wire when brought near, &c.

Turning to the transmitter used by Mr. Poulsen, there are two things of special interest, viz. the coupling and the signalling. As regards the coupling, the usual method employed is a very loose or close coupling, and the tuning is very sharp in either case. As regards the methods of signalling, various arrangements may be employed, but perhaps the most simple is by causing the key to short circuit a resistance periodically, which resistance must be large enough to reduce the amplitude and be included in the antenna-circuit. This method reduces sparking and permits of quick telegraphing. One may also telegraph by varying the tension of the magnetic field or of the feeding current, or altering the amount of hydrogen round the arc.

The receiving circuit for continuous waves includes an oscillation circuit with the least possible damping and in loose connection with the antenna-circuit. Owing to the continuity of the waves the detector may be arranged in such a way that it only intermittently forms part of the circuit of oscillation. Hence damping is avoided which the permanent inclusion of the detector would introduce. The apparatus which causes the intermittent contact is known as the "Ticker," and the usual material used for the contacts is either gold wire or German silver. Mr. Poulsen claims to be able to tune in practice to one per cent., and has received three messages simultaneously without mutual interference, the difference of wave-length in this instance amounting to three per cent.

Under the new method of undamped continuous waves Mr. Poulsen has sent a message from Lyngby, near Copenhagen, to North Shields, a distance of 530 miles, with a pole only 100 feet in height, for the expenditure of one kilowatt, and he hopes from this shortly to be able to get perfect communication across the Atlantic.

The chief advantages of Mr. Poulsen's system appear, therefore, to be:—(*a*) Extreme accuracy of tuning—thus ensuring selective signalling with no interference. (*b*) Freedom from interferences due to atmospheric electricity. (*c*) Greater efficiency due to accuracy of tuning and to the low potential of the electric surges impressed upon the aërial radiator.

Mr. Poulsen hopes that undamped and continuous wave-trains may yet be adapted to wireless telephony. The demonstration certainly proved that a great advance has been made in wireless telegraphy, and should the methods employed be brought into regular commercial use, there can be little doubt that Sir W. H. Preece's remark that probably the "death knell" of spark telegraphy has been sounded will prove to be an accomplished fact. In the first place syntony will become a really practical affair, and interference troubles between neighbouring stations, which have to a certain degree been responsible for the necessity of international legislation, will disappear. Secondly, the cost of transmission will be diminished, as with undamped oscillations the energy used in transmission can be enormously diminished. For the same reason the effective distance over which messages can be transmitted will be correspondingly increased, and we may hope to see the real establishment of that Transatlantic communication so often announced and so often abandoned. J. L. M.

THE MARINE BIOLOGICAL ASSOCIATION AND INTERNATIONAL FISHERY INVESTIGATIONS.

LORD CARRINGTON, President of the Board of Agriculture and Fisheries, paid a visit to the Lowestoft Laboratory of the Marine Biological Association on Friday, November 23, in order to see the work which is being carried on at the laboratory in connection with the international fishery investigations in the North Sea. The principal features of the work were illustrated by means of a number of specimens and charts, which were explained by Dr. Garstang, the naturalist in charge of the laboratory, and by his assistants.

After being entertained at luncheon at the Royal Hotel by the council of the Marine Biological Association, Lord Carrington, who was accompanied by Mr. W. E. Archer, assistant secretary to the Board, visited the steam trawler *Huxley*, which carries out the investigations at sea.

Among those present to meet Lord Carrington were Mr. E. Beauchamp (M.P. for Lowestoft), the Mayor of Lowestoft, Mr. C. Hellyer (chairman of the committee of the National Sea Fisheries Protection Association), Mr. Deputy Sayer, of London, Mr. A. B. Capps and Mr. J. Jackman, of Lowestoft, and the following members of the council of the Marine Biological Association:—Dr. A. E. Shipley, F.R.S. (chairman), Prof. Bourne, Sir Charles Eliot, K.C.M.G., Dr. Harmer, F.R.S., Dr. Lister, F.R.S., Prof. D'Arcy Thompson, C.B., Dr. Chalmers Mitchell, F.R.S., Mr. G. L. Alward, Mr. J. A. Travers (treasurer of the association), and Dr. E. J. Allen (secretary and director), together with the members of the Lowestoft staff (Dr. W. Garstang, Mr. J. O. Borley, Dr. W. Wallace, Mr. R. A. Todd, and Mr. A. E. Hefford).

Under the present arrangement the scheme of international investigations terminates in July, 1907, but the council of the Marine Biological Association, in view of the importance of the work already accomplished, is urging His Majesty's Government to continue similar researches upon a more permanent basis. In this connection the following statement of the views of the council has been forwarded to His Majesty's Government:—

The council of the Marine Biological Association consider that the experience of the past few years justifies the opinion (1) that scientific investigations carried out on the deep-sea fishing grounds by means of a special sea-going steamer have produced results of great value concerning the biology of our food-fishes; (2) that a continuance of such experimental investigations is urgently required, in addition to the regular maintenance of market statistics and observations, in order to provide the exact knowledge necessary for the formulation of effective measures for the improvement of the supply of fish; and (3) that the advantages of international cooperation in

investigations extending over large areas are so great that it would be a decidedly retrograde policy that such cooperation should be abandoned. In support of the opinions expressed above, the council adduce the following statements and arguments with reference to sections (1) and (2) respectively, and believe that the statements will be fully substantiated in the detailed reports on the international investigations already published or in course of preparation.

(1) In conformity with the main object of British participation in the international scheme of investigations, as explained in the House of Commons by Mr. Gerald Balfour on June 12, 1902, and in accordance with resolutions of the International Council at Copenhagen in July of the same year, the investigations carried out in the North Sea by the association, at the request of H.M. Government, have been largely concentrated upon the biological aspects of the undersized-fish question, especially as concerns the supply of plaice.

By means of nearly 1000 hauls of the trawl the sizes of the plaice in different parts of the southern North Sea have been determined in detail and mapped out for different seasons of the year. The measurements of plaice recorded at sea on the S.S. *Huxley* exceed a total of 100,000. These investigations have clearly revealed the distribution of the various sizes of plaice in the English area during the period of investigation, and have contributed extensive material towards the collective report on this subject which is in preparation by the International Committee.

The causes which influence this distribution have been carefully investigated with respect to (1) depth; (2) nature of sea-bottom; (3) character of the food-supply; (4) growth, age, sex, and maturity; (5) locality of the nursery and spawning grounds; (6) seasonal migrations; (7) density of fish-population; and (8) intensity of fishing; and on most of these points definite results have been obtained.

By means of experiments with more than 7000 marked plaice the migrations of this species have been plainly traced in important areas, and much progress has been made towards the explanation of the observed movements.

The same experiments have furnished important results concerning the rate of growth in the chief parts of the English area.

An examination of the otoliths of more than 12,000 plaice caught and measured during the trawling investigations has yielded much new information concerning the age of plaice at different sizes on the chief fishing grounds, and has indicated a valuable method of controlling the results obtained from the marking experiments.

The marking experiments have afforded a new factor for estimating the intensity of fishing under modern conditions, and for measuring differences in this respect in different regions. In the case of medium-sized plaice (10–15 inches in length), we have found that out of 1100 fish of this size liberated at various seasons of the year in the southern area, where sailing trawlers predominate, approximately 30 per cent. have been recaptured within one year from the date of liberation, and that out of 400 fish similarly set free on the Dogger Bank and adjacent grounds, where steam trawlers predominate, about 40 per cent. have been recaptured in the same period.

The council regard these results as of great significance from a practical, as well as a scientific, standpoint, especially as there is reason to believe that the figures understate the full severity of the fishing.

Other results derived from the marking experiments and otolith investigations throw new light on the relative mortality of the two sexes, their habits of seasonal segregation, and their relative susceptibility to capture by the trawl, points which bear directly upon the problem of the effects of trawling upon the economy, and therefore the supply, of this species.

By the transplantation of large numbers of small marked plaice from the coastal waters to the Dogger Bank and other grounds, it has been found, during two years in succession, that the rate of growth is much greater on the Dogger Bank than on the nursery grounds, and the consideration of other factors renders it highly probable that the supply of fish can be profitably influenced by the transplantation of small plaice on a commercial scale.

A number of special experiments have been carried out on the *Huxley* to determine the vitality of trawl-caught plaice of different sizes. Owing to the variety of the conditions which influence the experiments, it is not possible at present to express these results in a single set of figures representative of average conditions, but the experiments support the opinions (1) that under commercial conditions of trawling on the nursery grounds a large proportion of the small plaice taken are mortally injured, and would not live if returned to the sea, and (2) that the beam trawl is less injurious than the otter trawl under similar conditions.

With respect to other food-fishes, such as cod, haddock, sole, turbot, &c., a complete register has been kept of the catch of the large commercial trawls on every occasion (between 900 and 1000 hauls), and about 250,000 measurements, exclusive of those of plaice, have been recorded. The information thus acquired has laid a broad basis of exact and trustworthy knowledge concerning the general features of the fish-populations of different fishing grounds, and concerning the size, weight, and to some extent the rate of growth of the various species represented.

This information has been supplemented by more than 700 experiments with fine-meshed nets and dredges for determining the character of the sea-bottom itself, the dominant features of the bottom fauna, and the distribution of the fish eggs and fry which escape the commercial nets. In particular cases experiments have been carried out on the migrations and rate of growth of marked fishes, especially of cod, sole, lemon sole, and latchet, and the relation of size to age in the case of cod and sole has been studied to a certain extent by means of otoliths. Extensive observations have been made upon the food of many species in different localities, and concerning their relations to one another either as prey, competitors, or enemies.

With regard to the hydrographic and plankton investigations specified in the international programme, the association has fully carried out its obligations in this respect by the most thorough and painstaking investigation of the waters of the English Channel. The results have been regularly forwarded for incorporation in the quarterly charts and records issued by the Bureau of the International Council, and have been reported on from year to year.

(2) In view of the fact that special research has been mainly concentrated hitherto upon the plaice, and that other valuable species present points of practical importance which still await solution, especially the sole, turbot, cod, and haddock, it is very desirable that the investigations which have been begun on these species should be continued and developed.

In this connection the council would point out that the necessity of scientific investigations has been generally recognised, whether such investigations be or be not carried out under a scheme of international cooperation.

While the council have indicated above the substantial progress which has been made with the experimental work at sea under their control during the past few years, they strongly urge that if this work should be brought to a sudden conclusion the prospective value of much preliminary labour and expense would be lost. Continuity of work is a factor of more than usual importance in experimental investigation of this character, not only because the conditions of the phenomena are constantly changing, but also because the extent and value of the results likely to be obtained are largely dependent on the experience of the staff employed.

NOTES.

M. MASCART is retiring from the position of director of the Central Bureau of Meteorology in Paris. He will be succeeded on January 1, 1907, by M. Angot.

MR. L. A. PERINGUEY has been appointed to the directorship of the South African Museum, Cape Town, to fill the vacancy caused by the resignation of Mr. W. L. Sclater. Mr. Peringuey, who has been assistant director for some years, is a well-known entomologist, and author of many papers on South African Coleoptera and other insects.

MADAME CURIE'S opening lecture to the students attending the course in general physics at the Sorbonne on November 5, on the subject of "Les Théories modernes relatives à l'Électricité et à la Matière," has been published in full in the issues of the *Revue scientifique* for November 17 and 24.

DR. E. SYMES-THOMPSON, Gresham professor of medicine, and an authority on pulmonary diseases, died on Saturday, November 24, at the age of sixty-nine.

SIR RICHARD FARRANT, who died on November 20, at seventy-one years of age, was treasurer of University College, London, which owes much to his business capacity. It was largely due to him that the fund was started to raise 200,000*l.* to provide for the necessary buildings and financial arrangements required for the incorporation of the college and the University of London, and his exertions in connection with the scheme will not readily be forgotten.

THE New Zealand International Exhibition was opened on November 1. The exhibits are valued at three-quarters of a million sterling, and two-thirds of this value represents industrial exhibits. The exhibition is the largest that has ever been held south of the equator.

THE winter meeting of the American Association for the Advancement of Science is to be held this year in New York City. The first general session will be opened at Columbia University on the morning of December 27. The president of the meeting will be Dr. W. H. Welch. The sectional meetings will begin in the afternoon of the same day, and in the evening Dr. C. M. Woodward, the retiring president, will deliver his address. The meetings will be continued on December 28 and 29, and if necessary on December 31.

VISITORS to the old Swedish cathedral and university town of Lund will find no little interest in the comparatively recent collections at the ethnographical museum illustrating many phases of rural life. Old peasant houses have been taken down, brought from considerable distances, and set up at Lund, among the buildings being an old church and an inn. Models of interiors of houses with costumed figures of inmates give an excellent idea of rustic conditions, reminding one, though on a smaller scale, of the Cecho-Slavonic museum in the Kinsky park at Prague. No catalogue of the collections has yet been issued.

IT is pleasing to note, from the current issue of its Bulletin, that the useful Société d'Encouragement, which is now in the 105th year of its existence, is in a satisfactory financial condition. After several years of deficit, the accounts for 1905 show a substantial excess of income over expenditure. The Bulletin contains useful summaries of recent progress in chemistry and mechanics, and affords clear evidence of the admirable work that is done by the society towards the development of the French national industries.

THE Home Secretary received at the Home Office on November 22 a deputation of members of the Royal Commission on Coal Supplies, who asked that the records and estimates which they have prepared at great cost to the country should be kept up by the Geological Survey to prevent their labours from being almost abortive. Lord Allerton believes that the whole of the information required could be had at a cost of 1000*l.* or 1500*l.* a year. Mr. Gladstone, while replying in sympathetic terms, pointed out that the Home Office is not properly equipped for cooperating with the work suggested, and he is afraid there may be difficulty in obtaining monthly returns. Lord Allerton, however, thinks that the difficulty is exaggerated, because, as chairman of a railway company, he has found that monthly returns can be obtained without increase of staff and without having to pay overtime.

IN connection with the fourth International Fishery Congress which is to meet in the City of Washington during September, 1908, a number of competitive awards has been arranged for the most important investigations, discoveries, or inventions during 1906, 1907, and 1908, relative to fisheries, agriculture, ichthyology, fish pathology, and related subjects. The awards will be in the form of sums of money varying in amount from 12*l.* to 50*l.* The competition is open to any person, association, or company. Papers may be written in English, French, German, or Italian. The congress reserves the right to publish, prior to their publication elsewhere, any papers submitted in competition, whether such papers receive rewards or not. The awards will be announced at a session of the congress. All communications should be addressed to Mr. Hugh M. Smith, general secretary, United States Bureau of Fisheries, Washington, D.C., U.S.A.

AT the Institution of Mechanical Engineers on November 16 Mr. Thomas Clarkson read an interesting paper on steam as a motive power for public-service vehicles. The advantages of steam for public-service work were summarised as follows:—the employment of a safe and cheap fuel; freedom from noise and vibration; absence of smell; and absence of change-speed gears, electric ignition, and friction clutch. The maintenance cost of an engine that has been in regular public service on single-deck omnibuses for three years in Devonshire in 1905 was 6·23 pence per mile for total operating expenses, 1·5 pence per mile for tyres, and 1·16 pence per mile for depreciation. Much has been done towards obviating mechanical stops and breakdowns during the past two years, and the steam omnibus of to-day is shown by Mr. Clarkson to be a very satisfactory and trustworthy machine.

IN the first article of the fourth number of the *Journal of Economic Biology* (vol. i.) Prof. A. Nalepa, of Vienna, describes two "eriophyids" (Acari) from Fiji. The first, *Eriophyes hibisci*, forms galls on a species of Hibiscus, of which the second, *Oxypleurites bisetus*, is also a denizen. In the second article Mr. G. H. Carpenter records the occurrence of larva of the chrysomelid beetle *Psylliodes chrysocephala* on cabbage-plants at Limerick. Much damage was done to the cabbages on which the larvæ fed, but the author is of opinion that the occurrence is an unusual one, and that the normal food-plant of the species is different. The third article is devoted to an account, by Mr. R. Newstead, of the life-history of the fly *Stomoxys calcitrans*, the larvæ of which are found in stables, cowsheds, &c.

IN vol. xvii. of *L'Anthropologie* appears an illustrated paper, by the late Mr. E. Piette, on evidence for the domestication or partial domestication of the horse (and possibly a wild ass) during the Reindeer epoch. This evidence consists of a number of sculptured and incised heads of horses invested with halters or head-stalls. Some of these head-stalls, as shown in the figure of a head from the cave of St. Michel d'Arudy, are of a very complex nature, consisting not only of several strands of rope, but of a piece of buck's horn or bone under the lower jaw. The evidence seems to be conclusive as to the domestication of the horse

during the late Pleistocene epoch, and likewise demonstrates that, as might have been guessed, the head-stall is older than the bit.

THE cruciform brooches of Norway form the subject of a long article by Mr. Haakon Schetelig in the second part of the "Bergens Museum Aarbog" for 1906. Prototypes of these ornaments occur in the peat of Nydam, and are believed to date from about 350 A.D., and they are considered to have been introduced into Norway about the same time, since they are found there in graves containing weapons and implements of the Nydam type. In a second article Mr. O. J. Lie-Pettesen discusses the habits and etiology of Norwegian humble-bees, more especially in connection with the powers of orientating their position and finding their way home. The development of the crustaceans of the genus Sclerocrangon, and more especially that of *S. ferox*, discovered in the North Atlantic by the Norwegian expedition of 1876–78, forms the subject of a communication by Mr. Alf Wollebæk. A striking resemblance exists between the development of Sclerocrangon and that of *Astacus fluviatilis*, which is remarkable considering the comparatively wide geographical separation of the two forms, and that one is marine and the other freshwater. The concluding paper, by Mr. K. Høye, deals mainly with the mould, *Torula epizoa*, affecting dried cod. Tables are given showing the percentage of spores of this mould in various Norwegian localities, and measures are suggested for preventing its ravages on stores of the fish.

LIEUT.-COLONEL C. D. DURNFORD has a second paper on the flying-fish problem in the November number of the *Annals and Magazine of Natural History*. As was noted in our columns at the time, the author in his original paper (published in the January issue of the aforesaid journal) endeavoured to prove on mathematical grounds that the "aëroplane theory" of the flight of these fishes was a physical impossibility, owing to the relatively small wing-superficies, and that consequently progression through the air must be due to intensely rapid wing-vibration, aided in certain circumstances by movements of the tail, which in all cases give rise to the initial impetus. In the supplementary communication Colonel Durnford adduces further evidence in favour of his explanation of the phenomenon. Under average conditions, the chief features of the flight appear to be as follows:—(1) the tail-impelled, visibly wing-assisted jump from the water to a height where the wings can work visibly; (2) the flight continued by an intensely rapid and laboured wing-movement, generally mistaken for a condition of rest, and, if seen at all, visible only as a blur; (3) short periods of slowing down of wing-movement, when the vibrations again become perceptible; (4) either sudden cessation of wing-movement, followed by an immediate drop into the water, or a short slow-down into visibility immediately preceding the immersion. The result of careful dissection has been to demonstrate that flying-fish possess much greater development of the pectoral and caudal muscles than non-volant pelagic fishes of similar proportions.

PROF. C. O. WHITMAN has favoured us with a copy of an address (reprinted from vol. v. of the "Congress of Arts and Science, Universal Exposition, St. Louis, 1904") delivered by himself on the problem of the origin of species. It is argued that although Eimer's theory of orthogenesis and the mutation hypothesis of de Vries appear, respectively, to be contradictory to Darwin's natural selection, yet all three, in the professor's opinion, may be reconciled. Mutation may be admitted to be true in the case of the evening-primrose, but this by no means indicates that it occurs in most other instances. On the contrary, the author affirms that he possesses conclusive evidence that species-forming variation advances in a definite direction (orthogenesis), although there are also variations advancing in different directions (amphigenesis). Orderly variation does not imply teleology, and the orthogenetic progress (of which we have an excellent sample in the development of the dark markings on the wings of pigeons) is the primary and fundamental one. "In its course we find unlimited opportunities for the play of natural selection, escape the great difficulty of incipient stages, and readily understand why we find so many conditions arising and persisting without any direct help of selection."

ON the subject of the variations in the leaves of ferns grown in the sun or in shade, Miss J. H. M'Ilroy publishes some notes on the leaves of *Nephrodium Filixmas* and *Scolopendrium vulgare* in the Proceedings of the Royal Philosophical Society of Glasgow, 1906. A marked difference was noted for two plants of Nephrodium with regard to the surface area of the leaves, that was twice as large in the case of the shaded plant as on the plant grown in direct sunlight, while the proportion was exactly reversed in the matter of spore output.

THE Sea Island cotton produced in St. Vincent continues to maintain its excellent quality. Mr. W. N. Sands, the agricultural superintendent, states in his annual report for 1905–6 that a considerable quantity realised nineteen and twenty pence per pound. Owing to the refusal of planters in the United States to supply seed of this variety, St. Vincent seed was selected to supply local needs and the requirements of other islands in the West Indies. After cotton, cacao received the most attention, and nutmeg plants were also in request. With respect to shade for cacao trees, the Madura, *Gliricidia maculata*, is preferred in St. Vincent to Immortels, as being less liable to suffer from scale insects.

MR. E. M. FREEMAN, who has published previous papers on the fungus of *Lolium temulentum*, contributes a note on its affinities in *Annales Mycologici*, vol. iv., No. 1, showing that its continued existence in the grass is similar to the propagation of loose smut in wheat and barley. Brefeld and Hecke have observed that a spore of the smut falling on the young ovary of these cereals can produce a mycelium, and later on spores from which germinating tubes pass into the developing embryo. In Lolium spores are not formed, but the mycelium persists until the embryo begins to develop and then grows into it. The author suggests that the evolutionary sequence in Lolium is later than that in the cereals on the hypothesis that spore formation has been prevented.

THE "Agricultural Statistics of India for the Years 1900–1 to 1904–5" have been published in two volumes, the first dealing with British India and the second with the native States. The statistics have been compiled in the office of the director-general of commercial intelligence, and may be regarded as a trustworthy record of the agricultural industries of India. Running as the volumes do to more than 300 foolscap pages of figures, it is possible only to refer to one or two of the many interesting subjects included. The tables dealing with the area under cultivation and total yield in the case of indigo show that from 1892 to 1900 the number of acres under cultivation was never under a million, and in 1894–5 was nearly a million and three-quarters. During the same period the number

of hundredweights of indigo produced was never less than 112,000, and in 1894–5 reached 238,000. During 1905–6, on the contrary, the number of acres under cultivation fell to 381,000, and the amount of indigo produced to 45,000 cwt. The case of cotton, however, is quite of a different character. The number of acres under cultivation has steadily increased in recent years. In 1899–1900 about 12,000,000 acres were planted, but during 1905–6 the number was well on the way to 21,000,000. The outturn in bales of 400 lb. increased in a similar manner from 1,090,000 in 1899–1900 to 3,250,000 in 1905–6. The volumes certainly provide a rich storehouse of material for readers interested in Indian affairs.

Several important papers appear in the October number of the *Journal of Hygiene* (vi., No. 5). Dr. Ashburton Thompson, President of the Board of Health, New South Wales, discusses the epidemiology of plague, particularly the part played by the rat and flea in its transmission; Prof. Nuttall and Dr. Graham Smith contribute an important and exhaustive account of canine piroplasmosis and of the morphology and development of the parasite *Piroplasma canis*; Mr. A. T. MacConkey describes the bacteriology of some cases of food poisoning which have come under his notice; and Mr. J. D. Thomson certain blood parasites of the mole. An interesting instance of spirochætosis in mice is described by Mr. C. M. Wenyon, and Dr. Andrew Balfour gives some notes on herpetomonas parasites in fleas. Finally, the report of the commission for the suppression of ankylostomiasis in Porto Rico is abstracted. The disease is very prevalent, and probably 90 per cent. of the inhabitants, who number about one million, suffer from it, and are more or less incapacitated. It is estimated that for an expenditure of 20,000*l.* per annum 100,000 persons could be treated a year.

In the last volume of the Proceedings of the Institution of Civil Engineers (vol. clxv., session 1905–6, part iii.) an account is given by Mr. Baldwin-Wiseman of a series of investigations made by him during the last three years as to the relationship between the porosity of rocks, and the flow of water through the interstices, under varying pressures. A description and illustration of the apparatus employed also accompanies the paper. The stones selected for experiment range from the Carboniferous to the Cretaceous rocks. The stones were carefully selected and dressed into the form of cylinders 13 inches long and 6 inches in diameter. These blocks were placed in a steel case, and precautions taken to prevent any leakage. The water was supplied from an hydraulic accumulator at varying pressures up to 75 lb. on the square inch. A drop of the piston, which acted in the steel case, of 1 centimetre was equivalent to a discharge of 62·06 cubic centimetres, and the area exposed was such that a discharge of 1 cubic centimetre per second was equivalent to one gallon per hour per square foot of surface. Special attention was given to the question of re-soakage as bearing on the rate and amount of recharging depleted strata after a long-continued drought. The results of the investigations are given in thirteen tables in the appendix to the paper; where also there are two tables showing the geological formation, depth of wells, quantity of water pumped, and other particulars of a large number of waterworks, with details of the filter-beds.

The report of the Canadian Government Commission appointed to investigate the zinc resources of British Columbia and the conditions affecting their exploitation has been published by the Mines Department of the Department of the Interior (Ottawa, 1906). It forms a handsome volume of 400 pages, with numerous maps and illustrations. In British Columbia the silver-lead ores occur in close association with zinc ore, which hitherto has proved a detriment to the value of the former. The commission was appointed to arrive at a knowledge of the economic value of the zinc ores. Mr. W. R. Ingalls, an authority on zinc from the United States, was appointed to draw up the report, and Mr. Philip Argall, of Denver, Colorado, and Mr. A. C. Gardé, of Nelson, British Columbia, to act as his assistants. Their report contains a vast amount of authoritative information on the mining and milling of zinc ores. Some of the undeveloped zinc deposits of British Columbia are reported upon by Dr. A. E. Barlow, of the Dominion Geological Survey. The possibility of enriching the zinc ores of British Columbia to a high degree by magnetic separation is thoroughly demonstrated by the tests conducted by the commission. In every case it has been possible to produce a zinc concentrate assaying upwards of 40 per cent. of zinc, and in some cases as much as 57 per cent. of zinc. Magnetic separators should be of the high-intensity type, and means for roasting the ore are required. The Blake electrostatic separator proved unserviceable for these ores, which appear, however, to be amenable to separation by flotation processes. Electric smelting of the zinc ores is not advocated, as this process must undoubtedly go through many stages of experiment before it can be pronounced a metallurgical and commercial success. Smelting with Canadian coal is, however, quite feasible commercially. Zinc ores are widely distributed, and the situation is excellent for the creation of a zinc industry in British Columbia.

An interesting contribution to the study of pseudo-solution, dealing in particular with the colloidal forms of ferric hydroxide, is made by F. Giolitti in two papers published in the *Gazzetta* (vol. xxxvi., ii., pp. 157 and 433). When ferric hydroxide, freshly precipitated by ammonia and thoroughly washed with water, is examined microscopically, it appears to consist of homogeneous gelatinous masses. After being left in contact with water during several months, minute "nuclei" form in the gelatinous particles, and on adding acetic acid the gelatinous portion dissolves, leaving behind the "nuclei" in the form of minute spheres of a nearly uniform diameter of about 7 μ. These nuclei, after being allowed to settle, form with pure water pseudo-solutions which are characterised by being coagulable by dilute nitric acid. A definite concentration of nitric acid necessary to produce coagulation corresponds to each concentration of the colloidal solution. The pseudo-solutions of ferric hydroxide prepared by different methods have different physical and chemical properties; different solutions of the same concentration have, for instance, different absorption spectra. With some solutions the addition of nitric acid causes the hydroxide to dissolve as nitrate, whilst with others a coagulation of the "hydrosol" is obtained. With precipitated tungstic acid very remarkable phenomena are observed. On washing the freshly prepared material very thoroughly with water, suspensions are obtained which, after being left during several days, separate into a number of well-defined strata, differing in colour and degree of opalescence. From these different strata pseudo-solutions can be prepared which at the same concentration have different limits of stability in presence of a coagulating agent such as nitric acid. The explanation given of these phenomena is that the different pseudo-solutions contain particles of different magnitude or molecular complexes

of a different character; the latter view appears necessary to explain the variation in chemical activity.

IN the formula given in last week's NATURE (p. 85) for converting Fahrenheit to centigrade degrees, the minus signs should have been plus; thus

$$C=(\tfrac{1}{2}+\tfrac{1}{2}\cdot\tfrac{1}{10}+\tfrac{1}{2}\cdot\tfrac{1}{100})(F-32).$$

Though the formula was incorrectly stated, the example given of its use showed plainly that a plus sign was intended.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN DECEMBER:—

Dec. 3. 3h. Jupiter in conjunction with Moon. Jupiter 1° 58′ N.
,, 10h. 36m. to 11h. 10m. Moon occults ζ Geminorum (variable).
5. 11h. 15m. Minimum of Algol (β Persei).
8. 8h. 4m. Minimum of Algol (β Persei).
10–12. Epoch of Geminid meteoric shower (Radiant 108°+33°).
9. 6h. Venus in conjunction with β′ Scorpii.
13. 2h. Mercury and Venus in conjunction. Mercury 0° 49′ N.
,, 18h. 1m. to 19h. 28m. Transit of Jupiter's Sat. IV. (Callisto).
,, 19h. Venus in conjunction with Moon. Venus 2° 40′ S.
15. Venus. Illuminated portion of disc = 0·075; of Mars = 0·938.
19. 4h. 40m. to 5h. 39m. Moon occults γ Capricorni (mag. 3·8).
,, 8h. 32m. to 8h. 54m. Moon occults δ Capricorni (mag. 3·0).
20. 13h. Saturn in conjunction with Moon. Saturn 1° 15′ N.
24. 3h. 26m. to 6h. 26m. Transit of Jupiter's Sat. III. (Ganymede).
25. Saturn. Major axis of outer ring = 38″·59; minor axis = 3″·79.
,, 10h. 59m. to 12h. 12m. Moon occults μ Ceti (mag. 4·4).
28. 3h. Jupiter in opposition to the Sun.
,, 9h. 46m. Minimum of Algol (β Persei).
30. 8h. 6m. to 9h. 37m. Transit of Jupiter's Sat. IV. (Callisto).
31. 6h. 35m. Minimum of Algol (β Persei).
,, 6h. 41m. to 9h. 41m. Transit of Jupiter's Sat. III. (Ganymede).

COMETS 1906*g* (THIELE) AND 1906*h* (METCALF).—Further observations of comets 1906*g* and 1906*h* are recorded in No. 4134 of the *Astronomische Nachrichten*. Prof. Hartwig, observing at Bamberg on November 11, found that 1906*g* was of circular form with a diameter of 2′, having a central condensation 1′ in diameter and of the tenth magnitude. On November 14 the condensation was very hazy and difficult to measure, whilst the total magnitude was about 9·0. Several sets of elements and ephemerides are published in the same journal, and the following is an extract from the ephemeris computed by Dr. E. Strömgren:—

Ephemeris 12h. M.T. Berlin.

1906	α (true) h. m.	δ (true) ° ′	Brightness
Nov. 30	11 8	39 1	
Dec. 2	11 22	41 34	1·3
,, 4	11 38	43 59	
,, 6	11 54	46 14	1·2

Brightness at time of discovery = 1·0 (= mag. 8·5).

The comet is now circumpolar, and apparently travelling in a line roughly parallel to, and south of, that joining ψ and χ Ursæ Majoris.

Comet 1906*h* is so faint that it may only be observed with large telescopes.

PHOTOGRAPHIC OBSERVATIONS OF GIACOBINI'S 1905 COMET.—Some excellent photographs of comet 1905*c*, taken with the 10-inch Brashear doublet of the Yerkes Observatory by Prof. Barnard, are reproduced in No. 4, vol. xxiv., of the *Astrophysical Journal*. That secured on December 29, 1905, shows a great deal of structure in a tail 4½° long. Joined to the comet's head by a narrow neck, this tail first broadens out and then narrows again, its well-defined edges thus presenting a peculiar convex appearance. The photograph taken on January 7, 1906, shows an even greater amount of structure, a large number of thread-like strands diverging from a position about 1° from the head. Although the tail of this comet was subject to great physical changes, Prof. Barnard considers that all the phenomena were due entirely to the solar action, there being no evidence of any outside distorting influence such as was suspected in the case of Brooks's comet (1903 IV.).

SUN-SPOTS AND MAGNETISM.—A retrospect of the stages whereby our present knowledge of the relation between sun-spots and terrestrial magnetism has been advanced at Greenwich is published in the *Observatory* (No. 376) by Mr. William Ellis. For a long period Mr. Ellis had charge of the magnetic observations at Greenwich, and he describes steps of advance in which he took an actual part. These observations were commenced at Greenwich, and in several of our colonies, in 1840, and in September of the next year there occurred a considerable magnetic storm which was clearly shown to have commenced simultaneously in widely separated parts of the Empire, thereby suggesting an external independent cause. By the year 1852 General Sabine, from a discussion of the collected results, was able to suggest that this common cause was probably intimately connected with solar phenomena. Mr. Ellis proceeds to discuss the observations of both solar and magnetic phenomena, giving a number of direct references which should prove both interesting and useful to other observers.

THE SOLAR ECLIPSE OF NEXT JANUARY.—The Tashkent Observatory has issued a map of Turkestan showing the path of the moon's shadow during the total solar eclipse which will take place on January 13, 1907. In the circular accompanying the map a series of meteorological observations is given, and these show that the prospects of a clear sky during the eclipse are not particularly favourable. So far as is yet known, three expeditions, one each from the Pulkowa and Hamburg Observatories, and one from the Bureau des Longitudes, are going to Samarkand (*Astronomische Nachrichten*, No. 4133).

NAKED-EYE OBSERVATIONS OF VENUS.—In the November number of the *Bulletin de la Société astronomique de France* M. A. Benoit discusses numerous recorded instances of the crescent form of Venus having been seen by the unaided eye. To determine the question of the probability of such an observation being possible, a number of observations was especially made at the Juvisy Observatory during the period March–June, 1905. Although on one occasion the observers thought they certainly saw the crescent, subsequent examination with field glasses showed them to have been mistaken, and from the complete discussion M. Benoit concludes that this naked-eye observation is impossible.

THE INTERNATIONAL CHART AND CATALOGUE.—As the completion of the international scheme for charting the heavens is now within sight, a correlated history of its inception and prosecution should prove of general interest. Such an account is given, in German, in No. 48, vol. v. (new series), November 25, 1906, of the *Naturwissenschaftliche Wochenschrift* by Dr. H. Ludendorff, and is illustrated by engravings of the instruments and a reproduction from a portion of one of the Potsdam plates.

THE PERSEIDS, 1906.—In No. 10, vol. xxxv., of the *Memorie della Società degli Spettroscopisti*, Prof. Zammarchi records the results of the meteor observations made on the nights of August 10–14 at the Vescovile di Brescia Observatory. In all, 231 Perseids were observed, and for the majority of these the paths, brightness, colour, &c., are recorded. Many of the meteors left persistent trails, and two of them apparently followed zigzag paths.

RECENT EXPERIMENTS ON THE CRYSTALLISATION OF MINERALS.

ALTHOUGH the crystallisation of alloys and of minerals must in its nature be essentially similar to that of the more ordinary solutions handled in the laboratory, the ranges of temperature and pressure involved are so far different as to make any experimental study a matter of considerable difficulty. In the case of the metallic alloys, the difficulties incident on the production and measurement of high temperatures have in recent years been overcome by the use of platinum-resistance thermometers, as in the investigation of the copper-tin alloys by Heycock and Neville, or by the use of thermal-junctions of platinum with a platinum alloy, as used so effectively by Roberts-Austen and his colleagues in the work of the Alloys Research Committee. As a result of these investigations, the conditions under which the different constituents separate from a liquid alloy, and the changes which occur as the solid ingot cools, are as fully known as the conditions which determine the separation of ice or salt from an aqueous salt solution.

The study of the crystallisation of an igneous mineral from a liquid magma has proved to be a task of very much greater difficulty. The temperatures of crystallisation are much higher, and frequently lie above the melting temperature of platinum; the minerals to be examined are not easily obtained in a pure state; they are poor conductors of heat and—perhaps the most serious difficulty of all—many of the minerals are so viscous when first melted that several minutes elapse before even the corners of the crystals become rounded; conversely, the melted materials often cool to a glassy mass, and only reluctantly develop a crystalline structure. Difficulties such as these render almost inoperative the methods that have proved so effective in the study of metallic alloys, but new weapons have been provided by the perfecting of the radiation pyrometer as an exact method for the measurement of high temperatures, and by the commercial production of iridium melting at a temperature at least 600° above the melting point of platinum.

A quantitative study of the crystallisation of the lime-silica series of minerals has recently been published by Messrs. A. L. Day and Shepherd, of the Geophysical Laboratory of the Carnegie Institution of Washington (Journ. Amer. Chem. Soc., xxviii., pp. 1089–1114, September, 1906). The results they have obtained are so far in advance of anything that has previously been accomplished as to mark the opening of a new period in the development of experimental mineralogy.

Dealing first with the two pure substances from which this series of minerals is derived, it may be noted that lime melts at so high a temperature that it is not yet possible to make a satisfactory determination of the melting point; measurements can only be made with mixtures containing at least 20 per cent. of silica, and even these melt at temperatures ranging from 1400° to well over 2000° C. The melting point of silica lies below that of platinum, but the melting is so slow that when a charge of quartz was heated in an iridium crucible in an iridium tube-furnace to the melting point of platinum (1709°) the grains did not coalesce, although they became tightly sintered together. Incipient melting could, however, be detected at a temperature nearly 100° lower, and the melting point is fixed by the authors at 1600° C.

Silica is a dimorphous compound, the two mineral varieties being known as quartz and tridymite. At temperatures above 1000° both quartz and amorphous silica change to tridymite. This is, therefore, the form which is stable at the melting point, and the melting temperature of silica is thus properly the melting temperature of tridymite, and not of quartz, as is commonly described. Occasionally by rapid heating quartz can be partially melted without inverting to tridymite, but it would hardly be possible by any known method to determine a separate melting point for unchanged quartz.

The converse change from tridymite to quartz is less easily observed. In presence of a catalyst, such as sodium tungstate, vanadic acid, or a mixture of potassium and lithium chlorides, amorphous silica was found to crystallise to quartz below 760°, and to tridymite above 800°; by heating for five or six days the direct change of quartz to tridymite was proved at 800°, and from tridymite to quartz at 750°. The change is therefore reversible, and there is a true inversion point at about 800° C.

The melting-point curve for mixtures of lime and silica was explored by heating mixtures of definite composition, well mixed by grinding and repeated melting, on a platinum or (for higher temperatures) iridium strip, and noting the order of fusion. In this way two maxima and three minima were found, and these were subsequently investigated in such a way as to determine the exact composition and temperature at which each occurs. The maxima at 48 per cent. and 65 per cent. CaO correspond with the composition of the metasilicate $CaSiO_3$ and the orthosilicate $CaSiO_4$, but no indication could be obtained of the separation from the melt of the compounds $2CaO.SiO_2$ or $3CaO.SiO_2$, or of the silicate $4CaO.3SiO_2$ analogous to the mineral akermanite.

Both the metasilicate and the orthosilicate are polymorphous. The metasilicate crystallises at 1512° in a pseudo-hexagonal form, and inverts at 1200° to a form identical with the mineral wollastonite. The orthosilicate crystallises at 2080° in a monoclinic α-form of density 3·27, and inverts at 1410° to an orthorhombic β-form of density 3·28, and again at 675° to a monoclinic γ-form of density 2·97.[1] The latter change involves an expansion of 10 per cent. in the volume of the substance, and is thus responsible for the disintegration or "dusting" of the orthosilicate and all mixtures containing more than 51 per

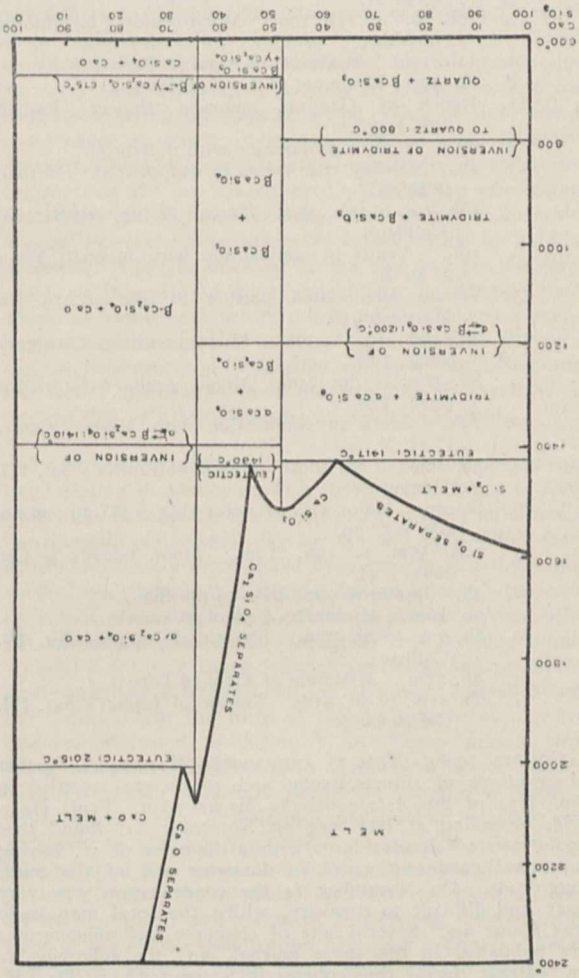

FIG. 1.

[1] It is unfortunate that the authors have reversed the convention which obtains in the case of iron, whereby the γ-form is that which is stable at the highest temperatures, and the α-form that which is stable at atmospheric temperatures.

cent. CaO. The orthosilicate is readily attacked by water, which dissolves out the lime in large quantities; this is probably the reason why it is not found as a natural mineral.

The three eutectics are:—(1) tridymite+metasilicate, 37 per cent. CaO, 1417°; (2) metasilicate+orthosilicate, 54 per cent. CaO, 1430°; (3) orthosilicate+lime, 67½ per cent. CaO, 2015°.

Although the melting point of lime is unknown, the authors have been able to plot a complete diagram of the different equilibria that may occur in this series of compounds (Fig. 1). The importance of such an achievement can scarcely be overestimated, and there can be little doubt that it will play as important a part in the development of experimental mineralogy as Roozeboom's classical diagram for the iron-carbon steels has done in modern metallurgy. T. M. LOWRY.

CHARACTER AND CAUSE OF SUN-SPOT SPECTRA.[1]

IT is now just forty years since the selective widening of Fraunhoferic lines in sun-spot spectra was first observed by Sir Norman Lockyer. Since then various papers relating to the same subject have been published by Sir Norman Lockyer, Prof. Young, and—more recently—Dr. Mitchell and Prof. Hale.

The authors of the present paper state at the outset that in considering the chief features of sun-spot spectra, three points especially attract attention:—

(1) The fact that certain lines in the spectrum of a given element are strengthened, others are weakened, the remainder being unaffected.

(2) The occurrence of the strengthened lines in the visible spectrum only; none appear in the ultra-violet.

(3) The relatively great intensity of the continuous background of the spot spectra in the less refrangible region.

From what is known of laboratory spectra taken under varying temperature conditions, the following facts accrue:—

(1) That in passing from a high temperature to a lower one, certain lines are relatively strengthened, some are unaffected, and others are diminished in intensity.

(2) That such a reduction of temperature is accompanied by an increase in the relative intensity of the less refrangible lines, and a shift of the maximum of a continuous spectrum towards the red.

The general correspondence of these two groups of facts led the authors to seek for an explanation of the spectrum of sun-spots, on the hypothesis that the metallic vapours within the spots have a temperature lower than that of the photosphere.

Photographs of spot spectra, made with the Snow telescope and a Littrow spectrograph of 18 feet (5·5 m.) focal length, and showing a great number of affected lines, were available for the investigation. The range of spectrum covered by these photographs is from D to Hβ. Supplementary photographs of the spectra of recent large spots, extending from A in the red to the ultra-violet, have been obtained by Mr. Ellerman.

The laboratory work began with a study of iron and other metals in a synchronous rotating arc, designed and constructed by Prof. Crew, but as the necessary photographs involved undesirably long exposures this was not continued. It occurred to Mr. Gale to try the effect of varying the current strength in an ordinary 110-volt direct-current arc, the difference of potential between the poles being kept approximately constant. Photographs were taken, with currents of 30 amperes and 2 amperes, of the spectra of iron, titanium, vanadium, chromium, manganese, calcium, and other metals characteristic of sun-spots. As the work progressed, a correspondence was noted between the enhanced lines (lines stronger in spark than in arc) and those weakened in sun-spots. To get further light on this, photographs were taken of the spectra of the same elements in the discharge of a 600-watt transformer, giving about 6000 volts at the secondary terminals. A condenser was used in the discharge circuit, and the potential was increased by an auxiliary air spark in series with the observed spark, both being exposed to a strong blast of air from an electric fan. Under these conditions the enhanced lines of the spark are well shown.

The instrument used to obtain the majority of the laboratory photographs was a grating spectroscope in the Littrow form of 13 feet (3·96 m.) focal length. The Michelson grating has 700 lines to the millimetre. In taking the comparison photographs of strong- and weak-arc spectra, two of the strong-arc spectra, with varying exposures, were generally placed on each side of the weak-arc spectrum. From the four different strong-arc exposures thus obtained that one was selected which was most nearly comparable in general strength with the weak-arc spectrum. In some cases the spark spectrum was added, adjoining the weak-arc spectrum, with the strong-arc spectra arranged as before.

Tables are given in the paper which contain the results of a study of the elements titanium, vanadium, iron, chromium, and manganese for the region extending from the ultra-violet to λ 5800. The tables include all the lines which are affected prominently, and which, being strengthened or weakened in spots, or in spark or weak arc as compared with strong arc, are of special importance in the investigation.

In discussing the behaviour of the lines of the elements mentioned, the investigation is divided into two parts, the relation of the weak arc to the strong arc, and of the arc to the spark. Two sets of tables are therefore given. The first shows the wave-lengths of all the lines which are much affected in spots, the amount by which they are affected, their behaviour in the weak as compared with the strong arc, and in the spark as compared with the weak arc. The second set of tables gives a comparison of the intensities of the lines of the same elements which are considerably enhanced in the spark, with their intensities in the weak arc. The majority of these which occur in the less refrangible part of the spectrum are weakened in spots, and such lines therefore appear in both sets of tables. As, however, most of the strongly enhanced spark lines occur in the violet and ultra-violet—where the spot lines seem to have the same intensity as the Fraunhoferic lines—independent lists of these lines have been added, since the evidence afforded by them as to the relation of spark to weak arc is extremely important.

The authors summarise some of the results accruing from the investigation as follows:—

(1) More than 90 per cent. of the lines in the tables which are strengthened in sun-spots are found to be strengthened in passing from a 30-ampere arc to a 2-ampere arc.

(2) More than 90 per cent. of the lines shown by the tables to be weakened in sun-spots are weakened or absent in the 2-ampere arc.

(3) More than 90 per cent. of all the enhanced lines included in the tables are weakened or absent in the 2-ampere arc.

(4) In a list selected at random of 152 lines which are not spot lines, no cases were found of lines strengthened in the low-current arc.

In discussing the temperature hypothesis as the probable explanation of the observed phenomena, some of the points made are:—

(1) Waidner and Burgess's investigation of the temperature of the arc showed that the temperature of the crater was reduced 70° when the current was reduced from 30 to 15 amperes. As the relative intensities of the lines undergo no material change in passing from 30 to 15 amperes, while the change from 30 to 2 amperes is very pronounced, the temperature of the crater is probably considerably reduced at 2 amperes.

(2) Since the enhanced lines of the spark diminish in intensity in the 30-ampere arc, and are still further reduced in the 2-ampere arc, no explanation hitherto advanced to account for these lines appears adequate in the present case, unless it be the explanation based on change of temperature.

[1] Abstract of an advance proof from Mount Wilson Solar Observatory of a "Preliminary Paper on the Cause of the Characteristic Phenomena of Sun-spot Spectra." (Contributions from the Solar Observatory, No. 11.) By George E. Hale, Walter S. Adams and Henry G. Gale. The paper is to be published in a future number of the *Astrophysical Journal*.

(3) The behaviour in stars of the lines affected in sun-spots appears to be consistent with the view that temperature changes alone are sufficient to account for their variation in intensity. (In this connection the authors formerly were inclined to the view that the presence of sun-spot lines in the spectra of red stars indicated the presence of many spots like those on the sun. Recent work has led them to the opinion that the comparatively low temperature of these stars offers the simplest explanation of the observed phenomena. The latter opinion had previously been arrived at and published by Sir Norman Lockyer in a paper "On the Relation between the Spectra of Sun-spots and Stars."[1]) In α Orionis—which from other considerations has been regarded as much cooler than the sun—lines that are strengthened in sun-spots are still further increased in intensity, and in Arcturus, which is always assumed to be intermediate in temperature to α Orionis and the sun, the intensities of its lines have been shown by Mr. Adams to agree remarkably with those observed in sun-spots.

In an addendum to the paper an account is given of further work with (1) the flame of an ordinary arc; (2) a modified form of a Moissan electric furnace.

It was found that the spectrum furnished by the flame of the arc—which is undoubtedly of a lower temperature than the core—showed changes of intensity similar to those observed with the 2-ampere arc and synchronous arc. Comparison of the lines affected in the flame with those affected in the weak arc showed that, of the lines of Ti, V, Cr, Fe, and Mn which were compared, nearly 90 per cent. were affected in the same direction, and of these latter the same proportion were affected to a like amount. Consequently, a large majority of the lines strengthened in sun-spots are relatively strengthened in the flame, while those weakened in sun-spots are relatively weakened in the flame.

The work with the electric furnace was done under conditions which, the authors state, eliminated all possible electrical effects, and left temperature as the only possible agent for producing any variations in intensity of the spectrum lines. Only Mn and Fe were investigated in this way, but the resulting spectra again showed great similarity to the weak-arc spectra, the majority of the lines being affected alike in the two cases.

At the end of the paper a few objections which can be laid against the temperature hypothesis are touched upon.

In a note added on October 2 an observation is included which seems to leave no doubt as to the comparatively low temperature of sun-spots. At least one of the titanium flutings which occur in the flame of the arc has been clearly demonstrated to be present in two of the best spot-spectrum photographs.

The work is regarded by the collaborators as being only at a preliminary stage, but it is evident that it will, with subsequent work on similar lines, have an important bearing, not only on the relative temperatures of sun-spots and photosphere, but also on the temperature classification of stars.

ANTHROPOLOGICAL NOTES.

O the second number of *Bulletins et Mémoires de la Société d'Anthropologie de Paris* (ser. 5, T. vii., 1906) Lieut. Desplagnes contributes an interesting paper on a little-known region of Central Nigeria, lying at the base of the plateau of Bandiagara (Banjagara), in the Massina district. This lake region seems to have been inhabited from the earliest antiquity, and in the Polished Stone period to have supported a dense population at a high grade of civilisation, to which numerous Megalithic monuments and a quantity of stone weapons and implements bear testimony; and long before our era examples of metal working, weaving, pottery, &c., show the industrial stage to which the inhabitants had attained. The character of the remains, physical and cultural, seem to suggest an Eastern origin for these early occupants, who were probably related to the ancestors of the Galla-Somali peoples. Later on, the nomad and pastoral peoples of the Sahara, attracted by the well-watered pastures, poured down from the north, and the tribes from the forests pressed up from the south; but all of these, though attaining right by might, had no aptitude for organised industry, and the primitive inhabitants were utilised as a sort of caste of workers, superior to slaves, but yet not mixing with the conquering clans. In the smiths, weavers, fishers, and potters, are found the descendants of the earlier owners of the land, while others maintained their independence by taking refuge in the islands in the river, the Sorkos, or in the surrounding mountains, the Habbès. The paper deals chiefly with the Habbès, describing their traditions, customs, habits, dwellings, industries, religious ideas, and sociology, in all of which they differ from their neighbours. The illustrations give an idea of the character of the country and the people, and the photographs of the masked figures in the religious dances, supposed to represent the Spirit of the Ancestors, are of particular interest.

L'Anthropologie, Tome xvii., 1906, contains the first instalment of a study by Dr. E. T. Hamy, "Les Premiers Gaulois." Dr. Hamy attempts to trace the physical characters of these invaders of northern Italy in the early Iron age from the evidence of the tumulus burials in France. The evidence is unfortunately very scanty, but it is worthy of note that the skulls in the neighbourhood of the forest of Châtillon have a cephalic index ranging from 80 to 84, with an altitudinal index of 88 to 93, although one skull from Banges, in the same district, has an index of 73·1. This is followed by a paper by Mr. Ed. Piette, "Le Chevêtre et le Semi-domestication des animaux aux temps pléistocènes," with many figures showing clear representations of halters in the engravings from the caves of Brassempouy, Mas d'Azil, &c. This communication forms the ninth in Piette's series of prehistoric ethnographic studies, and his last, for the volume ends with a notice of his death and a recognition of the great services which he has rendered to the science of prehistoric ethnography. The second part of "Les Restes humaines Quaternaires dans l'Europe Centrale," by Mr. H. Obermaier, continues the useful summary of the evidence for Quaternary man in Europe. The cautious tone of the writer is seen in the brevity of the list of human remains "sûrement quaternaires" when compared with the list of "Indications à écarter comme erronées, douteuses ou insuffisantes."

In *Globus*, lxxxix., Nos. 14 and 15, Mr. Vojtěch Frič gives an account of his travels along the Pilcomayo—a tributary of La Plata—in Central Chaco, with notes on the Pilagá and other Indians, and illustrations showing the character of the country and the fine-looking type of inhabitants. Among the majority of these tribes, it may be noted, the women propose marriage to the men, the *modus operandi* differing among the different groups. The method employed by the Pilagá women is to place a certain zigzag mark on a certain tree; the chosen man presents himself, and no further ceremony is needed. No. 17 contains a description, by Dr. Claus Schilling, of the Tamberma, who until a few years ago were an undiscovered people, near the borders of Togo. The illustrations taken by the author show the peculiar architecture and costumes of the district. This paper is followed by a short account of another African people, the Mpororo of the north-west corner of German East Africa, by Oberleutnant Weiss. Nos. 18 and 19 of the same periodical contain articles on the Gold Coast negroes by the medical missionary Dr. H. Vortisch, who gives a review (with illustrations) of their physical features, clothing, character, family life, sociology, political organisation, &c., and a careful record of their musical instruments, thirteen of which are figured. Mr. Erland Nordenskjöld contributes an article to *Globus*, lxxxix., No. 22, "Der Doppeladler als Ornament auf Aymarageweben," tracing the degeneration of the zoomorphic design through varying stages. In a series of papers (in Nos. 11, 20, 24, and xc., 1.) Dr. Theodor Koch-Grünberg describes his travels "Kreuz und Quer durch Nordwestbrasilien," giving excellent pictures of the scenery and of the natives, with a map to show the linguistic grouping. Of particular interest are the native drawings of animals. In xc., No. 4, W. von Bülow criticises the theories of Percy Smith, E. Tregears,

[1] Roy. Soc. Proc., vol. lxxiv. p. 53.

and A. Krämer, on the origin of the Polynesians, and identifies Savaiki (Havaiki, Avaiki, Savaii, &c.) with Java, *i.e. savah* (Javanese)=rice-field, and *iki* (also Javanese) diminutive suffix.

GEOLOGICAL RESEARCH IN SOUTH AFRICA.[1]

THE last number of the Transactions of the Geological Society of South Africa cannot fail to attract a greater number of geologists to follow the rapid progress being made in South African geology. This journal once threatened to be the dreariest; it is rapidly becoming one of the most interesting.

The visit of the British Association to South Africa has no doubt directed attention to the many points of interest in the geological history of one of the oldest land masses in the world.

Recent work between the Cape and the Zambezi has shown that the South African rocks present phenomena unparalleled elsewhere. The Dwyka Conglomerate undoubtedly affords the finest study of an ancient Glacial period. With this geologists have become familiar, but no more convincing examples have been found than those of the glaciated surfaces and boulder beds in Griqualand West described and beautifully illustrated by Messrs. Young and Johnson; but the Dwyka is not the oldest glaciation. Evidences of another have been obtained by Mr. Rogers from the Table Mountain Sandstone series, and he now describes a third and much older glaciation towards the summit of the Griquatown series. South Africa is thus yielding information on those points on which the older formations of the northern hemisphere are generally so persistently silent.

This is a very well preserved striated surface of flagstone forming one of a series of such exposures at Blaauwbosch Drift. The striæ run from N.E. to S.W. The grey patches on the glaciated rock, which are only faintly shown in the photograph, are delicate Bushman chippings. The upper rock seen at the top right-hand corner is boulder shale. From "Transactions of the Geological Society of South Africa."

The unfossiliferous and lithologically similar pre-Cape rocks have of late years been proved to be built up of several unconformable groups. The number is added to in the present volume. They also contain rocks of a unique character, none more so than the remarkable Blink Klip breccia of the Griquatown series described by Mr. Rogers. This is a brecciated rock, exceeding 200 feet in thickness, formed by the collapse of the Lower Griquatown series into hollows dissolved out in the underlying limestones and dolomites.

That the interesting character of South African geology is not recognised to the full extent it demands is perhaps due to the overwhelming preference hitherto given to the economic study of the gold-bearing conglomerates and coal deposits. A utilitarian spirit still apparently holds a prominent place among several members of the Johannesburg school of geologists, of which an indication will be found in the present volume. Why, it is asked, is the Transvaal Survey engaged in the investigation of "outside" areas, where "outside" seems to include everything beyond the immediate vicinity of the golden city? Considering the number of ridiculously divergent opinions concerning the age, order of sequence, and stratigraphical relationship of the gold-bearing conglomerates, it is evident that either the problem lies beyond solution or that the secret will be found in the outlying districts. That the enveloping movement around the Central Rand is being rapidly and systematically carried on is shown by the work of the Transvaal surveyors and by that of Mr. Rogers in Griqualand West. The results obtained by both surveys not only justify their existence, but warrant that, in happier times, they will receive a more liberal help. The fuller knowledge so obtained can afterwards be applied to any special economic region with that nicety of attention to detail on which the success of applied geology so much depends. W. G.

[1] Transactions of the Geological Society of South Africa. Vol. ix., January to April, 1906. Pp. 1–56. (London: Wm. Wesley and Son.) Price 15*s*.

THE SCOPE AND PROBLEMS OF PROTOZOOLOGY.[1]

PROTOZOOLOGY, a science that has only in most recent times attracted general attention, is nothing more or less than the study of a group of organisms which zoologists term protozoa, and therefore, in order to make clear the meaning and scope of the science, it is only necessary to explain, first, what the protozoa are, and, secondly, why one should study them—to the extent, that is to say, of having independent university chairs for that purpose.

In sea-water, or in the waters of lakes, rivers, ponds, and ditches, in any small puddle or in damp earth and moss, in fact, in any situation where sufficient moisture exists to float their tiny bodies, protozoa can almost always be found, usually in abundance. If an infusion or liquid containing organic matter be exposed for a sufficient time to the air, protozoa will make their appearance in it and multiply. And, finally, there remains for mention a large, but very important, section of the protozoa which do not get their living in an honest and independent manner, but live as parasites of other animals and nourish themselves on the internal juices of their hosts, it may be in the digestive tract, or it may be in the blood, or in some other organ or tissue of the body. Thus the situations in which protozoa may be found show the utmost diversity of character. It must not be supposed, however, that every minute living thing which can be detected growing or moving in a moist environment is necessarily one of the protozoa. Here we have to draw some distinctions and to eliminate certain types of organisms. In the first place, the protozoa must on no account be confused with the bacteria, a group of organisms which stands sharply apart from other microscopic forms of life. Apart from the bacteria, the world of microscopic life can be further divided into two groups, the one comprising those of animal nature and habit, the other those more distinctly vegetable in their mode of life. The distinction between plant and animal when applied to these lowly forms of life is, however, a most unnatural and artificial line of cleavage. It is impossible, therefore, to use vegetable or animal characteristics as a criterion for separating these minute organisms into natural groups. For this reason it has been proposed to unite all these primitive forms of life into one group

[1] Abridged from the inaugural lecture delivered before the University of London on November 15 by Prof E. A. Minchin, Professor of Protozoology.

under the name protista, meaning literally the very first things, living things (zoa) being understood. The protista would then rank as a separate *kingdom*, that is to say, as a category equivalent to the animal and vegetable kingdoms respectively.

Theoretically, there can be no doubt that to group all these primitive living things together as protista is the most natural and proper way of dealing with them. We should then talk of protistology rather than protozoology, and of a protist rather than of a protozoon, which would at least be more euphonious. But this method of dealing with these creatures is inconvenient and unsuitable in practice, chiefly because the group protista comprises such a vast array of organisms of different types that no one investigator can deal with them all satisfactorily, or with the different technical methods requisite for their study, and a division of labour has become necessary. Hence the bacteria have been assigned to the domain of a special science, bacteriology; the botanists claim for their sphere of investigations all those protista which are of vegetable nature; and there remain, finally, for the zoologist, those protista which can be regarded as *animals*, and which are, therefore, termed the *protozoa*.

We have now got so far, that the protozoa are minute, microscopic forms of animal life. There are, however, many minute animalcules which are by no means to be considered as protozoa. If we compare the protista with higher animals and plants, we find at once a fundamental difference. In the body of a protist the living substance, the protoplasm, is not divided up into cells, but forms one simple mass; that is to say, the whole body of a protist is comparable to a single one of the cells that build up, in vast numbers, the complex body of a higher animal or plant. Expressed briefly in the technical jargon, we may say that a protist is a unicellular organism, and that a protozoon is a protist of animal nature. Since such organisms may be regarded as the most primitive types of animal life, the earliest, probably, to appear upon our globe, they have been named the protozoa, or "first animals."

We are now in a position to attack the second question that was suggested for consideration, namely, what is the interest and importance specially attaching to the study of the protozoa? This is a matter which can be considered most conveniently from two different points of view, the theoretical and the practical. In dividing my discourse into these two heads, however, I do not wish to be understood to imply that there is any real distinction between theoretical and practical science. The whole history of human progress and culture shows that what is theoretical to-day is practical to-morrow. This is such a commonplace that it would be superfluous to waste time by citing instances. The theoretical knowledge of scientific principles must necessarily precede their application; hence to discover these principles is, even from the practical point of view, the most important occupation of the human intellect. This is a point of view which cannot be too strongly emphasised, and to which I shall return again.

From the theoretical point of view the protozoa are of the greatest interest on account of their primitive nature, and the light which they consequently throw on many obscure vital processes. The cells which compose the tissues of higher animals have become extremely specialised for their particular functions and modes of life, and their structural or developmental characters tend to follow certain stereotyped patterns and to conform to uniform rules of procedure, due perhaps to a common origin and ancestry. In the protozoa, on the other hand, each individual is an unspecialised cell, capable of performing equally well all the functions of life as a free and independent living organism, and the structural features or developmental processes of protozoa exhibit the utmost possible diversity of character. Only by the detailed comparative study of this primitive diversity is it possible to discover the course of evolution which has culminated in the relatively uniform characters of cell-structure and cell-behaviour in the higher forms, and so to elucidate the true significance of many obscure cytological problems. Just as the higher division of the animal kingdom may be reasonably supposed to have originated from protozoan ancestors, so the cytology of the higher animals may be said to have its roots in the cytology of the protozoa, and the same is perhaps true also of other subdivisions of biological science.

Turning now to the practical aspects and applications of protozoology, we find that these arise from the peculiarity already mentioned of many of these organisms, namely, that they live as parasites of other animals, and may produce diseases in them. For this reason the investigation of the protozoa has, like that of the bacteria, become of immense importance to medical and veterinary science, and for this reason protozoology has taken shape as a definite science, and has gained recognition, outside zoological circles, just as bacteriology did before it. Formerly it was always bacteria that were sought for as the agents of diseases. Now it is known that many diseases are caused by protozoa, and not by bacteria, and it is suspected that this is the case also in certain diseases of which the cause is still obscure.

Although, as I have stated, the practical importance of the study of protozoa has only been recognised generally in the last few years, nevertheless the actual discoveries of important disease-producing protozoan parasites date back, in some cases, a quarter of a century. Prof. Koch, of Berlin, has directed attention to three great discoveries, each of which opened up the way for a new line of investigation, and was of the utmost importance in establishing the true cause of diseases previously mysterious in nature. The first was the discovery of the malarial parasites by Laveran in 1880. The second was the discovery of the parasites of the so-called Texas fever of cattle in America by Smith and Kilborne in 1893. The third was the discovery of the parasites of tsetse-fly disease in Africa by Bruce in 1895.

The malarial parasite was first observed by Laveran, then an army surgeon, in the blood of fever patients in the military hospital at Constantine, in Algiers. Though working with inferior microscopical apparatus, Laveran described clearly all the principal stages that can be made out in human blood. This sensational discovery was received everywhere with coolness and disbelief. At that time the cause of malaria was generally believed to be a bacterium, which was named *Bacillus malariae*, and it was some years before the bacillus was discredited, and Laveran's parasite established, as the true cause of the disease. It still remained a mystery, however, in what way this minute organism got into the human blood, and the view was put forward that it gave rise to minute germs which passed out of the body and were scattered abroad, and which, like many other germs of protozoa, were able to float in the air. It was supposed that those germs were then inhaled by healthy persons, and so gave rise to the disease. This was simply an extension of the old miasma theory, the notion that the disease was contracted by inhaling the air of swamps and marshes, a notion expressed in the word malaria, meaning literally bad air. It remained for a countryman of ours, Major Ronald Ross, to discover, by a series of brilliant experiments and observations, the part played by mosquitoes in disseminating the disease. It was found, however, that a remarkable relation existed between the species of mosquitoes and the species of malarial parasites. The common gnats, for instance, belonging to the genus Culex, are incapable of transmitting the malarial parasites of man, but convey those of birds from one bird to another. The mosquitoes which carry the malarial parasites of man belong to a different genus, Anopheles, and they in their turn are incapable of transmitting the malarial parasites of birds. This is one of those remarkable adaptive specialisations so often seen in nature.

Let us now follow the course of infection briefly. If a mosquito bite a man suffering from malaria, it takes in a drop of blood in which are contained various stages of the malarial parasite. The blood is, of course, digested slowly in the mosquito's stomach, and if the mosquito be a Culex, all stages of the parasite are digested also: but if the mosquito be an Anopheles, certain stages of the parasite resist digestion. In the parasite of pernicious or tropical malaria, the resistent stages have a form like a sausage, and are known commonly as crescents. These crescents undergo changes in the mosquito's stomach which give rise to sexual forms, minute, slender males, and relatively large, bulky females. Fertilisation takes place,

and the result is a slender, worm-like creature which progresses by gliding movements, and which penetrates into the wall of the mosquito's stomach, and there multiplies to form an immense number of very minute germs, producing a small tumour on the outer side of the wall of the stomach. After a time this tumour bursts, and the little germs pass into the blood of the mosquito. They are carried to and fro in the mosquito's blood circulation, but ultimately pass into its salivary glands, and the mosquito is now infectious. When it next feeds, a swarm of the malarial germs passes down its proboscis into the puncture it makes, and in this way the disease is passed on from one person to another.

The second important discovery mentioned above, that of Smith and Kilborne, concerns a fatal epidemic disease of cattle and other animals, sometimes termed red-water. In this case the two American investigators discovered, not only the cause of the disease, but the method of transmission. The parasites are tiny, pear-shaped bodies which penetrate the blood corpuscles and multiply there, so that two or more parasites may be found in one corpuscle. Similar parasites are now known to occur in sheep, horses, dogs, monkeys, and rats, but are not known with certainty to occur in human beings.

Smith and Kilborne discovered that the parasites of cattle red-water were transmitted by ticks, but not quite in the same way as malaria is transmitted by the mosquito. When a tick feeds on an infected animal, it does not itself become infectious, but gives rise to offspring which are capable of infecting healthy animals, so that the parasite passes through two generations of ticks. Unfortunately, nothing intelligible is known of the development of the parasite within the tick, and an important field of investigation is as yet untrodden.

[For an account of the third discovery referred to above, that of Bruce, see NATURE, November 15 (p. 56).]

Enough has been said, I think, to show that protozoology offers a most interesting and important field of investigation, of which as yet only the fringe has been touched. Almost every day brings news of some new discovery in this field. There are still, however, many questions to be answered relating both to protozoa and to the diseases caused by them, especially in the tropics, where insect life of all kinds is so developed, and there are so many different blood-sucking insects to carry infections of all kinds.

This brings me now to the concluding section of my discourse—what are the problems of protozoology and how should they be attacked? The problems that present themselves to the student of the protozoa are principally of two kinds. In the first place, there are purely zoological problems, such as the recognition, classification, and registration of the innumerable varieties and forms of these tiny creatures; the tracing out of their complicated life-histories and their bewildering changes of form and appearance during development; and the study of their vital processes and reactions to surroundings, as throwing light on many problems of cytology, heredity and evolution, of psychology and physiology. In the second place, the results obtained by the zoologist—that is to say, by anyone working according to zoological methods—must be applied to the elucidation of questions relating to disease in man and beast, in other words, to the requirements of the healing art, as practised by the medical man and the veterinary surgeon. Here, however, all the zoologist can do is to supply a knowledge of facts and principles of which the healer can make use, and the final beneficial result must be obtained by a collaboration of the investigator and the practitioner.

Although it may be urged with justice that the most important outcome of human science is its application to human needs, it would be the greatest possible mistake to attempt to confine any scientific study to just those problems which are thought likely to yield results of direct practical importance. Such a course would be short-sighted in the extreme, and would tend to produce a narrow outlook and a limited range of ideas, in the place of broad fundamental principles on which to base deductions for practical guidance. Thus, to apply this statement to the special case of protozoology, the forms most important for medicine are those which are parasitic upon man, but it would be absurd to study only these forms, first, for practical reasons, because it is easier to experiment upon animals than upon our fellow-men, and, secondly, because the study of many different parasites and their development supplies analogies which throw light upon obscure points in the life-history of those attacking man. But if we take a still wider view, we find that three-fourths at least of the protozoa are not parasites at all, but live free, independent lives in various situations.

It is obvious, therefore, that to understand properly the highly-specialised parasitic protozoa we must be acquainted with the more primitive free-living forms first and foremost. This conclusion may be illustrated by a few facts from the career of the late Dr. Fritz Schaudinn, whose recent death at the early age of thirty-five was a most deplorable event, cutting off an investigator who, by his genius and industry, had won the very foremost place in the ranks of protozoologists. The bulk of his work was done on forms not of importance from the practical, that is to say, the medical, point of view, and yet it is not too much to say that his work has modified all our ideas upon the protozoa and has built up the modern conceptions of these creatures, so that no one at the present time can write upon them without taking into consideration the facts and principles discovered by Schaudinn, whose work is a living demonstration of the practical, as well as theoretical, imporance of non-practical scientific study.

The physician and the zoologist work from points of view which, though apparently opposed, are in reality mutually helpful. The physician, of course, takes the side of the patient, and his only object is to extirpate the parasite. The zoologist, on the other hand, identifies himself as an investigator with the interests of the parasite, and tries to become acquainted with all its migrations and changes, studying it for its own sake. In short, the zoologist must deal with protozoa as if he loved them, but the medical man as if he hated them. There can be no such thing as protozoology studied exclusively in relation to medicine. Protozoology must be studied as a science in which all knowledge is helpful, directly or indirectly. When the protozoologist has worked out his life-histories and obtained his results, then the medical man steps in and carries off the honey to the medical hive. In this way, by the cooperation of the purely scientific investigator with the practitioner, we may hope that protozoology may have before it a bright future, in which both theoretical science and the practice of the healing art may be advanced and benefited to an equal degree.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Vice-Chancellor announces that the treasurer of the Cambridge University Association has recently paid to the benefaction fund of the University the sum of 904*l.*, resulting from the appeal for the building fund for the new museum of archæology and ethnology. This payment, together with 60*l.* already received by the benefaction fund, is intended to form a nucleus of 1000*l.* for the building fund of the museum. The Vice-Chancellor publishes also a list of subscriptions, paid or promised, amounting altogether to 12,325*l.*, toward the building fund of the department of agriculture.

After considering a resolution of the Classical Association in favour of abolishing the Greek grammar paper in the previous examination, the board of examinations proposes that in part i. of the previous examination (*a*) the separate paper at present set on Greek and Latin grammar be discontinued; (*b*) the time allowed for the two papers on the Greek and Latin classics be increased from 2½ hours to 3 hours, in order that more questions in grammar may be set than at present, the questions in grammar to be such as arise from or are suggested by the passages given for translation; (*c*) the papers set on the alternatives to the Greek and Latin classics be similarly lengthened, with the same object; and (*d*) these changes shall first take effect at the examination to be held in October, 1907.

Sir James Dewar, who will be unable to lecture next term, has nominated Mr. H. O. Jones, of Clare College, as deputy for the Jacksonian professor of experimental philosophy during the Lent term of 1907. Mr. Jones has

been re-appointed demonstrator to the Jacksonian professor until September 30, 1911.

The Cavendish professor of experimental physics and the Lucasian professor of mathematics have elected Mr. F. Horton, fellow of St. John's College, to be Clerk Maxwell student in succession to Mr. O. W. Richardson, of Trinity College, who has resigned the scholarship.

THE treasurer of Guy's Hospital has received two anonymous donations of 200*l.* and 10*l.* respectively toward the fund for the endowment of medical education and research at Guy's Hospital.

As part of the scheme of university courses in advanced zoology, Dr. W. G. Ridewood will deliver two lectures on "The Structure and Affinities of Cephalodiscus" in the zoological lecture-room of University College, Gower Street, W.C., at 5 p.m. on December 5 and 12. Admission to the lectures is free by ticket obtainable on application to the Academic Registrar, University of London.

IT has been suggested to provide a regularly equipped central station for lighting the buildings of the University of Sydney. The work in this station might, it is thought, form part of the college engineering course. In addition to work connected with the generation of power, the scheme would provide opportunity for testing for faults in mains, and for training in the commercial side of station work.

THE Senate of the University of London has received from the Clerk of the Privy Council an intimation that the King in Council has approved the new statutes made for the management of University College and for the constitution and management of the North London or University College Hospital and the School of Advanced Medical Studies connected therewith. All the arrangements made in connection with the incorporation of University College in the University will come into operation on January 1, 1907.

THE University of California has been presented with the herbarium and botanical library of Mr. and Mrs. T. S. Brandegee, of San Diego. The herbarium, *Science* states, is one of the most important in the west of the United States, since it contains something more than 100,000 sheets of carefully selected plants, mostly representative of the Mexican flora, which for many years has been Mr. Brandegee's chosen field, and of the flora of California and neighbouring States, which has received careful treatment at the hands of Mrs. Brandegee. We learn from the same source that the Academy of Natural Sciences of Philadelphia has acquired two important zoological collections. One of these is the Gulick collection of Hawaiian land shells, which served as the basis of Rev. John T. Gulick's well-known work, "Evolution: Racial and Habitudinal," and the other is the Tristram collection of birds, numbering some 7000 skins and representing upwards of 3000 species. This is the second collection made by the late Canon Tristram, the first one having been secured some years ago by the Liverpool Museum.

THOUGH it was more common a few years ago, there is still a disposition in some educational circles to refer to the study of the applied sciences as merely "bread-and-butter studies." In a recent address to the Wolverhampton Technical Schools, published in pamphlet form by Messrs. Longmans, Green and Co., Prof. Ripper has much of value and interest to say as to this contention. He urges, very rightly, that these studies, if properly pursued, must develop scientific methods of thought and give new and higher interests to the student. As Prof. Ripper said, "The same spirit which originally led to the study of technical science will tend also to the desire to travel beyond it. The same qualities which have made the technical expert, will tend also to make the enlightened and cultured citizen." The address concludes with an optimistic estimate of the educational outlook. There is, Prof. Ripper thinks, much more demand than formerly for technically trained assistants. Employers are offering facilities for extended courses of study for their apprentices; for example, several firms in Sheffield arrange for some of their apprentices six months' study at the university and six months' study in the works. Employers, too, are immensely stimulating the work of education by making their appointments and promotions depend in an increasing degree upon educational fitness.

THE anniversary address of the Royal Scottish Geographical Society was delivered by Sir George Goldie, president of the Royal Geographical Society, on November 22. The subject of the address was "Geographical Ideals." Among a variety of subjects discussed in the address, great prominence was given to the question of the value of geography in war. This value, Sir George Goldie said, might be best brought home to our own countrymen by recalling the enormous expenditure in which the want both of maps and of geographical training of our officers indirectly involved us during the Boer war. He went on to say that he could speak confidently on these points from having served for nearly a year on the Royal Commission on the South African War. He added that the lesson of the war in this respect has not been altogether forgotten. During the last four years a certain amount of money has been expended in Imperial mapping of hitherto unsurveyed regions, and if this process is not altogether arrested by a spirit of false economy, we may possibly at some distant date possess fairly adequate maps of all British possessions. Our ideal must be to reach the level attained by Japanese and German officers. Sir George Goldie finally dwelt upon the importance of educating the people on the subject of geography, and its removal from the subjects of the examinations for the Foreign Office and Diplomatic Service.

THE report of the work of the department of technology of the City and Guilds of London Institute for the session 1905–6 is now available. Statistics are given showing the continuous growth of the work of the department since 1879. The number of subjects in which examinations were held during the session under review was the same as in the preceding year, but the number of separate classes increased from 2601 to 2820, the largest number recorded. There was, too, a marked increase in the number of students in attendance, the number having risen from 41,618 to 44,464. At the examinations at the end of the session 20,610 candidates were presented in subjects of technology, and of these 11,665 passed. Numerous candidates were examined in India and the colonies. We notice that Cape Colony, Jamaica, Malta, Suez, Melbourne, Granville (New South Wales), all presented candidates, but that the largest contingent of colonial candidates was that sent by New Zealand. The system of inspection inaugurated by the institute grows in usefulness. The inspectors appointed by the institute are men and women possessing somewhat different qualifications from those of the inspectors of the Board of Education, and their work is supplementary to that of the Board. Whilst the Board's inspectors report upon the general equipment of technical schools and upon the general character of the teaching, those of the institute are concerned only with the special facilities provided for trade instruction, and report on the methods and the value of the teaching as part of the training of artisans.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, November 15.—Prof. R. Meldola, F.R.S., president, in the chair.—The determination of the rate of chemical change by measurement of gases evolved. Preliminary notice: F. E. E. **Lamplough.** When a chemical reaction takes place in solution resulting in the formation of a gaseous substance, the solvent becomes supersaturated with the gas. The excess of gas so dissolved may be almost entirely expelled by brisk agitation. Under conditions of efficient stirring the rate of evolution of a gas furnishes an accurate and trustworthy method of investigating reactions.—The formation and reactions of imino-compounds, part ii., condensation of benzyl cyanide leading to the formation of 1:3-diaminonaphthalene and its derivatives: E. F. J. **Atkinson** and J. F. **Thorpe.**—Note on the anhydride of phenylsuccinic acid: F. B. **Dehn** and J. F. **Thorpe.** The authors conclude that the anhydride of phenylsuccinic acid exists only in one form, which melts at 53°–54°.—Influence of sodium arsenate on the fermentation of glucose by yeast-juice. Preliminary notice: A. **Harden** and W. J. **Young.** It has been previously shown

that the addition of a soluble phosphate to yeast-juice containing glucose increases the rate of fermentation, which proceeds until an extra amount of carbon dioxide (equivalent, molecule for molecule, to the phosphate added) has been evolved. The phosphate at the same time undergoes a change which renders it non-precipitable by magnesia mixture. When an equivalent amount of arsenate is substituted for the phosphate, a similar acceleration is produced, but the rate is greatly increased, and continues for a time without change until many times the equivalent of carbon dioxide has been evolved, and then falls gradually.—Xanthoxalanil and its analogues: S. **Ruhemann.**—Derivatives of cyanodihydrocarvone and cyanocarvomenthone: A. **Lapworth.**—Reactions involving the addition of hydrogen cyanide to carbon compounds, part vi., the action of potassium cyanide on pulegone: R. W. L. **Clarke** and A. **Lapworth.**—The influence of various substituents on the optical activity of tartramide, part ii., P. F. **Frankland** and D. F. **Twiss.** The authors have prepared and described the n- and iso-*propylamides*, the *allylamide*, the n- and iso-*butylamides*, and the n-*heptylamide* of tartaric acid.—The influence of various substituents on the optical activity of malamide: P. F. **Frankland** and E. **Done.** The authors described the preparation and properties of the *methylamide*, *ethylamide*, and iso*propylamide*, *allylamide*, and iso*butylamide*, n-*heptylamide*, *piperidide*, and *phenylhydrazide* of ordinary *l*-malic acid.

Royal Meteorological Society, November 21.—The abnormal weather of the past summer and some of its effects: W. **Marriott.** The principal features of the weather over the greater part of England—especially the south-east—were the high state of the barometer throughout the whole of the period, except a portion of August; the high temperature in July, August, and September; the great amount of sunshine; and the deficiency of rainfall. Over the south-eastern portion of England more than 900 hours of bright sunshine were recorded during the four months June to September, while at a few stations in the extreme south and on the east coast more than 1000 hours were recorded. The sunshine was more than 200 hours above the average over the Thames basin and on the coasts of Lancashire and North Wales. The most remarkable feature of the weather during the past summer was the exceptional heat wave which occurred between August 30 and September 3. The temperature rose above 90° over a large part of England on four consecutive days, viz. August 31 to September 3. With the advent of the hot weather the death-rate increased considerably, and it was pointed out that when the mean maximum temperature for the week reached 72° the death-rate at once began to rise. The increase of the death-rate was made up almost entirely of infants under one year of age. This was shown to be due to the prevalence of infantile epidemic diarrhœa, which sets in when the mean maximum temperature for the week rises above 72°.—The International Congress on Polar Exploration held at Brussels in September: Dr. H. R. **Mill.**

Mineralogical Society, November 13.—Prof. H. A. Miers, F.R.S., president, in the chair.—Growth of crystals of soluble salts on each other: T. V. **Barker.** This paper is a continuation of the author's previous work on the growths of salts on isostructural minerals to those of soluble isomorphous salts on each other. The group now investigated is that of the chlorides, bromides, iodides, and cyanides of Na, K, Rb, Cs, and Am, which crystallise in the cubic system. The view previously entertained that parallel growths are conditioned by a similarity of molecular volume is again found to hold good; some apparent exceptions are explained by the presence of isodimorphism. One pair of salts, however, NaCl–KI, yield parallel growths, although the molecular volumes are greatly different; this is perhaps to be accounted for by the fact that the molecular volumes are almost exactly in the ratio 1 : 2.—Notes on some Bolivian minerals: L. J. **Spencer.** Descriptions are given of crystallised jamesonite, semseyite from Oruro, new crystal forms on andorite, chalcostibite from Oruro, augelite from Oruro, vivianite from Tatasi and Tasna, tetrahedrite from Huanchaca, regular grouping of stannite and tertrahedrite, valentinite, cassiterite, tourmaline and tourmaline-hornfels, fluor, apatite, cupriferous miargyrite from Tatasi, crystallised miargyrite from Aullagas, jarosite from Chocaya, chalybite from Chorolque and Tatasi, enargite from Chorolque.—Note on ilmenite from Brazil: G. F. Herbert **Smith.** The crystals have three habits, *cam*, *camrX*, *cnXrs*, differing slightly from those described from the same locality by Hussak. The hemihedrism is shown by striations on the prism faces; some magnesium is present.—Description of the Lengenbach Quarry and of the minerals found there in 1906: R. H. **Solly.** The now well-known quarry was opened about the year 1850, and various new minerals were described by Des Cloizeaux and others. From 1860–70 a level was driven in a direction at right angles to the stream, and in it were found the specimens described by Vom Rath. In the decade 1890–1900 a little work was done each summer, resulting in the specimens studied by Baumhauer. Since 1900 Francis Jentsch and his partners have worked the quarry regularly each summer. In 1902 they came across the old tunnel constructed in 1731, the existence of which had been quite forgotten. Up to 1898 eighteen mineral species had been found, of which four are peculiar to the quarry; since that date twenty-five additional species, of which no fewer than twenty are new to science, have come to light. Nine of the new species have been named, two are pseudomorphs, and nine, owing to paucity of material, have not yet been described. The minerals found this year include trechmannite (fine crystals), baumhauerite (curiously striated and distorted crystals), seligmannite (a large crystal 20 mm. in length), jordanite (a twin about 301), dufrenoysite (a twin about 001), pseudomorphs of dolomite and baumhauerite after scapolite (?)—Note on the thirty-two classes of symmetry: H. **Hilton.**—Note on a Canadian mineral: Prof. **Harrington.**—Specimens of turnerite from Cornwall were exhibited by Mr. **Russell**, and crystals of sartorite by Dr. **Trechmann.**

DUBLIN.

Royal Irish Academy, November 12.—Prof. F. A. Tarleton, president, in the chair.—The stability or instability of the steady motions of a perfect liquid and of a viscous liquid; part i., a perfect liquid: Prof. W. McF. **Orr.** It is known experimentally that when water flows through a circular pipe the steady motion is unstable if the velocity exceed a limit depending on the radius of the pipe. Lord Rayleigh has proved mathematically that in this case, as well as in others of flow in plane sheets, including that of a liquid which is shearing uniformly, the fundamental modes of "free disturbance" are stable, when viscosity is ignored in the disturbed motion, the free periods being real. There is thus an apparent contradiction between theory and experiment. It is, however, contrary to the teaching of Fourier analysis to infer that a general disturbance is stable from the fact that the "free disturbances" possess stability, even of an exponential type. In a system disturbed from equilibrium, the question of stability is in reality decided by an energy criterion which is, as a rule, inapplicable to questions of the stability of motion. If a liquid bounded by the infinite planes $y=0$, $y=b$, and shearing uniformly in the direction of x, is subjected to an initial disturbance for which the stream function is $\psi=\sin lx \sin my$, it appears that, if mb and m/l are each large, the disturbance, as shown by equations in which only terms of the first order of small quantities are retained, increases in a great ratio as a certain time approaches, after which it diminishes indefinitely. A similar result is obtained for a symmetrical disturbance of simple type in a circular pipe when the steady motion is that of a viscous liquid. When the steady motion is that of a viscous liquid between concentric cylinders, one or both of which is rotating, a similar result also holds for a two-dimensional disturbance (except the liquid rotates as a rigid body). It is held that these results afford an explanation of the observed instabilities as satisfactory as can be expected from an investigation which ignores viscosity.—A theorem on moving distributions of electricity: Prof. A. W. **Conway.** The integrals which express the electric and magnetic forces for a moving distribution in terms of retarded potentials are discussed, and it is proved that they obey Maxwell's equations outside the electrical matter, but that

inside the equations have to be modified by adding the convection current to the displacement current, as done by Fitzgerald.—The contact-phenomena at the junction of Lias and Dolerite at Portrush: Prof. G. A. J. **Cole.** The paper describes the microscopic characters of the rocks at and near the junction of Dolerite (or basalt) and calcareous Lias shale at Portrush—a junction of considerable interest in the history of geological opinion. The silicification of the shale is accompanied by the production of abundant minute crystals of a pale green pyroxene. The "bronzite" of Portlock and Oldham, named by them with some hesitation, proves to be a brown mica, locally developed after the formation of the pyroxene. The author has had the advantage of using the original specimens collected by Portlock's survey. Some details as to the later sheets and veins of dolerite are given, and the occurrence in them of differentiation, by gravitation of ferromagnesian minerals to their under surfaces, is compared with similar cases elsewhere.

PARIS.

Academy of Sciences, November 19.—M. H. Poincaré in the chair.—The inflorescence of the seed-bearing ferns of the Culm and the Coal-measures: M. **Grand'Eury.**—Observations of the new comet (1906g), made at the Observatory of Besançon with the bent equatorial: P. **Chofardet.**—Curves reproduced periodically by the transformation $(X, Y; x, y, y')$: S. **Lattès.**—A family of hyperelliptic surfaces of the fourth order: L. **Remy.**—A theory of magneto-optic phenomena in crystals: Jean **Becquerel.**—The heat of combustion and formation of some cyclic nitrogen compounds: P. **Lemoult.** From the experimental data given in this paper the author calculates the thermal changes in passing from nitro-compounds to oxyazo-compounds, from the latter to azo-bodies, from azo- to hydrazo-compounds, and from the last to amines.—The isomorphous crystals of lead nitrate and barium nitrate: P. **Gaubert.** A mixed crystal of lead and barium nitrates is not homogeneous, in spite of its transparence and limpidity: it is constructed of groups of pyramids the composition of which varies with the nature of the faces to which they correspond. The results are applied to the explanation of a similar structure frequently found in minerals.—The distribution of *Anopheles maculipennis* in the neighbourhood of Lyons: A. **Conte** and C. **Vaney.** The reduction in the amount of malaria in this region is much greater than would be expected from the slight reduction in the numbers of mosquitoes that has taken place in recent years. The possible causes of this are discussed.—The consumption of the glucose of the blood by the tissue of the mammary gland: M. **Kaufmann** and H. **Magne.** The experiments cited are all in favour of the theory of the transformation of the glucose into lactose in the mammary tissue in secretory activity.—Study of the variations of the mass of the blood in man: Gabriel **Arthaud.**—Chromotropism and its artificial inversion: Romuald **Minkiewicz.**—The stroma of the red corpuscles: MM. **Piettre** and **Vila.** A new method of separating the stroma is described.—Experimental researches demonstrating that anthracosis of the lungs is due to inhalation, and not to the deglutition of atmospheric dust: ——.—The presence of the spirochæta of Schaudinn in the testicle of a new-born syphilitic infant: Ch. **Fouquet.**—The fractionation of the rare gases in mineral waters: the proportions of helium: Charles **Moureu** and Robert **Biquard.**—The hydrology of the Bulgarian Dobroudja: M. **De Launay.**

DIARY OF SOCIETIES.

FRIDAY, NOVEMBER 30.

ROYAL SOCIETY, at 4.—Anniversary Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Applications of Electricity in Printing-works: P. A. Spalding.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Steam as a Motive Power for Public Service Vehicles (Discussion): T. Clarkson.

MONDAY, DECEMBER 3.

SOCIOLOGICAL SOCIETY (Research Meeting), at 8.—Mating, Marriage and the Status of Women: S. S. Buckman.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Direct Estimation of Antimony: H. W. Rowell.—Bacterial Method of Investigating Disinfectants: M. Wynter Blyth.—The Detannisation of Solutions in the Analysis of Tanning Materials: Dr. J. Gordon Parker and H. G. Bennett.

SOCIETY OF ARTS, at 8.—Artificial Fertilisers: Nitrogenous Fertilisers: A. D. Hall.

TUESDAY, DECEMBER 4.

SOCIETY OF ARTS, at 4.30.—The Cape to Cairo Railway: The Hon. Sir Lewis Michell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Talla Water-supply of the Edinburgh and District Waterworks (Discussion): W. A. P. Tait.—Repairing a Limestone-concrete Aqueduct: M. R. Barnett.—The Yield of Catchment-areas: E. P. Hill.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Village Deities in Southern India: Lord Bishop of Madras.

WEDNESDAY, DECEMBER 5.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF ARTS, at 8.—The Metric System: Sir Charles M. Watson.

GEOLOGICAL SOCIETY, at 8.—On the Geological Conditions which have contributed to the Success of the Artesian Boring for Water at Lincoln: Prof. Edward Hull, F.R.S.—Notes on the Raised Beaches of Taltal (Northern Chile): O. H. Evans.

THURSDAY, DECEMBER 6.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* A Comparison of Values of the Magnetic Elements deduced from the British Magnetic Survey of 1891 with Recent Observation: W. Ellis, F.R.S.—The Theory of the Composition of Numbers, Part ii.: Major P. A. MacMahon, F.R.S.—On the Transpiration Current in Plants: Prof. Henry H. Dixon.—The Theory of Photographic Processes, Part iii., The Latent Image and its Destruction, an Abstract: S. E. Sheppard and C. E. K. Mees.—The Chemistry of Globulin: W. Sutherland.

CHEMICAL SOCIETY, at 8.30.—The Liquid Volume of a Dissolved Substance: J. S. Lumsden.—Some Derivatives of Benzophenone; Synthesis of Substances occurring in Coco-bark (preliminary notice): W. H. Perkin, jun., and R. Robinson.—A Synthesis of Terebic, Terpenylic and Homoterpenylic Acids: J. L. Simonsen.

LINNEAN SOCIETY, at 8.—*Papers:* A Contribution to the Physiology of the Museum Beetle, *Anthrenus museorum* (Linn.): Prof. A. Ewart.—Note on the Origin of the Name *Chermes* or *Kermes*: E. R. Burdon.—*Exhibitions:* An Abnormal Specimen of a Dab with Three Eyes: Dr. A. T. Masterman.—A Note on *Siegesbeckia orientalis*, Linn.: Rev. H. Purefoy FitzGerald.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Selection and Testing of Materials for Construction of Electric Machinery: Prof. J. Epstein.

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