THURSDAY, JANUARY 28, 1909.

RELIGIOUS AND SEXUAL PSYCHOLOGY.

(1) *Völkerpsychologie, eine Untersuchung der Entwickelungsgesetze von Sprache, Mythus und Sitte.* By Wilhelm Wundt. Zweiter Band, Mythus und Religion, zweiter Teil. Pp. viii+481. (Leipzig: W. Engelmann, 1906.) Price 11 marks.

(2) *Das Geschlechtsleben in der Völkerpsychologie.* By Otto Stoll. Pp. xiv+1020. (Leipzig: Veit and Co., 1908.) Price 30 marks.

(1) THIS volume contains a single chapter of Wundt's great work, and deals ostensibly with ideas as to the soul; in reality, however, its scope is much wider, and only one of the four parts actually deals with animism. The second part deals with animism at the outset, but passes on to discuss magic and fetichism; the third discusses totemism, tabu, sacrifice, and the cult of ancestors; and the fourth, again, approaches the subject-heading of the chapter in dealing with demons, vegetation "spirits," and tutelary deities.

Under certain conditions a work of this description would be invaluable, but the conditions are not fulfilled in the present case. In the first place, there must be an adequate monographic treatment of the sphere with which such a monumental work as the present deals, and monographs are far too infrequent in the field of comparative religion; to make matters worse, the author has not even consulted such as exist—he writes on sacrifice and magic without mentioning the indispensable studies on these subjects by Hubert and Mauss. In the second place, the author, if he is not an ethnologist by profession, must have clear-cut ideas on the subjects of which he treats, and define as rigidly as possible the terms which he employs. But in the present volume we find pages of discussion on magic, fetichism, totemism, and tabu, but nowhere an adequate definition of any of these terms, though they are far from unambiguous.

The lack of definition makes itself particularly felt in the pages on totemism; the author includes under totems not only totems proper, kin or individual, but also all the animals enumerated by Frazer in the "Golden Bough" under the heading of animal cults. He commits himself to the assertion that totems are originally soul-animals (Seelentiere), that is, animals inhabited by the souls of ancestors. One of the central features of South African totemism, if totemism it be, is the belief that the souls of dead chiefs pass into or become the totem animals of their kin; but so far from this being a universal belief, the totem in the greater part of Australia is neither an ancestor nor has any connection with ancestors, and where, as in the Central tribes, totems appear as akin to ancestors, they are not "Seelentiere," and the totemism is not primitive, according to the view most commonly held; in fact, some recent researches by P. W. Schmidt go to show that north Australian totemism is really derived from New Guinea.

To say that the work is not one which the student of comparative religion can read with profit would be to do great injustice to the book with which we are dealing; often the specialist in one branch owes invaluable suggestions to the unbiassed attitude of the specialist of another sphere; but the work is one to be read critically. We may be doing injustice to the distinguished author, but the comparative scarcity of examples and references to authorities suggests that the solution of many problems has been attacked with a quite insufficient preparation. In many places a characteristic Teutonic tendency to abstract argument manifests itself, and throughout the work we feel that the author stands rather far from primitive man, with whom he is largely concerned; if he were intimately acquainted with one uncivilised race his discussion of many points would gain immeasurably. The first part of this work—on language—has gained immensely by the author's careful revision, and we may hope that he will be able to give us in a second edition of the present part as many improvements as in the second edition of the earlier part.

(2) In this series of twenty-six lectures Dr. Stoll deals with many problems which at first sight seem to have little relation to the subject of the book, and in point of fact only one-third of them deal with strictly sexual questions. The author begins by a general account of sexual life in the animal world, and illustrates the *rôle* played by the various senses, sexual dimorphism and other points; he then proceeds to take the senses in man one by one, and discusses the factors of sexual life under these five heads. The category of sight, for example, covers such various subjects as the fattening of women in Africa, skull and other deformations, tatu and body scarring, treatment of the ear, nose, hair, beard, teeth, &c., body-painting and ornaments, amulets, &c., and in the chapters dealing with these subjects we find such unexpected themes as scalping, pariah castes, and mourning colours.

In the nineteenth chapter we approach more specifically sexual questions, such as circumcision, in connection with which Dr. Stoll discusses the subincision of the Central Australian area; it may be noted that he is mistaken in his account of the distribution of the operation, which he gives as "the interior of Queensland, New South Wales and South Australia, with a large part of the north and west." In point of fact, in Queensland it is found only in the west, and in the extreme north-west corner of New South Wales; more than one map of the distribution of the practice has been published.

In his discussion of the origin of circumcision Dr. Stoll rejects, as may be imagined, the common theories that cleanliness or other practical motives played any part; but apart from generalities about the cruelty of primitive man, the mystical nature of blood customs, &c., he has no suggestion to make. It is a well-known fact that peoples in the lower stages of culture sometimes emphasise instead of concealing the genital organs; and it is possible that in some cases this was a motive for circumcision; but in view of the fact that we find the knocking out of teeth taking the place of operations on the genital organs in, for example, the east of Australia, it seems reasonable to

look for some deeper meaning, such as that for which Dr. Frazer argued a year or two ago in the *Independent Review*.

In the visual section is included also a discussion of the dance, commonly unisexual in the lower stages of culture, and of phallic emblems and amulets. Under the heading of hearing we have a discussion of the *rôle* of music in sexual life, while the next chapter, *mirabile dictu*, is devoted to a classification of "gentlemen's stories" and allied themes.

In dealing with the sexual importance of the sense of smell Dr. Stoll gives an interesting discussion on the classification of odours, and has also a good deal to say on the subject of racial fœtor. The last chapter deals with the sense of touch; it includes a discussion of kissing, of specific sexual acts, and of inversion and perversion. It is clear that a work of this sort, if it is to be in any sense complete, demands encyclopædic knowledge, and can only be successfully carried through with the aid of numerous monographs on the various questions. In recent years a number of general works on the sexual life of primitive peoples have appeared, together with a certain number of monographs on special points such as inversion in Eastern Asia. Until the number of the latter has considerably increased it will hardly be possible to produce anything more than a sketch of the subject with which Dr. Stoll has dealt; he would probably be the first to recognise the fact. He is, however, as he informs us in the preface, chiefly concerned to classify from the point of view of psychology; and as a classification of anthropological facts Dr. Stoll's work is as useful as it must have been laborious.

That these two works should both have been produced in Germany is no accident. The Teutonic spirit aims at an all-embracing philosophy, whether the subject be metaphysical or something less abstruse. It is perhaps fortunate that both in England and France the feeling in anthropological circles is in favour of knowing all about something rather than a little about everything. Classification of knowledge may be the ultimate goal; at the present day we have still to lay the foundations of such a classification.

N. W. T.

THE BONE MARROW.

The Bone Marrow: a Cytological Study. By W. E. Carnegie Dickson. With 49 photomicrographs and 12 coloured plates by Richard Muir. Pp. xii+160. (London: Longmans, Green and Co., 1908.) Price 2*l.* 2*s.* net.

THE first part of the book contains a brief description of the histological methods employed, followed by a description of the various types of marrow and of the changes it undergoes in disease.

The second part deals with the cytology of the marrow, which the author has studied with the object of observing pathological changes in the cells. The reviewer is inclined to think that in the present state of our knowledge this attempt is premature. The changes illustrated on plate iii., Figs. 1–5, may be degenerative, but some of the nuclei in these cells have a remarkable resemblance to those figured by L. H. Huic in her papers on Drosera (*Q.J.M.S.*, vols. xxxix. and xlii., n.s.), where the cells were subjected to purely physiological stimuli. So also the type of eosinophil cell on plate iii., Fig. 1, No. 14, and Fig. 3, No. 23, is frequently met with in the tissues. Its nucleus somewhat resembles that of an exhausted nerve cell (Mann, *J. of Anat. and Physiol.*, vol. xxix., 1894), and is quite possibly a physiological appearance. Much more work on the lines of these three most important papers must be done before we can safely begin the study of intracellular pathology.

On p. 36 the author explains shortly the opinions of Dominici and Pappenheim on the parent cell of the neutrophil myelocyte, a cell called by the former non-granular basophil myelocyte, and by the latter identified with Ehrlich's large lymphocyte. He illustrates his idea of this cell in plate i., Figs. 10, 11, 12. The cells in each of these figures are quite different from those pictured by Dominici, Pappenheim and Ehrlich in the works cited in the bibliography. They are typical large mononuclears (Ehrlich's). It is a curious fact, but neither in the coloured plates nor the schemes on plate xii. is there a single example of an undoubted large lymphocyte, one of the most characteristic cells of the marrow, and common to it and the other blood-forming organs.

On the same page he says of this cell:—

"According to my own observations this staining reaction" (of the cytoplasm) "varies within somewhat wide limits, all gradations from a definite blue to a pale pink being obtainable with methylene blue and eosin."

This passage indicates that the technique used by the author is quite unsatisfactory. Every histologist knows that most things, especially the cytoplasm, can be stained with eosin. On the other hand, the cytoplasm of these cells (large lymphocytes, lymphocytes, large mononuclears) has a marked affinity for basic dyes, as can be seen in preparations stained with Pappenheim's pyronin methyl green mixture, or with toluidin blue or polychrome methylene blue, and differentiated with weak acetic acid. Ehrlich pointed out many years ago that successive methods, such as hæmatoxylin and eosin, or eosin and methylene blue, which the author has worked with, are quite inadequate for the study of the blood. The reviewer finds that in order to demonstrate neutrophil granules regularly in sections and wet fixed films, the acid and basic dyes must be used simultaneously, and their proportions so adjusted that the granules are stained with the acid dye while the cytoplasm of the adult leucocyte and myelocytes is unstained, and that of the promyelocytes and large and small lymphocytes is stained with the basic dye.

Judged by this standard, many of the figures in the coloured plates, although very beautiful, are worthless for the object in view. Thus, in plate i., Fig. 13, there are lymphocytes with eosin-stained cytoplasm. In plate iii., Figs. 1 and 2, the nuclear chromatin is blue to violet, all else pink. The majority of the cells in plate iii., Fig. 4, and the large cells with basophil cytoplasm in plate vii., Fig. 10, are labelled myelocytes, but their granules are not shown, and therefore it is not proved that they are myelocytes.

The introduction of the term premyelocyte (p. 49) for the non-granular cell with basophil cytoplasm which gives rise to the myelocytes is most regrettable, first because too many names have been given to this cell already, and, secondly, because the very similar word promyelocyte has already been in use for some time to describe cells like those in plate i., Fig. 8, Nos. 3, 4, 5, *i.e.* early myelocytes with granules in a still basophil cytoplasm (Pappenheim). Likewise the term intermediate myelocyte is both clumsy and unnecessary when the word metamyelocyte is already well established (Pappenheim).

From what the author says on pp. 40, 48, 62, and his figure on plate xii., it is obvious that he confuses the Reizungsformen with the large mononuclears. They are absolutely distinct cells, only differing from the young megaloblast in that the narrow rim of cytoplasm is extremely basophil and free from hæmoglobin.

The most valuable thing in this book is the series of plates illustrating the author's macroscopic bone-marrow preparations. These are jewels of a pathological museum. Taken as a whole, the book contains very little that is new, and is not a serious contribution to science.

PROGRESS OF CLIMATOLOGY.

Handbuch der Klimatologie. By Dr. Julius Hann. Band i., Allgemeine Klimalehre. Dritte wesentlich umgearbeitete und vermehrte Auflage. Pp. xiv+394. (Stuttgart: J. Engelhorn, Bibliothek geographischer Handbücher, 1908.)

A NEW edition of Prof. Hann's well-known handbook of climatology will be greeted with pleasure by geographers and meteorologists alike. The second edition has been rendered accessible to English readers by Prof. De Courcy Ward's translation. The present edition has been largely extended and revised, and much recent work has been incorporated in it. The numerous references to original papers, a feature which the book shares with its fellow, the "Lehrbuch der Meteorologie," are specially welcome. They render the work no mere text-book, but a veritable encyclopædia to which the student will turn as a matter of course to ascertain what has been accomplished by others in the field in which he proposes to work.

In external features the book has gained considerably from an increase in the size of the page which makes it possible to set out tabular matter in more comprehensive style. The more detailed subdivision of the material into books, chapters and sections is also of great assistance to the reader.

A comparison of the two editions is of the nature of a survey of the progress of climatology in the past decade. Perhaps the most striking development lies in the greater prominence given to the question of radiation, which finds expression in an introductory section on solar radiation and in a considerable extension of the chapter on the solar or mathematical climate. Langley's work on the distribution of energy in the solar spectrum and the researches on the determination of the amount of radiation received from the sun, which are associated with the name of Ångström, are dealt with, and open what is practically a new chapter in the science of climatology. The question of cyclical changes of climate has also come to the forefront in recent years, and the chapter thereon, with its numerous references, forms a useful summary of the present state of our knowledge of this question and of the allied one of the dependence of variations of terrestrial climate on solar phenomena. In this connection a bibliography of series of observations extending over long periods, many of them to the second half of the eighteenth century, is of great value. Prof. Hann endorses the generally accepted view that all available meteorological records show no permanent change of climate. On the wider question of a change of climate within historic times he preserves an open mind, and considers the usual statement that our climate is not changing to be a no more justifiable deduction from known facts than the reverse opinion.

Increased space is devoted to the consideration of methods of computing averages for temperature and rainfall from incomplete or short series of observations which shall be comparable with those deduced from long periods, a question which is of great importance in forming an estimate of the climatic factors of regions which have only recently been opened to civilisation. Finally, we mention an entirely new chapter on the great climatic zones of the globe, which gives a concise summary of the main features of the climate of each of the regions into which the earth's surface may be divided. We look forward with interest to the appearance of the second and third volumes of the book, which are to deal with the climates of special regions in greater detail.

R. G. K. L.

SOME NEW TEXT-BOOKS OF INORGANIC CHEMISTRY.

(1) *Cours de Chimie inorganique.* By F. Swarts. Pp. iv+706. (Paris: Librairie scientifique A. Hermann, 1908.) Price 15 francs.

(2) *A Text-book of Inorganic Chemistry.* By A. F. Holleman. Issued in English in cooperation with H. C. Cooper. Pp. viii+502. Third English edition, partly re-written. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1908.)

(3) *General Chemistry for Schools and Colleges.* By Dr. Alexander Smith. Pp. xiii+529. (London: G. Bell and Sons, 1908.) Price 6*s.* 6*d.* net.

(4) *The New Matriculation Chemistry, specially adapted to the London University Matriculation Syllabus.* By Dr. G. H. Bailey. Pp. viii+528. Sixth impression, fourth edition; revised by H. W. Bausor. (Cambridge: University Tutorial Press, Ltd., 1908.) Price 5*s.* 6*d.*

(1) THE "Cours de Chimie," so the author states in the preface, is a reproduction of his course on general chemistry. Theoretical questions are discussed as they happen to occur, and, it may be added, these theoretical questions are treated in a manner which few first-year students of an English University would grasp. It speaks well for the previous training in mathematics and physics of the Belgian schoolboy that on

entering the university he can follow a course which involves the thermodynamics of chemical reactions. This is done, we are told :—

"Because it furnishes the demonstration of the law of Guldberg and Waage and of the principle of Le Chatelier, which, concurrently with the atomic hypothesis and the hypothesis of Arrhenius, serve as the basis of my teaching. It gives a precise notion of affinity, the primordial cause of all chemical transformations, and it affords an opportunity for discussing the significance of the principle of maximum work. Furthermore, I have wished to combat the unfortunate tendency often observed among engineering students, whose studies are largely mathematical, to consider chemistry as an empirical and descriptive science which appeals mainly to the memory."

In the latter object we should think Prof. Swarts has been successful, and we are only doubtful whether the student may not carry away the impression that chemistry is a branch of mathematics. Although somewhat advanced, according to our notions of an introductory course, the book is clearly written and printed in excellent type. It is also well illustrated, and the purely chemical information seems up to date.

(2) In writing a text-book of moderate dimensions which shall at the same time embrace the most recent developments of the subject there is a risk of superficiality, a risk which the author has not altogether succeeded in avoiding. Short sections are devoted to the mass law, the phase rule, transition temperatures, electrolytic dissociation, the theory of valency or valence, as Americans call it, induced reactions, colloids, the new gases of the atmosphere, radio-active elements, the rare earths of the cerium group, &c. The more elementary chemical information has to suffer occasionally in consequence. We would instance the treatment of flame, which is carried no further than that of the most elementary text-book. On the other hand, it must be admitted that the author has produced, if not a suggestive, at least an interesting book, and has managed to collect in a small compass a large amount of information. The appearance of a third edition is a sufficient testimony of public appreciation. As proofs of composition we should like to see the electrolysis of water and hydrogen chloride disappear once and for ever from the text-book. The first is untrue, and is usually contradicted in a later part of the book; but if the first is true the second can afford no satisfactory evidence of the composition of hydrogen chloride because water is invariably present.

We should also like to see consigned to the same limbo of questionable statements Lavoisier's authorship of the principle of the conservation of mass. We might with equal truth assign to him the statement of the principle of the conservation of energy, since he was the first to attach to the imponderable matter of heat or caloric a real and permanent existence. What are the facts? Simply that matter has for ages been regarded by the majority of philosophers as indestructible, and Lavoisier did no more than accept the principle and base his experiments upon it. Jean Rey, in his somewhat figurative style, states that "the weight with which each portion of matter is endowed at the cradle will be carried with it to the grave," whilst Boyle expresses himself still more clearly :—

"For it far exceeds the power of merely natural agents (and consequently of the fire) to produce anew so much as one atom of matter which they can but modifie and alter not create, which is so obvious a truth that almost all sects of philosophers have deny'd the power of producing matter to second causes."

Let us compare this statement with that of Lavoisier ("Elements of Chemistry," vol. i., p. 226, Kerr's translation) :—

"We may lay it down as an incontestable axiom, that in all the operations of art and nature, nothing is created; an equal quantity of matter exists both before and after the experiment; the quality and quantity of the elements remain precisely the same, and nothing takes place beyond changes and modifications in the combination of these elements. Upon this principle the whole art of performing chemical experiments depends. We must always suppose an exact equality between the elements of the body examined and those of the products of its analysis."

But this is nothing more than the axiom laid down by Boyle! That Lavoisier actually weighed his materials and products scarcely gives him the claim put forward by Prof. Holleman that he first introduced the principle of the conservation of mass into chemistry. Nor is Prof. Holleman more correct in saying that Lavoisier "assumed that gravity is an inseparable attribute of all matter." What about the *imponderable* matter of heat!

(3) Those who are acquainted with the many excellences of Prof. Alexander Smith's "Introduction to General Chemistry" will question the wisdom of publishing an abridgment of it for the use of schools and colleges. For the new volume is an abridgment in the sense that the arrangement, the illustrations, and page after page of the text are taken without modification from the original. This is unfortunate, because, if the matter is to be simplified for younger students, it must be expanded as well as curtailed, which is not the case. For example, of all subjects which demand clear and explicit treatment at considerable length, that on the measurement of gases should stand among the first. Yet we find the twelve pages forming an excellent chapter on the subject in the original cut down to less than five pages in the abridgment. The same is true of the section on catalysis; but the danger of this process is perhaps best illustrated on p. 89, where the expression "critical temperature" occurs without, so far as we can ascertain, any further explanation, whereas the original volume contains a very lucid account of critical phenomena in general. It seems scarcely worth while to issue at so small a difference in cost a volume so distinctly inferior to the original, which we regard, apart from the introductory chapters, as one of the best books on the subject.

(4) Little need be said about Dr. Bailey's "Matriculation Chemistry." It has long been recognised as a standard work of the "Tutorial" series. A book of such substantial proportions should, we think, carry the student not only well through the matriculation stage, but very considerably beyond it. The book is well arranged and full, almost too full, of information,

clearly set forth, and illustrated by numerous experiments and well-drawn diagrams. Its weak point, if it has a weak point, is that it is a little too didactic and not sufficiently suggestive. There is little to stimulate the student to ask himself or other people questions relating to what he has read, which may be partly due to the rather crowded mass of information. To take one example, the action of steam on various metals is described; some react and others do not. No comment is made or question raised as to the reason of this remarkable difference, and the student must be satisfied with the bare fact. J. B. C.

OUR BOOK SHELF.

The Theory and Practice of Bridge Construction in Timber, Iron and Steel. By Morgan W. Davies. Pp. viii+594. (London: Macmillan and Co., Ltd., 1908.) Price 12*s.* net.

THIS work is based upon notes of lectures delivered by the late Mr. Davies to students of civil engineering at the Swansea Technical College, and the aim the author had in view was to collect together a series of easily understood rules to enable problems of bridge design to be solved by graphical and analytical methods. The first two chapters are devoted to the routine problems connected with the bending moments and shearing forces of simple and built-in beams; then follow a series of chapters on stresses in the bars of framed structures; all the trusses which have been generally used in bridge construction are considered; in some cases graphical methods are employed, and in others, such as lattice girders and bow-string girders, analytical methods.

Special chapters are devoted to such subjects as the moment of resistance of beams, the strength and fatigue of iron and steel, the strength of columns, and the design of riveted joints. The various rules which have been proposed for fixing the working stresses in the different members of bridges are given, and their justification discussed; the recent failure of two long-span bridges in America emphasises the importance of this subject, and bridge engineers will be hardly likely in future to be any more enamoured of the rules laid down by certain well-known American bridge designers for the working stresses in struts than they have been in the past. The design of arches is very fully dealt with in chapter xiii.; both masonry and metallic arches are treated of, though, as is usual in text-books, much more space is devoted to the latter; this chapter will be one much consulted by the student, who generally finds more difficulty in determining the stresses in metallic arches, and in selecting suitable forms for the different members, than he does when dealing with ordinary trusses; the methods adopted by the author are clear and concise.

This chapter is followed by three which treat of suspension bridges, opening or draw bridges, and traversing or transporter bridges, and then by a chapter full of useful practical details on various types of bridge flooring, piers, and bolsters, or shoes, for distributing the pressure uniformly to the bearing plates. In the last chapter the author has worked out several complete examples of bridge design in order to illustrate the principles he has laid down in the earlier chapters; these examples include timber trestle bridges, highway bridges with steel main girders, a plate girder railway bridge, and, lastly, a Murphy Whipple truss railway bridge of 100-feet span. These examples will be of considerable service to the young designer and to the student.

T. H. B.

Metallic Alloys: their Structure and Constitution. By G. H. Gulliver. Pp. xv+254; illustrated. (London: C. Griffin and Co., Ltd., 1908.) Price 6*s.* net.

THE study of metallic alloys is a "practical" subject. Many alloys were discovered long ago by accident, and the development of their manufacture and use is based on empiricism. Even the recent introduction of a number of other alloys has owed little to theoretical considerations, and no attention is paid to predictions as to the properties of untried combinations. There is plenty of experimental evidence to be classified and discussed, but the time has hardly come for the logical method of treating the subject adopted by Mr. Gulliver. At any rate, the book would have been better balanced if more attention had been paid to the experimental data.

The author has adopted the classification of alloys presented by Roberts-Austen and Stansfield at the Congrès international de Physique in 1900. This classification was based on Roozeboom's study of equilibrium in mixtures, but the author has amplified it in many respects, and with its aid has been enabled to present a tolerably complete theory of alloys on a systematic basis. He has consistently applied the name "solution" to any physical mixture of metals, liquid or solid, and there is doubtless no disadvantage in this way of regarding them, though it has not much claim to be considered as a "method of study." One of the difficulties in applying the solution theory to alloys in practice is that equilibrium is not established in solid mixtures in any reasonable length of time under ordinary conditions. The alloys used in the industries are generally in an unstable state, and when equilibrium has been established in them it often happens that their usefulness has departed. This is, of course, one of the reasons why the recent study of alloys has not thrown more light on their useful properties.

The book, taken by itself, will not be of much use to engineers or manufacturers. It is not even quite what is wanted for students, but it may be recommended to their teachers. The weakest part of the book is that devoted to methods of investigation, which could have been made to afford much more help to those engaged in research. Its greatest claim to be read is that it gives a more complete classification of alloys than has hitherto been available.

(1) *Ex-meridian, Altitude, Azimuth, and Star-finding Tables.* By Lieut.-Commander Armistead Rust, U.S. Navy. Pp. li+393. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 21*s.* net.

(2) *Nautical Charts.* By G. R. Putman, Director of Coast Surveys, Philippine Islands. Pp. viii+162. (Same publishers, 1908.) Price 8*s.* 6*d.* net.

(3) *A Text-book of Theodolite Surveying and Levelling.* By Prof. James Park. Pp. x+216. (London: C. Griffin and Co., Ltd., 1908.) Price 6*s.* net.

(1) THE author has gathered together a very useful set of tables and diagrams for finding the latitude, facilitating the plotting of lines of position, and giving new and practical methods for identifying stars in cloudy weather. The tables extend from lat. 0°–65° and declination 0° 71′ north and south. The book is excellently printed and arranged; full descriptions of how to use the tables are given, together with examples. It should prove most useful to the mariner, as its scope covers practically all the navigable portions of the globe.

(2) This small volume, which deals with the methods of the U.S. Surveying Service, gives a very good general idea of how the work is carried out

from the time of commencing the survey until the chart has been produced ready for issue. It contains good descriptions of the various sorts of charts used by seamen, together with much useful information on how to use them in a proper manner. The book is divided into eight chapters, each one dealing with a separate subject; it is well illustrated, and is a valuable addition to books dealing with hydrographical surveying.

(3) A very useful handbook dealing with general surveying work, levelling, railway curves, and mine surveying; each branch of surveying is well described, and accompanied by diagrams and practical examples collected from actual field experiences. It is a book which should prove as useful to the professional surveyor as to the student. H. C. LOCKYER.

Penrose's Pictorial Annual: a Review of the Graphic Arts. Vol. xiv., 1908–9. *The Process Year Book.* Edited by William Gamble. Pp. viii+208. (London: A. W. Penrose and Co., Ltd.) Price 5*s.* net.

IN directing our readers' attention to the annual volumes of this publication, we have year by year pointed out the very excellent nature of the contents and the very high state of efficiency which it has attained. So much care has been bestowed on the reproduction methods, the inks employed, and the other materials used that it seemed nearly impossible that any very conspicuous advance could be made except after the lapse of a few years.

Yet in the volume before us we have a proof that such an assumption is incorrect, for one has only to look through the present issue to see how marked the progress made has been since the last volume was issued to the public. Even the editor, in his preliminary remarks, writes:—"We can hardly realise ourselves how it is possible to continue improving on these mechanical processes as has been shown each year, yet here again is the evidence of the possibility, and one is inclined to wonder what further marvels the future has in store for us."

With such a wealth of text and illustration included in this volume it is difficult to name any one feature which is more conspicuous than another. The editor commences, as usual, with his summary of the year's progress in process work, and this is followed by a great number of articles on various branches of the subject by well-known workers. The illustrations, which are, of course, the chief feature of this publication, demonstrate, more than words can do, the excellence of the reproduction processes that are now available. All kinds of subjects are dealt with, from the reproduction of an old master to illustrations for boot catalogues, and these suggest the best kinds of process work for the particular subject to be dealt with.

Perhaps enough has been written to indicate that if anyone wishes to make himself acquainted with the results of process-work of to-day he cannot do better than obtain this handsome and moderately-priced volume. The editor and his co-workers deserve high praise for placing such a useful and valuable publication within easy reach.

The Edinburgh School Atlas. 32 plates. (Edinburgh and London: W. and A. K. Johnston, Ltd., n.d.) Price 1*s.*

A WIDE popularity may be predicted for this remarkably cheap atlas. The maps are clear, uncrowded, and entirely orographical. There is a good general index showing the latitude and longitude of places included in the maps. It is gratifying to find that geographical publishers are acquainting themselves with modern needs and producing maps which will assist greatly teachers of geography who adopt scientific methods in their work.

LETTERS TO THE EDITOR.

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

The Product and Rays of Uranium X.

FROM the present state of the subject it is clear that there is one, at least, and that very probably there are two, intermediate products between uranium X and radium giving α rays on disintegration. The direct parent of radium has recently been shown by Boltwood (*Amer. Journ. Sci.*, 1908, xxv., 377) to give α rays of characteristic range. Between the atomic weight of uranium and radium there is a difference of twelve units, corresponding to the expulsion of three α particles, of which only two, that from uranium and that from the parent of radium, so far are known. It is true there is a disposition to regard it as probable that the change of uranium into uranium X is accompanied by the expulsion of two α particles, as Boltwood (*loc. cit.*, p. 285) has shown that the contribution of uranium in minerals to the total α radiation of the mineral is about twice that of any of the succeeding products.

My recent result on the rate of production of helium from uranium (NATURE, December 3, 1908, p. 129) is against this view. In the thorium series—thorium → meso-thorium → radio-thorium → thorium X—complete chemical similarity occurs between the *alternate* pairs—thorium and radio-thorium, meso-thorium and thorium X—no chemical separation of these pairs having yet been found possible. If the hypothetical product of uranium X similarly was chemically analogous to uranium and gave α rays, the result obtained by Boltwood for the α radiation of minerals might perhaps be explained. In the present state of the subject there is hardly sufficient evidence that the number of α particles expelled by uranium is exceptional. Further evidence on the question whether an intermediate body exists between uranium X and the parent of radium may be expected so soon as the uranium preparations we have had for many years under observation in this laboratory begin to grow radium, as the power of the time which the rate of growth follows gives an indication of the number of intermediate stages. Already the results show that if there is not such a body (or bodies) the period of the parent of radium is at least six times as great as that of radium (*Phil. Mag.*, October, 1908, p. 636).

In the meantime I have attempted—so far without complete success—to detect the growth of an α-ray product from very active preparations of uranium X prepared from large quantities of uranium. I have established that there is a feeble residual α radiation remaining from all my uranium X preparations after the β radiation has decayed, and this residual activity *then remains constant.* The residual α activity of a preparation of uranium X some four or five years old has been kept under careful observation for nine months, and no change of activity has been detected. Newer preparations have shown that the α radiation has a practically constant value before the β rays have all decayed, showing that if the α-ray body is a real product of uranium X it must be the *direct* product. The attempt to follow a growth of the feeble α activity simultaneously with the decay of the intense β activity, which the latter view demands should occur, has so far been delayed by the β rays showing unexpected properties. I have not yet succeeded in establishing a genetic connection between the α-ray body and the uranium X, so that all that can at present be said is that the results are not opposed to the view that the direct product of uranium X may give the missing α ray of the series, and prove to be the parent of the parent of radium.

With regard to the β rays of uranium X, these until now have been regarded as homogeneous, with a value for $H\rho$ of 2000; but I have found that in a magnetic field twice as strong as that required to prevent β rays having the value 2000 from entering an electroscope, 5 per cent. of the total effect of the β rays still persists. Even in much stronger fields, using sufficiently active preparations of uranium X, the effect of the β rays is still marked. It

must be mentioned that in a paper just to hand, H. W. Schmidt (*Phys. Zeit.*, 1909, p. 6) gives the new value 4100 for these rays, making the usual assumption, apparently, that they were homogeneous. I obtained the value as high as 6500 for a small proportion of the rays, but no definite extreme upper limit can be assigned, and it is probable that some exist with a value even higher. Some of the β rays of radium possess, so far as I have yet been able to see, values for $H\rho$ above 9000, and probably the extreme upper limit is not reached at 11,000. The extreme value found in Kaufmann's celebrated experiments was 4500, but it must be remembered that he worked with the less sensitive—although more precise—photographic method. For $H\rho$ to have values so high as those recorded the velocity of the rays must be but a small fraction of 1 per cent. below that of light, and their mass must be at least four times in the case of uranium and six times in the case of radium the normal value found at lower speeds. I have had in mind the possibility that the effect might be due to a secondary radiation, and particularly in view of Bragg's theory of the nature of the γ rays, to a secondary radiation from the air; but I have not been able to prove that the rays are other than primary β rays. The direction of their deviation was specifically tested.

FREDERICK SODDY.

Physical Chemistry Laboratory, University of Glasgow.

P.S., *January* 26.—I have omitted to mention that Paschen (*Ann. Phys.*, 1904, xiv., 389) obtained evidence of the existence of β rays from radium with a value for $H\rho$ so high as 8000. F. S.

The Origin of the Aborigines of Tasmania.

IN kindly reviewing my little book on the Discovery and Settlement of Port Mackay, Queensland, in NATURE of September 24, 1908, the reviewer, "J. W. G.," states that Mr. Ling Roth "objects to calling the blackfellows aborigines, as he holds that Australia was first occupied by a negroid people who have been supplanted by the present race. This view, well known from its adoption by [the late] Sir William Flower, appears to be now generally discredited, owing to the lack of evidence in its support."

Since the above was written I have received from Sir William Turner his recently published memoir on the "Craniology, Racial Affinities, and Descent of the Aborigines of Tasmania" (Trans. Roy. Soc. Edin.). In this monograph Sir William Turner comes to the same conclusion as I have regarding the origin of the Tasmanians, arriving there by a totally different and probably more scientific method than that which I have been able to follow. He says (p. 394):—"Though, as has already been stated, a woolly-haired race is not now represented in Australia, the tendency of the South Australians to show Tasmanian characters in the cranial vault is worthy of consideration, in this particular, as an indication of the probable route of migration and of racial affinity. . . . The evidence seems to be in favour of the descent of the Tasmanians from a primitive Negrito stock, which migrated across Australia, rather than by the route of the Melanesian Oceanic islands lying to the north and east of the Australian continent." Linguistic evidence appears also to favour the view. In the December (1908) number of *Man* (p. 185) Father Schmidt ("Classification of Australian Languages") tells us that "the languages of S.E. Australia agree with Tasmanian in one of the most important points—the position of the affixless genitive."

I therefore venture to think that the more the question is studied the more does it seem probable that the real aborigines of Australia were the forefathers of the unhappy people we have known as Tasmanians.

H. LING ROTH.

Halifax, Yorks, December 28, 1908.

MR. LING ROTH'S letter involves two questions. The term "native" in Australia means white people born in Australia; the blackfellows are known as aborigines. It seems to me, therefore, only inviting misunderstanding and mistakes to reject the accepted Australian use of the word aborigines in a book dealing with Australia.

The second question is the possible descent of the extinct Tasmanians from the race that occupied Australia before the European colonisation. The very important memoir by Sir William Turner on the craniology of the Tasmanians (Trans. Roy. Soc. Edin., vol. xlvi., pp. 365–403, three plates) was not published at the date of the review; but though he admits the probable passage of the Tasmanians across Australia, he adds to the difficulty of connecting the Tasmanians with the present Australian aborigines.

On pp. 387–8 of his memoir he gives a long list of important characters in which the Australian skulls differ from those of the Tasmanians, and he concludes this catalogue of differences as follows:—"From the consideration of these characters the skulls support the opinion, based on the study by so many observers of the external features, that the existing aborigines of Australia are distinct from the Tasmanians, although the presence, in *a proportion* of the natives of South and West Australia, of skulls in which the height was less than the breadth, the not unfrequent sunk sagittal suture, the more marked parietal eminences, and the antero-posterior parietal depressions, point to a *possible amount of intermixture* and racial affinity of these Australian tribes with the Tasmanians." (The italics are mine.)

That "a proportion" of the aborigines of South Australia should have skulls approximating to those of the Tasmanians is easily explained. Tasmanians were taken to South Australia by the sealers, and gave rise to half-castes. The occasional Victorian aborigines with woolly hair and other Tasmanian features had probably the same origin.

Sir William Turner's memoir may be taken as the final dismissal of Sir William Flower's view that the Tasmanians were Melanesian, and the weight of authority, including Huxley and Mr. Ling Roth, that they were Negrito is now overwhelming; but this adds to the difficulty of alliance between the Tasmanians and the Australians. Sir William Turner says (p. 389), "the term Negrito should be limited to . . . black-skinned, woolly-haired people with small brachycephalic heads, jaws not very projecting, nose not so flattened, nostrils not so wide as in the Negro, and of dwarf-like stature." These characters are not those of the Australian aborigines, with their long, straight hair, hyperdolichocephalic heads, projecting jaws, extraordinarily wide nostrils, and tall stature.

The absence of evidence of the Tasmanian race in the well-searched drifts and gravels of Australia renders their passage across Australia improbable. I am, of course, glad to find that Sir William Turner adds his authority to the view of the Negrito affinity of the Tasmanians, but it does not follow that they crossed the mainland of Australia, a view that has been abandoned by some of those who formerly adopted it.

It would be strange if the Australian and Tasmanian languages had not some points of affinity, but the differences have been usually regarded as fundamental. Mr. Ling Roth has recognised Andamanese affinities in the language of the Tasmanians, which is, of course, consistent with Sir William Turner's conclusions, but it does not help to ally the Tasmanians and Australians.

J. W. G.

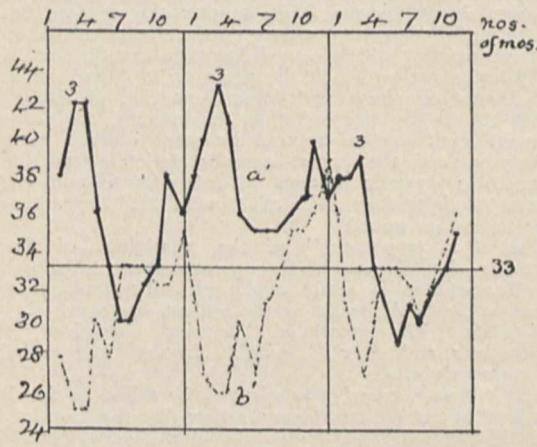
Warm Months in Relation to Sun-spot Numbers.

THE following method, applied to Greenwich data, seems to yield support to the view that sun-spots mean, on the whole, *warmth* in this region.

Taking your sun-spot numbers (from 1841), pick out the 22 highest (group A) and the 22 lowest (group B)—22 is about a third of the series. Next, confining attention to the year after each year of group A, note how many warm Januarys, Februarys, and so on, there were in the 22 years. This gives the series (*a*) below. Do the same in the case of group B, getting the series (*b*). Smooth each of these series with sums of 3, getting (*a'*) and (*b'*). On comparing (*a'*) with (*b'*) the former is found to be throughout in excess of the latter, as shown.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	
(*a*)	11	14	15	14	12	10	13	12	10	14	13	13	=151
(*b*)	11	8	8	10	8	12	7	12	13	10	12	14	=125
(*a'*)		40	43	41	36	35	35	35	36	37	40		
(*b'*)		27	26	26	30	27	31	32	35	35	36		
(*a'*):(*b'*)		+13	+17	+15	+6	+8	+4	+3	+1	+2	+4		

The series (*a'*) and (*b'*) are expressed in curve-form in the middle section of the diagram. Note that the (*a'*) curve culminates in the third month (*i.e.* with the 3-month group February–April), and just then the other curve is at its lowest point. The difference here is 43−26=17 (about 65 per cent. of the lower value).



Curves of total warm months in 3-month groups.

We might extend these curves on either side, considering in one case the temperatures in those years of highest and lowest sun-spot numbers, and in the other those in the second years after.

In both extensions we find, again, the extreme contrast at the third month, but in both, the curves cross each other in part; and in the third section there is general "break-down," with year-difference small. Thus we have, for totals of warm months:—

	Diff.
Years of (22) highest and (22) lowest sun-spot numbers	142 − 123 = 19
1st year after	151 − 125 = 26
2nd ,, ...	134 − 130 = 4

The sharp contrast above referred to in the early part of the year (February–April) seems to me remarkable, and may be usefully considered in relation to the flowering of plants and other phenological phenomena, the variations in which, from year to year, seem to be connected with the sun-spot cycle (as I have before tried to show).

ALEX. B. MACDOWALL.

RECENT EARTHQUAKES.

THE Italian earthquake still keeps a prominent place in the daily newspapers, and earthquakes still continue in the stricken country, but this is no more than must be expected. Every great earthquake is followed by numerous after-shocks, more frequent at first and gradually becoming fewer and fewer; 949 shocks were registered at Monteleone in 1783, and 159 in 1784. A similar experience is being repeated in Calabria at the present time; reports of more earthquakes at Reggio and Messina are common in the papers, but the record is too incomplete to be worth repeating in detail. Among these after-shocks some have been of sufficient violence to bring down shattered or weakened walls and buildings, and some were of a severity which would have caused serious damage and destruction to buildings had they stood by themselves. The first of these destructive after-shocks seems to have occurred at 7.24 p.m. on January 23, which brought down a good many houses left standing by the earthquake of December 28 at Reggio, and was described as of equal violence. This statement must be accepted with reserve, for experience has shown that after a very great earthquake and during the period when after-shocks are frequent, all sense of proportion is lost, earthquake-fear is developed, and every shock of more than average severity ranks out of proportion to its real importance. Though the shock was apparently a considerable one, and may well have compared in violence with its predecessor at Reggio, yet the much smaller area over which it had the power of inflicting damage, as also the much smaller size of the area over which it was felt, mark it as an altogether minor shock.

Besides the local after-shocks, earthquakes have been reported in the daily papers from other parts of the world, and not unnaturally a connection has been assumed which has probably no foundation in fact. The most important of these were the North American earthquake of January 11, and that in Asia Minor on January 19; the former of these was felt at Victoria, B.C., at 3.55 p.m., local time, and was described as severe; it was also felt at Vancouver and Nanaimo, in British Columbia, and in the Washington State, where some slight damage was done at Port Townsend. The earthquake in Asia Minor seems to have been more severe if not more extensive; it took place at 6.40 a.m. on January 19, and is said to have destroyed 679 houses at Phocœa, two persons are reported to have been killed at Menemen, and the same number at Cassaba. Neither of these was, however, of any importance, and would probably have passed without notice but for the attention directed to earthquakes at the present moment.

Much the same may be said of the shock which shook northern Italy on January 13, though possibly this may have been of the nature of a sympathetic after-shock, that is to say, brought about by a change in the distribution of strains in the earth's crust, consequent on the movements which have taken place in Calabria. It belonged to that little understood class of shocks which affect a large area without anywhere reaching destructive violence, and nowhere did more than trivial damage, though felt at Triest, Trient, Milan, Genoa, Siena, and in all the country between.

In spite of these earthquakes, there is no indication of any real increase in seismic activity; on the other hand, it is a somewhat remarkable fact that the Calabrian earthquake was a solitary one. World-shaking earthquakes almost invariably occur in groups, and are seldom unaccompanied by one or more companions, originating in distant parts of the globe, but within a few hours, or at most a few days, of each other; so frequent is this phenomenon that it has almost been elevated into a law, and an ingenious explanation, with experimental illustration, has been published. In the present instance, the records of Prof. Milne's instruments at Shide show that no other world-shaking shock accompanied the Calabrian one, and none was reported until the morning of January 23, when an earthquake, which probably originated somewhere in western Central Asia, was registered by seismographs in Europe, India, and at the Cape of Good Hope; probably we shall hear more of this earthquake, for its origin was in a region which is not devoid of villages and towns, but the interval which had elapsed prevents our regarding the two earthquakes as companions. This isolation of the Calabrian earthquake may find its explanation in the fact that although a great, it was not a very

great, shock. The extreme diameter of the seismic area did not materially exceed 350 miles, and making every allowance, the area over which the shock might have been felt—including in this the sea—could not have been more than 95,000 square miles; in the Californian earthquake of 1906, the corresponding figure was 372,500, and in the Indian earthquake of 1897 it was 1,750,000. These figures give some idea of the relative magnitude of the three earthquakes, and in the present state of the science it does not seem possible to find a more satisfactory means of comparison.

A point which has attracted notice, and is worthy of attention, is the peculiar weather which accompanied and followed the earthquake. We need not consider the fact that it coincided with the sudden break-up of an equally sudden and severe frost over northern Europe, nor the unusual cold and snowstorms which have followed it in southern Italy. These were due to meteorological conditions of great extent, in all probability unconnected with, and independent of, the earthquake, but the sudden fog which, according to every account, settled on the Straits of Messina stands in a different case. The earthquake in Mexico of January 24, 1898, was similarly followed by a heavy mist, at a time of year when mists are usually unknown, and rainfall is so frequently reported as the immediate successor of an earthquake that we can no longer reject the hypothesis of a real connection between the two. Earthquake weather is a common expression in earthquake countries, but is usually applied to a heavy and oppressive feeling in the air which is supposed to precede an earthquake. Mr. Maxwell Hall has attempted to find an explanation in alterations of the barometric gradient by rapid upheaval of the ground, and has shown that uplifts, which are within the range of possibility, would produce the required effects, but whether there is, or is not, an earthquake weather, in the ordinary sense of the words, there seems reason for believing that in another sense they represent a reality, and that, as has been suggested by Prof. Milne, the disturbance of the ground, when transmitted to the overlying air, may determine precipitation, and explain the apparent association of severe earthquakes with mist and rain. What may be the nature of the influence we know not, but if mechanical, it must be either the result of the vibratory motion of the ground, or else of permanent changes of level, accompanied by the sudden upheaval or depression of the overlying column of air, and of this permanent change of level we are still without any satisfactory evidence. In the accounts which have reached us, quays and pierheads are mentioned as having subsided beneath the water, but there is nothing to show that more than a settlement of made ground has taken place, while the photographs which have been published suggest that this rather than any displacement of the solid ground is the explanation of the apparent subsidence, and the commission appointed to inquire into the changes which have taken place in the harbour of Messina has reported that though the quays have been destroyed in places, no permanent change has taken place which will interfere with the continuation of its use as a port. R. D. O.

GRAVITATIONAL THEORIES.

IT is well known how cultivators of physical science in Great Britain lag behind the most up-to-date philosophical views in continuing to think that valuable light is thrown on physical phenomena by the elaboration and study of mechanical analogies of more familiar type, and more readily grasped by the mind. These matters are, perhaps unfortunately, for us largely the affair of specialists in science, who understand both the value and the limitation of the method.

For example, in the days of the very instructive—and somewhat insular—mathematical development of Lord Kelvin's idea of vortex atoms, the mechanical analogies of gravitation were much to the fore; and in particular Prof. W. M. Hicks elaborated, a quarter of a century ago (*e.g.* in *Camb. Phil. Soc. Proc.*, October, 1879), on the basis of experiments by Guthrie and others, a beautiful theory of how the attractions of gravitation could be imitated by pulsating bodies in a liquid medium. Further developments, theoretical and experimental, of interesting character, with relation also to electrodynamics, were made in the well known experiments of Bjerknes. Indeed, some such notion is the only simple direct mode of imitating gravitation which has presented itself; there is the alternative, of course, that it may be a residual of other more potent actions.

In this regard, the pulsation analogy lies at the back of the heads of most people interested in the subject. But lest we forget, the watchful enterprise of the daily Press in reporting by special correspondence from Berlin the recent exciting revival of these ideas illustrates one of the ways in which it can keep us in touch with the latest developments of science. Doubtless the experimental phenomena reported with so much emphasis will be found eventually to contain much that is interesting and useful as new aspects of this well-worn subject.

MOUNTAINEERING IN NORTHERN NORWAY.[1]

THERE being little left in Switzerland for the mountaineering pioneer, climbers who prefer exploration to gymnastics have been driven further afield. Mrs. le Blond (then Mrs. Fred Burnaby) was one of the leaders in Swiss winter climbing; but after fifteen seasons in the Alps she was induced to visit northern Norway, partly from the desire for virgin peaks and partly to give her well-known guide, Imboden of St. Nicholas, a change of scene after the death of his son on the Lyskamm. This volume records the story of five seasons' climbing amongst the glaciers and peaks of northern Norway near Tromso. The narrative is pleasantly and modestly written, and is occupied by short accounts of the author's twenty-seven first ascents in this district. The country has many advantages over Switzerland; it has the charms of solitude, of freedom, and of being imperfectly mapped and explored; until recently its peaks were unclimbed, and many of them even unnamed.

Mountaineering in northern Norway is free from two Alpine risks. No one can be benighted in this land of continuous daylight, and there is no danger from exposure to cold in the mild climate, repeatedly attributed by Mrs. le Blond to the Gulf Stream, in which her faith is firm and primitive. The country has, however, the drawbacks of long spells of bad weather. On one occasion, for example, two friends arrived at Mrs. le Blond's camp for a few weeks' climbing at the beginning of "five weeks of the very worst weather I have ever seen" (p. 179). The constant mists and clouds add greatly to the picturesqueness of the country, and to them are due the beauty of many of Mrs. le Blond's photographs; but fogs and continual rain may easily prevent any mountaineering except to those who have most of

[1] "Mountaineering in the Land of the Midnight Sun." By Mrs. Aubrey le Blond. Pp. xii+304; map and 71 illustrations. (London: T. Fisher Unwin, 1908.) Price 10*s.* 6*d.* net.

the season at their disposal. The mosquitoes do their best to render life intolerable, but Mrs. le Blond found them of no trouble except in the valley; the writer, however, remembers one easy rock-climb in an area to the south of Mrs. le Blond's district that became dangerous owing to a flight of mosquitoes, which took advantage of the shelter from the wind to accompany him up the cliff.

The extreme rottenness of the rocks renders the danger of falling stones greater than in Switzerland. The mountains are covered with such a litter of loose stones that, according to the author, it is unsafe for more than three climbers to go on a rope. "Dumkopf! you will have the whole mountain down," is one of Imboden's ejaculations to his son. Mrs. le Blond seems disposed to attribute the superior security of the Alpine rocks to successive climbers having cleared away the loose material. Her testimony throughout the book to the looseness of the rocks, and the photographs showing the sharp cones and jagged pinnacles characteristic of the country, suggest that only the lower slopes of the mountains have been glaciated. She speaks of well-rounded glaciated surfaces on the lower ground, and it appears possible, from her descriptions and photographs, that, as has long been well known regarding the Lofoden Islands, the mountains were never completely buried beneath an ice-sheet. Their upper slopes may still wear the débris due to pre-Glacial weathering.

The book gives very little direct geographical information other than details as to the climbing. To mountaineers in the Tromso district it will be indispensable. There is a short chapter on the Lapps, and much enthusiasm expressed for both Norway and the people. One of the most valuable features in the book is its fine series of photographs; the 304 pages of the text are illustrated by seventy photographs, nearly all of which occupy a full page, and the illustrations give an excellent idea of the geographical structure of the country. Some of them confirm the view that this part of Norway is a dissected plateau. The book has, unfortunately, no index and practically no map, for its useless chart of Scandinavia and the Baltic merely indicates the position of the district in which Mrs. le Blond's mountaineering feats were achieved.

J. W. G.

The Urtind at Midnight. In the background the Faestning and Kjostind. From "Mountaineering in the Land of the Midnight Sun."

A NATIONAL SCHEME OF AFFORESTATION.

THE Royal Commission on Coast Erosion and Afforestation has issued its second report, which deals with afforestation. If the scheme proposed in this report be adopted, it would mean that in eighty years from its commencement there would be afforested 9,000,000 acres of land at present classed in the agricultural returns as rough mountain land used for grazing. In their investigations the commissioners find that there are no less than 16,000,000 acres not under cultivation or permanent pasture in Great Britain. To this there may be added several million acres of similar land in Ireland. However, much of this land is not suitable even for tree-growth, and may be already used to better advantage. The commissioners find 9,000,000 acres of this land is suitable for afforestation, and they recommend that the State should undertake the task of afforesting that area.

Two schemes, a larger one and a smaller one, are proposed:—First, that the maximum area—9,000,000 acres—should be planted up at the rate of 150,000

acres annually for sixty years, a third of this area to be worked on a forty years' rotation, and two-thirds on an eighty years' rotation. The value of the property in possession of the State at the end of the rotation would be 562,075,000*l.*, or 106,993,000*l.* in excess of the sum involved in its creation, and, allowing 3 per cent. compound interest on the initial capital expended, the annual revenue would be 17,411,000*l.* Secondly, the smaller scheme provides for the afforestation of 6,000,000 acres to be planted at the rate of 75,000 acres annually for eighty years. The value of the property at the end of that time would be 320,000,000*l.*, or 60,944,000*l.* in excess of the cost of production, and would yield henceforth an annual return of 10,000,000*l.*

These figures, it should be mentioned, are based on average estimates of the cost of freehold and planting, as well as the returns from thinnings and final fellings. The experts and witnesses examined by the commission were unanimous in their opinion that the soil and climate of Britain are eminently well suited for the growth of trees and forests. That a shortage exists in the world's supply of timber is a fact which every day makes more apparent. The evidence placed before the commissioners shows that within the last decade the price of timber has increased 30 to 50 per cent., while the quality has decreased. No doubt many substitutes have been invented, but this has not decreased the consumption of timber, and in spite of those many substitutes there are indications that the consumption of timber is increasing. Mention is made in the report of many places where afforestation has been properly conducted in this country, and has yielded handsome returns on the outlay. For this and many other reasons too numerous to quote, the commissioners are satisfied that "with due regard to sound principles and economic management, timber-growing has in this country proved profitable," and that "success in the future with improved methods should be generally assured."

So far, the report thus shows that at present a vast area of what should be valuable productive land in this country is lying practically unproductive, and, if afforestation were started on the lines of the scheme proposed, this land would give employment to 18,000 labourers during the planting season. But forestry on such a large scale is bound to improve and encourage subsidiary industries, and even give rise to new ones which depend upon timber for their raw material. These industries, it is estimated, would absorb an amount of labour equal to that of one man for every eighteen acres of forest, while evidence has been placed before the commissioners that such land as is at present utilised provides employment for one man on 1000 to 2000 acres. This naturally opens up the question as to the possibility of providing work for the unemployed.

The commissioners have made exhaustive inquiries in this direction, and find that for certain kinds of labour involved in afforestation the unemployed have been used with satisfactory results. There is no doubt that the requisite number of labourers could be obtained from the ranks of the unemployed. A great deal depends, however, upon the physical fitness of the labourers so obtained. The commissioners believe that, with a judicious selection and probably a short period of training, many of the unemployed would be quite capable of engaging in the work of planting. It is a difficult question to decide whether the unemployed are suitable for such work. In this connection two problems are involved, viz. provision for the maintenance of our future timber supplies, and the relief of the unemployed. Undoubtedly the present needs of the unemployed are urgent, but the maintenance of our future timber supplies is equally important, and although the present generation sees the distress caused by unemployment, this would become worse in the next generation should our timber supplies run short.

The whole success of afforestation depends upon the skill and care with which the forests are established. To dig a hole and plant a tree may seem quite simple, but it nevertheless requires a considerable amount of skill. Bad planting has been the ruination in many cases of what should have been at present fine forests. If the unemployed are to be utilised at all, they would have to be subject to a considerable amount of supervision by skilled, practical foresters, and it is not very clear from the report how these trained foresters are to be procured. No doubt there are a good many such men in the country at the present time, but not sufficient to supervise the work of afforestation on such a scale as the commissioners propose. Manual labour is no doubt essential, but the success of the future forests will depend upon the skill with which such labour is directed towards the achievement of the object in view. It must also be kept in mind that a general survey of the country is necessary as a preliminary operation in order that the areas suitable for afforestation may be mapped out and located. After this work would naturally come a detailed survey of the different areas to determine many essential and important matters, such as the suitability of the area for the growth of certain trees, and the preparation of working plans or schemes of management. This work could only be entrusted to well-trained experts. It must be remembered that initial mistakes in sylviculture are not only difficult to remedy, but that their effects last over a long series of years—possibly a whole rotation.

In estimating the expense of carrying out a scheme such as they propose, the commissioners seem to have made very little provision for the maintenance of a properly trained forest staff apart from those engaged in manual labour. Although it is quite certain that our soil and climate are capable of producing high-class timber, still we have yet a great deal to learn about sylviculture in this country. Comparisons with Germany are useful, but even in Germany local conditions have to be studied, and suitable systems of sylviculture and management adopted.

In their report the commissioners state that they have been reminded that "on the Continent large areas of woodland are periodically overrun by destructive insects, whose depredations entail large loss, whereas the most troublesome of these pests are practically unknown in this country." This is very optimistic. We have already a fair share of those insect pests, and, should we ever have large areas of woodlands like the Germans, there is very little doubt but that we shall also have the insects and other attendant evils, such as fungi. These, however, could be kept in check provided proper scientific protective measures are adopted in time.

On p. 41 of the report it is stated that "the afforestation of suitable lands in the United Kingdom, if undertaken on an adequate scale and in accordance with well-recognised scientific principles, should prove at present prices a sound and remunerative investment." It is suggested that, if Parliament should determine to carry out the recommendations proposed, the scheme should be administered by commissioners specially appointed for that purpose. But between those administrators and the working staff comes a gap which can only be filled by the man who knows.

The commissioners, it seems, have not taken this part of the staff into account in drawing up their estimates of working expenses. The forest schools at present in existence in this country, with a little development, would be quite capable of undertaking the scientific training of this very essential part of the staff. For many years past the pressing need for demonstration areas and forest gardens has been urged upon the Government. Had these institutions been in existence now, their value would have been inestimable in indicating the soundest and most economic lines upon which extended afforestation should be carried out.

Coming now to the question of the acquisition of the necessary land, the commissioners recommend that compulsory powers be obtained by legislative enactment whereby proprietors would be forced to sell suitable land should private negotiations fall through. However, certain alternative schemes are proposed. For example, a scheme suggested by Lord Lovat of co-partnership between the private owner of land and the State, the owner to provide the land free of cost, the State to provide the capital necessary for its afforestation, the profits to be shared *pro rata* of their respective contributions, the owner to have the option at any time of buying out the State's interest. Again, it is suggested that the commissioners might be given power to afforest land acquired otherwise than by purchase by special arrangement with the owner, on such terms and conditions as may be approved by the Treasury, provided due security be taken for the continuity of the scheme. Still another plan is suggested, viz. that, if the owner of a surveyed area is prepared to afforest his land in a reasonable time under the supervision, and to the satisfaction, of the Forest Commissioners, compulsory powers of purchase should not be enforced against him. Finally, the commissioners suggest that the existing facilities given to landowners for obtaining loans for planting might perhaps with advantage be increased by extending the time for the repayment of the loan.

There are weighty reasons in favour of these alternative suggestions. In the first place, it would ensure the important cooperation and active assistance of landowners, many of whom are at present engaged in renewing and extending their forest areas, while many others would be willing to do the same should forestry become an established industry. The compulsory acquisition of the necessary areas would be bound to lead to a breaking-up of the existing arrangement of the land, especially as regards the larger sheep farms, and the consequent diminution of the food supplies, especially mutton, would possibly be greater than the 4·81 per cent. at present anticipated. By encouraging private owners to extend their forest areas, and by the gradual purchase of suitable land where available, the State would more slowly, but at the same time with greater certainty, attain the object which the commissioners have in view.[1] Legislative enactment might be directed towards the adjustment of the present railway rates, and the abolition of the tax on afforested areas.

In discussing the cost of plants and planting, the statement made at the top of p. 26, namely, that "if plants are purchased they will probably cost 4*l*. to 5*l*. per acre," does not seem to tally with the evidence, or what immediately follows in the next paragraph.

[1] It would also entail less initial expenditure. Under the present scheme it is proposed to raise the necessary capital by loan, the interest to be defrayed out of taxation. For the full scheme 2,000,000*l*. would be required annually. The net deficit in the first year would be 90,000*l*., which would increase to 3,131,250*l*. in the fortieth year, after which it i calculated the forest would have become self-supporting.

DR. FRANCIS ELGAR, LL.D., F.R.S.

THE sudden death of Dr. Francis Elgar, F.R.S., at Monte Carlo, on January 16, has deprived the profession of naval architecture of one of its most eminent representatives, and the loss will be felt throughout the world of science, in which he had made many friends. He came of a family which had for generations been connected with the great naval arsenal at Portsmouth, and was himself apprenticed there about fifty years ago. For nearly seventy years the Admiralty has maintained an admirable system of schools for its apprentices, and has provided facilities by which those who prove capable of benefiting thereby shall receive higher instruction in those branches of mathematics which are used in connection with shipbuilding, as well as in the operations and processes incidental to practical work in drawing offices and mould lofts. Elgar was one of the young men whose progress in the school secured advancement to higher instruction. Fortunately for his career, just at the period (in 1864) when he had completed the preliminary stages of training at Portsmouth, it was decided by the Admiralty and Science and Art Department to join forces and to establish the Royal School of Naval Architecture and Marine Engineering at South Kensington. The Admiralty students at this school were selected by competitive examination in which apprentices in all the Royal dockyards took part. Elgar was one of eight young men chosen in this way from a very large number of candidates, and given an opportunity of passing through a three years' course of advanced study in the theory and practice of shipbuilding. This he did with distinction, and was awarded a first-class diploma of Fellow of the Royal School of Naval Architecture in 1867.

Sir Edward Reed—then chief constructor of the navy, and himself a graduate of an earlier school of naval architecture—took a warm interest in the welfare of the graduates from the new school, and appointed Elgar an assistant overseer of the ill-fated turret ship *Captain*, which was then building by Messrs. Laird, of Birkenhead. In the preparation of the design for that vessel, Captain Cowper Coles, R.N., had collaborated with Messrs. Laird, and Admiralty inspection was limited to supervising the work of construction. In this manner Elgar at an early age supplemented practical training obtained in Royal dockyards by close association with the business of a great private shipyard. About two years later he was recalled to Portsmouth, and received an appointment as a shipbuilding officer, being employed on important practical work in that establishment when the loss of the *Captain* took place. The master shipwright of the dockyard was asked to give evidence before the court martial in regard to the stability of the *Captain*. These conditions were altogether exceptional owing to the extremely low freeboard and heavy sail equipment of that vessel. In the preparation of this evidence, Elgar gave considerable assistance to his superior officer, and in this way began a series of investigations into the stability of ships which extended over many years, and covered mercantile vessels of various types, as well as warships.

In 1870 Sir Edward Reed resigned his position in the Admiralty, and established a private practice in London. Elgar became his chief professional assistant in 1871, and took charge of the London office, in which, during the next few years, novel and important designs for foreign warships and for mercantile vessels were prepared. In all these designs, as well as in the supervision of the work of building the ships, Elgar took an important part, and his services were acknowledged by Sir Edward Reed.

From 1874 to 1876 Dr. Elgar occupied an important position as general manager of Earle's Shipbuilding Company, at Hull; and from 1876 to 1879 practised in London as a consulting naval architect in conjunction with Sir Edward Reed.

A close connection with the Japanese Government, for whom Sir Edward Reed had designed several warships, led to the appointment of Elgar, in 1879, to be their special adviser upon naval construction. He proceeded to Japan, and remained there for about two years, dealing with important questions relating to dockyard organisation and shipbuilding programmes. This appointment indicated the high reputation Elgar had already achieved. On his return from this period of foreign residence, Elgar practised as a consulting naval architect in London, and continued to act in that capacity until 1886. For the most part his work was of a private character, but it included service as the confidential adviser of leading steamship companies, and was marked by public appearances in connection with special investigations into the causes of accidents to, or the loss of, important vessels. When the Orient liner *Austral* foundered in Sydney Harbour, Elgar investigated the matter, and demonstrated that the accident was due to a lack of proper precaution during the process of coaling the ship. When the *Daphne* capsized while being launched on the Clyde, Elgar exhaustively investigated the circumstances, and gave a rational explanation of the disaster. He also served as a member of the Special Committee appointed by the Board of Trade in 1883—with Sir Edward Reed as chairman—to propose rules for fixing the load-line of merchant vessels. The work done by this committee included the consideration of the strength and stability of many types of ships, furnished a settlement of a most difficult question, is still bearing fruit, and promises to lead to an international agreement.

During this period of his career, Elgar was appointed the first university professor of naval architecture in Great Britain. This chair was established at Glasgow (in 1883) by the munificence of Mrs. John Elder, and the selection of Elgar to fill it gave universal satisfaction, and afforded fresh evidence of his high professional reputation. The inaugural address which he delivered at the commencement of his work not merely attracted a large and representative audience, but was in itself a most excellent performance. The period during which Elgar served as a teacher of naval architecture was comparatively brief, for early in 1886 the Admiralty created the new post of director of dockyards, and sought out a man to fill it who should combine experience in private yards with an intimate knowledge of warship-building. Elgar was selected, and accepted the great responsibility of making proposals for reorganisation of the dockyards and giving practical effect thereto, with the view of increased economy and rapidity in the work of construction and repair of the ships of the Royal Navy. This was no light task; it was well performed, and voluntarily terminated in 1892, when Elgar accepted an invitation to become a director and consulting naval architect to the Fairfield Shipbuilding and Engineering Company, of Glasgow. This business had been first established by John Elder and others, had been greatly developed by Sir William Pearce, and after his death was in need of a capable and thoroughly trained professional head. The connection which thus began was terminated by his own choice about two years ago, with the intention to obtain and enjoy a well-earned leisure. From this retirement, however, he soon emerged in order to undertake the chairmanship of the great industrial enterprises belonging to Cammell, Laird and Co., including steel works, armour-plate factories, shipbuilding and marine engineering departments, and mining operations. Immediately after accepting this position it was associated with that of chairman of the Fairfield Shipbuilding Company. When Elgar assumed these responsibilities, a radical reorganisation had to be undertaken in the establishments and staffs of Cammell, Laird and Co. In carrying out this heavy and delicate task, Elgar gave remarkable proofs of ability and energy, and necessarily made demands upon his strength which may have tended to bring about the unexpected and sudden death so widely mourned. He had taken a holiday on the Riviera at the close of the year; a slight accident occurred, but there was no thought of consequent danger, and the end came suddenly.

Elgar united practical experience with a wide knowledge of science and strong literary tastes. His papers on professional subjects—most of which are published in the Transactions of the Royal Society, and in those of the Institution of Naval Architects—furnish illustrations of these qualities, and contain much original work. About two years ago Elgar undertook the delivery of the Forrest lecture at the Institution of Civil Engineers, and dealt with "Unsolved Problems in Naval Architecture" in a manner which excited admiration amongst those familiar with ship design, while it proved interesting to engineers generally. He was elected F.R.S. in 1895, and some years previously had become F.R.S.E. The University of Glasgow gave him the honorary degree of LL.D. in 1885. His closest connection was naturally with the Institution of Naval Architects, on the council of which he had served for twenty-five years, and of which he was treasurer and honorary vice-president at the time of his death. He was a member of council of both the Institution of Civil Engineers and the Royal Society of Arts, in the affairs of which he took an active interest. He was also a member of many engineering and scientific societies at home and abroad. The council of the Institution of Naval Architects chose him to act as their representative on the governing body of the Imperial College of Science and Technology, on the committee of the National Physical Laboratory, and on the Advisory Committee on Shipping established recently by the Board of Trade.

Elgar did good work in connection with the British commissions for international exhibitions at Chicago, Paris, and elsewhere, and his services were recognised by his appointment as Chevalier of the Legion of Honour. His last work in this department was done for the Franco-British Exhibition, where he served as chairman of the shipbuilding section, and organised one of the most remarkable collections of ship-models ever brought together. Busily engaged as he always was, Elgar had little opportunity for extensive literary work. In 1873 he produced an interesting and beautifully illustrated book on "The Ships of the Navy," and in various papers—some of which were contributed to the "Sette of Odd Volumes"—he displayed an intimate knowledge of the earlier history of shipbuilding. He was intimately concerned also with the production of the review, *Naval Science*, founded by Sir Edward Reed in 1872, and continued until 1875. Elgar was a man whose interests were wide and varied; his personal qualities secured for him a multitude of friends who mourn his loss; but, above all, he will be remembered as a brilliant example of the modern naval architect in whose work were embodied the results of thorough training in both the science and practice of his profession, which training was supplemented by ripe and varied experience, and bore fruit in original investigation, the solution of novel and difficult problems, and valuable contributions to the development of a great British industry.

W. H. WHITE.

NOTES.

THERE is a sign that some interest is being shown by Court officials in scientific matters, for the Court Circular announced on January 20 that an "Empire clock" had been brought under the notice of the King and its mechanism explained. The invention which has been afforded this honour is a terrestrial globe kept in rotation by clockwork. A fixed ring parallel to the equator has time divisions marked upon it, and as the globe rotates the position of any meridian with reference to this ring enables the time to be seen. Judging from the prominence given to this clock, it would seem that the King's household and writers in the daily Press marvel that it should be possible to show the effects of the diurnal motion of the earth by means of a model driven by clockwork, or to represent the change of declination of the sun by a gilded ball sliding on a wire. To anyone familiar with astronomical models the device would scarcely appear worthy of being brought under the King's attention. Perhaps we shall next see the announcement by the Court newsman that someone has had the honour of demonstrating a method of proving the principle of Archimedes. A beginning having been made, we may look forward to the time when apparatus really of scientific importance will be regarded with the interest given to a clockwork globe.

A STRIKING instance of the assistance which can be rendered by wireless telegraphy in overcoming the difficulties and dangers of navigation was afforded in the case of the collision of the steamship *Florida* with the White Star liner *Republic* in the early morning of January 23. The collision occurred in a dense fog at 5.30 a.m., 175 miles east of the Ambrose lightship, New York. The *Republic* is equipped with a wireless telegraphy installation, and the captain, who was on the bridge at the time of the accident, at once had wireless messages for help sent out. The operator was Mr. J. Binns, and he remained at his post until help was received. The messages were received by the liners *Baltic*, the *Lorraine*, and the *Lucania*, the nearest of these being some 100 miles away. The steamships proceeding to the rescue were able to transmit a wireless message to the *Republic* asking for the latitude and longitude of the collision, which was answered from the *Republic* as being 40° 17′ N. and 76° 26′ W. Wireless telegraphy has thus been the means of averting a terrible calamity. It also enabled the responsible authorities at New York to get into communication with the ships, to learn promptly the exact state of things, and to issue any necessary instructions.

THE inoculation of soils intended to carry leguminous crops with the appropriate organism for fixing nitrogen has recently been the subject of several letters in the *Times*. It was pointed out in these columns a year ago (February 6, 1908, vol. lxxvii, p. 330) that the experiments quoted in favour of these particular cultures really prove nothing. Since then extensive trials have been made at the Royal Horticultural Society's Gardens, Wisley, and gave entirely negative results. We know of no properly conducted experiments with these cultures that have given definite positive results; the evidence adduced in Messrs. Carter's letter is of the same kind as that given in the original pamphlet, and cannot be regarded as throwing fresh light on the subject. It is distinctly unfortunate for soil bacteriology that a process should be recommended for adoption on the practical scale when it is as yet only in the laboratory stages.

THE seventeenth Deutscher Geographentag will meet at Whitsuntide (June 1–3) in Lübeck. Communications intended for the meeting should be sent before March 1 to the secretary of the association, Königstrasse 5, Lübeck.

UPON the recommendation of a joint committee of the Royal Society of Arts and the Royal College of Physicians, the Swiney prize has been awarded to Dr. C. A. Mercier, for his work on "Criminal Responsibility." The prize is a cup of the value of 100*l.* and money to the same amount.

THE death is reported of Dr. C. Denison, of Denver, Colorado, a specialist in the problems of tuberculosis, particularly in their relation to climatic conditions. He was professor emeritus of diseases of the chest in the University of Denver. In 1890 he was president of the American Climatological Association.

IT is reported that Monte Cagua, a volcano situated in the Tayabas province, in the south-western part of the island of Luzon, Philippines, became suddenly active on January 19, breaking out into a violent eruption and doing serious damage to the surrounding country. During the eruption streams of lava are stated to have rushed down the sides of the volcano.

A GERMAN mineralogical association has been inaugurated, says the *Revue scientifique*. Prof. Max Bauer, of Marburg University, has been elected president, and Prof. F. Berwerth, of the University of Vienna, and Prof. R. Brauns, of the University of Bonn, vice-presidents. It is said that the first general meeting of the association will be held at Salzburg on September 18 next.

WE learn from the *Lancet* that the efforts of the Grecian League against malaria have had wonderful results in the plain of Marathon, which used to be a hotbed of fever. In 1906, 90 per cent. of the cases of sickness were due to malaria. In 1907, after the first efforts of the league, the malaria cases fell to 47 per cent. of all cases of sickness. During last summer, however, usually the most intensely malarious season, the sickness due to malaria fell to only 2 per cent. of the total amount of sickness at Marathon.

ON Tuesday next, February 2, Prof. A. A. Macdonell will begin a course of three lectures at the Royal Institution on "The Architectural and Sculptural Antiquities of India." During the course the Buddhist, Hindu, and Mohammedan antiquities will be dealt with, and illustrated with lantern-slides. The Friday evening discourse on February 5 will be delivered by Prof. J. G. Frazer, on "The Influence of Superstition on the Growth of Institutions," and on February 12 by Prof. H. A. Wilson, on "The Electrical Properties of Flame." The discourse on February 26 will be delivered by Prof. H. L. Callendar, on "Osmotic Phenomena," instead of by the Earl of Berkeley.

AT the annual meeting of the Entomological Society held on January 20 the following officers and council were elected for the session 1909–10:—*President*, Dr. F. A. Dixey; *treasurer*, Mr. A. H. Jones; *librarian*, Mr. G. C. Champion; *secretaries*, Mr. H. Rowland-Brown and Commander J. J. Walker, R.N.; *other members of the council*, Dr. T. A. Chapman, Mr. A. Harrison, Mr. Selwyn Image, Dr. K. Jordan, Dr. G. B. Longstaff, Mr. H. Main, Mr. G. A. K. Marshall, Prof. E. B. Poulton, F.R.S., Mr. R. Shelford, Mr. Rowland E. Turner, Mr. J. W. Tutt, and Mr. C. O. Waterhouse.

A REUTER message from Stockholm states that on January 22 Dr. Sven Hedin delivered a lecture upon his travels in Central Asia before a large audience, which included King Gustav and the Royal Family, and the

members of the Anthropological and Geographical Societies. The Wahlburg medal of the latter society has been conferred on Dr. Sven Hedin, and the society has raised a fund of 10,000 kroner (about 555*l.*), to be known by the explorer's name, which will be devoted to purposes of geographical research.

THE following are the names of officers and council elected at the annual meeting of the Royal Meteorological Society on January 20:—*President*, Dr. H. Mellish; *Vice-Presidents*, Mr. W. W. Bryant, Mr. W. H. Dines, F.R.S., Commander M. W. C. Hepworth, C.B., Dr. H. R. Mill; *Treasurer*, Dr. C. T. Williams; *Secretaries*, Mr. F. C. Bayard, Commander W. F. Caborne, C.B.; *Foreign Secretary*, Dr. R. H. Scott, F.R.S.; *Council*, Messrs. R. Bentley, F. J. Brodie, C. J. P. Cave, Dr. H. N. Dickson, F. Druce, E. Gold, R. Inwards, B. Latham, R. G. K. Lempfert, Colonel H. E. Rawson, C.B., Captain R. C. Warden, Captain D. Wilson-Barker.

AN Imperial International Exhibition is to be held this year on the site occupied by the Franco-British Exhibition of 1908. The exhibition will be opened early in May, and close in October. We notice that the general committee includes a generous proportion of well-known men of science, and that prominence is to be given in the exhibition to science and technology. Among the groups of exhibits to be arranged will be collections representing education, mechanical and civil engineering, agriculture, mines and metallurgy, and chemical and electrical industries. Judging from the detailed subheadings under which the exhibits are to be arranged, the exhibition, as a whole, will serve to illustrate recent progress of applied science in various countries.

THE International Waterways Treaty, which was under discussion in the United States Senate last week, is the outcome of the International Waterways Commission, consisting of three representatives from the United States and three from Canada, which was appointed four years ago. Among the objects which the treaty has in view is the preservation of the levels of all the international waters in the North American continent—a matter of vast importance to the peoples of both countries, and, in the case of the river Niagara, to the whole world. According to the Ottawa correspondent of the *Times*, the two countries are entitled to the water in equal proportion, but if the United States were to take a quantity similar to that taken by Canada, unquestionably the beauty of the American falls would be spoiled and, perhaps, entirely destroyed. One mile above the Niagara Falls the water flows evenly between the two countries, but as it approaches the crest of the falls the current swings over towards the Canadian side. The Waterways Commission recommended that the limit of Canada's rights should not exceed 36,000 feet per second, and, in order to preserve the American falls, a limit was suggested of 18,500 cubic feet per second for the United States. The latter provision has been increased by the new treaty to 20,000 feet, as experiments made last summer demonstrated that the effect of the diversion of water on the American falls was less than had been anticipated. Canada receives 16,000 feet more than her neighbour, and this will enable the three companies on the Ontario side to develop 425,000 horse-power, as against 236,000 on the New York side. By the new treaty neither country can take any action which will lower the levels of the waters of the Great Lakes without the consent of the commission. In the opinion of competent authorities, the diversion of 20,000 feet per second for the Chicago Drainage Canal, which has been proposed, will affect the levels of Lake Michigan, Lake Huron, Lake Erie, Lake Ontario, and the St. Lawrence River seriously. It is not likely that the commission will authorise the diversion of so large a quantity of water.

A MOVEMENT has been set on foot by the English Ceramic Society for a conference of representatives of the various technical institutes and societies to consider ways and means of arranging for the "grading" and standardising, so far as possible, of the refractory materials, such as fireclay, magnesite, &c., used in the construction of furnaces, kilns, ovens, &c. Representatives of various institutes of societies met at Stoke-on-Trent on January 4 and formed themselves into a committee for the standardisation of refractory materials. The general opinion of the representatives present was that there is need for such a committee, and that the following preliminary scheme should be adopted:—(*a*) to arrange and classify the various refractory materials—clay; siliceous, as silica and gannister; special, as magnesite, chromite, &c.; (*b*) to arrange standard specifications for the raw materials and for the manufactured products; (*c*) to consider the possibility of arranging for uniformity in certain "stock" or "standard" sizes; (*d*) standard methods of testing, analysis, &c. To carry out this scheme, it was agreed that the representatives of the institutes should consult with their respective fellow members, and wherever possible procure information bearing on their specific requirements, together with data as to furnace temperatures and conditions of operation. There is no doubt that the work undertaken by the committee is important. The methods in vogue for the investigation of clays have so advanced in recent years that this subject can now be treated in a manner which would have been impossible five or six years ago. It is to be hoped that all consumers of refractory materials will communicate their views on the matter either to the secretaries of the different institutes and societies or direct to the general secretary, Dr. J. W. Mellor, English Ceramic Society, Stoke-on-Trent.

THE life and works of Thomas Pennant (1726–98) form the subject of this month's contribution to the biographies of early British ornithologists in Witherby's *British Birds*. Few persons other than professed naturalists are probably aware of the number of works which flowed from the pen of this voluminous writer, not many of which are, however, now consulted. The memoir is illustrated by a reproduction of the portrait by Gainsborough.

THE retirement of Mr. Montagu Browne from the post of curator has furnished the authorities of the Leicester Museum and Art Gallery with a favourable opportunity of reviewing, and when necessary modifying, the arrangement and scope of the natural history exhibits. According to the sixteenth report, dealing with the period from April 1, 1905, to March 31, 1908, it has been decided to display collections forming a complete record of the natural history, geology, and antiquarian ethnography of the district. In addition to this, as may be justifiable in a city so large as and so distant from the metropolis as Leicester, general collections in certain groups are to be exhibited. In future the reports will be issued and published annually.

TWO papers on the mammalian brain appear in the January number of the *Journal of Anatomy and Physiology*. In the first of these Prof. Peter Thompson gives a description of a model of the brain of a fœtal cat 20 millimetres in length, while in the second Dr. E. H. J. Schuster continues his elaborate and richly illustrated

account of three Chinese brains in the museum of the Royal College of Surgeons. Special interest attaches to the model of the kitten's brain on account of the fact that very few such models illustrating the early stages of mammalian cerebral development have hitherto been prepared. It is noteworthy that this brain presents a striking resemblance to that of the human fœtus at the third month.

WE are indebted to Prof. T. D. A. Cockerell for certain desirable corrections in a note published in NATURE for November 12, 1908, on his article in the *American Naturalist* for September of the same year on the Miocene fresh-water beds of Florissant, Colorado. He points out that it is the genus Trichophanes, and not the Florissant representative thereof, that was first described from Nevada. Also, it is the existing genus Percopsis, and not Trichophanes (which is solely Miocene), that lived in open glacial water during the Florissant period. In place of expressing a definite opinion on the bearing of the Florissant fauna and flora on the problem of a former connection between the southern continents, the author leaves the question open. We may take this opportunity of mentioning that a case containing a representative series of the Florissant fossils was recently placed on exhibition in the reptile gallery of the geological department of the Natural History Museum.

AN illustrated paper, read at the Ipswich Conference of 1908, on the history of the museum at Ipswich, by the curator of that institution, forms the opening article of the *Museums Journal* for December last. This is one of the few local museums established in the eighteenth century, dating from 1791, when the Rev. William Kirby, the well-known entomologist, was granted the use of a room in the Town Hall as a museum. From this humble beginning the present institution, with its invaluable collection of Crag vertebrates, has been gradually evolved. A great impetus was given in 1846 by a member of the local firm of Ransomes and Sims, when a special building was erected; another advance was made in 1868, when the erection was enlarged, while in 1881 the present handsome building was opened to the public. It is mainly to the energy of the late Prof. Henslow that Ipswich owes its collection of phosphatic nodules containing vertebrate remains from the Crag.

AT the Physiological Laboratory, London University, South Kensington, the opening lecture of the year was delivered by the director, Dr. A. D. Waller, F.R.S., on January 10, the Vice-Chancellor, Sir William J. Collins presiding. Dr. Waller took as his subject the positive and negative phenomena attendant upon the activity of living matter, as illustrated by the electrical phenomena aroused in the retina by light. He showed experiments demonstrating the double effect of light upon the retina, and demonstrated similar currents in response to electrical stimuli. Experiments on nerve were shown in illustration of the same principle, and the effect of anæsthetics at definite percentage was demonstrated with the aid of Dr. Waller's chloroform balance. The effect upon muscle of anæsthetics in solution was demonstrated as a lantern experiment, the physiological equivalence brought out by this method being that one molecule of chloroform is physiologically equivalent to ten molecules of ether and to 100 molecules of alcohol. This method is also convenient for the physiological standardisation of drugs. The Vice-Chancellor, Sir William J. Collins, spoke of the laboratory as fulfilling in one subject, physiology, the general aim of the University, since its re-constitution, to become a seat of learning, to bring to a focus at the headquarters of the University the knowledge and talents of the distinguished men in the many colleges of the metropolis, and congratulated Dr. Waller on the success that had attended his efforts during the last seven years. The Vice-Chancellor referred to the liberal donors who had supported the work financially, Sir Walter Palmer and Mr. George and Mr. Alfred Palmer at the University, South Kensington, and Dr. Ludwig Mond and Dr. Plimmer at the University, University College.

IN connection with the proposed utilisation of the river Tuolumne, flowing through part of the famous Yosemite National Park, California, as the source of a water-supply for San Francisco, Mr. J. Muir contributes a short article to the *Century Magazine* (January) on this valley, the Hetchy-Hetchy. It is not difficult to understand that this is the home of magnificent specimens of California live-oak and white pine, below which the ground is tufted "with ceanothus and manzanita bushes, azalea and brier-rose." Fortunately, the conversion of a valley into a water-reservoir does not necessitate the annihilation of natural scenery, and this article will serve its purpose if such a disaster is averted.

AN investigation of the nuclear changes during the first division in the pollen mother-cell of species of Œnothera, undertaken by Mr. R. R. Gates to look for an explanation of the hybrid and mutant formation in the genus, is described in the *Botanical Gazette* (July, 1908). The early stages of the first heterotypic division appear to favour the end-to-end rather than the lateral union of homologous chromosomes. It was observed that frequently pairing of the chromosomes on the nuclear spindle fails to take place, with the result that two chromosomes of a pair proceed to the same instead of to opposite poles, and so enter the same daughter nucleus. If the chromosomes are transmitters of definite characters, one nucleus would then be lacking in a certain character, and thus a hypothesis may be deduced for explaining the peculiarities noted.

THE recently published number of the Transactions of the Royal Scottish Arboricultural Society (vol. xxii., part i.) contains the report of a lecture by Sir Herbert Maxwell on the need for scientific management and extension of the forests in the United Kingdom. He points out that the proportion of woodland to the total area is about 4 per cent., less than in any other European country, and that the existing woods are a source of great expense instead of producing revenue. It is instructive to contrast with this an article on the Zürich woods by Mr. F. Story. These date back to the fourteenth century, and yield a good annual profit. Beech forms the bulk of the hard-wood forest; sycamore and ash come next in importance, while oak is practically disregarded; spruce is the most valued conifer. Within modern times a saw-mill and turnery, also apparatus for drying and impregnating timber, have been introduced.

IN a memorandum on the meteorology of India during October and November, 1908, Dr. G. T. Walker, director-general of observatories, discusses in detail the conditions likely to affect the precipitation of January and February. From present data and from experience gained from the indications of previous years, the inference drawn is that it is "probable that the amount of rainfall in northern India and of snowfall on the neighbouring mountain areas will, at any rate during the earlier part of the season, approximate closely to the average."

IN the *U.S. Monthly Weather Review* for September last Prof. C. F. Marvin describes a new form of compensated siphon barograph, consisting of three separate parts, which he has invented and has found to give very satisfactory results. The long and short branches of the siphon are simple, straight tubes fitted into the upturned branches of the bend, or U. This three-piece construction enables the barometer to be filled very easily, and, when once filled, it can be dismantled and transported without loss of the vacuum. In the barograph illustrated in the paper the changes are magnified five times by means of a large and small wheel operating on the principle of the wheel and axle, with a pen marking upon a drum driven by clockwork in the usual way. The drum revolves once in three days and two hours, moving at the rate of about a quarter of an inch per hour. The instrument is provided with a time-marking device consisting of an electromagnet, which operates once each hour. A small section of an actual record is reproduced in the paper, and shows that the pen responds to minute changes of level of the mercury. Prof. Marvin concludes by giving useful illustrations of the various methods adopted in filling barometer tubes.

THE British Fire Prevention Committee has just published two pamphlets giving particulars of experimental tests which have been carried out by it of the merits of asbestos cloths, sand, steam, hand-pumps, buckets of water, and other appliances in common use for extinguishing fires when they originate. The tests appear to have been thorough, and they were also carried out with impartiality, so that the records furnish valuable data for determining which is the most suitable equipment to adopt in given circumstances.

THE current number of the *Zeitschrift für physikalische Chemie* (January 5) contains a contribution by E. Cohen and H. R. Kruyt on the E.M.F. of the Weston cell. They are unable to confirm the abnormal results for 10 per cent. and 12·5 per cent. cadmium amalgams described by Janet and Jouaust, but are in agreement with Bijl's views. At 0°, cells made up similarly show variations amounting to 0·2 millivolt, and if an accuracy of this order is required in comparisons at low temperatures the cells must be immersed in a bath. Full details are given of the precautions taken to secure the purity of the materials used, and a diagram is given of a convenient form of cell.

THE notification of the Metropolitan Gas Referees for the year 1909 is practically identical with that for 1908. In addition to a detailed account of the construction of the apparatus used, methods of testing are laid down for the detection of sulphuretted hydrogen, the determination of the amount of sulphur compounds (other than sulphuretted hydrogen), of the illuminating power with the London Argand, No. 2, and with the flat flame, of the gross and net calorific values, and of the pressure. Of these, the only figures now subject to statutory requirements are the sulphuretted hydrogen, pressure, and illuminating power as measured by the No. 2 London Argand.

IN a paper published in No. 4, vol. xxviii., of the *Astrophysical Journal*, Prof. Fowler and Mr. A. Eagle describe a method whereby from any prismatic spectrum a rectified copy, for comparison with a grating spectrum, may be obtained; the importance of such a method will readily appeal to all spectroscopists. Dr. E. S. King has previously obtained such corrected copies, but, apparently, he secured the necessary adjustments of his copying apparatus by trial. In the method now published these adjustments may be calculated so that the apparatus may be set up straightway, and very accurately rectified spectra obtained. The writers state the formulæ they have developed for this purpose, and also give an example to illustrate the accuracy of the results obtained. In a section of the spectrum of the iron arc, extending from λ 4823 to λ 5127, the greatest error in the result amounted to only 0·1 of a tenth-metre; this corresponds to a displacement of about 1/300 of an inch, the range of the whole spectrum being more than 10 inches.

MESSRS. ISENTHAL AND CO.'s new list of rheostats contains illustrations and particulars of many forms and types of resistances for switchboards, bridges, and experimental work. A neat form of potentiometer rheostat is shown, which consists of a cylindrical block of serpentine having a helical groove cut on its outer surface, into which the wire is placed. A central spindle is firmly fixed to the block, and a screw-thread is cut on this spindle having the same pitch as the helical groove on the block. A tube fits over this spindle and carries the sliding spring which makes contact. An ebonite knob fixed at the top of the tube enables the sliding contact to be moved gradually along the whole length of the wire, and its position can be read off on a scale engraved on the spindle of the tube. Coarse adjustments can rapidly be made by pressing a button on the central rod, which releases the contact and enables it to be displaced in a vertical direction. When the button is released the contact always automatically replaces itself on the wire, and cannot fall between the turns. Some good regulating resistances with sliding contacts are also shown. These are made up of slabs of hardened asbestos, which may be mounted up together to form magazines of ten or any number of slabs. The contact levers each work between two slabs, making contact on both simultaneously. The contact fingers are very carefully made, and ensure a more gradual regulation than is usually the case in this type of resistance. The potentiometer rheostat mentioned above is also adapted to a Wheatstone drum bridge, which is made with a fixed drum and an additional direct ohm scale. Plug contacts for the comparison resistances and the terminals are carried on the base, and the resistances of 0·1, 1, 10, 100, 1000 ohms are enclosed in a ventilated box on which the whole is mounted. Several types of electric furnaces are also described.

THE first article in the February number of *Travel and Exploration*, published by Messrs. Witherby and Co., is on Dr. Sven Hedin's explorations, by Sir Thomas Holdich. Among other articles in this attractive magazine is one by Dr. C. G. Seligmann, on the Veddas of Ceylon. The interesting text and brilliant illustrations should make the magazine appeal to a wide circle of readers.

Science Progress for January well maintains its usual high standard of interest. The articles on the destruction of wood by fungi, by Dr. A. H. Reginald Buller; the south-eastern coalfield, its discovery and development, by Mr. Malcolm Burr; and the Palæolithic races and their modern representatives, by Prof. W. J. Sollas, will appeal to a wider circle than the remaining more technical articles. A characteristic paper by Prof. H. E. Armstrong, entitled "A Dream of Fair Hydrone: a Chemical Idyll," will be read with interest by chemists.

WE have received a copy of the thirty-sixth annual issue, that for 1909, of "Willing's Press Guide." It contains a comprehensive index of all newspapers, magazines, reviews, transactions of learned societies, in fact, of every form of periodical literature published in the United Kingdom.

The guide also provides a list of the principal colonial and foreign journals and a variety of general information. This useful work of reference is published at 125 Strand, London, and its price is 1s.

THE current number of the *London Quarterly Review*, which is published by Mr. Robert Culley, is rich in thoughtful articles on subjects receiving great attention just now from intellectual readers. We note, in particular, articles by Mr. J. Butler Burke on materialism and life, and by Mr. Henry Gulliford, of South India, on "Todas and Tibetans: a Study in the Evolution of Religion." In addition to articles, the magazine provides notes and discussions on literary and theological topics, and an unusually large number of reviews of recent books.

Two large coloured maps, showing respectively the political boundaries and economic products of Brazil, have been issued by the director of the Mission Brésilienne, 28 Boulevard des Italiens, Paris. Upon the back of each sheet is printed a large amount of useful information relating to the general political and economic geography of the country.

THE Carnegie Institution of Washington has published the seventh of a series of volumes which will form eventually a complete index of economic material in documents of the States of the United States. The present volume deals with California from 1849–1904, and has been prepared for the department of economics and sociology of the Carnegie Institution by Adelaide R. Hasse, of the librarian department of public documents, New York Public Library. The scope and character of this exhaustive index have been explained in these columns in referring to previous volumes.

MESSRS. CASSELL AND CO., LTD., have published a booklet, written by Mr. H. H. Thomas, on "Sweet Peas and how to Grow Them." The text contains just that practical information the amateur gardener requires, and includes numerous illustrations from photographs and sketches.

OUR ASTRONOMICAL COLUMN.

RECENT BRILLIANT FIREBALLS.—Mr. W. F. Denning writes:—A brilliant Quadrantid passed horizontally, with a slow motion and long course, along the W. heavens on January 6, 8h. 40m. Other fine meteors were noticed on January 7, 9h. 27m.; on January 11, 5h. 30m., 7h. 40m., 8h. 11m.; January 13, 9h. 48m.; January 17, 8h. 20m.; January 19, 5h. 50m., 7h. 50m., &c. But the most striking object of all was that of January 11, 8h. 11m., and a large number of descriptions of the appearance and position of this brilliant visitor have come to hand. From these I have worked out the real path as follows:—Height, 58 to 29 miles over Llandovery to Usk, South Wales; length of path, 52 miles; velocity per second, 13 miles; radiant point, 332°+36°; earth point, Chippenham, Wilts. The meteor was estimated by Mr. H. Chapman, of Newtown, N. Wales, as brighter than the full moon, and it gave two flashes of sufficient intensity to light up the firmament and terrestrial objects for several seconds. The meteor moved slowly from a radiant in the western sky. Several of the observers describe the motion as undulatory, as though the object experienced some difficulty in penetrating our dense atmosphere. The radiant point is not conformable with that of any known meteoric shower, but it falls in the same place as that of an active stream or streams visible in the months of July, August, and September.

MARTIAN FEATURES.—In No. 34 of the Lowell Observatory Bulletins Prof. Lowell describes, and gives the positions of, certain white spots which have been observed in the arctic and subarctic zones of Mars, time after time, by the Flagstaff observers. Eight of these spots have been recorded, and they do not appear to be restricted to any zone, although, individually, they always appear year after year in the same place. The chief of them appears in long. 206°, lat. 83° N., and was first observed by Schiaparelli in 1884; in 1903, at Flagstaff, this spot was kept under observation from June 21 to August 10 (Martian dates), being seen at every one of the six presentations.

To account for the appearance of these white spots a natural supposition would be that they are snow-fields or glaciers on high mountain tops; but observations show that there are no considerable mountains on Mars, therefore the question as to the nature of these phenomena remains to be solved by future discussion.

In a paper communicated to the Royal Astronomical Society (Monthly Notices, vol. lxix., No. 2, December, 1908) M. Antoniadi discusses a composite drawing which he made from a print showing forty images of Mars, taken at the Lowell Observatory. The analysis of the photographs and the comparison of the results with those previously obtained from visual observations lead to some important conclusions respecting the objective existence of certain features about which various visual observers have hitherto disagreed. In general, the photographs confirm the existence of many features reported by Schiaparelli, Lowell, and others, and, what is perhaps more important in the discussion of the results obtained by different observers at different epochs, they afford strong evidence of change in several important features of the planet's disc, *e.g.* the Syrtis Major is shown to be of a slightly different shape on these photographs, taken 1907, July 11, from that observed visually by Schiaparelli between 1877 and 1888.

ATMOSPHERIC POLARISATION.—In an extract from the *Astronomische Nachrichten* (No. 4283) Herr Chr. Jensen discusses the question of atmospheric polarisation, and shows that there are two neutral points where there is no polarisation. These two points are shown to vary with the solar activity and the amount of volcanic dust and other impurities in the atmosphere, and the author suggests that more observations should be made by meteorologists and astronomers in order to elucidate the question of relationships suggested by the results of his discussion.

MAKING A FORTY-CENTIMETRE (15·7 INCHES) CASSEGRAIN REFLECTOR.—In a brief note which appears in No. 4295 of the *Astronomische Nachrichten* M. Schaer describes the method of making a 40-cm. Cassegrain reflector, which he has made and has found very efficient at the Geneva Observatory.

The large disc is 7 cm. in thickness, and is pierced by a central hole 8 cm. in diameter; the method of mounting is the older one employed by Herschel, and is found to give sufficient resistance to the flexure of the mirror.

A great disadvantage in a Cassegrain telescope, as compared with a refractor, is the amount of stray light which enters the ocular and reduces the contrast of the image. This may be eliminated by suitable diaphragms, but it is a difficult matter to fix the latter in exactly the correct position. M. Schaer has surmounted this difficulty by mounting a conical tube inside the telescope, so that the stray light is intercepted before it reaches the eye-piece. This conical tube is made of thin sheet iron, and is 150 mm. long; the diameter of the open end is 60 mm., that of the eye end 75 mm., and as the focal plane is limited to 70 mm. diameter, this additional tube in no way interferes with the image.

Tests made with this instrument indicate that in intensity of the focal image it is superior to a crown-flint refractor of equal aperture, whilst its superiority for photography is obvious in many directions.

THE POLES OF DOUBLE-STAR ORBITS.—In No. 4291 of the *Astronomische Nachrichten* Prof. Doberck discusses the relation of the poles of double-star orbits to the ecliptic and to the galaxy. The results show that the poles do not lie along the galaxy nor near the pole of the ecliptic, but it appears to be more probable that they lie along the ecliptic than that they lie near the galactic pole.

REMARKABLY DARK PENUMBRAL ECLIPSE OF THE MOON.—Visual observations and photographs made at the Juvisy Observatory show that the penumbral eclipse of the moon, which took place on December 7, 1908, was an exceptionally dark one. By giving short exposures on slow plates

it was found possible to obtain photographs on which the contrast between the eclipsed and uneclipsed parts of the lunar disc was very striking; on the photograph reproduced the latter is almost entirely obscured.

Several other observations recorded in the January *Bulletin de la Société astronomique de France* confirm those made at Juvisy.

L'ANNUAIRE ASTRONOMIQUE ET MÉTÉOROLOGIQUE, 1909.—Amateur astronomers and meteorologists who read French will find M. Flammarion's year-book a valuable acquisition. The volume for 1909 contains the usual data, with the calendar of events so useful to amateur observers and others interested in astronomical phenomena, and some useful instructions to observers; the annual review of the progress of astronomy during the past year should also prove interesting. The "Annuaire" is published at 1.50 francs.

THE BRITISH SCIENCE GUILD.

THE third annual general meeting of members of the British Science Guild was held at the Mansion House on Friday last, January 22, under the presidency of the Right Hon. the Lord Mayor. We give this week extracts from the report of the executive committee presented by Sir W. Ramsay, and adopted on the motion of Sir Frederick Pollock, seconded by Sir Oliver Lodge.

The president of the Guild, in his address at the annual meeting last year, remarked:—"It is known now that without skill it is impossible to hold your own in the competition of the day. The change that has come over things in the last fifty or sixty years is immense. Without science no one can organise his business; without science no nation can keep its place in the van. Therefore, one of the great responsibilities of the nation is, not only to keep her knowledge in the minds of a few individuals abreast of the age, not only to produce her Kelvins and her Darwins, but to see that her science is disseminated and that it enters the mind and actuates the endeavours of her Captains of Industry generally. This is the creed of the Guild, and that is the lesson which we ourselves have endeavoured to teach."

During the year the Guild has steadily laboured forward, and, in spite of the vast quantity of inertia against which its missionary efforts have to contend, the nation is gradually commencing to realise the importance of the scientific spirit. Public speakers, particularly those who have to do with educational subjects, are almost unanimous in urging the importance of the inclusion of science in all educational schemes.

Dr. Warren, the Vice-Chancellor of Oxford University, at the last annual meeting made the following striking remarks:—"If there is one thing about which I have been persistently keen all through my academic career, it has been the desire to introduce science into the regular and compulsory curriculum of Oxford, to ensure that everyone who takes the ordinary degree should at least know what science and the scientific attitude of mind are like. I hope I shall see this accomplished before my own active career closes."

Following this, Sir William Anson, the representative in Parliament of the same University, has recently said:—"No boy should leave school without the rudiments of one branch of science and some knowledge of scientific method."

The Chancellor of the Exchequer recently affirmed at Bangor that what is wanted is not only teachers, but also explorers. Science has its dark continents, unlimited oceans, chartless. Germany has said, You must have a university to teach and to educate and to develop the German mind, and now the effect is seen in the German industries.

Visiting recently one of the largest workshops in Germany, he was taken round by a professor. In these workshops the professors are the experts. The Germans get their ideas from their professors. We in this country heave coal and blast rocks, but the great industries that finish these products are elsewhere. The universities are the factories where the future of the country is being forged. *There is no investment that will produce such a return, not to the investor, but to the generations to come, as the endowment of higher education.*

The public Press is also becoming more constant in pointing out the need of scientific education; in urging that with each year it becomes more clear that scientific knowledge is the root of both social prosperity and social progress; that the real function of a university is not to teach men a business, but to cultivate their intellects, to make them the best possible citizens, and, humanly speaking, the most accomplished citizens; that a university ought to be the nursery of our leaders of industry, of our politicians and professional classes; *of all men, in fact, upon whose initiative and by whose counsel the great affairs of the nation are carried on.*

It was mentioned in last year's report that the main educational advance had been in primary education. This has again been the case in the year just passed. Of course it is of the utmost importance that primary education should be efficient, because unless there is a sure foundation the edifice can never be satisfactorily completed; but it must be remembered that secondary education is also of the highest importance. Unfortunately, owing to religious and denominational differences, there is much unrest in the educational world, and this most seriously militates against efficiency. Until some adequate settlement, agreeable to all parties in the controversy, is arrived at, the cause of true education must inevitably suffer.

In Scotland, where sectarian strife is happily non-existent, primary and secondary education reach a much higher level than in the rest of the United Kingdom. It is with the sincerest pleasure that we note the passage into law of the Scottish Education Bill, which deals in particular with compulsory attendance at continuation schools.

In connection with the higher scientific and technical education, the Imperial College of Science is now being organised, and the appointment of Dr. Bovey as its principal is noted with particular pleasure. As a consequence of this reorganisation, the technological education of London is being placed on a much firmer footing.

The Senate of the University of Manchester, having realised the necessity of the times, are fitting out new laboratories, a number of them to be employed entirely for chemical research in connection with commercial problems.

In last year's report attention was directed to the very meagre national endowment of the universities of Great Britain and Ireland. It is much to be regretted that the Government have not seen their way to increase this national endowment, which, compared with what is granted to universities abroad, is infinitesimal. The sight of the ancient universities struggling to obtain an adequate sum from private sources to enable them to carry out needed reforms is one which could not be witnessed on the Continent of Europe.

It is now universally admitted that those countries which most efficiently support their universities and technical schools, and where education of the highest class can be obtained the most readily with the lowest fees, are most in a position to command the markets of the world. Surely it is high time that more attention was paid by the State to the needs of the universities and colleges. It should be realised that there are many steps to be taken beyond primary education if the nation is to be in a position to compete with its rivals. Our national system of education must eventually include the universities.

The neglect of higher education, and the difficulties of finding ways and means which the universities have had to put up with, account for the loss of many specialised trades to the country. Little can be expected from a university or technical institute which is always in the throes of trying to make income balance expenditure. It sometimes happens that a beneficent donor will give a new wing or building to a university or institute, but forgets that such a building will require a staff and an income to keep it up. The consequence of this is that fees are often exorbitant, and students who have the ability to take advantage of the instruction, but not the pecuniary means, are prevented from attending. It also causes the staff to be inadequate, overworked, and underpaid. An overworked staff is unable to spare time for original investigation, and

the natural sequence is that unless they have extraordinary energy they neglect research, lose their originality, and in consequence, become inefficient teachers.

We are glad to acknowledge that in many ways the present Government has made new departures in directions which cannot fail to benefit the nation by bringing science to bear more fully upon various departments and utilising it to greater effect.

We also note an increasing recognition of the national importance of the work done by scientific men, and of the men themselves as nation builders. A remarkable indication of this new spirit was recently afforded by the official dinner, presided over by a Cabinet Minister, given to the members of the International Conference on Electrical Units, and provided for out of a new fund.

The new Irish Universities' Bill, which enacts that universities shall be erected and endowed in Dublin and Belfast, is very welcome, and there is already some evidence that advantage will be taken of the greater educational opportunity thus given to the Irish people.

The Colonial Office, after consultation with the Royal Society, has established a national bureau in London to deal with sleeping sickness, that terrible disease which decimates yearly the population in many of our tropical possessions. The cost of administration is to be defrayed from imperial funds, including a contribution from the Sudan. The bureau was established in June, and one of the rooms of the Royal Society has been placed at its disposal.

After centuries of neglect, the condition of our ancient and historic monuments is now recognised as a matter worthy of the nation's care. Three Royal Commissions have been appointed dealing with them in England, Scotland, and Wales respectively.

The Board of Trade has appointed a committee to deal with international exhibitions, in order to organise and arrange the part to be taken by this country in connection with them. This permanent committee is to take the place of the special commissions which have in the past been appointed by Government to deal with each large international exhibition. In all probability, by having a permanent committee, a more continuous policy will be evolved. The French have had such standing committees for many years, the committees having to deal both with internal exhibitions and with those held outside France. They have also a special organisation to deal with jury awards, and it would be well if some such organisation could be arranged in this country. The value of such an organisation was particularly noticed by those who served on the juries at the Franco-British Exhibition. The French jurors came over here completely organised, but the British jurors had to start their organisation *de novo*. If there had been a British standing committee to arrange beforehand the *modus operandi*, this would not have been the case, and much valuable time would have been saved.

In consequence of the new allocation of the land following the withdrawal of the Board of Education from South Kensington, the Solar Physics Observatory, which was founded by the Government in 1879, and located there as a temporary measure, is to be removed elsewhere. It has been decided to locate it near Caterham, to occupy a position 900 feet high, previously a mobilisation centre, which has been placed at the disposal of the observatory by Mr. Haldane. In the near future, therefore, it will be possible to carry on the important investigations under much more satisfactory conditions.

The President of the Local Government Board has authorised for the current year a large number of researches in connection with the annual grant voted by Parliament in aid of scientific investigation connected with the causes and progresses of disease; also chemical and bacteriological investigation, as to the influence of softening and other chemical processes on the purity of water supplies from chalky sources.

The Board of Agriculture has shown increased activity, and although little is so far done for research, pamphlets of great use to farmers have been widely distributed.

The appointment of these committees and the increased means of research are steps in the right direction, but they are purely departmental.

It is interesting in this connection to direct attention to the speech made by our president at the anniversary dinner of the Chemical Society nearly four years ago (*Daily Telegraph*, March 30, 1905):—"Mr. Haldane expressed his conviction that the problem that lay in front of the British nation was how to develop the grey matter of the executive brain. All the controversies that agitated the minds of politicians were of less importance than the big question of how to make the permanent element in politics more powerful and better. There was too little science in it at the present time. There was hardly a department which did not require the aid of science if it was to be effective, but there were not attractions like those held out by private firms and foreign Governments to lead men of the highest attainments to put themselves at the disposal of the State. Was it impossible to hope for the birth of an era when the head of the Government should have at his disposal a corps of the finest brains which the nation could produce? If great Britain was to hold her own, she must not be behind Germany, the United States, or France in this matter."

The importance to the nation of such a council as that referred to by Mr. Haldane was first pointed out by the Duke of Devonshire's Commission in 1874.

As mentioned in last year's report, a deputation of the Guild on the pollution of rivers and water supplies was received by the Right Hon. John Burns (President of the Local Government Board) on October 31, 1907. Mr. Burns expressed his intention of bringing in a Bill to deal with the subject in the spring of 1908. No legislation upon this subject was, however, brought forward. It is hoped that this does not mean that nothing is to be done next session, as the matter is one of the utmost urgency.

Conveyance of Scientific Literature at Reduced Rates.

The question of a reduction in postal rates on scientific literature was brought before the Postmaster-General by a deputation organised by the Guild, and received by him on March 12, 1908.

The following memorandum was submitted to the Postmaster-General by the deputation:—

This deputation has been organised by a committee of the British Science Guild, and represents seventy-five societies which have asked to have this matter favourably considered. The names of these societies are given as an appendix.

This list of societies is very far from exhaustive, and, as a matter of fact, only 100 societies were consulted in the first instance, a good many of which by their position could not take action in this matter. It will be understood, therefore, that there is an almost unanimous desire on the part of the scientific and learned societies in Great Britain and Ireland that the Government will see its way to help them in the matter which is now put forward.

These societies fully acknowledge the sympathetic treatment which a few of their number have received from the Government in such matters as the provision of rent-free quarters, monetary help in the prosecution of original research, in exemption from income tax, and in other ways, but they wish to point out that only a few societies really benefit by the first two of these concessions, and that even then this help is small.

The societies wish, however, that these may be taken as precedents for conferring upon them the further small benefits which they now ask for.

This deputation would claim that the scientific and learned societies in this country are thoroughly deserving of sympathetic and generous aid from the Government, for the advancement of science and of original investigation in Great Britain is to a large extent due to their fostering care and to the fact that they afford facilities for the publication of original work and for its free discussion, and by circulating large numbers of their proceedings and transactions describing such original work, they disseminate widely the most recent scientific and other discoveries.

The societies in question are thus practically the custodians of the national advance in science, and it is almost a truism to say that the material progress of the country is strictly dependent on the applications of science, and hence that such societies help largely in keeping our country in a position to compete with other countries in commerce and industry, and that without this continuous

advance in scientific work Great Britain must gradually recede from its premier position among nations.

The work of these societies not only fosters the advance of science, but it is largely educational, and this educational work is of the highest type, as it follows on after the ordinary general education is finished. The present Government, it is known, is keenly anxious to foster education in every possible way, and it is suggested that this is a legitimate direction in which aid is at once possible without any reference to politics and without undue expense.

The deputation wishes to urge very strongly that these societies are in no way working with the view of ulterior profit, but that they work solely for the advancement of knowledge and the well-being of our country. The deputation would invite reference in this connection to the balance sheets of various societies, and from these it will be seen that their expenditure is solely with the view of fostering science, and that in no way does any profit accrue to their members.

The cost of the publication of the journals of the various societies is a very large item in their expenditure, and the cost of the postage of their journals to the members is in many instances a very heavy tax on their resources. This item of cost handicaps such societies in many ways. A reduction in the rate of postage would give great relief to such societies, while the cost to the Post Office, and finally to the public, would be almost nominal.

So heavily do some of the societies feel this rate of postage on their publications that they now actually employ their own servants or special messengers to deliver their publications in London with considerable saving in expense to themselves. Cases may be mentioned showing this.

The deputation does not ask for any precise amount of reduction, but would plead for some consideration and help in the matter, and in passing would mention that the newspaper rates in this country are much lower than the rates at which scientific publications can be sent. The deputation also does not suggest any very hard and fast definition as to the line to be drawn between the publications of learned and scientific societies and other serial publications, but it is suggested that the case of each society, applying for any favourable rate which might be granted, should be considered by the Postmaster-General himself, and if he is satisfied that such society is working wholly (*a*) for the public benefit; (*b*) for the advancement of knowledge or learning; (*c*) without any view to profit to its members, and fulfils any other conditions the Postmaster-General may think fit to add, then such benefit could be granted to each individual society which may be approved.

With this end in view, the following is a suggested regulation for any concession which the Postmaster-General and the Government might be pleased to make:—

"Any publication coming within the following description can, on the application of the society, and upon payment of an annual fee of 5*s*., be registered at the General Post Office for transmission by inland post as a publication of a society as hereinafter defined."

DEFINITION OF A PUBLICATION.
(*Under this Section.*)

"All such scientific, learned and technical publications as may be issued periodically not for profit, but for the advancement of knowledge by societies and institutions in the United Kingdom."

The deputation would urge that such a regulation (which may, of course, be amplified if necessary) would at once differentiate the publications for which relief is sought from all magazines and other similar periodical matter which are published as commercial speculations, whereas, on the other hand, if the rates of postage to be given to the periodicals by scientific societies are reduced, the definition above given could equally be used to assimilate their treatment with that already given to the newspapers in this country.

The executive committee of the Guild subsequently decided that it is undesirable to proceed at present any further in this question, but it is hoped that circumstances may prove to be more favourable later, when perhaps a further move may be made.

Reports of Committees.

During the year meetings of a number of committees have been held. In some cases the results obtained have been incorporated in the form of reports, from some of which extracts are given below. Two reports upon educational subjects appear elsewhere in the present issue.

Coordination of Charitable Effort.

At the last annual meeting of the Guild Sir William Bousfield directed attention to the want of coordination in charitable effort, and suggested that this would be a very fitting matter for the Guild to inquire into. As a consequence, a subcommittee was appointed to deal with the subject. In a memorandum drawn up for the committee Sir William Bousfield says:—

"There would appear to be few subjects on which scientific thought and deductions from practical experience in the past would be more valuable to the community than those relating to expenditure on relief of the poor and provision for sickness and incapacity for work. The amount spent at present out of the national income on these objects and the waste is extremely great. The funds are provided by the State, including central and local authorities, by subscriptions made by the classes who receive the benefit, and by voluntary contributions given in the form of charity by the wealthier sections of the public.

"The time seems to have come when the relation of these various efforts towards the same objects should be examined from a general and national point of view. At present there is no common aim realised by those who improve the lot of the needy or of persons depending on weekly wages and their families. There is a great overlapping in administration, owing to the absolute ignorance of charitable people as to what the working classes are themselves doing, or what provision is being made by the State, and *vice versâ*. New charitable organisations are constantly springing up on a large scale, which merely duplicate the work of others and add greatly to the cost without necessity.

"The general effect of this want of system has been very unfair to the poor themselves, and has promoted a pauperised spirit.

"The want of recognised principle to guide the community in its aim of improving social conditions leads to all kinds of contradictory proposals, and Parliament and the nation alike are at sea and in a state of bewilderment when wide and far-reaching schemes for that end are set on foot."

Agricultural Committee.

A committee has been formed to inquire into the present condition of agricultural research. Mr. A. D. Hall has drawn up a report dealing with agricultural research in the United Kingdom. Mr. John Percival has drawn up a report dealing with the state of agricultural research in the Netherlands, Sweden, Denmark, and Germany, and the amount of State aid which is extended to the different experimental farms and institutions. The subject, however, being very broad, there still remains a large amount of work for the committee to undertake.

Franco-British Exhibition.

Owing to the action of the executive committee of the Guild in 1907, a special science committee, consisting of members of the British Science Guild and representatives of the Royal and other societies, with Sir Norman Lockyer as chairman, organised a separate Science Section of the Franco-British Exhibition. The executive of the exhibition most generously granted to the committee the use of the large building, which was specially erected for the purpose, having a floor space of 14,000 square feet. Not only did they build and grant this hall free of cost, but they also contributed a sum of 1000*l*. to defray the cost of the glass exhibition cases, with installation and other expenses. The total contribution of the executive to the cause of British science exceeded 7000*l*. The Guild feel that this public-spirited action on the part of the exhibition authorities calls for the highest praise. In no other international exhibition has a special portion been entirely devoted to science.

The Synchronisation of Clocks.

Attention was directed in the public Press by Sir John Cockburn to the divergence in time shown by the publicly exposed clocks in London and other large centres, also the inconvenience thus caused to the public. A suggestion was received by the executive committee that a subcommittee should be appointed to deal with the subject.

After careful consideration of evidence brought before it, the committee drew up the report printed in NATURE of August 13, 1908. This report was sent to the Lord Mayor, the London County Council, the General Post Office, His Majesty's Office of Works, the Local Government Board, the British Horological Institute, and the various railway companies. Most of the bodies referred to merely acknowledged receipt of the communication, or else expressed disinclination to act owing to administrative difficulties or to the expense of synchronisation. The reply received from the Public Health Department, Guildhall, City of London, is of special interest, as it states "that the Corporation on March 26, 1903, made it a condition of future consent to the erection of clocks over public ways in the City that they should be synchronised with Greenwich time."

Naming of Streets.

The executive council has considered the matter of naming new streets, and the re-naming of streets, the names of which it is intended to alter, after distinguished men of science, now deceased. The members of the executive committee were requested to send in names which they considered it would be desirable to employ in this way. A list containing a large number of names was thus drawn up, and was presented to the executive committee, who, after careful consideration, reduced it to the following thirty-one names:—Newton, Darwin, Harvey, Jenner, Huxley, James Watt, Gilbert, Kelvin, Faraday, Joule, Clerk Maxwell, Stokes, Tyndall, Captain Cook, Livingstone, Franklin, Ross, Bruce, Mungo Park, Cavendish, Dalton, Priestley, Boyle, Andrews, Halley, Herschel, Horrocks, Adams, Bradley, Howard, Piddington. This list was then sent to the County Council with the following letter:—

"I am directed by the president, Mr. Haldane, to ask you to be so good as to bring before the L.C.C. the striking difference which exists between the street nomenclature in London and Paris. In the latter City there is no illustrious French man of science whose name is not connected with some street or square. It is hardly too much to say that in London there is no case of which the same can be said."

"This matter has been inquired into by the executive committee of the British Science Guild, and I am directed to forward to you the accompanying list of thirty-one names, which they have carefully considered, and think could be properly used in this connection should the opportunity arise in the naming of new thoroughfares or the change of name of old ones."

"They are well aware that the present condition of things has arisen in the past because there has been no such body as the London County Council interested in the nation's history and intellectual development; in its absence, the builder and the owner of the land during the last 300 years have been the chief people interested."

New Patents and Designs Bill.

Two years ago the Guild appointed a committee to consider the question of the amendment of Patent Laws. Sir John Cockburn was also appointed to confer with the authorities of the Associated Chambers of Commerce, and to take part in a deputation to the President of the Board of Trade. It is with pleasure that the Guild is able to direct attention to the beneficial effect of the new Patent Act of 1907, the results of which are now beginning to be apparent.

So far back as 1884, in his presidential address to the Society of Chemical Industry, the late Sir William Perkin said that one of the causes of the loss of the coal-tar colour industry to this country was the condition of our patent laws. For more than twenty years Mr. Levinstein and others have been working to convince the Governments of the need of reform in this direction.

The consequences of the Act now in force are that, not only are many wealthy foreign firms building new factories in this country, but that licences to work foreign patents are being obtained by many purely British firms which, before the passing of this Act, they were unable to secure. Messrs. Meister Lucius and Brunning, of Höchstam Main, in Germany, have erected a factory at Port Ellesmere, on the Mersey, and are now employing a large staff of workmen in the preparation of anilin dyes, synthetic indigo, and fine chemicals. The Badische Anilin- und Soda-Fabrik are also erecting large works on the Manchester Ship Canal. The Gillette Razor Company, of America, have works at Leicester. The German Pottery Co., of Alfred Johnson and Co., are starting works in Kent, and many other firms from abroad are setting up works at Liverpool, Manchester, Warrington, Enfield, Tottenham, and other localities. Altogether about twenty new works have been erected by foreign patentees owing to the passing of this new Act, and independent of these a large number of licences have been granted to British firms.

Formation of Sections in Australia and Canada.

A committee has been formed in Sydney, New South Wales, with the Hon. Sir H. Normand MacLaurin, Chancellor of Sydney University, as chairman, and Dr. Walter Spencer as secretary. A number of members have joined the New South Wales branch of the British Science Guild. In Montreal a strong committee has been brought together, with Mr. George E. Drummond as president and Prof. H. T. Barnes as secretary. It is intended to hold a meeting at the end of the winter, either in Montreal or Toronto, to inaugurate the Canadian branch of the Guild. The formation of branches of the Guild in the colonies will add strength to the parent society, and cannot fail to foster goodwill between the colonies and the Mother Country, thus helping to strengthen the fabric of the Empire.

Presentation of Illuminated Address to President Fallières.

The opportunity of the visit of the President of the French Republic to England to inspect the Franco-British Exhibition was taken advantage of to present him with an illuminated address. The movement was originated by Sir Norman Lockyer, and after consultation with the Royal Society and the Royal Academy, the Guild was asked to undertake the work. The address was presented on May 27, 1908, at St. James's Palace, and was received by M. Fallières in a most cordial manner.

SYSTEM AND SCIENCE IN EDUCATION.

Primary and Secondary Education.

AFTER taking into consideration the memorandum prepared by the chairman of the executive committee, the education committee has adopted the following resolutions which embody and extend those already submitted to the executive committee:—

(1) No local authority or other body should be empowered to grant total exemption from attendance at school to children under fourteen years of age.

(2) Provision should be made for compulsory attendance at day or evening (preferably day) continuation schools for young persons above the age of fourteen years, who are not attending craft or secondary schools, for two to four hours a week during two years of forty weeks in each year. Pupils attending evening continuation schools between these ages should not be permitted to commence work before 8 a.m. on those days on which they attend the schools. The number of hours during which pupils attend part-time day or evening continuation schools should be counted as "hours of employment" for the purpose of the Acts dealing with the employment of young persons.

(3) There should be established in all educational areas a sufficient number of craft schools with a two-years' course for boys and girls between the ages of about fourteen and sixteen years. Due regard should be paid in these schools to the continuance of the general education of the pupils, but special provision should be made for sound scientific and technical training in relation to the industries or requirements of the district. The aim of these schools should be to provide preparatory training in

[1] Reports of two committees of the British Science Guild presented at t annual general meeting on January 22.

handicraft for pupils who propose afterwards to follow industrial or commercial careers or to manage households intelligently. The fees should be low, and there should be scholarships giving free tuition, travelling, and maintenance allowances, graduated according to the ages of the scholars. These schools might also provide for the continuation classes referred to in clause 2.

(4) Local education authorities should be urged to establish or aid in establishing an adequate supply of secondary schools of a high educational type. These schools should have highly qualified staffs adequately paid, and should be administered by a board of governors or managers. No effort should be spared to make these schools thoroughly efficient, and to this end the curriculum followed should admit of some amount of variation. Where the majority of pupils remain to eighteen years of age a higher standard on the purely academic side could be aimed at than in the case of schools where the bulk of the pupils leave at sixteen years of age or thereabouts. To secure that the best minds in the primary school shall pass into the secondary school, there should be a sufficient number of free places and maintenance scholarships to render secondary education accessible to boys and girls capable of benefiting by it who propose to remain at school until the completion of at least a four-years' course from the date of entry.

(5) A primary school certificate should be introduced which would serve as a passport to the craft school and the secondary school. School certificates should also be granted to pupils who work satisfactorily through the courses at the craft school or at the secondary school. The certificates should be based not upon examinations, but chiefly upon reports by the teachers as to the ability of the pupils to profit by higher courses of instruction.

(6) The matriculation examination of any British university, and the secondary school leaving certificate, certain requirements being satisfied, should qualify for entrance to any British university or technical college, and to the various professional courses, without further examination and in lieu of the present preliminary examinations.

(7) School records and the reports of teachers should at every stage supersede largely the present system of estimating ability by examinations. The award of scholarships should be based largely upon the reports of the teachers of the schools which the pupils are attending at the time of their promotion. School-leaving certificates should be awarded only to pupils in schools certified as efficient for that purpose by a responsible inspecting authority, and a list of these schools should be published. Schools in which this privilege was abused should be removed from the list. By placing upon the teachers the responsibility for nominating pupils for certificates or scholarships, the credit of the school would soon secure that only the most capable or promising pupils would have their passage facilitated to places of higher learning. In all examinations the teacher should be associated with the external examiner.

(8) In every public or private primary or secondary school, the instruction in all branches of the curriculum should be so given as to accustom the pupil to careful observation and experiment, whatever may be the specific nature of the subject that is being studied; and to this end not only should there be a proper amount of labortory and workshop practice, but the scientific spirit of the laboratory and workshop should so far as possible be employed in the ordinary class-room. In this way the school would provide the best kind of preliminary training for industrial life, and would also ensure that those who subsequently receive a university education shall bring to the work which will devolve upon them in various fields of activity, including the administration of public departments, an adequate training in scientific method.

(9) An arrangement should be arrived at whereby a satisfactory report as to educational efficiency, made by a responsible inspecting authority would in ordinary cases render similar inspection during the same school year unnecessary.

(10) Local authorities, governing bodies, and parents should realise that the salaries at present paid are in most cases quite inadequate to secure a supply of highly-qualified and capable teachers. The opportunities for advancement offered by other careers attract from the teaching profession many men, who by attainment and aptitude would promote the educational welfare of the nation. The conditions of service, salaries, and outlook of assistant teachers, whether engaged in the work of primary, secondary, or technical education, are in general most unsatisfactory, and unless they are improved they must fail to attract or retain the services of many men and women best qualified for the profession of teaching. A high standard in education can only be attained by generous provision for those who do the work, both in their active and declining years. Until this is recognised, it is futile to anticipate progress in procedure or success in any organic educational system, or to obtain from the present efforts and expenditure on education a sufficient return.

The Cost of teaching Practical Science in Schools.

An opinion expressed by the headmaster of Eton at a general meeting of the British Science Guild in 1907, to the effect that an extension of the teaching of science in public schools is checked by the heavy expenses attaching to practical work, has been under the consideration of a subcommittee of the Guild, and its members beg to make a brief statement of their convictions with regard to such practical teaching of science and the question of its extension.

The procedure adopted in teaching science should always differ considerably from that employed in teaching literary and linguistic subjects, and ordinarily does so differ. The main reason for this distinction lies in the fact that all exact physical knowledge must admit of objective realisation, that is, its demonstration in material objects under natural conditions must be possible; while the acquisition of any part of this knowledge already recorded, not to mention possible additions to the stock, necessarily involves extensive experience of a concrete character. The equipment for this purpose, still considered in some quarters as more or less separable from the course of instruction, involves expense, but that expense may be regarded, not so much as a defect at once tangible and flagrant in a branch of education still under suspicion, but rather as the life-blood of an activity inherent in modern civilisation. Whether a given society ignores it or turns it to its own use, the movement continues—in Lebensfluthen, in Thatensturm.

Expense is a relative term. All those who have been engaged in teaching science for the last twenty years are aware of a revolution during that period in the character of the apparatus employed for instruction in schools. A remarkable change has taken place in the direction both of cheapness and of simplicity. These results have been gained by organised efforts on the part of science masters by meeting in conference or by publication. It is widely recognised among these masters that simplicity and plainness in apparatus is a positive gain, and that the educational value of the instruction even increases with the bareness of the material by which it is supplied. As experience in this work has widened, it has become more and more apparent that scientific method rather than technical knowledge should be the aim of school teaching, and that in the earlier stages at all events preference should always be given to the study of the course of events which are normal and familiar rather than of such as are exceptional or specialised. There has been, in other words, an increasing tendency to assimilate the scope of elementary scientific study to the ordinary experience of civil and industrial life and the material of experiment to the range of every-day requirements. It is now generally admitted that the over-elaboration of apparatus inhibits enterprise and invention in the young pupil just as a costly mechanical toy stunts the imagination of the child, while it tends also to separate the exercises of the laboratory too abruptly from the events of the daily round. It is maintained that workshop practice may with advantage supplement the work of the laboratory and give it a broader practical basis: that the surviving though weakened boundary-wall between them might be broken down, with gain to both in the matter of increased economy as well as of added wealth of interest.

Such an outlet for the practical exercise of inductive reasoning is an urgent need in a scheme of education which is still very largely a matter of deductive exposition. A large stock of the experience only to be gained from an intimate acquaintance with the qualities and limitations

of matter is a necessary disciplinary corrective of all abstract thinking, whether scientific or not, and we should beware how we repress it lest we destroy that practical-mindedness which we treasure as one of the most valuable of our national assets. Imbued as we are with these convictions, it is discouraging to meet with opinions which appear to have been formed at a period when they were in some measure justified by the direct transference to the school of the practice of the university without the necessary adaptation to a lower intellectual plane, and by other inevitable errors of the early and empirical stage of science teaching. It is some relief, however, that the charge which has to be met is a matter of pounds, shillings and pence, and not one of squandering educational opportunity or of wasting human effort.

Economy bears upon science teaching precisely at it bears upon every branch of education and every department of social administration, nor do its principles perforce wither away in the atmosphere of science. As practical experience extends, as the supply of trained teachers improves, as examinations become more scientific and less restricted in style, so will the spirit of investigation and research be stimulated, and sound standards of thought be established. Indeed, the question of outlay will almost cease to be relevant as the relation of output to expenditure improves, but if definite statements be called for, a wide range of inquiry has furnished them. From the information thus gained, it appears that the present average expenditure on apparatus and material is about 1*l.* per annum for each pupil receiving practical instruction in science in the public schools, and about 10*s.* per annum for each pupil in other secondary schools. It may be safely accepted as a maximum estimate—a fairly generous one—that physical and chemical laboratories can be equipped, maintained in apparatus, and supplied with consumable material, and provision also be made for the practical study of animate nature, on a basis of 100 boys working for 10 hours a week (or 40,000 boy-hours per annum), by an average annual expenditure of 150*l.* for a period of ten years. After this period of installation and accumulation of plant, the annual cost of maintenance and renewal need not exceed 100*l.* In other words, the cost per head should never exceed 30*s.* a year during the early constructive stage, and may be expected to fall much below that value after a period varying with the scope of the work, the degree of specialisation, and the number of students. But it is imperative that expenditure should be guided by experience, for a wrong start by a tyro may hamper himself or his successor for years. For this reason there is much valuable work to be done by any independent body which would undertake to serve as a standing committee for the sifting and co-ordination of results in these matters, and for advising and guiding those in need.

Save for a few of the chief public schools, the statements here made in connection with secondary education are fortunately to a great extent unnecessary. There are now about 750 secondary schools in England and Wales inspected by the Board of Education and receiving grants for efficient teaching. In these schools there are about 100,000 pupils taking a course which has been approved by the Board, and this course must provide instruction in science. The Board insists that "the instruction in science must include practical work by the pupils." In each of these secondary schools, and they include most of the grammar schools and endowed schools of the country, one or more laboratories must be provided. They are to be fitted with benches for their special purpose, and supplied with water, gas, and, when possible, electric current. Sufficient apparatus must also be provided for a reasonable course of work.

The governing bodies of all these schools must provide laboratories and apparatus for individual practical work whether they like it or no. The schools are not regarded as efficient or entitled to receive grants in aid of education, unless they comply with the regulations laid down by the Board for individual practical work in science. Provision for this purpose cannot be evaded by any secondary school which receives grants in aid, nor, on the other hand, would any reduction in its cost permit the teaching to be extended beyond the limits already imposed by the rightful claims of other subjects. Secondary schools which are less local in character and not qualified to receive grants, but are subject to considerable competition among themselves, are prompted by motives of self-preservation to give a prominent position in their curricula to scientific training. It is now only a few public schools which remain in an exceptional position and offer but limited opportunities of learning science to a portion of their pupils. If an extension of science teaching in such schools be desired, the cost of its provision does not appear to be the real obstacle.

THE WORLD OF LIFE: AS VISUALISED AND INTERPRETED BY DARWINISM.[1]

THE lecturer began by stating that, although the theory of Darwinism is one of the most simple of comprehension in the whole range of science, there is none that is so widely and persistently misunderstood. This is the more remarkable, on account of its being founded upon common and universally admitted facts of nature, more or less familiar to all who take any interest in living things; and this misunderstanding is not confined to the ignorant or unscientific, but prevails among the educated classes, and is even found among eminent students and professors of various departments of biology.

Darwinism is almost entirely based upon those external facts of nature, the close observation and description of which constituted the old-fashioned "naturalists," and it is the specialisation in modern science that has led to the misunderstanding referred to. Those who have devoted years to the almost exclusive study of anatomy, physiology, or embryology, and that equally large class who make the lower forms of life (mostly aquatic) the subject of microscopical investigation, are naturally disposed to think that a theory which can dispense with all their work (though often strikingly supported by it) cannot be so important and far-reaching as it is found to be.

Numbers, Variety, and Intermingling of Life-forms.

Coming to the first great group of facts upon which Darwinism rests, the lecturer directed attention to the great number of distinct species, both of vegetable and animal life, found even in our own very limited and rather impoverished islands, as compared with more extensive areas. Great Britain possessed somewhat less than 2000 species of flowering plants, while many equal areas on the Continent of Europe have twice the number. The whole of Europe contains 9000 species, and the world 136,000 species already described; but the total number, if the whole earth were so well known as Europe, would be almost certainly more than double that number, or about a quarter of a million species. The following table, showing how much more crowded are the species in small than in large areas, was exhibited on the wall. It affords an excellent illustration of the fact of the great intermingling of species, so that large numbers are able to live in close contact with other, usually very distinct, species.

Numbers of Flowering Plants.[2]

	Square miles	Species
The County of Surrey	760 ...	840
A portion containing	60 ...	660
" "	10 ...	600
" "	1 ...	400

The above figures were given by the late Mr. H. C. Watson, one of our most eminent British botanists, and as he lived most of his life in the county, they are probably the results of his personal observation, and are therefore quite trustworthy.

Continuing the above inquiry to still smaller areas, one perch, equalling 1/160 acre, or less than the 1/100,000 of a square mile, has been found to have about forty distinct species, while on a patch 4 feet by 3 feet in Kent (or about 1/25,000,000 of a square mile) Mr. Darwin found twenty species.

[1] Abstract of discourse delivered at the Royal Institution on Friday January 22, by Dr. Alfred Russel Wallace, O.M., F.R.S.

[2] Other tables illustrating similar facts in other parts of the world were prepared, but not exhibited, as being likely to distract attention from the lecture itself.

The same law of increase of numbers in proportion to areas applies to the animal world, if we count all the species that visit a garden or field during the year, though those that can continuously live there are not perhaps so numerous in very small areas.

The Increase of Plants and Animals.

The powers of increase of plants and animals were next discussed, and were shown to be enormously great. An oak tree may produce some millions of acorns in a good year, but only one of these becomes a tree in several hundred years to replace the parent. Kerner states that a common weed, *Sisymbrium Sophia*, produces about three-quarters of a million of seeds; and if all these grew and multiplied for three years, the plants produced would cover the whole land surface of the globe.

Equally striking is the possible increase in the animal world. Darwin calculated that the slowest breeding of all animals, the elephant, would in 750 years, from a single pair, produce nineteen millions. Rabbits, which have several litters a year, would produce a million from a single pair in four or five years, as they have probably done in Australia, where they have become a national calamity. As illustrative of this part of the subject, the lecturer referred at some length to the cases of the bison and the passenger pigeon in North America, and the lemmings of Scandinavia. In the insect tribes still more rapid powers of increase exist. The common flesh-fly goes through its complete transformations from egg to perfect insect in two weeks, and Linnæus estimated that three of these flies could eat up a dead horse as quickly as a lion.

It is these enormous powers of rapid increase that have ensured the continuance of the various types of existing life from the earliest geological ages in unbroken succession, while it has also been an important factor in the production of new forms which have successively occupied every vacant station with specially adapted species.

Inheritance and Variation.

The vitally important facts of inheritance with variation were next discussed, and their exact nature and universal application pointed out. The laws of the *frequency* and the *amount* of variations, and their occurrence in all the various parts and external organs of the higher animals, were illustrated by a series of diagrams. These showed the actual facts of variation in adult animals of the same sex obtained at the same time and place, which had been carefully measured in numbers varying from twenty to several thousand individuals.

The general result deduced from hundreds of such measurements and comparisons was that the individuals of all species varied around a mean value, that the numbers became less and less as we receded from that mean, and that the limit of variation in each direction was soon reached. Thus, when the heights of 2600 men, taken at random, were measured, those about 5 feet 8 inches in height were found to be far the most numerous. About half the total number had heights between 5 feet 6 inches and 5 feet 10 inches, while only ten reached 6 feet 6 inches, or were so little as 4 feet 10 inches, and at 6 feet 8 inches and 4 feet 8 inches there were only one of each.

The diagrams from the measurements of various species of birds and mammals were shown to agree exactly in general character, and the further fact was exhibited by all of them that the parts and organs varied more or less independently, so that the wings, tails, toes, or bills of birds were often very long, while the body or some other part was very short, a point of extreme importance, as supplying ample materials for adaptation through natural selection.

The Law of Natural Selection.

The next subject discussed was the nature and mode of action of natural selection. It was pointed out that since the Glacial epoch no decided change of species had occurred. This showed us that the adaptation of every existing species to its environment was not only special, but general. The seasons changed from year to year, but the extremes of change only occurred at long intervals, perhaps of many centuries, with lesser, but still very considerable, variations twice or thrice in a century. It was by the action of these seasons of extreme severity at long intervals, whether of arctic winters or summer droughts, that the very existence of species was endangered; and it was at such times that the enormous population of most species and their wide range over whole continents always secured the preservation of considerable numbers of the best adapted in the most favoured localities. Then the rapidity of multiplication came into play, so that in two or three years the population of each species became as great as ever, while, as all the least favourable variations had been destroyed, the species as a whole had become better adapted to its environment than before the almost catastrophic destruction of such a large proportion of them.

It is the fact of the adaptation of almost all existing species to a continually fluctuating environment—fluctuating between periodical extremes of great severity—that has produced an amount of adaptation that in ordinary seasons is superfluously complete. This is shown by the well-known fact that large numbers of adult animals that have not only reached maturity, but have also produced offspring and successfully reared them, continue to live and breed for many years in succession, although varying considerably from the mean, while almost the whole of the inexperienced young fall victims to the various causes of destruction that surround them.

The Nature of Adaptation.

The next subject discussed was the complex nature of adaptations in many cases, and probably in all, a subject of great extent and difficulty. The lecturer directed special attention to the relations between the superabundance of vegetation in spring and summer, the enormous, but to us mostly invisible, hosts of the insect tribes which devour this vegetation, and the great multitudes of our smaller birds the young of which are fed almost exclusively on these insects. Without these hosts of insects the birds would soon become extinct, while without the birds the insects would increase so enormously as to destroy a considerable amount of vegetable life, which would, in its turn, lead to the destruction of much of the insect, and even of the highest animal groups, leaving the world greatly impoverished in its forms of life.

The vast numbers of insects required daily and hourly to feed each brood of young birds was next referred to, and the wonderful adaptation of each kind of parent bird which enables it to discover and to capture a sufficient quantity immediately around its nest, in competition with many others engaged in the same task in every copse and garden, was next pointed out. The facts were shown to involve specialities of structure, agility of motions, and acuteness of the senses, which could only have been attained by the preservation of each successive slight variation of a beneficial character throughout geological time; while the emotions of parental love must also have been continuously increased, this being the great motive power of the strenuous activity exhibited by these charming little creatures.

Lord Salisbury on Natural Selection.

As illustrating the strange and almost incredible misconceptions prevailing as to the mode of action of natural selection, the lecturer quoted the following passage from the late Lord Salisbury's presidential address to the British Association at Oxford in 1894. After describing how the diverse races of domestic animals have been produced by artificial selection, Lord Salisbury continued thus:—

"But in natural selection, who is to supply the breeder's place? Unless the crossing is properly arranged the new breed will never come into being. What is to secure that the two individuals of opposite sexes in the primæval forest, who have been both accidentally blessed with the same advantageous variation, shall meet, and transmit by inheritance that variation to their successors? Unless this step is made good the modification will never get a start; and yet there is nothing to ensure that step but pure chance. The law of chance takes the place of the cattle-breeder or the pigeon-fancier. The biologists do well to ask for an immeasurable expanse of time, if the occasional

meetings of advantageously varied couples, from age to age, are to provide the pedigree of modifications which unite us to our ancestors, the jelly-fish."

Here we have the extraordinary misconception presented to a scientific audience as actual fact, that advantageous variations occur singly, at long intervals, and remote from each other, each statement being, as is well known, the absolute reverse of what is really the case. It totally ignores the fact that every abundant species consists of tens or hundreds of millions of individuals, and that as regards any faculty or quality whatever, this vast host may be divided into two portions—the *less* and the *more* adapted—not very unequal in amount. It follows that at any given time, in any given country, the advantageous variations always present are not to be counted by ones and twos, as stated by Lord Salisbury, but by scores of millions; and not in individuals widely apart from each other, but constituting in every locality or country somewhere about one-half of the whole population of the species.

The facts of nature being what they are, it is impossible to imagine any slow change of environment to which the more populous species would not become automatically adjusted under the laws of multiplication, variation, and survival of the fittest. Almost every objection that has been made to Darwinism assumes conditions of nature very unlike those which actually exist, and which must, under the same general laws of life, always have existed.

Protective Colour and Mimicry.

The phenomena of protective coloration and mimicry were very briefly alluded to, both because they are comparatively well known and had formed the subject of previous lectures, while they are very easily explained on the general principles now set forth. The explanation is the more easy and complete, because of all the characters of living organisms, colour is that which varies most, is most distinctive of the different species, and is almost universally utilised for concealment, for warning, or for recognition; and, further, its useful results are clear and unmistakable, and have never been attempted to be accounted for in detail by any other theory than that of the continuous selection of beneficial variations.

The Dispersal of Seeds.

The subject of the dispersal of seeds through the agency of the wind, or of carriage by birds or mammals in a variety of ways, and often by most curious and varied arrangements of hooks, spines, or sticky exudations almost infinitely varied in the different species, was also briefly treated, since they are all readily explicable by the laws of variation and selection, while no other rational explanation of their formation has ever been given.

Conclusion.

In concluding, the lecturer directed attention to a series of cases which had shown us the actual working of natural selection at the present time. He also explained that these cases were at present few in number, first, because they had not been searched for, but perhaps mainly because they only occur on a large scale at rather long intervals, when some great and rather rapid modification of the environment is taking place.

In the following paragraph he endeavoured to summarise the entire problem and its solution:—"It is only by continually keeping in our minds all the facts of nature which I have endeavoured, however imperfectly, to set before you, that we can possibly realise and comprehend the great problems presented by the 'World of Life'—its persistence in ever-changing but unchecked development throughout the geological ages, the exact adaptations of every species to it actual environment both inorganic and organic, and the exquisite forms of beauty and harmony in flower and fruit, in mammal and bird, in mollusc and in the infinitude of the insect-tribes; all of which have been brought into existence through the unknown but supremely marvellous powers of Life, in strict relation to that great law of Usefulness, which constitutes the fundamental principle of Darwinism."

LONG-DISTANCE TELEGRAPHY.

THE developments which have recently taken place in long-distance direct telegraphic working show that progress has been made in telegraphic transmission by wire as well as in wireless telegraphy. The direct transmission of public messages between London and India was put into operation last week, and messages were sent at the rate of forty words per minute between London and Karachi. Direct working with Calcutta, Bombay, and Madras has been successfully established, the experiment of direct transmission to the first-named centre being attempted for the first time last Saturday, when a world's record was established of about 7000 miles.

Direct Wheatstone working over the line between London and Teheran—a distance of 3748 miles—has been possible since the beginning of 1903, but no land line existed between Teheran and Karachi. This line has been recently erected by the Indo-European Department of the India Office, and was put into operation in November, 1907, bringing the total length of line—London to Karachi—up to 5532 miles. Wheatstone automatic transmission is used throughout the line, and many improvements in telegraphic instruments which have been introduced in recent years have been installed. One of the latest key-board perforators is the Kotyra, which is so arranged that the key-board is made to actuate three electromagnets so constructed that the necessary number of blows are communicated to the keys of a Wheatstone perforator. At each relay station a receiving apparatus is placed in circuit enabling the operator in charge to see how the signals are leaving that station, and any fault in regulation can be at once rectified.

The great advantage of being able to transmit direct messages over such distances is that, apart from the time saved and the consequent increase in the capacity of the line, greater accuracy is ensured owing to the fact that no intermediate handling takes place. Thus liability to error is reduced to a minimum. The importance of this will be understood when it is realised that 1600 messages per diem—97 per cent. of which are in code—are sent on the average over this line. The Indo-European Telegraph Company and the Telegraphic Department of the India Office have, with the cooperation of the Indian Government, achieved a great success, considering the enormous difficulties attendant upon a land line traversing every variety of country and exposed to all sorts of climatic conditions. J. L. M.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. H. F. Newall, F.R.S., has been elected a fellow of Trinity College. Mr. Newall has been engaged for many years in astrophysical research at the observatory, in connection with a large Equatorial presented to the University by his father. He was formerly an assistant to the Cavendish professor of physics, and demonstrator in the Cavendish Laboratory. He is at present assistant director of the Observatory, treasurer of the Cambridge Philosophical Society, and president of the Royal Astronomical Society. Mr. Newall, by his continuous generosity, has firmly established the study of astrophysics in the University, and to him the University owes a considerable debt of gratitude.

LONDON.—A course of eight lectures on national eugenics, in connection with the Galton Laboratory, will be given at University College on Tuesdays at 5 o'clock, beginning on February 23. The first lecture will be given by Prof. Karl Pearson, on "The Purport of the Science of Eugenics." On the four following Tuesdays the lectures will be given by Mr. D. Heron, and will deal with the following subjects:—methods of eugenic inquiry; transmission of physical characters in man; transmission of psychical characters in man; inheritance of disease and deformity. The course will be continued in the third term, beginning on May 4, when Miss E. Elderton will lecture on "Effects of Kinship in Marriage" and "Comparison of Heredity and Environmental Factors." Full par-

ticulars of the lectures can be obtained from the secretary of University College.

THE annual prize distribution and conversazione of the Northampton Polytechnic Institute, Clerkenwell, E.C., will be held on Friday and Saturday, February 5 and 6. The Earl of Halsbury, P.C., will distribute the prizes on February 5, and after the prize distribution the new buildings, which have been recently erected in the courtyard with funds provided by the London County Council, will be formally declared open. After the above ceremonies the whole of the laboratories, workshops, drawing offices, and studios of the institute will be on view in working order.

THE second international course for legal psychology and psychiatry will be held at Giessen (Grandduchy of Hesse), Germany, on April 13—18. The course will be under the direction of Prof. Sommer, with the cooperation of Profs. Mittermaier and Dannemann, of Giessen, and Prof. Aschaffenburg, of Cologne. All communications should be addressed to Dr. Sommer, professor of psychiatry, University of Giessen.

AN article by Prof. Fleming in *Engineering* for January 8 directs attention to the need for a revision of the syllabus for the B.Sc. degree in engineering at London University. It is contended that the syllabus now in force enables a candidate to obtain the degree without having undergone a systematic training in civil, mechanical, or electrical engineering, owing to the freedom of choice allowed, especially in the second or "B" group of subjects. The experience of several years has shown that a large number of candidates exercise their freedom of choice by taking the path of least resistance, and they do not, as a rule, select subjects which form complete and well-arranged courses of study. Subjects of minor importance have, to the majority of candidates, a wide popularity for examination purposes, and Prof. Fleming suggests that if university degrees are to possess, or to continue to possess, any importance in the engineering world, the courses of study must be framed solely with a view to equip students for their work in after life, and not for the immediate purpose of passing an examination.

WE have received a copy of the second series of papers published by the Department of Education of the Armstrong College, Newcastle-upon-Tyne. The special feature of the pamphlet is a very full account of an experiment of a novel character in training-college practice. As Prof. Mark R. Wright, the head of the department, points out, in ordinary school work there is a tendency for the relations between teachers and taught to become formal and artificial, and the motive of the experiment described in these pages was to determine how far a training-college camp could be made to obviate such tendency and to import humanising influences and greater cordiality into the work of education. Outdoor life and the study of nature under skilled guidance were among the distinguishing characteristics of the fortnight's life under canvas, and the results of the experiment appear to have been gratifying. The experiment is, we understand, to be repeated annually, and we hope it may be imitated by other training-college authorities. There can be no doubt that intelligent, well-planned experiments, followed by an impartial and correct account of the results obtained, will contribute more than any other expedient to the development and formulation of a science of education. These "papers" may be commended to the attention of students of educational problems.

THE report on the operations of the University of the Punjab for the year ending September 30, 1908, emphasises the contention, says the *Pioneer Mail*, that in Indian universities the arts side, which comprises exclusively literary courses, is patronised to the neglect of the scientific side of education. In the Punjab University there is no faculty either of engineering or of commerce. There is a faculty of science, but its examinations, compared with those of the faculty of arts, do not attract many candidates. Referring to the examinations of the two faculties held in 1908, it is pointed out by our contemporary that in the matriculation examination, whilst in the arts faculty there were 3408 candidates, of whom 1470 were successful, in the science faculty there were only 72, of whom 36 were successful. In the intermediate examination, whilst 697, of whom 308 were successful, appeared on the arts side, the number of those who appeared on the science side did not exceed 39, and of these 18 were successful. Whilst 315 appeared for the degree of Bachelor of Arts and 116 were successful, a much smaller number, of whom 5 were successful, competed for the degree of Bachelor of Science. As regards the master's degree in the two faculties, whilst 42 competed on the arts side, there were only 4 on the science side. The results on the science side were, however, better than those on the arts side.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, Received November 3, 1908.—"Reciprocal Innervation of Antagonistic Muscles. Thirteenth Note. The Antagonism between Reflex Inhibition and Reflex Excitation." By Prof. C. S. **Sherrington**, F.R.S.

In this paper the question is raised as to how reflex excitation and reflex inhibition are related one to another in their action on a reflex centre common to both of them. In the case of such antagonisms as the action of the vagus and accelerans on the heart and that of the vasodilatator and vasoconstrictor nerves on a vascular area, and that of depressor and excitatory asphyxial influences on the vasomotor centre, several observers have shown that the antagonism is a pseudo-antagonism rather than a real antagonism—that is, the one action interferes with the other by delaying it, but does not directly annul it or really abolish or counterbalance it.

The present paper brings experimental evidence that in reflex inhibition and reflex excitation playing upon a common centre we have two influences which are really in the strict sense antagonistic in that they behave one to another as two forces which act in opposite direction at the same point of application. The result is an algebraic summation of the effects obtainable from the two nerves—the excitatory afferent and the inhibitory afferent—singly. The individual effects of the two nerves fuse to a resultant. The two opposed nerves must have in the reflex centre a common locus of operation. There the antagonistic influences collide. This point of collision may lie at a synapse, in which case the opposed influences may be thought of as altering oppositely the permeability of the synaptic membrane. Or it may lie in the substance of a neurone, if so, probably in the motoneurone itself, and in that part of it which lies within the reflex centre. In either case the net change which results when the inhibitory and excitatory afferents are concurrently stimulated is an algebraic sum of the *plus* and *minus* effects producible by the two antagonistic nerves singly. Tracings illustrate the experimental results.

November 19, 1908.—"Measurement of Rotatory Dispersive Power in the Visible and Ultra-violet Regions of the Spectrum." By Dr. T. Martin **Lowry**.

In order to measure rotatory dispersive power in the visible region of the spectrum, the light from an arc formed between a pair of rotating metallic electrodes is concentrated by a lens on the widely opened slit of a constant-deviation spectroscope. An achromatic lens of 22-inch focus (displacing the telescope of the instrument) casts a magnified image of the slit on the polarising prisms of a triple-field polarimeter. The colour of the image can be varied by rotating the prism of the spectroscope; its maximum width for monochromatic illumination is determined by the openness of the spectrum and the efficiency of the dispersive system. Of the twenty-six wave-lengths employed, those shown in heavy type can be read with the full width of the aperture, the remainder as bands occupying one-third of its width; the yellow mercury doublet can be read as a single band or as two narrow separate lines:—

Li ... **6708**	Na ... **5893**	Tl ... **5351**	(flame spectra)	
Hg ... *5790*	... *5769*	... **5461**	... **4359**	... (enclosed arc)
Cd ... **6438**	... **5086**	... **4800**	... **4678**	
Cu ... 5782	... 5700	... 5219	... 5154	... 5105
4705	... 4651	... 4587	... 4378	
Zn ... **6364**	.. 4811	... 4722	... 4680	
Ag ... **5469**	... **5209**			

A photographic method is also described which can be used throughout the visible and ultra-violet regions of the spectrum.

December 10, 1908.—"Results of Magnetic Observations at Stations on the Coasts of the British Isles, 1907." By Commander L. **Chetwynd**, R.N. Communicated by Rear-Admiral A. M. Field, R.N., F.R.S.

With a view to compare the values of secular change of declination, horizontal force, and inclination, at various stations on the coasts of the British Isles, with the values derived from the continuous records at Kew Observatory, observations have been made at certain stations selected from those occupied by Rücker and Thorpe during their magnetic survey for the epoch January 1, 1891.

The observers detailed to make the observations were Captain M. H. Smyth, R.N., H.M.S. *Research*; Captain W. Pudsey-Dawson, R.N., H.M.S. *Triton*; and Captain J. W. Combe, R.N., H.M. surveying vessel *Gladiator*. The stations selected were fairly distributed around the coasts, so that a mean of the results would represent the mean for the whole area embraced.

The observations have been reduced to the epoch January 1, 1907, by means of comparisons with the records at Kew Observatory. The resulting values of mean annual changes for the British Isles are as follows:—

	a 21-year period, 1886–1907	*b* 16-year period 1891–1907
(1) Declination...	− 5′·7	− 5′·1
(2) Horizontal force...	+19 γ	+18 γ
(3) Inclination	− 1′·6	− 1′·4
(4) Vertical force (excepting the results at Dublin and Tanera Mor)	—	−14 γ

The mean annual changes of declination at Kew comparable with (1) *a* and *b* are respectively 5′·2 and 4′·9. Thus the mean for the British Isles during the 16-year period is 0′·2 greater than at Kew.

The mean horizontal force change appears to have been 3 γ less than at Kew. The mean inclination change during the 21-year period was 0′·1 less, and during the 16-year period 0′·6 less, than at Kew.

The mean vertical force change during the 16-year period has been 8 γ less than at Kew.

Diagrams showing the mean annual changes at Kew from 1889 to 1904 indicate that the declination change, which since 1894 has been decreasing in amount, is now increasing, and that the probable value at Kew for January 1, 1907, is 4′·8. For the whole of the British Isles, therefore, the mean value is assumed to be 5′.

The annual increase of horizontal force continues to diminish, and is at the present time very small; there has been a very marked diminution during the last two years, and the annual increase may shortly become a decrease.

The annual change of inclination continues to decrease in amount, and is now 1′ (nearly).

A comparison of the value of the mean annual change of declination at Kew, Greenwich, and Stonyhurst shows that during the period embracing Rücker and Thorpe's survey (1886–94) the change at Stonyhurst was considerably greater than at Kew and Greenwich, this being in accord with the results found by Rücker and Thorpe (that the secular change was greater in the north-west than at Kew).

Since the year 1894, however, the values have been in closer agreement, that at Stonyhurst being slightly less than at Kew. Thus it is indicated that the variations of secular change are not, over the area referred to, synchronous.

Comparisons of results of declination observations made at sea with those made on shore show considerable differences, and although the sea observations cannot be considered to the same degree of accuracy as the shore observations, the differences are in most cases outside the margin which might be assigned to this cause.

The results indicate that the values at sea are, off the east coast generally greater, and on the west coast generally less, than the corresponding values adduced from observations made on shore. It is intended to investigate this subject further.

Royal Meteorological Society, January 20.—Annual meeting.—Dr. H. R. Mill, president, in the chair.—Presidential address, Some aims and efforts of the society in its relation to the public and to meteorological science: Dr. **Mill.** In dealing with the subject-matter of meteorology, as of other sciences, there are two extreme points of view which appeal to opposite types of mind; these are the simply observational and the purely analytical, and it is one of the great advantages of a scientific society to bring representatives of the two types together, and to encourage mutual toleration and understanding. After referring to the activity of the society in the establishment of well-equipped and carefully inspected stations for accurate observations of meteorological phenomena, and to the work carried out by various special committees, the president proceeded to direct attention to two lines of usefulness open to the society at the present time. One is the correction of the impulsive sensationalism and anti-scientific spirit in meteorological matters of a certain section of the Press in this country, which no doubt faithfully reflects the somewhat muddled ideas of the careless public; of these he gave some striking instances. The other is the advance which has been made in meteorological science during the last few years, and the new opportunities it brings. He alluded to the popular errors which are current concerning published weather records, and the prejudicial effect of these on the meteorological departments maintained by many municipalities. He had heard of instances of reports being suppressed in order to "obviate misconceptions," and of instruments being moved in order to obtain more agreeable records. He deprecated the keenness of rivalry between health resorts claiming low rainfall, high sunshine, and small range of temperature, and pointed out that modern bacteriology had shown that dust, not rain, was the chief menace to public health. He went on to say that we now stand at an important point in the history of meteorology, which bids fair to expand in interest and importance in the twentieth century as chemistry did in the nineteenth, and from the same cause, the increasing necessity of applying its principles to practical ends. The point of view of the meteorologist to-day is different from that of fifty or even of twenty years ago. Then the only department in which much general interest could be expected was climatology—the study of the average conditions of the atmosphere at different places. Much remains to be done in that direction; but the main interest is being diverted from the study of the air 4 feet above the ground, on the study of which climatology has been based, to the vast expanse of the upper atmosphere miles above the abode of man. He believed that in a few years the practical needs of aviation will demand a far more exact knowledge than is now required of atmospheric circulation, of the relation of wind to gradient, of the disturbing influence of insolation on pressure, and especially of the nature and movements of cyclones and squalls, and these things becoming of practical importance, it will become worth while commercially to find the means for studying them. The position of meteorology now is not unlike that of oceanography before the necessity of laying cables led to the exact study of ocean depths, and it is to be expected that the flying machine will do for the study of the air what the cables did for the study of the sea.

Entomological Society, January 20.—Mr. C. O. Waterhouse, president, in the chair.—Presidential address, The claws of insects: C. O. **Waterhouse.** After briefly describing the various forms of insects' claws, which are classified as toothed, appendiculate, bifid, or pectinate, and having given examples of each, the president suggested as a subject for investigation, which he hoped entomologists would take up as a study, "Are these forms of claw merely the result of heredity without any special object, or is there evidence to show that the different forms are adapted to particular modes of life, in fact, have been developed to meet special needs?" He then proceeded to show by numerous examples that closely allied species often had dissimilar claws, that insects with quite different habits had the same form of claw, and that others with different forms of claw seemed to have the same habits. The question, therefore, appeared to be still an open one requiring careful investigation.

DUBLIN.

Royal Dublin Society, December 22, 1908.—Prof. A. F. Dixon in the chair.—The production of ammonia from atmospheric nitrogen by means of peat: Dr. H. C. **Woltereck.** The author showed that by the various processes known only about one-third of the nitrogen contained in the peat can be recovered. The evolution of the synthesis from the use of hydrogen and nitrogen with reduced iron, down to coke and peat, with air and steam was described, and the analogy of this process with that using iron was definitely proved by the use of sugar carbon, free from nitrogen, thus demonstrating the indisputable cooperation of atmospheric nitrogen.—The pollination of certain species of Dendrobium: Dr. A. F. G. **Kerr.** An arrangement often found in the flowers of the section Eu-dendrobium is described, whereby the elasticity of the filament causes the anther to be jerked down and to block the passage past the stigma to the nectary as the visiting insect withdraws from the flower. By this mechanism only the first visitor can pollinate the stigma. The pollinia are only discharged as the visitor leaves, consequently it is evident that cross-pollination only can occur. The mechanism is quite different from that described by Darwin in *D. chrysanthum*, which, he believed, aided self-pollination. Experiments on many specimens of sixteen species of Eu-dendrobium in their native habitats showed that self-pollination was effective in only 8 per cent., and cross-pollination in 100 per cent. Modifications of the mechanism described allowing self-pollination are found in the species which contribute this 8 per cent. The paper also contains descriptions of arrangements obtaining in other Dendrobia which favour or oppose self-pollination, as well as records of experiments on these species of self- and cross-pollination. All the observations were carried out in the natural localities.—The absorption of water by seeds: W. R. G. **Atkins.** An examination of the behaviour of seeds of *Phaseolus vulgaris* and *Lathyrus odoratus*, both living and dead, in water and salt solutions, shows that no semi-permeable membrane exists in them until after germination, when the protoplasm of the cells acts as such. The evolution of CO_2 may be detected within two hours after moistening air-dried seeds, whether they are living or killed by chloroform.

PARIS.

Academy of Sciences, January 18.—M. Bouchard in the chair.—Some applications of the method of M. Fredholm: H. **Poincaré.**—A general method of preparation of the trialkylacetic acids: A. **Haller** and Ed. **Bauer.** Ketones of the type $C_6H_5.CO.C.R_1R_2R_3$ were dissolved in benzene and heated with sodium amide, and split up quantitatively into benzene and the amide of the trialkylacetic acid,

$$(R_1R_2R_3)C.CO.NH_2;$$

the latter, treated with nitrosyl sulphate, gives the corresponding acid, $C(R_1R_2R_3).CO.OH$. The method is general, and has been applied to the preparation of pivalic, dimethylethylacetic, dimethylpropylacetic, methyldiethylacetic, triethylacetic, and methylethylpropyl acetic acids, as well as the corresponding amides. The distinguishing physical properties of these compounds are given.—A hæmogregarian of *Tupinambis teguixin*: A. **Laveran** and M. **Salimbeni.** This organism appears to constitute a new species, for which the name *H. tupinambis* is proposed. The paper is accompanied by six diagrams showing various stages of development.—An epithelium with striated muscular fibres: F. **Henneguy.** A demonstration of the existence of striated muscular fibrillæ in the walls of the epithelial cells of the digestive tubes of *Alcyonidium hirsutum* and *Bugula alveolata*.—An apparatus for recording the absolute acceleration of seismic movements: G. **Lippmann.**—The evolution of the Tertiary mammals: the importance of migrations. The Pliocene epoch: Charles **Depéret.**—M. W. Kilian was elected a correspondant in the section of mineralogy in the place of the late M. Peron.—Discussion of the micrometric measurements made at the Observatory of Lyons during the eclipse of June 28, 1908: F. **Merlin.**—A zenithal photographic telescope: A. de la Baume **Pluvinel.** The instrument is designed to determine the astronomical coordinates of the place where it is set up. The latitude is deduced from the zenithal distance of a star measured on a negative, the longitude from a knowledge of the time at which the star occupies, on the negative, a certain position corresponding to the passage through the meridian.—A problem concerning geodesic lines: Jules **Drach.**—A generalisation of a theorem of Jacobi: W. **Stekloff.**—The theory of continuous functions: Maurice **Fréchet.**—Differential equations the general integral of which is uniform: J. **Chazy.**—Some optical and magneto-optical phenomena in crystals at low temperatures: Jean **Becquerel.** A discussion of the causes of the differences between the conclusions of the author and those of MM. H. du Bois and Elias.—A characteristic property of a hexagonal network of small magnets: L. **de la Rive** and Ch. Eug. **Guye.**—An optical arrangement for varying the lighting of a surface according to a law determined in advance: Th. **Guilloz.**—The rapid preparation of calcium phosphide for making hydrogen phosphide: C. **Matignon** and R. **Trannoy.** Dried calcium phosphate is heated with aluminium powder, and the mixture started off at a dull red heat. The product is a mixture of calcium phosphide and alumina, which on treatment with water gives a nearly pure non-inflammable phosphoretted hydrogen. The only impurity of the gas obtained in this way is hydrogen, which may be present up to 3 per cent.—The action of sulphur chloride, S_2Cl_2, on the metallic oxides: F. **Bourion.** It has been found that in certain cases in which the method of treating the oxide with chlorine and sulphur chloride fails, the latter alone gives a good yield of the anhydrous chloride. Amongst other chlorides prepared in this way, that of samarium is noteworthy, as of all the oxides of the cerium group this is the most difficult to transform into chloride.—Colour reactions of dioxyacetone: G. **Denigès.**—The nature of the bromacetamide of Hofmann: Maurice **François.** This bromine derivative can be prepared by the evaporation of a mixture of hypobromous acid and acetamide. On this account the author considers its composition to be $CH_3.CO.NH_2.Br.OH$.—Researches on the products of saponification of dioxalsuccinic ester. Isopyromucic acid: E. E. **Blaise** and H. **Gault.**—The preparation of aldehydes and anhydrides of acids: A. **Béhal.** Benzylidene chloride, heated with acetic acid, reacts according to the equation

$$C_6H_5.CHCl_2 + 2CH_3.CO_2H = 2HCl + C_6H_5CH{:}O + (CH_3CO)_2O.$$

The presence of certain salts, such as chloride of cobalt, assists the reaction.—The artificial oxydases and peroxydases: M. **Martinand.**—The successive induction of coloured images after a very strong stimulation of the retina, and the classic theories of vision: Romuald **Minkiewicz.**—X-rays of high penetration obtained by filtration. Their advantage in radio-therapy for the treatment of deep-seated tumours: H. **Guilleminot.** The filtration of the rays through 5 mm. of aluminium is recommended; the issuing rays will be approximately "monochromatic." Although the absolute quantity transmitted will be much reduced, necessitating a longer exposure, the percentage absorption in the soft tissues will be small, and deep-seated tumours can be more effectively reached by the rays.—The identification of revolver bullets: V. **Balthazard.** The problem was to prove whether certain bullets found on the floor had traversed the arm of the wounded person. It is shown that after traversing a cloth material, characteristic markings are produced on the leaden bullet, and these are not obliterated by the subsequent passage through flesh, provided a bone is not encountered. It is even possible to identify the nature of the garment through which the bullet has passed by a careful examination of the markings on the bullet.—Sexual reproduction in the Actinocephalids: P. **Léger** and O. **Duboscq.**—Some Sertulariidæ in the British Museum collection: Armand **Billard.**—Biological researches on the conditions of viviparity and larval life of *Glossina palpalis*: E. **Roubaud.**—New observations on the habits of the asparagus fly (*Platyparea poeciloptera*) in the neighbourhood of Paris. The insufficiency of the method of destruction now in use: P. **Lesne.**—A possible interpretation of the waves of the principal phase of seismograms: M. de Montessus **de Ballore.**—The earthquake of December 28, 1908, recorded at the Fabra Observatory, Barcelona: J. Comas **Sola.**

NEW SOUTH WALES.

Linnean Society, November 25, 1908.—Mr. Henry Deane, vice-president, in the chair.—The *rôle* of nitrogen and its compounds in plant-metabolism, part i., historical: Dr. J. M. **Petrie.** A summary of the recent advances made in the study of proteins and their antecedents in the plant. An account is given of the nitrogen compounds which occur in seeds, and the modern views of their function in germination.—The *rôle* of nitrogen and its compounds in plant-metabolism, part ii.: Dr. J. M. **Petrie.** Deals with the non-protein nitrogen compounds of seeds, and gives the results obtained from the analyses of the seeds of thirty different plants. Previous investigators have seldom found less than 90 per cent. of the total nitrogen existing as protein, whereas the author finds as much as 45 per cent. of non-protein nitrogen compounds in ripe Acacia seeds. Exact descriptions of the methods employed are also given.—Contribution to a knowledge of Australian Hirudinea, part ii.: E. J. **Goddard.** A new genus is proposed for a leech from a fresh-water pool at Oberon, New South Wales.—Contribution to a knowledge of Australian Oligochæta, part ii.: E. J. **Goddard.** Another phreodrilid worm, from pools on the Mt. Wellington plateau, Tasmania, is described. It is of interest because its Tasmanian habitat completes the circuit of distribution of the family—from South America to New South Wales.—Illustrations of polycotyledony in the genus Persoonia (N.O. Proteaceæ): J. J. **Fletcher.** In 1882, as the result of his examination of the fruits of twenty-three out of a total of sixty-one described species of Persoonia, the late Baron von Mueller was able to announce that the embryos of nineteen of them were polycotyledonous. The object of the present paper is to supplement the Baron's observations in so far as these relate to the species of Persoonia to be found in the neighbourhood of Sydney and on the Blue Mountains, from a study of seedlings, and whenever it was possible of a considerable number of them. The cotyledons of about 700 seedlings, representing ten species, four of which are not in the Baron's list, and, in addition, the embryos of two species of which seedlings were not procurable, one of which is not in the Baron's list, were examined. The only seedlings or embryos with two cotyledons met with were those of *P. ferruginea*, Sm. Not only is the number of cotyledons in all the other species examined inconstant, but about 10 per cent. of the total number of seedlings were found to possess one, occasionally two, or rarely three notched, bifid, or bipartite cotyledonary members; some of these possibly may have been cases of connate cotyledons.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 28.

ROYAL SOCIETY, at 4.30.—The Action of the Venom of *Sepedon haemachates* of South Africa: Sir Thomas R. Fraser, F.R.S., and Dr. J. A. Gunn.—The Colours and Pigments of Flowers with Special Reference to Genetics: Miss M. Wheldale.—The Variations in the Pressure and Composition of the Blood in Cholera; and their Bearing on the Success of Hypertonic Saline Transfusion in its Treatment: Prof. Leonard Rogers, I.M.S.—The British Freshwater Phytoplankton, with Special Reference to the Desmid-plankton and the Distribution of British Desmids: W. West and G. S. West.—The Selective Permeability of the Coverings of the Seeds of *Hordeum vulgare*: Prof. Adrian J. Brown.—The Origin of Osmotic Effects. II. Differential Septa: Prof. H. E. Armstrong, F.R.S.

ROYAL INSTITUTION, at 3.—Mysteries of Metals: Prof. J. O. Arnold.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Parallel Operation of Alternators: Dr. E. Rosenberg.

ROYAL SOCIETY OF ARTS, at 4.30.—Some Phases of Hinduism: Krishna Gobinda Gupta.

FRIDAY, JANUARY 29.

ROYAL INSTITUTION, at 9.—Improvements in Production and Application of Gun-cotton and Nitro-glycerine: Sir Frederick L. Nathan.

SATURDAY, JANUARY 30.

ROYAL INSTITUTION, at 3.—Sight and Seeing: Sir Hubert von Herkomer.

ESSEX FIELD CLUB, at 6 (at Essex Museum of Natural History, Romford Road, Stratford).—Subsidence of Eastern England and Adjacent Areas: W. H. Dalton.—Some Notes on "Moorlog," a Peaty Deposit dredged up in the North Sea: H. Whitehead and H. H. Goddchild.

MONDAY, FEBRUARY 1.

ROYAL SOCIETY OF ARTS, at 8.—Electric Power Supply: G. L. Addenbrooke.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Manufacture of Nitrocellulose: Sir Frederick Nathan.

TUESDAY, FEBRUARY 2.

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

ZOOLOGICAL SOCIETY, at 8.30.—Notes on the Fauna of Christmas Island: Dr. C. W. Andrews, F.R.S.—Report on the Pathological Observations at the Society's Gardens during 1908: Dr. H. G. Plimmer.—Preliminary Account of the Life-history of the Leaf-insect, *Phyllium crurifolium*, Serv.: H. S. Leigh.—The Mammals of Matabeleland: E. C. Chubb.

ROYAL SOCIETY OF ARTS, at 4.30.—The Production of Wheat in the British Empire: Albert E. Humphries.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On Heat-flow and Temperature-distribution in the Gas-engine: Prof. B. Hopkinson.

WEDNESDAY, FEBRUARY 3.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The use of Quartz Combustion Tubes especially for the Direct Determination of Carbon in Steel: B. Blount and A. G. Levy.—The Composition and Analysis of Chocolate: P. A. Ellis Richards, C. H. Cribb, and N. P. Booth.—Note on some Commercial Samples of Monobrombenzene: J. H. Coste.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, FEBRUARY 4.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Electricity of Rain and its Origin in Thunderstorms: Dr. George C. Simpson.—The Effect of Pressure upon Arc Spectra, No. 3, Silver. λ 4000-λ 4600: W. G. Duffield.—The Tension of Metallic Films deposited by Electrolysis: G. Gerald Stoney.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—The Stability of Arches: Prof. Henry Adams.

LINNEAN SOCIETY, at 8.—On *Fucus spiralis*, Linn.: Dr. F. Börgesen.—Economy of *Ichneumon manifestator*, Linn.: C. Morley.—On the Polyzoa of Madeira: Rev. Canon Norman, F.R.S.

RÖNTGEN SOCIETY, at 8.15.—The Transport of Ions: Dr. Howard Pirie.

FRIDAY, FEBRUARY 5.

ROYAL INSTITUTION, at 9.—The Influence of Superstition on the Growth of Institutions: Prof. J. G. Frazer.

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

CONTENTS.