THURSDAY, JANUARY 11, 1900.

ASTRONOMICAL AND OPTICAL INSTRUMENTS.

Handbuch der Astronomischen Instrumentenkunde. Von Dr. L. Ambronn. Zwei Bände. Mit 1185 in den Text gedruckten Figuren. Pp. vi + 1276. (Berlin: Julius Springer, 1899.)

Die Optischen Instrumente der Firma R. Fuess deren Beschreibung, Justierung, und Anwendung. Von C. Leiss. Mit 233 Holzschnitten im Text und 3 Lichtdrucktafeln. Pp. xiv + 397. (Leipzig: Wilhelm Engelmann, 1899.)

WHOEVER undertakes to write a manual on astronomical instruments, or indeed on the instruments that the study of any branch of physics demands, engages in a task of no common difficulty. It is impossible to turn over the two handsome and ponderous volumes that Dr. Ambronn has compiled, without being struck with the wealth and variety of material that is submitted to our notice. The successive effects of ingenuity as detailed in these volumes are so bewildering in their extent, that it is quite impossible within the limits of a few paragraphs to do justice to the labour and research to which these volumes are an eloquent witness. We can only hope to sketch the scheme, to suggest the lines on which, in the opinion of the author, a text-book on astronomical instruments should proceed. The lucidity of explanation and the wealth of illustration only make the task the more difficult, by demonstrating the number of points that are worthy of comment and attention.

The history of construction, the gradual evolution of the telescope or equatorial, interesting and inviting as such a subject must be, is not allowed to any extent to interfere with the author's project of presenting before astronomers, and before mechanicians, the devices which have been sanctioned by experience and approved after repeated tests. Historical remarks there must be, the comparison of the work and methods of one maker with another, the growth of convenience and power of instruments necessitates descriptions which illustrate historical progress; but such remarks are incidental, and do not concern the main purpose of the work. The present standpoint of mechanical art and the achievements of workshops of known reputation, of themselves cover an enormous ground, which will be studied with profit alike by those who seek to modify existing instruments in a direction which will make them available for special investigations, and by those to whom are necessarily entrusted the duties of manufacture and the details of arrangement.

The work really consists of seven separate treatises, each fairly complete in itself, and the whole forming an encyclopædia, an invaluable work of reference on astronomical instruments. These seven sections are entitled: (1) Accessory apparatus; (2) clocks; (3) separate parts of instruments; (4) micrometers; (5) instruments devoted to special purposes; (6) complete instruments; (7) observatory buildings. The division is somewhat artificial, and cannot be rigorously maintained. For instance, a heliometer might be described as a complete instrument rather than as a special form of micrometer, and there seems no reason why chronographs should not be treated under clocks. Of course, no confusion can possibly arise from such a method of division, because each instrument serves a definite purpose, and its mode of use is perfectly defined. Simplicity of construction is perhaps the best guide to arrangement, and it may be that which the author has followed. Certainly he is well advised in selecting the screw as the first subject for detailed description, and the effective treatment applied to this simple piece of apparatus, whether as a tool in the hands of a mechanic or in the more delicate application to measurement as a micrometer, assures us that we are in presence of a master. We have many useful and ingenious hints both in construction and use, and it is of special importance to notice, as lifting the book out of the category of merely descriptive works, that the author has added an example of the method of determining the errors of a screw as the problem comes before the practical astronomer. But this, and other perfectly legitimate applications of theory to be met elsewhere in the book, suggest a difficulty which, we feel sure, the author has experienced, and introduce a feature which may be considered not altogether satisfactory. How far should a manual of this character concern itself with the theory of instruments? It was evidently the intention of the author not to supply a descriptive work simply, not a manufacturer's catalogue illustrated by many engravings, but to add also a theoretical treatise which might be useful to the astronomical student. But to enter into the theory with that rigorous detail which characterises many text-books, would evidently carry the author too far, and might add another volume to a work whose length is already sufficiently forbidding. There is, therefore, a constant struggle between the theoretical and descriptive parts, in which the former is usually worsted, and the maintenance of the same high standard of excellence common to both is rendered impossible. For instance, the theory of the sextant is in its way more complete than that of the heliometer, simply because the same actual space is approximately allotted to each. One cannot help feeling that the author has not done himself justice in the matter of theoretical discussion, and we hope that he may be tempted to return to the subject and complete his work by giving a theory as precise and thorough as the descriptive portion is clear and satisfactory.

From the screw it would have seemed natural to have gone at once to the reading microscope and the micrometer; but the author has preferred to interpolate the description of levels, collimators, and other mechanical devices, which are not so much astronomical instruments as aids to adjustment and means for inquiry into the stability of the instrument properly so-called. In the second section, Dr. Ambronn breaks away from his account of space measurement in order to describe clocks and time-recording instruments. The treatment here is mainly conducted from a German point of view, and more attention might have been bestowed on improvements that have been suggested by English authorities. But, of course, one admits readily enough that he has to do with a German book, written in German for German students and workpeople, and some allowance must be made for patriotism. What would seem a fault in one longitude may be regarded as a merit in another. In fact, a comparison between rival methods of construction and the effort to apprehend the manner in which merits, fully recognised here, are appreciated abroad, constitute one of the main features of interest in this book. For instance, we should gather that the gravity escapement is not so highly considered in Germany as among ourselves.

The separate parts of the instrument which come under detailed description in the next section are axes, the telescope properly so-called with its optical arrangement, and circles. Each of these sections will be found to contain excellent matter, and though one might point out small omissions, to which accident has possibly directed special attention, it would be ungracious to do so without admitting that the author has also collected numerous facts that one has either forgotten or imperfectly apprehended. Under the heading of circles will be found some very interesting remarks on the subject of dividing engines. Whether the introduction here is legitimate we will not stop to inquire, for it might be urged that a dividing engine is no more an astronomical instrument than a lathe or a screwdriver; but the information is so pertinent, and, as we imagine, rather inaccessible, that we cannot but welcome this slight excursion from the observatory to the workshop.

The second volume opens with an account of the micrometer in all its various forms, with wires and without. Under this second head the author places the heliometer, and does not appear prepared to regard this peculiar device as a complete instrument. But his practical acquaintance with its use not only entitles him to speak authoritatively, but supplies him with instances and examples of the method of determining the corrections. We doubt, however, if the popularity of this form of measurement will increase in this country. The fifth section is the only one to which we are inclined to take any exception. In it we have to do with the modern developments of photography, as applied to astronomy, whether in the determination of stellar positions or the interpretation of spectroscopic results. Photometers, spectroscopes, heliostats, and a variety of other apparatus are dovetailed together into this section, with the result that we miss the minute and varied detail that lends a charm to so much of the work. Neither can we altogether accept the author's excuse that a thorough description would lead him too far from his purpose, or that able authorities like Müller and Scheiner have recently discussed in detail the matter treated in this section. To have compiled an account of the instruments used for the determination of position would have been a perfectly intelligible undertaking, and it is in fact what Dr. Ambronn has accomplished with great skill and elaboration. We think he would have been well advised, considering the completeness on which he had planned his work, to have limited his task to such instruments, and refused to consider those that are more particularly adjuncts to the physical laboratory. But it must be clearly understood, that it is only in comparison with the remainder of the book that we notice any falling off from the high level which is elsewhere uniformly maintained. Some 150-quarto pages with 134 illustrations is in itself a treatise of considerable size and merit, and one which we may accept with gratitude.

Under the heading of "complete instruments" we have descriptions of every kind of Transit Circle and Equatorial that ingenuity has suggested and engineering skill has constructed. Indeed, in some instances, such as the particular form of Transit Circle suggested by Dr. Common, the fertility of resource on the part of the inventor has outrun the makers' capacity to realise. Sextants and Altazimuths; the Almucantar and the Chronodeik are not only illustrated by a profusion of diagrams, but examples of results are added. It is impossible to do justice either to the wealth of information or the judicious arrangement which characterise this section on meridional and extra-meridional telescopes. For the numerous forms of equatorial receive the same share of careful attention and historical illustration as do the transit instruments. From Sissons early experiment down to the latest addition to the Cambridge observatory, one might say that no typical construction has been omitted. The more one studies the pages of this excellent encyclopædia of astronomical instruments, the more convinced will he be that it should find a place on the shelves of every observatory, and in the library of every instrument maker.

The second work placed at the head of this article must of necessity partake of something of the nature of a manufacturer's catalogue, but it is so much in advance of the usual compilations of that character, that a very feeble notion of its aim and contents is gained by such a comparison. The production betokens not only a very considerable amount of enterprise on the part of those who are responsible for its preparation, but it intimates the extent of the demand for high-class instruments in Germany, and shows the manner in which that demand is met and encouraged. In reading the book, or portions of it, we experience the same feeling as in being conducted through a scientific exhibition by the ablest of guides. A constant succession of pleasurable surprises meets one at every turn, in noting how difficulties are smoothed away by ingenious appliances. Dr. Leiss, who is well known from his contributions to the *Zeitschrift für Instrumentenkunde*, plays the part of the guide with a skill which suggests that many of the instruments, with whose adjustments he is so familiar, owe their final form to his ingenious skill. There is no necessity to enumerate the various classes of instruments that here find adequate illustration. All that is needed for the physical laboratory on the side of its optical equipment, whether for education or research, finds its place here. Spectrometers and spectroscopes, goniometers and polarising apparatus in wonderful variety, microscopes with endless accessories, are pictured and described. And not only is the student considered, but the lecturer also, for an excellent chapter on projection apparatus is added. The one fact that stands out clearly from this wonderful display is the progress that has been made in recent years, both in the variety of apparatus and the excellence of workmanship.

WIRELESS TELEGRAPHY.

A History of Wireless Telegraphy, 1838–1899. By J. J. Fahie, M.I.E.E., &c. Pp. xvii + 325. (Edinburgh and London: William Blackwood and Sons, 1899.)

La Télégraphie sans Fils. Par André Broca. Pp. vii + 202. (Paris: Gauthier-Villars et Fils, 1899.)

WIRELESS telegraphy is a subject of absorbing popular interest at the present time. Its sensational possibilities are being gradually demonstrated; and just now a special popular interest arises from its obvious applicability to the amelioration of the state of isolation of our beleaguered garrisons in South Africa. Telegraphy without tangible means of communication has, however, proved an attractive field of inquiry almost since Volta's discovery of the electric current a century ago. And when in later years the submarine cable became a success, the high earning power, and the high cost also, served both to attract and to stimulate many inventors and scientific enthusiasts in their search for a system of telegraphy which would dispense with the costly cable.

The first of the two books here noticed contains matter of great interest, and is written by an authority on the history of telegraphy. Mr. Fahie has unearthed with much diligence a great mass of almost, or quite, forgotten experimental work (largely relating to efforts based on the conducting power of water). This, together with descriptions of the more recent work of Preece, Lodge, Marconi and others, he presents to the reader chiefly in the form of copious extracts from original papers.

One is able to gain an idea from this book of the immense amount of experimental work continually being carried out; to be noticed possibly in the current literature of the day, and then to be forgotten save when some striking practical success, such as that of Marconi, calls forth a historian who will rescue such work from oblivion.

For a frontispiece, the book has a collection of small but excellent portraits of "the arch builders of wireless telegraphy," from Oersted to Marconi; and at the end are gathered a number of extracts embodying the views of Lodge, Henry and Rowland, followed by Prof. Branly's classical paper on the behaviour of imperfect contacts to electrical radiation, and by a most interesting letter to Mr. Fahie by Prof. Hughes, describing his hitherto unpublished work on what are now called "coherers," which he was led to carry out after his invention of the microphone in 1877. The book concludes with a reprint of Marconi's patent of 1896, which shows how extensive his experiments had been before he came to England.

All these appendices are worthy of the most careful reading in the light of recent events. In fact, the book teems with interesting matter from cover to cover.

While the work is certainly opportune, yet a careful perusal brings us to the rather opposite conclusion that it is also premature. It is opportune, for a work on wireless telegraphy from an authority like Mr. Fahie is very welcome now. It is premature, in that the subject is changing so rapidly that a consistent account is impossible. For Marconi's present arrangement, though arrived at after the most careful investigation, yet seems to be still very empirical, as for example in the almost arbitrary choice of the kind of electric waves or of coherers, out of the infinite variety of both which are possible. It is still to be hoped that some other set of waves and some different type of coherer may be found equally available, and furnishing and receiving signals more amenable to projection in any required direction. Success in localising the electric waves is vital to the extended adoption of wireless telegraphy, yet Mr. Fahie is of course unable to include an account of this part of the subject in his book.

The author has adopted a chronological arrangement. No other seems in fact possible. Yet we think that many would prefer the accounts of mere *conduction* experiments to be kept separate from *etheric* telegraphy. Among other anomalies of arrangement we may mention that Lodge's work on wireless telegraphy is described under the general title of "G. Marconi's Method" (pp. 227–235).

Apart from obsolete expressions and unfortunate quotations from public utterances (as, "the Röntgen form of telegraph," p. viii.), the author's own language is not always precise. Thus "a rapidly revolving rheotome which broke up the current into a musical note" (p. 152), though perhaps expressive, is not accurate. Again, the reference to Hertz's "experimental proof of the hitherto theoretical fact" (p. 183), of the identity of the velocity of propagation of light and of electric waves, is hardly felicitous. Some of the author's elucidations of theory, also, are not perhaps as clear as they might be. An edition prepared at greater leisure, however, would no doubt be free from such passages.

The most obvious criticism of the book relates to the disjointed reading which arises from the author's very frequent insertion of extracts. But this criticism Mr. Fahie meets half way, for in his preface he "seems to hear the facetious critic exclaim, 'Why, this is all scissors and paste,'" and he rejoins, "So it is, much of it"; and he further adds that "so is all true history when you delete the fictions with which many historians embellish their facts." If this rather pessimistic view be adopted, then it would seem that a readable history is an impossibility. At all events, we certainly think that the constant change in literary style, both in character and quality, combined with the obsolete scientific expressions in which many of the extracts are couched, does not contribute to make the book readable. Indeed, we would describe the book as an excellent and well arranged store of material for writing a book on wireless telegraphy. It may be, however, that the attempt to render a *history* readable is to be deprecated.

The author has dedicated his work to Sir William Preece. Its later chapters bear witness to the striking way in which a Government department has so consistently and actively encouraged advance and scientific investigation wherever results of importance to its own work were to be hoped for.

There remains to state in conclusion that Mr. Fahie's book is certainly the best, if not the only work of reference which has appeared on the history of wireless telegraphy.

For a lucid and thoughtful exposition of the theory of the propagation of electric waves we can cordially recommend a little book by M. André Broca, "La Télégraphie sans Fils," which has lately been published. Within the compass of two hundred small pages of large print will here be found, first, a description of simple telegraphic apparatus; then a number of chapters which, with the help of hydraulic analogy, serve in an effective and remarkable manner to introduce the electromagnetic theory of light; and, lastly, a good account of the action of the vertical-wire transmitter and of the most recent work on coherers.

M. Broca succeeds in giving in simple scientific language, and without the help of mathematical analysis, an explanation of many abstruse points, such as the flow of electric currents in submarine cables and of electric waves along wires.

The vertical wire, according to him, emits an electric disturbance having an axis of symmetry, the wire itself; and a wave having this quality distributes its energy mostly in a plane perpendicular to the axis, a horizontal plane in this case, the energy diminishing with the square of the cosine of the angle from the vertical axis. It is to this concentration of energy in a horizontal plane that the vertical wire owes its success as a transmitter, but real concentration of messages transmitted by this means is not to be expected. (The employment of two or more wires inclined at different angles in the same vertical plane, but not necessarily close together, might possibly, we think, furnish by the intersection of two or more planes of greatest action, a *line* of reinforced action—a kind of imperfectly *directed* message which might be received by an arrangement similar to the transmitter.)

An appendix gives in a few pages the mathematical theory of the propagation of waves along a conductor.

M. Broca's little book is a valuable addition to the fast accumulating literature of wireless telegraphy, and we shall be glad to see an English translation.

D. K. M.

WORK AND THOUGHT AT WOOD'S HOLL, U.S.A.

Biological Lectures from the Marine Biological Laboratory, Wood's Holl, Massachusetts, 1898. Pp. 343. (Boston: Ginn and Co, 1899.)

THIS volume, like its predecessors, is the joint production of several of the leading biologists of the United States, indicative to a certain extent of the trend of thought and investigation in their midst, and, like its predecessors, it teams with interest and suggestiveness. Of the sixteen lectures reported, the majority are by well-known authors, and the book is remarkable for the extent to which it deals with questions of a cytological and psychological nature, in contradistinction to those of a more strictly morphological, such as we are accustomed to associate with a marine laboratory. Not that the latter have been neglected! for a remarkable essay by A. D. Mead, on the "Cell Origin of the Prototroch," which would seem to justify once more the belief in the ancestral nature of the Trochophore larva, is a thorough-going piece of sea-side work. The subject of "Cell-Lineage and Ancestral Reminiscence," in the hands of Prof. E. B. Wilson, yields fresh support for the theory that homologies only gradually arise during development, and that "the ultimate court of appeal lies in the fate of the cells"; and in a preliminary account of some investigations into the "Structure of Protoplasm" the same author is led to conclude, with von Kölliker, basing his observations of the Echinoderm egg, that "no universal or even general formula for protoplasmic structure can be given, and that the foam-structure of Bütschli is in certain cases at least of secondary origin."

In the course of his work he has done a great service in pointing out that so-called "granules" are often really liquid in nature, and in emphasising the extent to which error has hitherto asisen from the general tendency to regard these as solid bodies.

Among the more recondite problems dealt with are "Adaptation in Cleavage" of the Egg, "Protoplasmic Movement as a Factor of Differentiation," "Equal and Unequal Cleavage in Annelids," and "The Relation of the Axis of the Embryo to the First Cleavage Plane." In the hands of Messrs. F. R. Lillie, E. G. Conklin, A. L. Treadwell and Miss C. M. Clapp, both the practical and philosophic aspects of these and cognate subjects receive adequate consideration. The whole series of essays are well worth reading, and except that the Filose Phenomenon has not come under observation, the present moot points in embryology have been for the most part boldly attacked. Interest amounting to curiosity attaches to the description by Mr. Lillie in *Unio* of what, following Conklin, he terms provisionally a "sphere-substance," said to be "derived entirely from the inner sphere of the second maturation-spindle," and to his allegation, which seems to us none too clear, that it "moves and elongates so as to mark out a definite horizontal plane in the egg, and that the first cleavage-spindle places itself in conformity with this predetermined arrangement."

More sensational, and to our thinking less sound, is a lecture by T. H. Montgomery, jun., on some "Observations on Various Nucleolar Structures in the Cell." Like that on "The Heredity of the Marking in Fish Embryos" (J. Loeb), and on "Injury" to the Lower Animals as concerning "Pain Sensations" (W. W. Norman), this appears to us premature, and the authors would have done well had they given both their observations and reflections fuller consideration. An essay on "Some Problems of Regeneration," by T. H. Morgan, is noteworthy, for the fact that its author emphasises the degree to which it is now becoming evident in the progress of biology, that, as we attempt "to reduce living phenomena to simpler terms," we sooner or later "meet with a factor that defies further physical analysis," with the refrain that "we gain nothing by calling it a vital force, unless we can define what we mean by vitality."

In a lecture on the "Elimination of the Unfit," Dr. H. C. Bumpus deals in an analytical form with the effects of a severe storm on the Introduced Sparrow, and his observations at least serve to remind us that we are perhaps not sufficiently on the alert for evidence of processes in organic evolution obtainable from the study of passing events. Dr. W. M. Wheeler, in an interesting essay on "The Theoria Generationis" of Wolff, justly controverts some adverse criticism by Sachs, and establishes Wolff's position as a pioneer among præformationists—

as the Siegfried who overcame "the monstrous theory of *emboîtement*, not only false in itself, but one jealously guarding the problem of development and preventing all access to it." The author points to an analogy between the rise and progress of præformationist and Darwinian schools, which, agreed in maintaining a transformation of the simpler into the more complex have neither succeeded in demonstrating how that process is achieved.

The three lectures which remain are somewhat more special than the rest. That by Dr. Watasé on phosphorescence gives welcome support to the theory of Quatrefages that this is intimately associated with contractility, and that a common cause would appear to underlie the two processes. Dr. Watasé has been for years engaged upon this fascinating subject. His treatment of it has been no less original than that of other topics upon which he has left his mark, and we sincerely hope, now that he has returned to Japan, he will promptly give us the definitive treatise of which we are expectant. Prof. W. B. Scott, whose patient, consistent work upon the palæontology of the American Artiodactyles has for years been eagerly followed by all interested in mammalian descent, has in the lecture which he contributes to the present volume built up a masterly defence of the principle of convergence—the first comprehensive defence from the palæontological side—by lack of appreciation of which it has long been patent to anatomists that not a few of our accepted classificatory schemes and conceptions of affinity are erroneous. He deals chiefly with recent discoveries in the now famous Uinta formations, and his thesis, like the work upon which it is based, is thoroughly English in method. By contrast to the bulk of the volume before us, it comes as a set off to the too frequent indications of that "Germanising" to which our American brethren appear somewhat prone. His chief deduction that "all the strictly indigenous North American selenodonts are branches of the great tylopodan stem" is replete with interest.

Finally, there is a lengthy lecture by Prof. C. O. Whitman on "Animal Behaviour," setting forth in detail, and with comment which is exemplary in its moderation and cautiousness, a series of experiments on the phenomena of response exhibited by certain American creatures under his hand (especially a *Clepsine*, *Necturus*, and certain pigeons). He frames a thoughtful argument, which leads to the conclusion that "instinct precedes intelligence," and that its primary roots lie in "the constitutional activities of protoplasm," which, as he justly remarks, relieves us of the inconsistencies "involved in the theory of instinct as lapsed intelligence." His aphorism that "organisation shapes behaviour" would seem destined to bear the fate of his truism, "organisation precedes cell formation," now prophetic; and to him, the guiding spirit in the work which necessitated the publication of the present volume, as to all his collaborateurs, we offer our hearty congratulations. A little more work and a little less theory would be acceptable in some cases, but so long as the connection between the two is maintained to the extent exemplified in the present volume, we shall remain content.

The book closes with a series of short obituary notices, which include those of the former Assistant Director at Wood's Holl and of the author of one of the lectures, together with a passing reference to the death of W. R. Harrington, an enthusiastic young American, well known and greatly respected on the European side of the Atlantic, who recently met his death in a second attempt to secure the young of the Bichir (*Polypterus*). G. B. H.

OUR BOOK SHELF.

Darstellung der 32 möglichen Krystallklassen. By Prof. H. Baumhauer. Pp. 36. (Leipzig: Wilhelm Engelmann, 1899.)

PROF. BAUMHAUER discusses the symmetry of crystals in accordance with recent views, and employs the axes of symmetry to distinguish the classes. Weiss and Mohs first recognised that crystals fell into seven groups depending on the relative lengths and inclinations of the crystallographic axes. The older school of crystallographers, following the lead of Naumann, commenced with the class of highest symmetry in each system, and derived the remainder by removing elements of symmetry. The logical method, as was pointed out by Gadolin, is to start with the class of lowest symmetry and add elements of symmetry until the most complicated class is reached. Each class is, in reality, quite independent of any other, even if in the same system. Groth adopted this view in the last edition of his "Physikalische Krystallographie," and rejecting all ideas of hemihedrism, introduced a nomenclature which has been here employed by Prof. Baumhauer. He, however, differs from the Munich professor, but joins Schönflies in dividing the thirty-two classes into groups depending on the axes of symmetry present. This method splits up the monoclinic system, two classes of which join the rhombic system to form the digonal group (*i.e.* the group with at least one axis of two-fold symmetry), whilst the third, which possesses a plane of symmetry only, remains by itself in the monogonal group. The triclinic class, according to the author, forms the anaxial group; Schönflies, on the other hand, splits it up and gives the holohedral class to the digonal group, and the other to the monogonal group. The latter arrangement is certainly more logical, though there is something to be said for Prof. Baumhauer's objection that a "2-zählige Spiegelachse" being in any direction, and therefore not necessarily parallel to a crystallographically possible edge, cannot be said to exist. The author follows Schönflies in placing the classes represented by phenacite and calcite respectively in the hexagonal group, whereas Groth includes them in the trigonal group. These two groups, however, might well be regarded as one.

A word must be said for the excellent diagrams, which show very clearly the symmetry of each class. At the end is given a description of illustrative models, to be obtained from Dr. F. Krantz, of Bonn.

The Essex Naturalist: the Journal of the Essex Field Club. Edited by William Cole. Vols. ix., 1895–6, and x., 1897–8. (Essex Field Club, 1899.)

THE *Essex Naturalist* has long been known as the ably conducted journal of one of the best field clubs in existence. Full accounts of the meetings and excursions of the Essex Field Club are given, and, in addition to these, any observations of interest to naturalists made within the limits of the county are recorded, and when necessary illustrated. The term naturalist is quite properly used in the very widest sense, so that the journal includes meteorological, geological, geographical and anthropological observations, as well as others dealing with ancient marks, boundaries and buildings, customs and trades.

The journal is an excellent example of all that the organ of a field club and county natural history society should be. It fulfils a double function, recording interesting observations which would otherwise have been forgotten, and stimulating its members to make fresh efforts in their own districts. Throughout every county opportunities for observation are continually occurring, opportunities which are often wasted for want of an alert local naturalist. A fresh cutting made on a railway, a new gravel pit opened, an old house pulled down, afford the chance of interesting and often valuable observations when the keen and trained observer is on the spot. The encouragement of such work is of no less importance for the progress of science than the comprehensive papers by acknowledged leaders of their subject which appear in the *Essex Naturalist*. These would be published under any circumstances, whereas the former are rescued from the multitude of observations which might have been.

The journal is exceedingly well printed, and is a model of careful and successful editorship. E. B. P.

Anleitung zur Darstellung chemischer Präparate. Ein Leitfaden für den praktischen Unterricht in der Anorganischen Chemie. Von Prof. Dr. H. Erdmann. Second edition. 92 pp. (Frankfort: H. Bechhold, 1899.)

THE great educational value of a well-chosen set of chemical preparations, as an adjunct to the usual analytical courses, is now generally admitted; it has been, however, usual to select the examples almost wholly from the field of organic chemistry. To Prof. Erdmann is due the credit of showing that a course of inorganic preparations was not only feasible, but on account of the greater variety of difficulties met with in many cases, even preferable for educational purposes to a selection wholly organic. In this second edition several additions have been made to the original text, including the preparation of ammonium perborate, dry aluminium chloride, arsenious oxide, violet chromium sulphate and potassium iodate.

The instructions throughout are very practical, the cost of the material having been borne in mind throughout, many laboratory bye-products or residues being utilised as the raw material for preparations.

In the few instances where the methods given are not the best available, the residues are worked up in other preparations. The book as a whole fills a gap in chemical literature.

The Boyhood of a Naturalist. By Fred Smith. Pp. vi + 227. (London: Blackie and Son, Ltd., 1900.)

THIS genial account of his boyhood by a naturalist, writing under the pseudonym Fred Smith, will afford unlimited interest to any youngster with a love for live things. That Fred Smith did not shine in school, and was only with difficulty made to play cricket fairly regularly, rather adds to his winsomeness. Indirectly, the book should prove useful in demonstrating the educational value of the study of nature at first-hand. Fred's education was unmistakably of the kind which it is at present fashionable to call "heuristic," and his progress in his numerous researches is further evidence of the possibility of a boy, though considered a dunce at school, arriving at manhood educated in the better sense of the term, since his faculties are properly trained and his perceptions keenly alert. As a gift book for a child with a natural proclivity for biological work the volume can be thoroughly recommended; it is both instructive and amusing.

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 New Zealand Zoological Region.

IN a paper on "The Geography of Mammals" (*Geographical Journal*, vol. iii. p. 95, and vol. iv. p. 35, 1894), Mr. W. L. Sclater divides the land surface of the earth into three great divisions, Notogœa, Neogœa, and Arctogœa, and these are subdivided into six regions, the Australian region corresponding with the division Notogœa. It seems to me, however, that had Mr. Sclater considered what is natural rather than what is convenient, he would have divided his Notogœa into two regions, separating the New Zealand area from that of Australia, for these two areas are essentially distinct from one another in all their great fundamental zoological characteristics. According to Mr. Sclater, Prof. Huxley and Prof. Newton make the New Zealand area a primary zoological region (I have not seen the "Dictionary of Birds" or Huxley's paper). Mr. Sclater then says: "there is, no doubt, as has just been shown, a good deal to be said for this proposal; but, on the other hand, there are even more valid reasons for retaining New Zealand as a sub-region of the Australian region." Mr. Sclater then states his "more valid regions," which are three in number. The first is that as he is dealing with mammals only it would be absurd to give a small group of islands, which is almost entirely without terrestrial mammals, the rank of a primary region. Had Mr. Sclater therefore left the New Zealand area out of his considerations altogether, as was wisely done by Mr. P. L. Sclater in his lecture "The Geographical Distribution of Mammals" (Manchester Science Lectures, No. 5, Sixth Series, 1874), I should have been entirely in accordance with him, and there would have been no occasion for this paper.

The second reason given is that of "practical convenience." It seems to me, however, that convenience should only be a secondary consideration, and that what is natural is far more important. Mr. Sclater goes on to say that "other small insular areas might with some justice put forward nearly similar claims."

New Zealand, however, stands alone in its very remarkable physical and biological conditions, and presents with those of Australia the strongest contrasts rather than similarities.

It is, however, to Mr. Sclater's third reason that I have more especially to take exception. He says: "Although New Zealand possesses no indigenous terrestrial mammals, yet the fauna, such as it is, shows an unmistakable affinity of various degrees to that of Australia, and more especially to the tropical parts of that continent. It is, indeed, probable that the whole of the fauna of New Zealand has been originally derived from that source."

There are no doubt affinities between the faunas of Australia and New Zealand; but when we consider that in Tertiary times (probably Pliocene) the New Zealand land area extended far to the north and west of its present limits, probably as far as Lord Howe Island, and the facilities for the diffusion of species from the one area to the other were immensely greater than they are at present, the wonder is that these affinities are so slight and insignificant. It has been usual to look for similarities in the faunas, and to attach much importance to the occurrence of the same or representative species in both areas, and the great and essential differences of the faunas as a whole have been largely lost sight of or little understood.

I would first remark that the presence in Australia of a rich mammal fauna (marsupials and monotremes), and its total absence from New Zealand, is certainly significant. But let that pass, and, as Mr. Sclater has himself suggested, to determine the geographical affinities of New Zealand we must take "the fauna such as it is," consisting of birds, reptiles and other lower groups; and when we do this we find that the result is exactly opposite to what Mr. Sclater would lead us to expect.

Prof. Newton has no doubt ably dealt with the affinities of the New Zealand birds in his work, "Dictionary of Birds"; I need not therefore discuss them here, except to remark that one of the most interesting and remarkable features of our bird fauna is the fact that during recent times—at most a few hundred years back—there existed in these lands numerous species of two families of raft-breasted birds, *Dinornithidae* and *Apterygidae*, which are so essentially distinct in structure that they are probably not even distantly related to one another, but have arisen quite independently, and no representatives of these families have been found in any other country. (The supposed finding of *Dinornis* and *Apteryx* remains by Mr. De Vis in Queensland, having been discussed by Captain Hutton and Mr. Lydekker, is now considered to have been a mistake.)

As regards the reptiles, we have the well-known and peculiar Tuatara (*Hatteria punctata*) and a number of lizards, which Messrs. A. H. S. Lucas and C. Frost have recently revised, and they tell us that the New Zealand forms are not related to those of Australia (*Trans.* New Zealand Institute, vol. xxix. p. 264).

The land and fresh-water molluscs have been critically revised by Mr. H. Suter; and Mr. H. Crosse, in his introductory note to Mr. Suter's paper, summarises his conclusions thus:—" Les faunes malacologiques Australienne et Néo-Zélandaise sont, d'ailleurs, à première vue, fort différentes l'une de l'autre, et elles présentent souvent des caractères opposés. . . . En réalité, les Mollusques terrestres et fluviatiles de la Nouvelle-Zélande, et nous comprenons sous cette dénomination, non seulement les deux grandes îles du Nord et du Sud, mais encore les îles Stewart, Auckland, Campbell, et Kermadec, forment un ensemble d'espèces très particulières, toutes, ou à peu près toutes, indigènes, et constituant une faune locale, insulaire et parfaitement caracatérisée.

" Pourtant, à notre avis, il existe un archipel, dans la faune duquel, si originale qu'elle soit, on trouve des affinités marquées et des rapports incontestables avec celle de la Nouvelle-Zélande: c'est la Nouvelle-Calédonie" (*Journal de Conchyliologie*, 1894, vol. xli. pp. 215, 216).

Mr. C. Hedley has also pointed out that the land molluscan fauna of New Zealand is quite distinct from that of Australia, and has affinities rather with the faunas of Lord Howe Island, New Caledonia, Fiji, the New Hebrides, and Solomon Islands (*Records* Australian Museum, vol. i. No. 7, 1891; *Proc.* Linn. Soc. N.S.W., 1892 (2), vol. vii. p. 335; *Ann. and Mag. Nat. Hist.*, 1893 (6), vol. xi. p. 435). This is indeed significant, especially when the form of the "New Zealand Plateau" and the ocean-floor beyond is taken into consideration.

As regards the earthworms, Dr. Benham tells us that they "are very different from those of Australia, on the one hand, and Europe on the other" (*Canterbury Weekly Press*, May 3, 1899). I cannot, however, agree with Dr. Benham when he reasons that because species of one genus—*Acanthodrilus*—which is widely spread in other southern lands, are found in New Zealand and Queensland there must have been at one time a land connection between New Zealand and north-eastern Australia. There is another explanation which appears to accord better with the distribution of other groups, if a land connection is necessary. Far back in Cretaceous or early Tertiary times (Cretaceo-Tertiary of N.Z. geologists) before the north-eastern part of Australia had received its mammal fauna, the New Zealand area may have been connected with New Guinea *via* Lord Howe Island, New Caledonia, the New Hebrides, and the Solomon Islands; or more probably these islands were then connected with New Guinea and the main land, and afterwards when the land connection was broken up, some of them became connected with New Zealand, so that a few of the plants and animals which spread into Australia or northwards into New Guinea were also able to reach New Zealand. This is not a new suggestion; it has been proposed by Captain Hutton and others. Mr. H. Deane, in his presidential address, delivered before the Linnean Society of New South Wales, March 31, 1897, said:—" The difficulties are too great in the way of such a supposition (a Pacific continent), but only connections similar to that which we are certain existed between New Zealand, New Caledonia, the Fijis and the main land which was perhaps at its period of greatest development in a state of oscillation need be conceded." Regarding the alpine flora of the Owen Stanley Range in New Guinea, the late Baron Sir F. von Mueller, after enumerating a number of extra-tropical genera found there, said: "Many of these approach in their affinity to forms familiar to us in Europe, a few even being identical with British species, and appear thus to reach in New Guinea their most southern geographic limits. But, on the other hand, many of these Papuan highland plants are of far southern type, such as Drimys, Drapetes, Donatia, Styphelia, Phyllocladus, Libertia, Carpha, Oreobolus, Gahnia, Dawsonia; indeed, some of the species are absolutely the same as congeners of the Australian and New Zealand Alps" (*Proc.* Roy. Geographical Soc., Australia, Queensland Branch, vol. v. p 20, 1889). But without the necessity of a land connection, when in Tertiary times the New Zealand land area extended as far as Lord Howe Island, and perhaps New Caledonia, a few earthworms and other animals may have been carried across the intervening comparatively narrow sea by birds and on floating timber.

New Zealand insects have been much neglected, and some groups have hardly been touched. The Coccids, however, have been admirably worked up by the late Mr. W. M. Maskell, so that a comparison is possible. When we add to Maskell's "Synoptical List of Coccidæ" the forms described in his three subsequent papers (*Trans.* N.Z. Inst., vols. xxviii., xxix., xxx.), and summarise the results, we find that of the 105 species and varieties which have been found in New Zealand, 78 (74 per cent.) appear to be endemic. Of the remaining 27 forms, 13 occur also in Australia. These 13 are widely ranging forms which have been found in other countries—North America, Europe, &c., and occur in New Zealand in greenhouses, and on introduced plants.

Most of them have no doubt been recently introduced to both Australia and New Zealand. Two or three, such as *Icerya purchasi*, may have originally come from Australia. Coccids often multiply and spread very rapidly when introduced to a country where the conditions are favourable to them. The number of forms peculiar to Australia is 202. As regards the distribution of the genera, twenty-three have been found in New Zealand, of which only two are peculiar to that country; two of them have been found in other countries but not in Australia; and two occur in New Zealand and Australia, but not elsewhere. These latter are *Ctenochiton* with eleven species in New Zealand and two in Australia, and *Coelostoma* with five species in New Zealand and three in Australia. This would seem to indicate that New Zealand was the original home of both. The remaining seventeen genera occur in Australia and other countries, most of them being cosmopolitan or almost so. Of the ten genera which have been found, so far, only in Australia, four belong to the sub-family *Brachyscelinae*, which is essentially Australian, four of its five genera, and forty-five species, being found only in Australia, and not one representative of this sub-family occurs in New Zealand. It has often been pointed out that the animals and plants characteristic of Australia are absent from New Zealand, and those of New Zealand from Australia.

A large number of beetles have been described by Capt. Brown ("Manual of New Zealand Coleoptera"); Mr. A. T. Urquhart and others have described many spiders in the *Transactions* of the New Zealand Institute; and Mr. R. W. Fereday has enumerated 617 species of lepidotera in the same publication (vol. xxx. p. 326). When these and the other groups come to be revised, and disentangled, and their affinities worked out, it may be reasonably supposed that the results will accord with what has already been done.

In view of the above facts it is clear that not only is it *not* "probable that the whole of the fauna of New Zealand has been originally derived from that source" (Australia), but that only a small and insignificant portion came thence; that the New Zealand terrestrial fauna, as a whole, is essentially distinct from all others; and that its alliance with the fauna of Australia is extremely slight. As far back as 1880 Captain Hutton pointed out that, "The better the fauna of New Zealand becomes known, the more prominently does it stand out distinct from that of any other country" ("Manual of N.Z. Mollusca," p. 2).

In discussing the affinities of the New Zealand fauna it is fair only to consider those groups which have been revised, for many animals have been recently introduced from Australia, and rapid changes have been going on since settlement began in New Zealand and the Australian Colonies. Also in former times collections often got mixed; naturalists and collectors were not very particular about localities, for they did not then know the immense importance and interest attaching to the distribution of species.

The paucity of New Zealand insects is not by any means so great as has been represented. The reason that so few species have been described in many groups is largely due to the fact that they have been neglected by New Zealand naturalists, rather than that there are few to be found. A diligent worker here will be amply rewarded by the discovery of many new forms, whatever group he may choose to take in hand. Mr. P. Marshall recently described sixty-six species in a first instalment of New Zealand diptera, fifty-four of which were new (*Trans.* N.Z. Inst., vol. xxviii.).

As the general laws regarding the distribution of species can only be discovered from the knowledge of a very great number of facts, I fully agree with the Rev. T. Blackburn that "the special task to be accomplished by this generation, and in the present state of knowledge, is that of collecting and recording *facts and data*" (Presidential Address, *Trans.* Roy. Soc. South Australia, 1891, vol. xiv. p. 371); and that when we attempt to generalise we find how very little is known in comparison to what is yet to be discovered, and feel "the need of that exhaustive collection of the data and records of the facts that we are at present engaged in procuring." Nevertheless, I cannot concur in the suggestion that we should altogether relegate "the investigation of the *reasons* of the facts of nature" to the naturalists of the next generation. Not only is it even now exceedingly interesting and important to summarise what we do know and to understand the direction in which our observations are tending, but it also makes all future work immensely more interesting, and enables the work to be carried out more intelligently and thoroughly. It is, however, very necessary when recording facts to have the mind free from all theories and preconceived ideas which might in any way influence one's observations and conclusions. H. FARQUHAR.

Wellington, N.Z.

The Resistance of the Air.

REFERRING to Mr. Bryan's summary, on page 107 of the current volume of NATURE, of the observations on the resistance of the air, made by Le Dantec and by Canovetti, it is but fair to say that the conclusion "No. 3," viz. that the resistance to a plane surface depends upon its contour, *i.e.* whether circular, square or triangular, is by no means new. Precisely this result was deduced by Prof. Hagen, of Berlin, in his most delicate experiments published by the Berlin Academy in 1874. His memoir is the first in Abbe's collection of translations, entitled "The Mechanics of the Earth's Atmosphere," and a detailed discussion of his results is given at pp. 234–238 of his "Treatise on Meteorological Apparatus and Methods." Hagen's results, when expressed in grams, decimetres and seconds, give the resistance per square decimetre as $(0{\cdot}00707 + 0{\cdot}0001125\,p)\,v^2$ where p is the contour of the plate and v the velocity. As his experiments were made with plates of only from 1 to 12 decimetres on a side, and as he showed that the size affects the coefficient quite as much as the shape, it would scarcely be proper to exterpolate from his small plates up to the large ones used by the French investigators. We should not expect any close agreement for a surface of one metre square between Hagen's figures and these newer ones, but the general law that the pressure per square unit depends upon both the size and the shape of the plate is due to Hagen. The explanation of this result is also largely due to him; it is not merely a question of gaseous viscosity or internal friction, but especially of that dissipation of energy that occurs in the ideal perfect fluid, and which has been called convective friction in the above-mentioned treatise and elsewhere. Le Dantec and Canovetti, by experimenting on a large scale, have necessarily encountered such irregularities and difficulties as must have limited the accuracy of their results quite as much as in the case of many other experiments since those of Sir Isaac Newton. In general, inasmuch as resistance per square unit varies with the size and shape of plane plates or other bodies, it can hardly be called an important physical constant of great scientific interest. It certainly has a practical interest to the aeronaut, the navigator, and the millwright, but the scientific interest of such experiments consist essentially in determining the lines of flow and the transformations of energy involved in the discontinuous motions. C. A.

Washington, December 13, 1899.

THE object of my notice was to give a general account of Le Dantec's and Canovetti's experiments, and certainly not to deliver judgment on those delicate questions of priority which are mainly of personal interest. The "law of perimeters" being so noticeably put forward as a new result, I could do no less than cite the views of Le Dantec and his referee, between whom and Hagen or his advocate "C. A." the matter must rest. There is surely a contradiction of terms in your correspondent's expression, "that dissipation of energy that occurs in the ideal perfect fluid, and which has been called convective friction in the above-mentioned treatise and elsewhere." A fluid which dissipates energy, especially by means of anything called friction, is not an "ideal perfect fluid" according to universally accepted definitions. As to the "scientific interest" of determinations, not only of the aërial resistance of a square metre, but also of the weight of a cubic centimetre of water, the so-called mechanical equivalent of heat, the electrical resistance of a copper wire, the E.M.F. of a Clark cell, or any other physical quantity whose value is affected by various conditions, this surely is a matter of opinion; but the great amount of attention which is now devoted to accumulating statistical data of this class is sufficient indication of a general consensus of opinion in favour of such researches being regarded as valuable from a scientific standpoint. G. H. BRYAN.

Grey's Rock Paintings.

IN Prof. Haddon's review of Mr. Mathews' "Eaglehawk and Crow" there are several references to Grey's rock paintings, amongst which your reviewer remarks, "These rock paintings are certainly very puzzling, and deserve renewed investigation on the spot." They were investigated by Mr. A. C. Gregory, the Australian explorer, who, about seventeen years ago, gave me the following particulars relating to them:—

"The importance of the native coloured drawings, published by Grey in his "Travels," is much exaggerated. The colours are by no means so bright as printed, and the drawings are generally of a very primitive kind, more or less crude outlines of hands or weapons placed on the face of rocks, and lines marked round the edge of the object" (see *Jour. Anth. Inst.*, xvi., p. 133). I have also a clear remembrance of Mr. Gregory blaming the printers for attempting to make comparatively finished drawings of the faces out of crude outlines much in the same way as was so commonly done in the elaborate plates that accompany the volumes of Cook's "Voyages." Mr. Mathews' "identification" may therefore be dismissed. H. LING ROTH.

Halifax, Yorks., January 1.

Evidence of Upheaval in Vanua Levu, Fiji.

DURING an examination of the geology of this large island evidence of very extensive upheaval frequently came under my observation. Speaking generally, the main elevated mass of the island is the product of submarine fissure-eruptions. Its surface is in great part traversed by mountainous ridges, which form an intricate system, and consist in each case of an axis of basic and often coarsely crystalline volcanic rocks concealed beneath calcareous tuffs and volcanic muds, which in their turn are covered over by agglomerates. During the movement of upheaval, and in the ages that have since elapsed, the denuding agencies have been so actively at work that it is not easy to restore the original form of the surface; but it may be observed that in the eighteen months of my stay no evidence of a crateral cavity came under my notice in the main mass of the island. By studying the contours it can be shown that Vanua Levu has been formed by the union during the process of upheaval of a number of smaller islands with a central larger island.

Foraminiferous and pteropod-bearing muds together with calcareous volcanic tuffs are not infrequent up to elevations of 1100 or 1200 feet. They are of scanty occurrence at greater heights; but they are to be found in different parts of the island at elevations of from 1500 to 2000 feet; and in one locality I found sea-shells in a coarse tuff at 2200 feet. Elevated coral-reefs have taken a very little part in the building-up of the island. They exist in a few localities at the coast, and do not attain a higher level than some 200 feet. In this connection it should be noted that flints and silicified corals occur on the surface of the lower regions all over the island. Corals in various stages of silicification are found in quantities in some places, especially where a low-lying district now marks the situation of what was once an inland sea. H. B. GUPPY.

R. C. Mission, Rewa, Fiji, November 21, 1899.

THE ECLIPSE EXPEDITION AT VIZIADURG.[1]

II.

WITH regard to securing the best possible observations along all lines, the perfect organisation of time signals was of the first importance; indeed, a fundamental condition for success. The headquarter staff, under Captain Batten, was stationed at the eclipse clock, about which a word must be said. In an eclipse, especially when there are as many observers as we had on this occasion, it is well that every one shall know that he will get a good square look at it some time or other. In early eclipse work this was not recognised, and I never felt more annoyed in my life than, when I was in India, in 1871, I found that in consequence of my ignorance of eclipse organisation, Captain Bailey, of the Royal Engineers, who travelled 400 miles to our camp to help us, did not see the eclipse at all. He volunteered to give us the time, and took to rehearsing the work daily. I said to him, "What you have to do is to put your chronometer on the table and then sit down facing the sun, so that at any time you like during the eclipse you can look off the face of the chronometer and see the eclipse; because now you have come so far it won't do for you to go away without seeing anything." He said, "Well, I have been practising for the last two days, and I find it very difficult." I said, "What are you going to do about it?" He replied, "Well, I shall go on practising it till I do it." But to my horror, just before the eclipse began, I saw him take his chair to the other side of the table, deliberately place his back to the sun and look at the chronometer, and he never saw the eclipse at all. I was determined that that should never happen again in any eclipse that I had anything to do with, and since then I have always doubled the timekeepers, and given one-half of the eclipse to one timekeeper, and the other half to another. The "eclipse clock" is of rather peculiar construction. It only possesses a seconds-hand controlled by a seconds-pendulum. The face of the clock shows seconds, and a spiral on which the times are marked, so that there can be absolutely no mistake made as to the time. Not only can the even seconds be given in that way, but if a signal at any particular time is requisite for any particular operation in any of the observatories, the time signalman can give that time as well, so that all the operations are kept perfectly steady. The pendulum (and therefore the clock) is started by cutting a thread at the word "go," which means the beginning of the eclipse. Then one of the timekeepers turns his back to the sun, stands in front of the clock, and reads out the time-signals "120 seconds left," and so on, which are marked along the spiral, as the hand reaches them, while the other is looking at the eclipse. The half-time signal ("60 seconds" on this occasion) is sung out by both, and then they right-about face, one man going off duty and the other taking it up. In that way both see the eclipse. In order to give an idea of the importance of keeping the time during an eclipse, I will give our eclipse time table.

At 11 o'clock the "Thermometer" party commenced work.
11.12 a.m.—The "first contact" took place.
12.16 p.m.—"Naturalists and Landscape" party commenced operations and were followed at
12.30 p.m. by the "Slit Spectroscope and Prism" parties.
Ten minutes before "totality" Lieut. de Wet, with an Admiralty chronometer "gave the word," on which the "alert" was sounded on the bugle.
At this signal—
The "stops" were taken off telescopes.
Caps off siderostat and cœlostat.
Clocks wound.
Timekeepers reported eclipse clock correct.
Observers at discs blindfolded.
Remainder of observers turned backs to sun.
Seven minutes before "totality" 3 "G's" were sounded on bugle as a signal to Prof. Pedlar with 6-inch.
25 seconds before "totality"—90° from Lieut. de Wet. 2 "G's" on bugle.
5 seconds before "totality"—45° from Lieut. de Wet. 1 "G" on bugle.
On the order "go" the first timekeeper, with his back to the sun, called out "127 seconds," and every 10 seconds till 17 seconds, followed by 10 seconds and 7 seconds, and then every consecutive second till "over" was given.

[1] Continued from p. 233.

Why it was necessary to use the bugle will be seen at once. That was the order given to the various parties, several of whom, especially the disc observers, were a long distance from us. At the "alert" the stops were taken off the telescopes; a very wise precaution, for in some eclipses even caps have not been taken off at all—there were other things to think of! All the clocks were wound, and the observers at the discs were blindfolded. Then all the observers turned their backs to the sun in order that they might not weary their eyes by trying to see a series of phenomena of no interest to anybody. At 25 seconds before totality we had two "G's" sounded on the bugle. It had been determined that at that moment the uncovered arc of the sun measured exactly 90°. It was most important for the spectroscopic work that we should get a signal 5 seconds before totality—that is to say, 5 real seconds before totality quite independent of any errors in the *Nautical Almanac*. For the work of the prismatic cameras it was important to get a signal as nearly as possible five seconds before the beginning of totality, and, in order to eliminate the possible error of the chronometer, it was arranged to determine this by direct observations. Captain Batten did a thing which has certainly never been done in any eclipse expedition before. We expected, of course, a very definite shadow, and he was good enough to find a native dhow and charter it, and anchor it in the roadstead at such a distance that the shadow would strike it exactly 5 seconds before it struck the camp. For another signal we calculated that 5 seconds before totality the portion of the sun still visible would subtend an angle of 45°. The moment of totality was to be determined by means of the $3\frac{3}{4}$-inch.

THE WORK ATTEMPTED.

The Prismatic Cameras.

In the two prismatic cameras about sixty photographs were required, the exposures varying from one to fifty seconds. These included two series of ten snap-shots at the beginning of totality, and another ten at the end of totality, and shots of different periods, up to thirty-six seconds in one case, taken during the totality itself. That was done, of course, in the hope that one exposure would be better than any of the others, so that we should be sure of getting something at its best. Another reason was that we hoped to get records of fainter phenomena in the middle of totality than we were likely to do at the beginning and end of it. It was necessary to throw the sunlight into the camera by means of a mirror of a siderostat.

To carry out this programme of work, to secure the results required, a minute subdivision of labour was imperative. In the case of each of these two instruments six volunteers were employed, and they were distributed in the following manner:—

One observer with the finder, his duty being to keep the image in the centre of the field of view which corresponded (by previous adjustment) to the centre of the plate in the prismatic camera. He had a timekeeper to record the times of contact.

A third acted as timekeeper to record the exact moments at which the exposures were begun and ended.

A fourth volunteer, by means of a piece of cardboard, covered and uncovered the front of the prism, from directions given by Mr. Fowler and Dr. Lockyer respectively.

In one case two, and in another three, men were required to hand and receive the large dark slides before and after exposure, taking them out of, or placing them back in, bags made for this purpose.

Six-inch Prismatic Camera.

This instrument, the dispersion of which had been increased by the addition of a second prism, was worked by Mr. Fowler, with the assistance of Lieut. de Wet and five men. Mr. Fowler's programme was to begin taking a series of ten snap-shot pictures five seconds before the commencement of totality, to obtain a record every second or thereabouts of the spectrum of the chromosphere. After this he exposed eight other plates to secure photographs of the coronal rings, the exposures being of various lengths. It was also arranged that at five seconds before the end of totality he should commence another series of ten snap-shots, exposing the last of these some few seconds after totality.

FIG. 4.—Six-inch prismatic camera.

Nine-inch Prismatic Camera.

This instrument was in charge of Dr. W. J. S. Lockyer, who was assisted by Lieut. Percival Jones, R.N.R., and six men. This instrument was also fed by a siderostat, but the tube was not placed horizontally. It was intended with one of the prismatic cameras to so mount the tube that the arcs formed on the photographic plate should be symmetrical about the direction of dispersion, and it was decided that the 9-inch camera should adopt this plan of mounting.

The exact position of the tube to obtain this result was carefully determined by calculation. To facilitate the erection of the instrument at the station two wooden frames to carry the tube were previously made and taken out.

It is satisfactory to state that the photographs showed that the experiment was very successful, the arcs coming out exactly as forecasted.

FIG. 5.—Nine-inch prismatic camera.

Although this instrument was capable of only giving about half the dispersion of the 6-inch, the optical parts were better adapted for recording the ultra-violet region of the spectrum.

The programme adopted was similar to that of the 6-inch, there being two large plates (16 × 6½) for recording a series of ten snap-shots at and near the times of second and third contacts, and nine smaller plates for exposure during totality.

Integrating Spectroscope.

This instrument consisted of a large collimator, two prisms of 60°, and a receiving camera. It was entrusted to the care of Lieut. G. C. Quayle, R.N., with two assistants. The light which fed this instrument was obtained from a cœlostat, and there was still sufficient room for another instrument to be utilised, so the coronagraph was set up in the same hut.

employed, of 4½-inch aperture, was entrusted to Staff-Engineer A. Kerr, R.N., who was assisted by three volunteers from the engine-room staff.

There being still a small amount of available surface of the cœlostat for other purposes, this was utilised for the 10 × 8 landscape camera, which was operated by Mr. Turner.

Discs.

The discs, six in number, were put into position by Lieut. G. C. Quayle, R.N., and Lieut. C. E. B. Colbeck, R.N., being ranged along the southern wall of the fort, close to the Eclipse Camp. The great altitude (53°) of the sun rendered the operation of setting them up somewhat difficult. Their sizes varied from six to two inches, and they were so placed that they cut off 3, 5, and 7 minutes of arc round the dark moon.

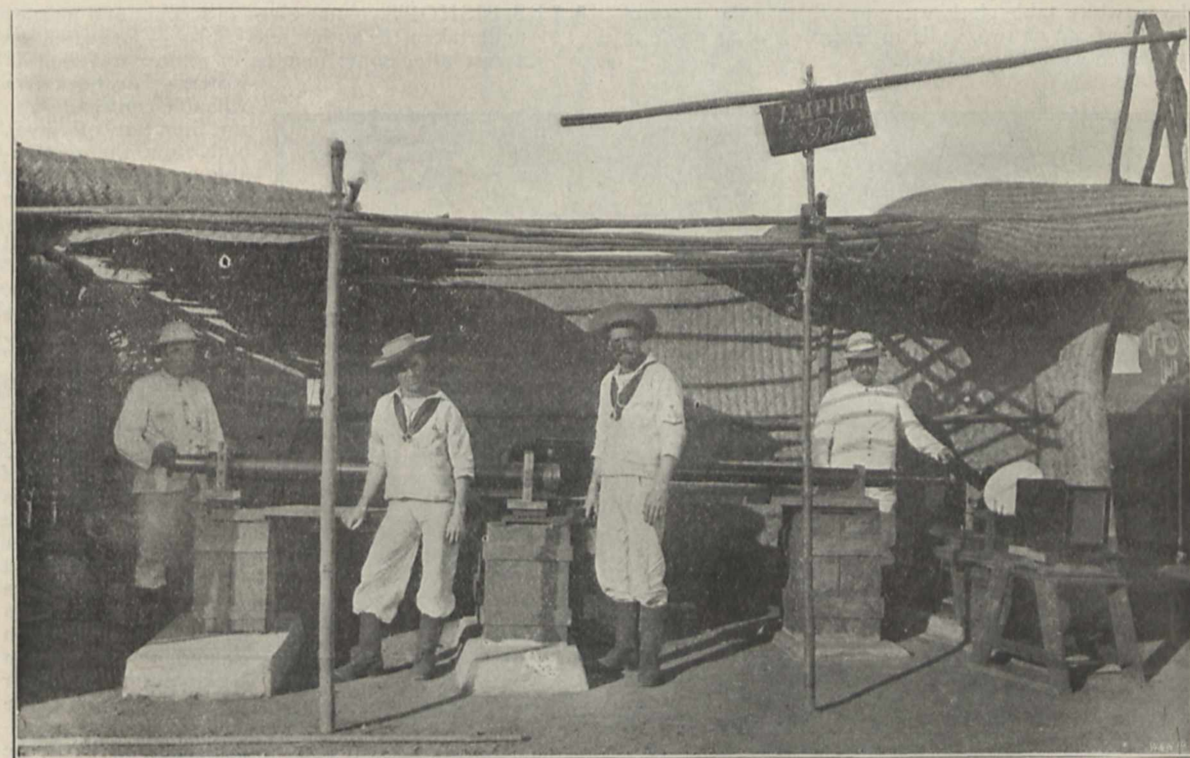


FIG. 6.—The coronagraphs and the integrating spectroscope.

Six-inch Equatorial with Grating Spectroscope.

This instrument consisted of a 6-inch lens mounted equatorially. The small grating employed contained 17,296 lines to the inch, and in the focus of the eyepiece was placed a small photographic spectrum of iron for comparison.

Prof. R Pedler, who came to take charge of this instrument, was assisted by Mr. Steele, R.N., gunner, and three other volunteers.

The Coronagraph.

We made no attempt to obtain any very fine photographs of the eclipse, because we knew that the Indian observers would do that. But it was necessary to get some photographs which would give us the relationship between the different parts of the corona which we saw and those photographed by means of other instruments. The chromosphere and coronal rings we especially hoped to get in the prismatic cameras. The instrument

Each disc occupied the time of three men, so that in all eighteen volunteers were employed. Of each party of three, one volunteer kept the eye end in adjustment up to the time of totality, another who was blindfolded ten minutes before totality acted as observer, and the third wrote down the remarks of the observer.

The 3¾-inch Equatorial Telescope.

This telescope was used by me to observe the exact time of second and third contacts to give the signals "go" and "over" to the timekeepers. For the first fifty seconds of totality I employed this instrument myself to minutely observe the structure of the rifts and streamers. In my absence it was used by Assistant Engineer H. H. Willmore, R.N., for the examination of the structure of the corona.

Star Observations.

I will pass from the larger instruments and come to the star observations. These observations were entirely in charge of Lieut. Blackett, R.N., and what he did every night before the eclipse was to get his staff of seven or eight to observe certain groups of stars from the deck of the ship or from the shore, and determine their magnitudes as well as they could, and make maps of them. It was perfectly wonderful how, after three or four nights, they could make a map of the constellation of Orion, not going very far wrong. That stood us in very good stead during the eclipse.

Each observer was supplied with a photograph of a small star chart of the region near the sun, prepared by Dr. Lockyer. This was afterwards supplemented by another on a larger scale photographed at the office of the Trigonometrical Branch of the Survey of India at Dehra.

Observations of Shadow Bands.

Staff-Surgeon Nolan, R.N., observed these phenomena with the help of two assistants. Previous to the eclipse a large white table-cloth was spread on a flat piece of ground in front of two walls intersecting at an angle of 115°, which were whitewashed.

FIG. 7.—The kinematograph hut.

Small Prism and Grating Observations.

The spectroscopic work was in charge of Lieut. Colbeck, R.N., and Senior Engineer Mountifield, R.N. I took out several spare prisms and spectroscopes with me in the hope they would be of service, and they were used to the very great advantage of science.

Meteorological Observations.

Mr. Eliot, the Meteorological Reporter to the Government of India, brought with him several important instruments with a view of making observations similar to those he had arranged along the whole line of totality. He was assisted by twelve volunteers.

Landscape Cameras and Kinematographs.

All the available landscape and hand cameras were put in charge of Mr. Turner, of the Survey Department, Calcutta, who was assisted by five volunteers.

As a well-defined shadow had been anticipated, the kinematograph was used for the first time in an attempt to photograph its passage through the air.

The Marquis of Graham brought out with him two kinematographs, one for the recording of the whole phenomenon of the eclipse, and the other for photographing the moon's shadow as it swept across the earth's surface. The latter was put in charge of Mr. H. P. Barnett, R.N., Paymaster, with one assistant. The kinematograph for the eclipse was worked by the Marquis of Graham himself, and five volunteers. The instrument was fed by a small cœlostat.

The above statements will give an idea of the completeness of the organisation rendered possible by such a wealth of observers, and it is to be hoped that the example set in 1898 may be followed in the eclipses of this and the following years. NORMAN LOCKYER.

THE YANGTZE VALLEY.[1]

MRS. BISHOP'S volume gives an account of a journey undertaken, the author tells us, solely for recreation and interest after some months of severe travelling in Korea. The book is a valuable contribution to the literature of travel, both from the remarkable personality of the writer and from the public interest recently directed to our projected "sphere of influence" in the Yangtze Valley. The greater part of the route followed has become a "beaten track" for travellers who from time to time have recorded their experiences and supplied valuable statistical accounts of the potentialities of this part of China. The author, however, in her daring attempt to reach the heart of the Mantze country, entered upon new and untrodden ground, and has given a graphic account of her adventures in one of the most picturesque mountain lands of China, the home of this obscure aboriginal tribe.

The story is all the more fascinating because it is written by a woman who has been careful to note the details of her environment day by day in a manner quite her own, and always interesting. Some light has been thrown upon this race of mountaineers, who, physically and in their manners and customs, are a people apart from the Chinese, who have maintained their characteristics, their language, and their independence through the centuries, and at last have been driven by their foes to the mountain solitudes of Szechuan and other parts of the empire.

It is to be regretted that Mrs. Bishop was unable to add to her excellent series of photographs some types of the race, or to afford some clue to the language, which appears to be an unknown tongue written in Tibetan characters. They are, one would suppose, allied to the Sifan and Lolo visited by Baber.

The first chapter deals with the Yangtze Valley—our sphere of influence. Approximate figures are here set

1 "The Yangtze Valley and Beyond." By Mrs. J. F. Bishop. Pp. xv + 557. (London: John Murray, 1899.)

down relating to geographical area and population, and the constant soil-creating and fertilising functions of the great river. The Yangtze and its many tributaries are described, supplemented by an account of the inestimable value of these affluents as highways of commerce. The annual rise of the Yangtze is dealt with, and its influence over the districts flooded during part of the year.

The burning questions of "spheres of influence" and the open door are noted as modes of expression designed to conceal (especially spheres of influence) "much greed for ourselves not always dexterously cloaked, and much jealousy and suspicion of our neighbours, and much interest in the undisguised scramble for concessions, in which we have been taking our share at Peking." All this while we ignore the men who have been for two thousand years making China worth scrambling for. The author dreads "breaking up the most ancient of earth's civilisations without giving any equivalent." After having read the book throughout, the impression left on one's mind is that China's most antiquated type of civilisation is not without its grave defects, and that it might be replaced with advantage by a fresh importation from any European state.

Theoretically, there is much virtue and goodness in the paternal government of China, while its practical results, as one sees them in the condition of the people, are far from satisfactory. The rulers have fallen away from the ancient paths of righteousness, and lapsed into iniquity. The *malfaisance* of Mandarins may not prove so oppressive in the interior of Szechuan as in other parts of China, where nature is less bountiful, and the consequent struggle for existence harder. The author says: "The human product of Chinese civilisation and government is to us the greatest of all enigmas," and so he remains to those who know him best. His best points are then catalogued correctly, and the qualities which are the making of him when an immigrant under a liberal and enlightened government in a colony such as the Straits Settlements, and which, at the same time, render him a most objectionable addition to a community where his thrift, sobriety and industry enable him to compete successfully in the lower fields of white labour. One peculiar phase of Chinese character may be noted, that is, the dignified gravity of the race, which one is disposed to think is the product of mingled vacuity and conceit, rather than the expression of deeply sensitive Confucian minds.

"The Yangtze basin is a magnificent sphere of influence for all the industrial nations for fair, if not friendly rivalry, and to preserve the open door there."

This squares with the consensus of opinions of travellers in that favoured region. It offers no field for emigration; it is now over-populated, hardly producing food enough for the requirements of its people, who during failure, or partial failure of crops, perish in thousands of famine and pestilence. It is alone to the commercial possibilities that will follow opening up the country, and exploiting its vast coal-fields and stores of mineral wealth, that foreign enterprise must look for its reward.

Shanghai is described and illustrated. The value of the exports and imports of this great trading centre is set down at 37,000,000*l.* sterling per annum. Here British, American and French settlements adjoin, and one notes that nothing is said in praise either of the French settlement or French colonial aspirations. Civilisation of an antique and obsolete sort may have its charms; but the contrast drawn between the model European settlement of Shanghai and the Chinese city of like name leaves no shade of doubt as to the respective merits of the two civilisations—the old and the new. Here one is confronted with another enigma. For the past half century the Chinese city, in insanitary and withal dignified apathy, has been looking on this splendid European settlement, a fitting outpost of all that is best in modern advancement.

FIG. 1.—God of Thunder, Lin-Yang.

Mrs. Bishop says: "On returning to the broad, clean, well-paved and sanitary streets of foreign Shanghai, I was less impressed than before that many of its residents are unacquainted with the dark, crowded, dirty, narrow, foul and reeking streets of the neighbouring city. So native Shanghai, with its 5,600,000 souls, goes its sweltering way as of yore, breathing the mingled precepts of Confucius, and malodours of the waste products of centuries."

We breathe again freely as the author conveys us to Hangchow, giving a popular description of its picturesque surroundings, the present condition of the grand canal, pointing out the cause of its falling into utter disrepair.

The city has a chequered history like that other favoured city Soochow. It is a centre of sereculture and resort of opulent and leisure-loving literates and merchants. The illustrations of this part of the work, in common with others scattered through the book, are remarkable for their artistic excellence and fine technical quality, reflecting great credit on the author, who is a lady successful in many pursuits.

There is an interesting account of Medical Missions in China, throwing light on the valuable work done by this important branch of Christian Missions. "I believe in Medical Missions, because they are the nearest approach now possible of the method pursued by the founder of the Christian faith." The Medical Mission has proved one of the most successful branches of mission work in China.

The division of missionaries into sects is unfortunate, and militates against success. Chinese are apt to inquire why such differences exist in the one faith, and within one's own experience to say that "when you have all made up your minds what to believe, come and teach us." But there remains the potent influence at work,

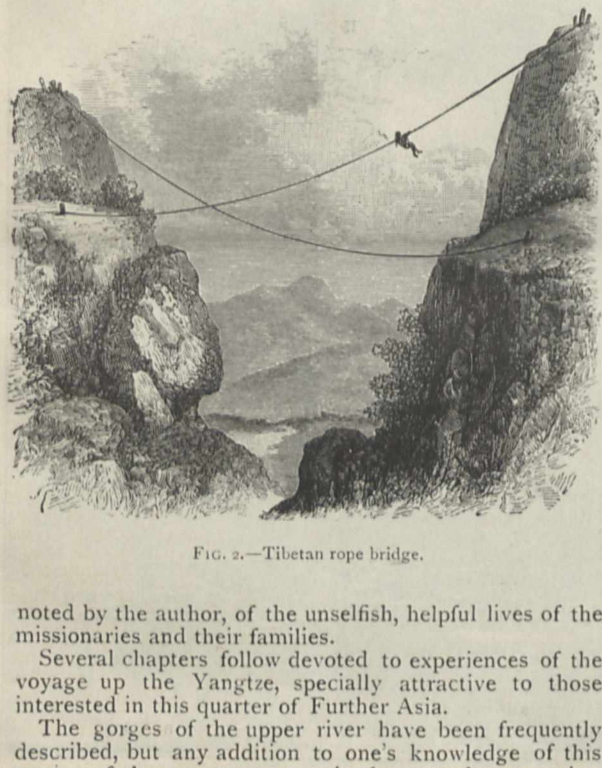


FIG. 2.—Tibetan rope bridge.

noted by the author, of the unselfish, helpful lives of the missionaries and their families.

Several chapters follow devoted to experiences of the voyage up the Yangtze, specially attractive to those interested in this quarter of Further Asia.

The gorges of the upper river have been frequently described, but any addition to one's knowledge of this section of the great waterway is always welcome, owing to the difficulty of navigation and danger caused by old and new rapids to native craft in the carrying trade. Mr. Little succeeded in taking a small steamer up the rapids to Chungkeng, but navigation of the gorges by steam must yet be more fully tested before it can be proved that the loss entailed by wreckage will not outweigh the advantages derived from the enterprise.

There are several mistakes in place names. One rather confusing error occurs in describing the Mi-tsang Gorge. It is set down in the index as Mitan Gorge, and the photograph showing the entrance to this gorge is labelled Ping-shan Gorge. It is at the entrance to this gorge that the great Ch'-ing-tan rapid bars the way to steam traffic on these upper turbulent waters. Blackuton, Thomson, Baber, Gill and others have passed this way, but Mrs. Bishop has been the first woman to give us the benefit of her keen observation, sense of humour, and literary talent in throwing some new light on native characteristics, and on weighty matters concerning this part of China.

The book must be read, and the reader will not be without his reward when he has finished the volume.

The most important part of the journey was the daring attempt to penetrate the mountain lands of the aboriginal Mantze, which nearly cost the author her life, and in which she succeeded so far as to be able to give a most interesting and graphic account of this obscure race. One would like to know something of their language, which is wholly different from Chinese, and written in Tibetan. It is also to be regretted that the camera of the intrepid explorer so scared the natives as to render portraiture impossible. The reader is purposely left to his own resources, and must read for himself the author's account of her adventures among the Mantze.

The work concludes with one or two brief essays:—"On the Poppy and its Use," "Christian Churches in China," "Secret Societies," "Questions of the Future," &c., subjects which have occupied the attention of other writers, disclosing a singular lack of unanimity of opinions on the part of the writers.

THE RELATION BETWEEN SCIENCE AND MEDICINE.

AN address upon the relation of science to experience in medicine, delivered to the Middlesex Hospital Medical Society by Sir J. Burdon-Sanderson, Bart., at the first meeting of the present session, is printed in full in the *Middlesex Hospital Journal* for December. The concluding part of the address is here reprinted, and the principles stated in it deserve careful consideration both from the point of view of science and of education. What Sir J. Burdon-Sanderson insisted upon throughout his address was that though the physician regards disease as a thing to be cured or prevented, while the investigator aims at discovering the causal relations between certain morbid changes and the conditions which give rise to them, both depend for their success upon the extent to which their faculties of observation have been developed. He held that medicine has hitherto advanced chiefly by the perfecting of its clinical method, using the expression in its modern and most comprehensive sense, but that future progress will be obtained by the scientific study of disease as a natural process. Some suggestions as to the best means to promote this advance are contained in the following extract from the address:—

We may, I think, rightly regard the Metropolitan schools collectively as constituting in themselves a great medical university. We do so in the hope that at no distant period they may be united for university purposes. Now, the two great functions of a university are education and the extension of knowledge by research. As regards the first I shall have nothing to say this evening. We may confidently anticipate that the clinical instruction given and the opportunity for clinical study afforded to students will improve year after year, and that practitioners will twenty years hence be even better informed, and their practice more sound than it is at present. But it is the other function of a university to which I would call your attention. Admitting, as I think must be admitted, that the Metropolitan schools have been hitherto, and will continue to be, admirable institutions for the training of men competent to exercise the healing art to the public advantage, it may still be asked whether our hospitals are, as they ought to be, observatories in which the scientific method is employed, not with a view to immediate utility, but for the eventual benefit of mankind by the advancement of knowledge. If we are right—as I am sure no one present doubts—in regarding a hospital school as an academical institution of which it is as much the function to make additions to knowledge as to educate, the organisation of every hospital school should comprise a special department for research in medicine—that is, that just as we have recognised for long the importance of pathological anatomy by the establishment in each school of a museum for the collection and display of morbid specimens, so we should provide what is of much more importance to the progress of medicine—a working place for the investigation of morbid processes. And, inasmuch as in most instances such investigation could be carried out much more effectually by the co-operation of several hospitals, I should further desire to see established a Hospital Association or an Association of Hospitals for the advancement of medicine by research. The organisation of such an Association would be simple. Each hospital would, as I have said, provide a research laboratory, under the direction of a working pathologist, the equipment of which would be the best that the resources obtainable for the purpose would admit of. The function of the Association would be the selection of subjects suitable for combined investigation.

Of the nature of these problems I need, I think, speak only very shortly. They would probably be of two kinds, namely, etiological and therapeutical, for it seems evident that for the investigation of the action of remedies—including under this term all the agencies which can be employed for the purpose of modifying pathological states—the same combination of clinical with physiological research is required as for the investigation of the processes of disease. But the greater part of the work of the Association would come under the other head. It would be advisable to restrict the scope of the investigation undertaken by well-defined limitations, and particularly to guard against the attractiveness of topics deriving their interest from their novelty, or from the rarity of the diseases to which they relate, rather than from their intrinsic importance. Preference would rather be given to the standing questions of clinical pathology, as, for example, to the investigation of the nature and causes of functional disorders or organic changes which, however frequently they may occur, are very imperfectly understood; and among these it might be well to select those in respect of which current medical opinion appears to be less in agreement than could be wished with the data of science. Let us take, for example, the case of gout. Here the difficulty which we find in harmonizing what is ordinarily believed as to the etiological relation of gout with uric acid, with the relatively complete knowledge we now possess of the physiological significance of that substance, at once suggests that it is desirable that the two kinds of knowledge now apparently at variance should be, so to speak, confronted. Another field in which it is difficult to reconcile the clinical and physiological aspects of the same phenomena is that of the relation between chronic renal disease and the functional disorders of the vascular and lymphatic system to which it gives rise. Here, again, the light which has been thrown on these subjects by such experimental investigations as those of Dr. Starling (which, I may mention in passing, have since their publication been confirmed by subsequent work in Germany) make us feel a certain degree of disappointment in finding ourselves still compelled to speak with the utmost reserve about such questions as the etiology of renal dropsy. Here, as in many other instances of a like nature, unsolved problems present themselves in connection with even the best-known diseases from the moment that we turn our attention to the underlying processes, of which the familiar clinical characteristics are but the outward and visible signs.

I trust that the suggestion I have made to you may not seem wholly unworthy of your attention, however imperfectly I may have been able to set it forth. I do not, myself, feel it to be premature. I should not, however, have the boldness to propose it even now, were it not that, as I have already told you, the reason which would have forbidden its being entertained no longer exists. We have now what we had not before—a sufficient number of men who, with youthful enthusiasm and with the best of their lives before them, have at the same time the scientific training necessary for pathological research.

If, as I trust may be the case, the new Metropolitan university is successfully constituted, it may be hoped that the economy of resources consequent on a better organisation of scientific teaching may set free the hospital medical schools from obligations which at present seriously impair their efficiency as academical institutions. At present, as we all know, elementary chemistry, elementary natural philosophy, and natural history are taught in schools of medicine; and large sums have, no doubt unavoidably, been spent in providing accommodation for subjects which lie outside the legitimate scope of medical study. It is surely not too much to hope that when these preparatory disciplines are duly provided for elsewhere, the resources hitherto required for their maintenance may be devoted to purposes in which we, as the representatives of medical science, can take a deeper interest, and particularly to the establishment in all hospital schools of well-equipped working places for clinico-pathological researches.[1]

In all that I have said this evening my aim has been to advocate the claims of scientific research in medicine; I have made no reference to the teaching of science. It is, however, easy to see that if the organisation of pathological research were to become more distinctly recognised as a function of a hospital medical school, the tendency of the change would be to infuse into the teaching of the science of medicine a reality and life which it has not as yet possessed.

Under present conditions there is much too wide a gap between the scientific and the practical part of the course of study for medicine. Let me take, for example, the case with which I am most familiar—that of the Oxford or Cambridge student, who, after receiving his preliminary instruction in the exact sciences in biology, and then acquiring a more thorough knowledge of anatomy and physiology, repairs to a Metropolitan medical school for the most essential part of his medical education. A considerable portion of these comparatively well-trained students are able to grasp the connection between science and practice, so as to appreciate the bearing of the science they have learned with the practical work in which for the rest of their lives they are to be engaged. But as regards the rest, we know what happens as soon as they have got rid of their last examination in science. It would be of little consequence that the details of the knowledge which has been so painfully acquired should fade from the memory, if one could believe that some notion of the scientific way of looking at questions was retained.

Whatever plan of study is followed, it is inevitable that the competent should succeed and the incompetent fail; but in our medical course there are causes of failure which it seems possible to obviate. One of these is no doubt the over-loading of our preparatory scientific curriculum with subjects which have no bearing on future work, an evil against which the General Medical Council has failed to protect us. The other is the unfortunate interruption of continuity which exists between the practical and the scientific stage in medical study.

It may, I think, be stated generally that every student when he enters on his hospital career feels that he is turning over a new leaf. It is quite natural that he should do so, and quite right, provided that he does not lose his interest in what he has previously learned. How is this to be prevented?

I have submitted to you this evening the proposition that research ought to be a recognised function of every medical school that lays claim to an academical position, on the ground that research is necessary for the advancement of medical science. The more this principle is acted upon the more effectually will the science of medicine be taught, for there is no qualification so essential to a teacher of science, and especially of pathology, as that he should himself be engaged in trying to master its difficulties.

Every advance in the direction I have indicated will have a direct effect upon teaching. The breach will cease to exist. The physiologically-minded student will no longer feel that in approaching the bedside he must leave his scientific preconceptions behind. In turning over the new leaf he will not forget what was inscribed on the old, but will rather find that the old has acquired a new value from its intimate connection with the work of his life.

But, gentlemen, all depends on whether you accept the proposition I have submitted to you—namely, that the science of medicine, even more than the art, holds the promise of the future.

[1] At the Middlesex Hospital a systematic investigation of the pathology of cancer is now in contemplation. I learn that it is intended to appoint a highly-qualified young pathologist to conduct the proposed research, and that in the necessary clinical work he will have the co-operation of the Registrar of the Cancer Department of the Hospital. The whole will be under the direction of a Committee of the Hospital staff. I refer to this as an example of the kind of work that can be done, and of the way of doing it.

SIR JAMES PAGET, BART., F.R.S.

THE death of Sir James Paget removes from our midst one of the ornaments of the medical profession. The loss is not an acute one since, though living up till some ten days ago, Sir James has for the last decade taken little active part in professional matters, but still, although the sphere of his activities has been during this period restricted by infirmity, one had evidence from time to time that he was there, using to the best of his strength that cultured mind, which never lost its vigour, for the benefit of those branches of knowledge which he loved so well.

This week's medical papers are so full of the professional attainments of the subject of this notice, and so rich in minute biographical detail, that there remains on these subjects little to be said. Sir James Paget was chiefly known to the world as a great surgeon, who, in addition to his actual professional abilities, exercised a profound charm over his patients. He was for the years he worked actively at St. Bartholomew's the student's model; not only what he did in the wards, but how he did it, served as a type to be imitated. His lectures and demonstrations were eagerly attended, and no note of discordance was there. The medical student, now of academic habits, was apt, in the early teaching days of Paget, to be rowdy, but there was never any disorder at his lectures, his fascinating diction rendering even the details of the most unæsthetic subjects sufficiently attractive to ensure the attention of his class.

Although Sir James Paget's practice as a surgeon, when he was at the height of his vigour, has perhaps never been surpassed, it was to the science of surgery rather than to its art, to its theory rather than to its practice, that he mainly contributed. He was no operating surgeon in the sense of Billroth. His surgery always contained in it an element of philosophy, a projection, so to speak, of his own philosophical spirit. He was a teacher, and enunciator of principles rather than mere facts.

In these days of what may be termed mathematical biography, one is apt to sum up a man's works, his contributions to knowledge, and regard the sum of them as an accurate measure, if not an actual expression, of his intellectual influence. This is not a fair test of the actual work of Paget. His original work on the catalogue of the Hunterian Collection at the College of Surgeons, and on that of the museum at St. Bartholomew's, his discovery of the trichina spiralis, his description of Paget's disease of the nipple and osteitis deformans, are perhaps the chief examples of his labours sufficiently sharp to wedge themselves through the crude and erratic surface of popular professional recognition. This, however, is no real measure of the man; he learnt from everything and taught from everything. He had the power of impressing the most varied subject-matter with his own philosophical individuality; the subject-matter in 1846 being the flora of Yarmouth; in 1896, or thereabouts, the medical student; his routine duties as warden at St. Bartholomew's affording to him material for a most valuable essay as to the ultimate fate and chances of success of the medical student.

In Paget's intellectual prime principles of exact science were beginning to be applied to medicine and surgery, such men *inter alia* as Pasteur, Liebig, Helmoltz, Brücke, &c., were busy examining with instruments of precision the fundamental phenomena and manifestations of life; not the least merit of Paget was that he kept well abreast of these stirring times, and gleaned from the purely scientific work of the great masters, facts and principles which he applied to surgery and surgical pathology. In these days of triennial medical congresses one can form but a very poor idea of what it meant in Paget's early days to be well up in contemporary science. His frequent advice to students to learn German seems now difficult to understand; it would be interesting to inquire how many men there are now who wish they had taken it.

Paget must be regarded, then, as an original teacher more than an original worker or writer; his ideas, perhaps somewhat metamorphosed in accordance with more exact technique, by his pupils, are springing up today on all sides, and will continue to do so. Like all truly great, he was truly benevolent, and many suggestions and ideas emanating from his mind have seen daylight under the names of his pupils.

F. W. TUNNICLIFFE.

NOTES.

THE Chemical Society's Victor Meyer Memorial Lecture will be delivered by Prof. T. E. Thorpe, President of the Society, on the evening of Thursday, February 8, at 8.30.

WE learn from *Science* that Prof. William Harkness, astronomical director of the U.S. Naval Observatory, retired as Rear-Admiral on December 17, on reaching the age of sixty years. Prof. S. J. Brown has been appointed to succeed him at the Observatory.

A SEVERE earthquake occurred on New Year's day in the province of Tiflis. The greatest amount of damage was done in the district of Achalkalak, in which six villages were completely destroyed and seven others had many houses ruined. Up to the present time, eight hundred dead bodies have been recovered.

WE regret to have to record the death, on January 1, after a very short illness, at his residence in Norwood, of Mr. W. T. Suffolk, the Treasurer of the Royal Microscopical Society, in his sixty-ninth year. Though but little known to the general public, and carried out in a very unobtrusive way, his services to microscopical science were great.

THE general manager of the South-Eastern and Chatham Railway, Mr. Alfred Willis, has made arrangements with the Wireless Telegraph and Signal Company for the Marconi system to be used in the course of a few weeks on the company's Royal Mail steamers between Dover and Calais, and also on their Royal Mail steamers between Folkestone and Boulogne. By this arrangement the vessels when in mid-Channel, or half-an-hour from either the French or English shores, will have telegraphic communication with either side.

THE Paris correspondent of the *Chemist and Druggist* remarks:—Prof. Riche, who was recently succeeded at the Paris School of Pharmacy by Prof. Moissan, was born at Gray (Hautes Saône) in 1829, and studied at the Faculty of Sciences and the Polytechnic School. He was appointed assistant professor at the School of Pharmacy in 1859, and professor of inorganic chemistry in 1873. His principal researches are on tungsten and its compounds. He has done some valuable work at the French Mint in compounding alloys, and is an active and usefu member of the Paris Council of Hygiene. His successor, M. Moissan, declares that it was in listening to his chemical lecture that he felt his first enthusiasm for the subject and resolved to become a chemist.

SINCE last week's issue we have received the *Connaissance des Temps* for 1901, the opening year of the new century. We then quoted a statement in the *Times* that the Paris Observatory "will henceforth in all its publications reckon the day from midnight to midnight." In spite of a suggestion to the contrary made some time ago, both the *Nautical Almanac* and the *Connaissance des Temps* have made no change, and the day is reckoned from noon to noon.

THE *Board of Trade Journal* states that nettle fibre has of late come greatly into favour in the manufacture of fine yarns and tissues. In Germany there are factories which use these fibres both in spinning and also for ulterior purposes. Nettle fibre produces one of the finest tissues obtainable from any known kind of vegetable fibre. In view of the importance which this seems likely to attain in connection with the weaving industries, it is intended to introduce the cultivation of nettles, if possible, into the Cameroons. The idea is to prepare the products of this experimental culture at the place where they are obtained, and test them in German factories. Should favourable results follow from these experiments, it is intended to organise nettle-growing enterprises on an extensive scale.

A NEW commercial intelligence branch of the Board of Trade has been established with a view to meet the constantly increasing demand for prompt and accurate information on commercial matters, so far as it can be met by Government action. In deciding to establish this new branch, the Board of Trade have been largely influenced by the recommendations contained in the report of a departmental committee appointed to consider and advise as to the best means of collecting and of disseminating among those interested prompt and accurate information upon commercial subjects, and as to the collection of samples, especially of goods of foreign manufacture competing with British productions, and the exhibition of such samples to manufacturers and traders in this country. The principal officer is Mr. T. Worthington, who recently acted as Special Commissioner to the Board in an inquiry into the condition and prospects of British trade in certain South American countries. The *Board of Trade Journal* will be the chief medium through which intelligence collected by the Branch and intended for general information will be conveyed to the public. The journal, which has up to the present been published monthly, is now issued weekly.

THE science of aerostatics has just lost one of its pioneers by the death of Mr. H. T. Coxwell, at the age of eighty-one. Mr. Coxwell's balloon ascents with Mr. James Glaisher, F.R.S., for the investigation of the meteorological conditions of the atmosphere at high altitudes, have long been prominent in scientific history. The circumstances which led him to take part in the work are described in an obituary notice in the *Times*. It appears that in 1862, hearing that a committee of the British Association at Wolverhampton had been making some unsatisfactory experiments with a Cremorne balloon, in order to take meteorological observations in the upper regions, he set about the construction of a special balloon for this purpose, finally producing one that stood 80 feet from the ground, had a diameter of 55 feet, and was capable of containing, when fully inflated, 93,000 cubic feet of gas. Mr. James Glaisher, F.R.S., who had not previously made an ascent, was to go up with Mr. Coxwell and take charge of the observations, while Mr. Coxwell himself was to attend to the balloon. The first of the long series of ascents thus carried out by them under the auspices of the British Association took place at Wolverhampton on July 17, 1862, and on that occasion they travelled sixty miles in two hours, and attained a height of four miles. It was on September 5, in the same year, that the pair made the record journey of rising to a height of no less than seven miles above the surface of the earth; and the story of this exciting exploit shows that the intrepid investigators had a very narrow escape indeed of their lives. The result of the many ascents by Mr. Coxwell and Mr. Glaisher was some important contributions to the science of meteorology. Moreover, they proved more clearly than had ever been done before, that ballooning was not merely a pleasant pastime, but might be rendered of great practical utility. From the same point of view Mr. Coxwell was most persistent in urging the advantages of employing balloons in times of war.

THE advantages of cremation as a means of disposing of the dead are too well known to need to be stated here. Neglecting sentimental considerations, the problem is, as Sir Henry Thompson puts it:—"Given a dead body: to resolve it into carbonic acid, water, and ammonia and the mineral elements rapidly, safely, and not unpleasantly." The present mode of burial is neither a satisfactory nor sanitary means of accomplishing this; and some of its dangers were pointed out by Dr. R. Farquharson in an address recently delivered at Aberdeen, and reported at length in the *Court Circular* of December 23, 1899. The lecture will be of service in enlightening people upon the subject of cremation, and directing their attention to the terrible condition of many old burial grounds.

IN the course of an interesting paper on lightning and its effect on trees, Mr. F. J. Brodie remarks in the *Journal* of the Royal Agricultural Society that in America much damage to live stock by lightning is believed to have arisen from the increasing adoption of wire fences. The director of the Iowa Weather and Crop Service, in his report on the thunderstorms of 1898, says: "Unquestionably wire fences, as now constructed, serve as death-traps to live stock, causing a vast amount of loss every year. And it is also quite evident that a considerable percentage of danger may be avoided by the use of ground wires at frequent intervals in the construction of wire fences." The point appears to be a practical one, deserving the notice not only of American but of English farmers, the means of protection from a real source of danger being after all very simple.

THE Meteorological Reporter to the Government of India has published a statement of the meteorology and rainfall of India during the past six months, and a forecast of the cold weather rains in Northern and Central India for the three months ending February 1900. The forecast issued in June last, from the conditions antecedent to the south-west monsoon, anticipated a rainfall slightly above the normal. This prediction was unfortunately not verified, as an area comprising nearly two-thirds of India is suffering from the most severe drought of the century. It is to be regretted that the meteorological conditions of October and November of last year strongly indicate the probability that the general character of the winter rains in the Persian area and North-Western India will be similar to that of the past four cold winters, and that the amount of the precipitation will probably be in general defect. The chief chance of the occurrence of more favourable rain than is anticipated lies in the early termination of the unknown causes which have produced abnormal conditions in the Persian and Upper India areas.

THE twenty-first yearly report of the Deutsche Seewarte, for 1898, has just been issued. The department of maritime meteorology continues to show great activity; the number of complete logs received from the mercantile marine alone amounted to 470, exclusive of 258 abstract-registers containing less complete observations. The great majority of the voyages were in the North Atlantic, but other oceans were fairly represented. In order to obtain as many observers as possible, agencies are established in many ports outside Germany, including the Consulates at Glasgow, London, Liverpool and Cardiff. The results of the observations are published in various ways useful to sailors, and have been frequently referred to in our columns. The system of weather telegraphy, and the possible acceleration and improvement of telegraphic weather reports receive considerable attention; storm warnings were issued to the various ports on 74 days, but the amount of success is not stated. In March last a conference was held under the presidency of Dr. Neumayer, on the subject of the rating and improvement of chronometers; those of German manufacture were recommended for use, as far as practicable.

THE Rev. John M. Bacon, on the occasion of a night balloon ascent, underwent an enforced detention in the upper regions of the atmosphere exceeding in duration that of any other English balloon voyage on record, and he made use of the opportunity to study the varying currents blowing at different altitudes. In the January number of *The National Review* he gives the results of these observations in an article, entitled "The War of Winds," which, together with the facts he has collected, forms an interesting commentary on weather forecasts.

DR. FREDERICK A. COOK'S description of the Belgian Antarctic expedition, of which he was a member, contributed to the January number of the *Century Magazine*, is accompanied by several exceptionally fine half-tone colour plates representing some of the Antarctic views seen during the journey of the *Belgica*. How promising the Antarctic is as a field of exploration may be judged from the following summary of the geographical results of the expedition :—"The work of the first two weeks when assembled proved the discovery of a highway perfectly free for navigation during the summer months from Bransfield Strait, two hundred miles south-westerly, through an unknown land to the Pacific. This highway has received the name of our ship, Belgica Strait. To the east of Belgica Strait we discovered a high, continuous country, which connects with the land charted as Graham Land. This has been christened Danco Land, in honour of our companion, Lieutenant Danco, who died on the ship during the long drift in the pack-ice which followed. The land to the west of the strait is cut up into islands by several channels, and was named Palmer Archipelago, in honour of Captain Nathaniel Palmer, the American sealer, who first of all men saw the outer fringe of this land. Scattered about in the waters of Belgica Strait are about one hundred islands and some groups of islands. About fifty of these are of considerable size. The islands, the capes, the bays, the headlands, and the mountains will mostly receive the names of Belgian friends of the expedition; but prominent outside workers have not been forgotten, as is evidenced by Nansen and Andrée Islands, and Neumeyer Channel."

MR. JOSEPH JACOBS, in an article, entitled "The Paths of Glory," in the current number of the *Fortnightly Review*, subjects the latest issue of "Who's Who" to a rough analysis, with the view of giving some idea of the kind of career which confers distinction on Englishmen. It seems that one Englishman out of every fifteen hundred throughout the British Empire attains popularity enough to secure a place in the biographical dictionary referred to. Among the results at which Mr. Jacobs has arrived, it may be noticed that "the comparative importance of politics as a means of figuring prominently in the world's thought" has changed but little during the thirty years since the publication of Mr. Galton's "Hereditary Genius." A comparison of the conclusions in this book with the contents of "Who's Who" leads to the remark that "scientific men must have increased more than fourfold in the interval (the last thirty years), yet their proportional parallax has declined from 73 to 42. Specialisation, doubtless, advances science and secures a man's position, but it rarely brings him prominently before the public." The argument as to the decline of the "proportional parallax" of men of science is, of course, unsound; for if "Who's Who" had been edited by some one familiar with the work of scientific men instead of a literary man, many minor writers would have been omitted from it and the names of more investigators well-known in the scientific world would have been included. The data from which Mr. Jacobs determines his "proportional parallax" are thus not comparable.

FOR several years Prof. W. O. Atwater has been engaged in investigations to determine whether the energy given off from the body of a man in the form of heat, or of heat and external muscular work, is equal to the potential energy or heat of combustion of the material actually burned in the body; in other words, whether the law of the conservation of energy holds good for the living organism. The lastest number of the *Physical Review* (vol. ix., No. 4) contains a concluding account, by Prof. Atwater and Mr. E. B. Rosa, of experiments made with the view of testing this point. A slight difference was found between the estimated income and measured outgo of energy in the experiments, and the authors conclude: "In view of defects and sources of error in methods and apparatus, we would, perhaps, be unwarranted in assuming that the experiments thus far made completely demonstrate the applicability of the law of the conservation of energy in the human organism. They do, however, seem to us to be reasonably near to such demonstration." The mechanical efficiency of a man was determined by a comparison of the energy used when at rest and when performing muscular work. The work done, divided by the total energy yielded by the body, gave 7 per cent. as the mechanical efficiency. As, however, a large amount of the energy received was used up in the body, only the excess of energy absorbed in the work experiment over that required when the subject was at rest should be charged against the work done. When this was taken into account the mechanical efficiency of man came out at 21 per cent., which equals or exceeds that of the best compound condensing engines with the highest efficiency boilers.

TWO more parts of the zoology of the Norwegian North Atlantic Expedition have recently been issued; one (No. xxv.), by Hans Kiær, dealing with the Thalamophora (Foraminifera), and the other (No. xxvi.), from the pen of Kristine Bonnevie, treating of the Hydroid Zoophytes. As usual, an English translation is printed in parallel columns with the Norwegian text; and although this, in the main, is well done, it would have been all the better for revision by an English proof-reader. The Foraminifera indicate that the portion of the Atlantic basin surveyed by the expedition is capable of division into three areas. Firstly, the southern grey clay, including the fjords and banks along the Norwegian coast, about as far as long. 19° E., as well as the similar clay area near Iceland and Jan Mayen. Secondly, the northern grey clay, comprising the fjords and banks along the aforesaid coast to the eastward of long. 19° E., and likewise the vicinity of Bear Island and Spitzbergen. Thirdly, the brown clay, subdivided into the *Biloculina* and the transition clay. So greatly does the brown clay differ in its fauna from the grey, that of the species of Foraminifera found on the former, only about two-thirds are common to the latter. It is also noticed that, with the exception of the eastern portion, the grey clay on the Norwegian coast is remarkably rich in these organisms, half of those met with during the expedition being taken there. From the great depths towards the coast the *Globigerinae* gradually diminish in number, until they almost disappear near the coast and in the fjords.

Modern Medicine states that Dr. A. Campbell White has been experimenting with liquid air on the tissues of the body. The results obtained encourage the belief that it will come into use as a local anæsthetic, and possibly for other medical and surgical purposes. The difference in temperature between liquid air and the human body is so great that it affords a unique means of producing a sudden and extreme shock to a localised part of the body, without localised destruction of tissue, or without affecting the general system.

MR. G. A. HEMSALECH, who, in conjunction with Prof. Schuster, recently published an account of their joint researches on the constitution of the electric spark (*Proc.* Roy. Soc., vol. lxiv. p. 331), has continued the research in the laboratory of M. Lippmann, in Paris. In the *Journal de Physique* (Series 3, vol. viii. pp. 652-660) he gives a detailed account of the action of the jar spark, with and without self-induction in the secondary circuit, on the metals bismuth, copper, cadmium, zinc, lead, iron, cobalt, silver, mercury and also on the gases hydrogen and oxygen. In every case the effect of self-induction in the secondary is to lower the temperature of the spark, the resulting spectrum being intermediate between that of the arc and the ordinary condensed spark, the air lines entirely disappearing and the long lines of the metals only persisting. With a very long exposure (fifteen times normal), the band spectrum of nitrogen was faintly perceptible in the spectrum of the self-induction spark. In the case of metals containing impurities, the spectrum of the impurity is well shown in the modified spark spectrum. Photographs of the metallic spectra mentioned accompany the paper, showing clearly the contrast between the two types of spark. The apparatus consisted of a 10-inch spark coil, three Leyden jars, each of 1200 sq. cm. surface, with self-induction varying from 0·00012 to 0·0038 henry in secondary circuit. The photographed spectra extended from λ 5900 to λ 3400.

THE Annual Progress Report of the Geological Survey of Western Australia for 1898, reached us at the close of 1899. Field-work has been carried on mainly by Mr. A. Gibb Maitland and Mr. Torrington Blatchford in areas which were considered to be of economic importance. Among these the crystalline rocks of the southern and western portions of the colony received attention. The schists and gneisses have a general strike to N.E. and S.W., but it was not found possible to draw any lines separating granite from gneiss or other schistose rocks. A belt of iron-bearing schist, about six miles in width, has been traced to the north of Northam. The country consists chiefly of granite, in which are belts of vertical mica- and hornblende-schists, and banded iron-bearing quartzites. In places these quartzites have proved to be auriferous.

THE anthropological aspect of primitive mathematics has recently been approached in two such very different ways by Herr L. Frobenius ("Die Mathematik der Oceanier"; *Naturwissenschaftliche Wochenschrift*, Bd. xiv. 1899, p. 573), and W. J. McGee ("The Beginning of Mathematics"; *American Anthropologist*, N.S. vol. i. 1899, p. 646) as in itself to constitute an interesting psychological study. The German investigator gives lists of numerals from numerous localities, and classifies them into structural groups, which fall naturally into geographical districts; for example, the group which has practically only two numerals lies to the south of Indonesia (*i.e.* part of New Guinea and Australia); that with five is found in the middle district (portions of New Guinea), while that with ten numerals is characteristic of the northern district, whence it has spread into Micronesia, Melanesia, and Polynesia. The various exceptions and variations are noted, as well as the way in which the numerals illustrate primitive addition, multiplication and subtraction. The American student starts with the axioms that (1) Primitive men are mystics; (2) Primitive men are egoists. The Australian binary concept of things is expressed not only by their numeration, but even more clearly by their social and fiducial systems. The most widespread of the mystical numbers is four, the devotee of the Cult of the Quarters is unable to think or speak without habitual reference to the cardinal points. To most of the devotees of the quatern concept—forming probably the majority of the middle, primitive tribes of the earth—the mystical number four is sacred, perfect, all-potent, of a perfection and potency far exceeding that of six to the Pythagoreans and the hexagram to Paracelsus. A somewhat higher stage is marked by the use of six as a mystical or sacred number; in this stage the cardinal points are augmented by the addition of zenith and nadir. In the case of last two cults the exoterically perfect numbers of four and six are esoterically perfected through the unity of subjective personality; hence the mystical numbers of five and seven. The author denies that the quinary system was primeval. The method of treatment by Prof. McGee is sufficiently illustrated by these quotations.

AN account, with illustrations, of the most interesting of the medals awarded to students in London Hospitals, is contributed to the current number of the *British Medical Journal* by Mr. T. E. James.

THE twenty-seventh annual dinner of the old students of the Royal School of Mines will be held on Friday, January 26, at the Hotel Cecil. The chair will be taken by Mr. H. G. Graves, who, for the past eight years, has acted as hon. sec. of the dinner committee.

THE current number of the *Electrician* contains, as a supplement, a large sheet-table giving details concerning the Electricity Supply Works in the United Kingdom. An immense amount of information concerning the plant in stations in operation or in progress is given in the table.

THE fish hatching experiments recently started by the Crystal Palace School of Fish Culture have now been resumed, and the operations may be witnessed daily at the Palace. The first lot of ova salmonidæ was laid on Friday last.

MESSRS. WHITTAKER AND CO. have published the fourth edition of Mr. T. H. Blakesley's "Papers on Alternating Currents of Electricity for the use of Students and Engineers." A prominent characteristic of the book is that various electrical problems are dealt with by geometrical methods.

A COPY of the seventh volume of *Natur und Haus*—an illustrated magazine for naturalists, using the word in its widest sense—has been received. Numerous excellent illustrations are distributed through the pages, and the articles will interest all students of natural history having even an elementary knowledge of the German language. The publisher is Gustav Schmidt, Berlin.

THE second of the Selborne winter lectures will be delivered at the Linnean Society's Room at Burlington House, W., on Tuesday, January 16, at 8.30 p.m. The subject will be "Man's First Contact with Nature," by Prof. G. S. Boulger. The February lecture will, it is hoped, be the one promised some months ago by the Hon. J. Scott Montagu, M.P., on "South African Fauna and Flora"; and the March lecture by Dr. Lubbock.

THE thirteenth edition of "Discoveries and Inventions of the Nineteenth Century," by Mr. Robert Routledge, has been published by Messrs. G. Routledge and Sons. In matters which have been brought prominently before the public, such, for instance, as Röntgen photography and wireless telegraphy, the book is up-to-date, but in some of the less familiar sections it i many years behind the times. The section on the spectroscope particularly needs to be revised. Used with discrimination, the book contains much instructive information concerning achievements of modern science and industry.

HORTICULTURAL science and practice are fortunate in having such a trustworthy exponent as *The Garden*, of which the first number of a new series has just been published. The journal was founded in 1871 by Mr. William Robinson, and during its existence has done much to promote improved methods in horticulture and extend the knowledge of beautiful flowers, shrubs and trees, and of the best ways of dealing with them. Botanists, horticulturists, and all lovers of plants should see the number which commences the new series. Among the articles we notice one on the Royal Gardens, Kew, illustrated, as are the other contributions, with several instructive half-tone pictures.

ASTRONOMY figures prominently in the January number of *Knowledge*. Mr. A. Fowler contributes an article on the constituents of the sun, in which he summarises the researches and conclusions of modern solar physics. Mr. E. W. Maunder commences a series of articles on astronomy without a telescope, and the Rev. J. M. Bacon describes the balloon ascent made by him with the object of observing the Leonid meteors. Among other subjects of articles are plants and their food, by Mr. H. H. W. Pearson, and the natives of Australia and their origin, by Mr. R. Lydekker, F.R.S.

OUR contemporary, *Science Gossip*, is doing good work in publishing a series of papers, by competent naturalists, dealing with different groups of the British invertebrate fauna, in the form of popular monographs. Portions of three memoirs of this series appear in the January number—namely, one, by Mr. Sopp, on dor-beetles; a second, by Mr. Soar, on freshwater mites; and a third, on spiders, by Mr. F. P. Smith. By the quotation from *Antony and Cleopatra*, the author first named seems to have proved beyond cavil that the Shakespearian term *shards* refers to the elytræ of the dor-beetle. While thus keeping in the main to the British fauna, the editor has admitted one descriptive paper dealing with a wider area—to wit, a contribution, by Dr. H. C. Lang, describing the Palæarctic butterflies, of which the present section is devoted to the numerous species of the beautiful genus *Parnassius*.

THE *Jubelband* of the *Zeitschrift für physikalische Chemie* contains an interesting memoir by Dr. T. Estreicher upon the solubility of argon and helium in water. The value given by Prof. Ramsay in his preliminary note in 1895 for the solubility coefficient of helium (·0073 at 18°·2) would make helium the least soluble of gases, a conclusion borne out by its exceedingly low critical point: but from the experiments of Dr. Estreicher it would now appear that the true value of the coefficient is about double this preliminary value. The apparatus used was identical in principle with that of Ostwald, but was improved in two important points: the use of a glass spiral connecting the measuring and absorption vessels, enabling the apparatus to be made wholly of glass, and the immersion of the whole apparatus in water. This water jacket rendered accurate determinations of the solubility coefficients possible at temperatures between 0° and 50° C. The results are plotted in the form of curves, nitrogen being also shown on the same scale for the sake of comparison. The solubility curve of argon is of the usual type, decreasing with rise of temperature from ·0578 at 0° to ·02567 at 50°. The solubility of helium varies very slightly with temperature, the curve exhibiting a minimum at about 25° C., the values being ·015 at 0°, ·01371 at 25°, ·01404 at 50°. The nitrogen and helium curves intersect at 30°, where their solubilities are the same; above this temperature nitrogen has a smaller solubility than helium. The author points out that although the occurrence of a minimum of solubility is peculiar, it is not unique, since Bohr and Bock found a minimum of solubility for hydrogen at about 60°.

THE additions to the Zoological Society's Gardens during the past week include a Diana Monkey (*Cercopithecus diana*) from West Africa, presented by Mr. S. W. Thompston; a Common Tern (*Sterna fluviatilis*), European, presented by Mr. J. Newton; a Tawny Owl (*Syrnium aluco*), British, presented by Madam de Bunsen; Moor Macaque (*Macacus maurus*) from the East Indies, a Crested Porcupine (*Hystrix cristata*) from West Africa, two Crossbills (*Loxia curvirostra*), European; three Serrated Terrapins (*Chrysemys scripta*), a Prickly Trionyx (*Trionyx spinifer*), a Bull Frog (*Rana catesbiana*) from North America, deposited; two White-eyebrowed Wood-Swallows (*Artamus superciliosus*), two Masked Wood-Swallows (*Artamus personata*) from Australia, purchased.

OUR ASTRONOMICAL COLUMN.

CENTRAL STAR OF RING NEBULA IN LYRA.—M. W. Stratonoff, of the Tashkent Observatory, has been engaged in measuring the brightness of the central star of the annular nebula in Lyra, and has communicated his results to the *Astronomische Nachrichten*, Bd. 151, No. 3607. A considerable number of photographs of the nebula have been obtained with the large telescope of 0·83m. aperture, extending over the period September 8, 1895, to September 15, 1899, the exposures varying from 30 to 90 minutes. From his measures of the brightness of the central star as compared with the magnitudes of 30 neighbouring comparison stars, M. Stratonoff shows that the magnitude varies from 13·1 to 9·5. A special series of photographs taken with extra long exposures, however, renders the question of variability, as measured from photographic impressions, somewhat doubtful. On a plate exposed for anything between 22m. and 1h. 23m. the mean magnitude of the star was 11·6. On a plate exposed for 10 hours, the magnitude was 10·1; while on exposing for 20 hours, the measured magnitude was 3·6. The author suggests, as explanation of this, that the star may really be simply a condensation of part of the whole nebulous matter, and the effect of long exposure will be to lessen the contrast between the condensed centre and the outlying fainter matter.

THE INDIAN UNIVERSITY OF RESEARCH.

A Conference was held at Simla at the end of October last to consider the Tata scheme for a Research University for India. A full report of the Conference is in the Madras *Educational Review*, from which the following particulars have been derived:—

The gentlemen invited by the Government of India to meet in conference with Mr. J. N. Tata regarding the proposed University were as follows:—The Hon. Mr. T. Raleigh, presiding, Mr. Jamsetji N. Tata (with his Secretary, Mr. Padshah), the Hon. Mr. Justice Ranade, Surgeon-General Harvey, the Hon. Dr. Duncan, Director of Public Instruction, Madras, Prof. Pedler, F.R.S., Director of Public Instruction. Bengal, Mr. Sime, Director of Public Instruction, Punjab, Principal MacMillan, Bombay, Mr. A. H. L. Fraser, Officiating Home Secretary.

The Conference first discussed fully the manner in which the scheme should be launched, so as to keep in view the ultimate ideal and at the same time make progress as funds permit. The Conference were of opinion that it is an essential feature of the scheme to have a central institution for research, as well as a central authority to control the operations conducted under the scheme. And they were of opinion that there is ample room, and indeed a clear necessity, for such a central institution.

At the same time they realised the necessity for taking advantage of existing facilities for research, whether in the shape of special local facilities (as of trade, products, &c.), or in the shape of good laboratories or museums, and men qualified for scientific research. They acknowledged that even in the unfavourable circumstances hitherto existing, students had shown in certain instances distinguished aptitude and capacity for research; and they believed that much good would be done by the grant of studentships, and also, where necessary, by assistance to the teaching and supervising staff. While, therefore, recognising that a central institution is necessary, and that there are certain departments of research (such as Technical Chemistry), which must even from the very first be provided for at that central institution, they recommended that at the outset every effort should be made to utilise existing facilities and so economise funds and resources. It is undoubtedly clear that certain branches of research must be conducted away from the central institution. But the Conference are of opinion that that institution should be gradually strengthened as circumstances permit.

The Conference also concurred fully in the view accepted by the Provisional Committee that certain parts of the scheme should be first carried out, and that the rest should follow as funds permit. They concurred in giving preference to Parts I. (Scientific and Technical) and II. (Medical) and leaving Part III. (Philosophical and Educational) to follow, though they were of opinion that the promoters of the scheme and its governing body ought to keep in view the scheme in its entirety. They were also of opinion that the scheme of studies and of subjects should be stated in the most general terms, and that provisions should be made for its revision from time to time so as to leave the authorities in charge of the work as free a hand as possible in taking up subjects that seemed specially at any time to demand attention, and in conforming to the progress of science. In regard to bacteriology, they were quite prepared to postpone action, both because there are many subjects to which the funds may at the first be at least as usefully applied, and also because they understood that the Government of India are taking such action as seems at present necessary in regard to this subject. They think that probably the best application of their funds to this subject, for the present at least, will be the provision of studentships in the Government institutions.

The Conference considered the question of the site of the central institution. It seemed to them that of all the sites named the choice lay between Bombay and Bangalore. In regard to the former the main considerations were (1) the fact that it is the home of the founder (who, however, rather favours Bangalore); (2) that it is a great centre of commercial and industrial activity; (3) that it is easy of access from all parts of India and from England; and (4) that a strong governing body could be easily obtained there. On the other hand, the climate, though not altogether unfavourable, is not bracing, and is injurious to machinery and apparatus. It would not be so favourably regarded by Europeans as Bangalore, and in Bombay land is not available in sufficient quantity. If (as is believed) special concessions in respect to site, and aid in regard to the scheme generally, be made in Bangalore on condition of the institution being there, the Conference would recommend that site.

The Conference considered the name or title of the institution. There was a strong opinion in favour of the title "Institute" as more suitable than "University" to the objects in view. But in deference to the views of Mr. Tata, and in consideration of the sentiment of the educated community of India, the Conference decided that it was expedient to adopt the well-known title of "University." They, therefore, decided to recommend that the institution be styled "The Indian University of Research." They were, however, of opinion that it should maintain its post-graduate character, and that it should, therefore, grant not degrees but fellowships.

The Conference are unanimously of opinion that there is great need for such an institution as has been indicated; that there is no reasonable ground for doubt that its work would be successful; that it would exercise a most beneficial influence on higher education and on the development of the resources of the country; and they strongly recommend it to the sympathy and support of the Government of India. They trust the Government of India will express their favourable opinion on the scheme, and give the promise of necessary legislation to be carried out as soon as it is matured, so that an appeal may be made to the public for funds, and that the details of the scheme may be definitely settled.

The Conference then proceeded to revise the Draft Bill and determined to recommend the Draft Bill as revised to the Government of India for publication. And at the request of Mr. Tata they resolved to ask the Government of India to nominate some officer to consult with him about the transfer of the property with which he proposed to endow the University.

The *Gazette of India* gives the following outline of the Tata University scheme:—It is proposed to found an institution which shall be or correspond to a teaching University for India, its primary aim being to teach, not to examine. Diplomas, therefore, will be conferred on those who have completed a certain course of higher education. This work of higher instruction will be conducted on principles followed now in Europe—*e.g.* in German Seminaria, French Conferences, and English and American Research Classes. These courses will be the beginning of a purely specialist training. In order not to interfere with the existing agencies, the new institution will take up teaching where Colleges and existing Universities leave off. The new courses will be post-graduate. The new specialist courses, which are post-graduate, will naturally be professional and technical, rather than simply literal school sanitary and science practice. For qualified medical men a school of pedagogics for those intending to be higher secondary teachers (inspectors, head-masters, &c.), and a school for higher studies, are some of the obvious directions of the development. It is not proposed to take all these up at once. The order in which they may be proceeded with will be best arranged by the committee. It is not intended to cut off the post-graduate students from education in Europe. It is contemplated to select the best for further training in Europe or America, with a view to their future return to this country. It will be necessary to make ample provision for scholarships and fellowships, both for the students in the institution and for those who proceed from it to Europe or America. The development of a scheme so complete must entail a vast capital annual expenditure, the construction of libraries, laboratories and museums, and the invitation to specialists to teach and prosecute research. All this must require large sums of money. A committee has been formed to secure the necessary financial support by making a general appeal for funds to take the preliminary steps in connection with the scheme, and to obtain a short legislative enactment enabling the institute to hold property.

His Excellency the Governor, the Chancellor of the University of Bombay, has kindly consented to let it be known that the proposed scheme has his personal approval and sympathy.

The Government of India accept the recommendations of the Conference, and they desire to place on record their appreciation of the generosity and public spirit displayed by Mr. J. N. Tata in making his munificent offer of an endowment for the proposed University of Research. They are confident that the proposed University will meet a great need, and will contribute to the advancement of higher education and the development of the resources of the country. They will be ready to proceed to legislation as soon as the scheme has been matured in all its details. They wish the undertaking every success. In accordance with the request made by the Conference, the Government of India have requested the Government of Bombay to nominate an officer to arrange with Mr. J. N. Tata for the transfer of the property with which he proposes to endow the University.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. F. KOHLRAUSCH, president of the physikalisch-technischen Reichsanstalt, has been appointed honorary professor of physics at Berlin.

MR. G. F. HARDCASTLE, senior assistant in the chemical department of the Technical College, Huddersfield, has been appointed instructor in dyeing, and assistant in chemistry, at the Municipal Technical School, Leicester.

THE Annual General Meeting of the Association of Technical Institutions will be held on Wednesday, January 24, at the Mercers' Hall, London. The president (Earl Spencer, K.G.) will preside, and an address will be given by the president-elect, Sir Swire Smith.

A COURSE of fifteen lectures on organic chemistry will be given at the Goldsmiths' Institute, New Cross, S.E., on Friday evenings, at 8.30, by Mr. W. J. Pope, commencing on January 19. Particular attention will be paid to the discussion of recent work and current views relating to organic chemistry.

THE University of Pennsylvania's free museum of science and art at Philadelphia, one of the late Dr William Pepper's cherished hopes, was, says *Science*, formally opened in the presence of several thousand people on December 20. Immediately following the presentation to the board of trustees of the museum, a bronze statue of the late Dr. Pepper, the gift of friends, was unveiled. Mrs. Pepper, the widow of Dr. Pepper, has presented to the university trustees, as her memorial to the memory of her husband, a gift of 50,000 dollars, as a fund to carry on the work started by Dr. Pepper.

THE dissertation for which Mr. H. N. Dickson has received the B.Sc. research degree of Oxford University was "On the circulation of the surface waters of the Atlantic north of 40° N. lat." The work consisted primarily of a chemical and physical examination of the surface waters of the North Atlantic during the twenty-four successive months of the years 1896 and 1897. For the purpose of the investigations special arrangements were made for the continuous supply of samples by officers of ships trading in the North Atlantic. The results were exhibited in monthly charts showing the distribution of temperature and salinity, and the changes during the period are fully discussed. The existence of definite seasonal changes in the circulation has been established by the investigation.

WITH a view to encourage the adoption of scientific methods in the teaching of physical geography, the authorities of the Cambridge Local Examinations have issued a syllabus of a course of work which has several commendable characteristics. In the first place, it is distinctly stated at the head of the syllabus that "The object of the examination will be to ascertain as far as possible to what extent the candidates' powers of observation and reasoning have been cultivated." Even more noteworthy than this remark is the schedule which accompanies the syllabus and contains an outline of a course of practical instruction designed "(1) to develop the power and habit of observation; (2) to give the pupils clear and accurate conceptions of natural phenomena and their relations; and (3) to enable them to seek for the causes and rational explanations of the phenomena which they observe" Among the subjects in which practical instruction is to be given are: the drawing of sections from contour maps, the study of local land-forms, the use of meteorological instruments, the study of ocean current maps, simple astronomical observations, the determination of time and latitude, and the use of the terrestrial globe. It is to be hoped that the efforts of the Cambridge authorities to encourage the scientific study of the earth will meet with success. No subject stands in greater need of rational methods of instruction than geography.

THE English Education Exhibition, which was opened by H.R.H. the Prince of Wales at the Imperial Institute on Friday last, contains the materials from which the English educational exhibits for the Paris Exhibition will be chosen. The whole field of educational activity in this country is more or less satisfactorily represented by these exhibits, though a walk through the galleries shows the initiated observer how impossible it is to materialise certain factors of educational effort, which though intangible are none the less real and powerful. Every step in a career from the kindergarten to the university can be followed by the inspection of the objects collected in the different sections. It is satisfactory to be able to record that the equipment necessary for proper instruction in science takes a prominent place in the collections sent by nearly all the elementary schools, most of the secondary schools, the technical institutes, and the colleges of university rank. Hand and eye training is evidently now almost universal, for one exhibit after the other contains admirable examples of wood-work, metal-work, clay-modelling, and miscellaneous occupations of a varied kind having the same end in view. We noticed with some satisfaction an etching of Charles Darwin in the Shrewsbury School exhibit: even if he received little encouragement in science at the school, it is quite clear the authorities are proud of him.

SCIENTIFIC SERIALS.

Wiedemann's Annalen der Physik und Chemie, No. 12.—Magnetic deflection of kathode rays, by E. Wiechert. The velocity of kathode rays is determined by deflecting them at two different points of their path by currents of a Lecher wire system slightly retarded with respect to each other. The velocity comes out as about one-seventh of that of light, and the mass transported with each electron is about 1/1300 part of an oxygen atom.—Relation between electric conductivity and pressure, by G. Tammann. Gaseous ionisation is reduced by increase of pressure, while the ionisation of a solution is increased. In incompletely dissociated solutions, an increase of conductivity with pressure is observed. Thus, a deci-normal solution of acetic acid is reduced in resistance to one-half its original value by a pressure of 2500 atmospheres.—An experimental and theoretical fallacy in electrical doctrine, by E. Lecher. The author maintains that a magnetic line of force can in no sense be defined as a line along which a positive pole would move, and that as a matter of fact a pole never moves along a line of force.—Distribution of free electricity at the surface of a Crookes' tube, by E. Riecke. The author uses a mixture of red lead and sulphur to discover the free charges on the outer surface. The fluorescent patch is marked by a wide ring of sulphur, the interior of which is marked by irregular patches of red lead, showing negative charges distributed irregularly, probably owing to want of symmetry in the kathode. The remainder of the tube is coated with sulphur, except the portion behind the kathode, which is negative again.—Strains in Rupert's drops, by K. Mack. Rupert's drops show black on the screen in polarised light, but they can be made to show their colours by immersing them in a trough containing a liquid of the same refractive index, such as cedar oil or a mixture of carbon bisulphide and ethyl ether. The colours resemble those of peacock's feathers.—Magnetic deflection of Becquerel rays, by F. Giesel. The deflection may be demonstrated by means of a polonium preparation attached to a sensitive plate laid face downwards across the poles of an electro-magnet. The deflected rays on the negative show a curious hairy structure.—The photography of current curves, by J. Zenneck. Instead of using a sliding plate or a revolving mirror with the Braun kathode tube, the author produces the current curve direct upon the screen in the kathode tube.—He uses two deflecting magnets, one for producing the oscillation due to the current under investigation, and the other for imparting to the kathode beam a lateral movement proportional to the time.

Memoirs of the Novorossian (Odessa) Society of Naturalists, vol. xxii. Part 2.—The whole of this volume is given to the results of the exploration of the *liman* (salt lake) of Kuyalnik, situated near Odessa, which exploration was undertaken several years ago by the Odessa University. Most of the volume is occupied by a most exhaustive report, by A. Wassilieff, about the astronomical, topographical and bathymetric work made in connection with this liman. A large scale map (1 : 16, 800) of the lake and several vertical profiles accompany the report, which will be a precious document for all subsequent exploration.—The rest of the volume is taken up by a paper, by L. Silberberger and M. Weinberg, on the bacteria found in the mud of the liman. They originate partly from the surrounding air and partly from the waters entering the lake, their composition varying with the seasons. The mud is not favourable for the life of the bacteria, which add to the mud by their decay.

IN the *Journal of Botany* for December 1899, the most important article is by Dr. A. B. Rendle, Notes on *Xyris*, in which several new species are described.—Messrs. J. A. Wheldon and Albert Wilson conclude their paper on the mosses of West Lancashire. In the number for January 1900 we find papers on *Sphagnum medium* in Britain, by Mr. H. W. Monington (with a plate).—Some Welsh hawkweeds, by the Rev. Augustin Ley, in which one more is added to the long list of British "species" of *Hieracium*.—On some species of *Cracca*, by Messrs. Jas. Britten and E. G. Baker.

THE *Journal of the Royal Microscopical Society* for December 1899 contains a continuation of Mr. F. W. Millett's paper on recent Foraminifera of the Malay Archipelago, and the usual summary of current researches in zoology, botany and microscopy. In the latter section several valuable recent novelties in microscopic construction are described. This number also contains the list for 1899 of new terms introduced during the year in zoological and botanical literature.

SOCIETIES AND ACADEMIES.

LONDON.

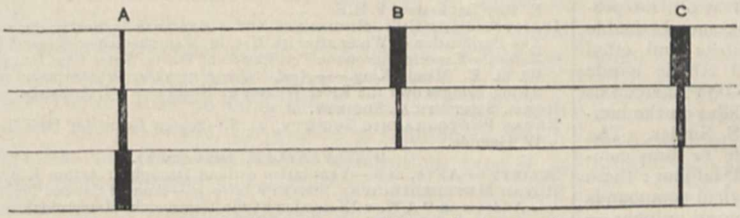
Royal Society, November 23, 1899.—"Note on the Spectrum of Silicium." By Sir Norman Lockyer, K.C.B., F.R.S.

The recent observations show that the lines of silicium may be divided into three sets, no two of which behave alike under varying electrical conditions. The wave-lengths of the lines composing the different sets are:—

A.	B.	C.
3856·1	4089·1	4552·8
3862·7	4116·4	4568·0
4128·1		4575·3
4131·1		

There is a line at λ 3905·8 which is associated in the spark spectrum of silicium with the lines in set A, but while these are entirely absent from the arc spectrum of silicium, 3905·8 is a strong line in the arc spectrum. This line differs from the others, therefore, in not being enhanced in intensity in passing from the conditions of the arc to those of the spark. So far as is known, the lines in sets B and C have not been recorded by any other observers of the silicium spectrum.

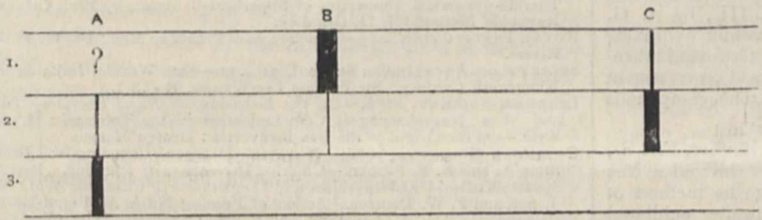
The behaviour of the three sets of lines in terrestrial spectra is shown in the following figure:—



1. SiF_4 vacuum tube (capillary). 2. SiO_2 spark with Spottiswoode coil. 3. Vacuum tube (bulb) SiO_2 spark with small coil.

It is found, on investigating the occurrence of these silicium lines in stellar spectra, that the three sets of lines respectively attain a maximum intensity at the three different levels of stellar temperature represented by β, γ, and ζ Orionis.

The accompanying figure shows the behaviour of the different sets A, B, and C in the spectra β, γ, ζ Orionis.



1. ζ Orionis. 2. γ Orionis. 3. β Orionis.

We find that set A is most prominent in the spectrum of β Orionis, that set C predominates in the spectrum of γ Orionis, and that set B is by far the strongest in that of ζ Orionis.

That the stars named represent three different grades of temperature, ζ Orionis being the hottest, and β Orionis the coolest, has been previously deduced by the discussion of other lines in their spectra. This result was embodied in a paper "On the Order of Appearance of Chemical Substances at different Stellar Temperatures," read to the Society in February, 1899. In that paper α Crucis was given as a typical star representing a stage of temperature between those of β Orionis and ζ Orionis. That star can be very well replaced for the purpose of the present discussion by γ Orionis, the two spectra being nearly identical.

It was recently shown that silicium made its appearance first at the temperature represented by α Ursæ Minoris, and strengthened at the higher temperature of α Cygni and β Orionis, afterwards weakening as we pass through the still higher temperatures of ζ Tauri and γ Orionis, until at the ζ Orionis stage it is bordering on extinction.

In the same paper the behaviour of a line at λ 4089·2 was plotted, and at the same time it was quoted as an "unknown" line.

It is interesting to note that this line is now traced to silicium, and is the strongest line in set B. It is apparently a short-lived line in stellar spectra, as it only occurs between the stages of temperature represented by γ Orionis and ζ Orionis, being one of the weakest lines in the spectrum of the former star, and one of the strongest in that of the latter.

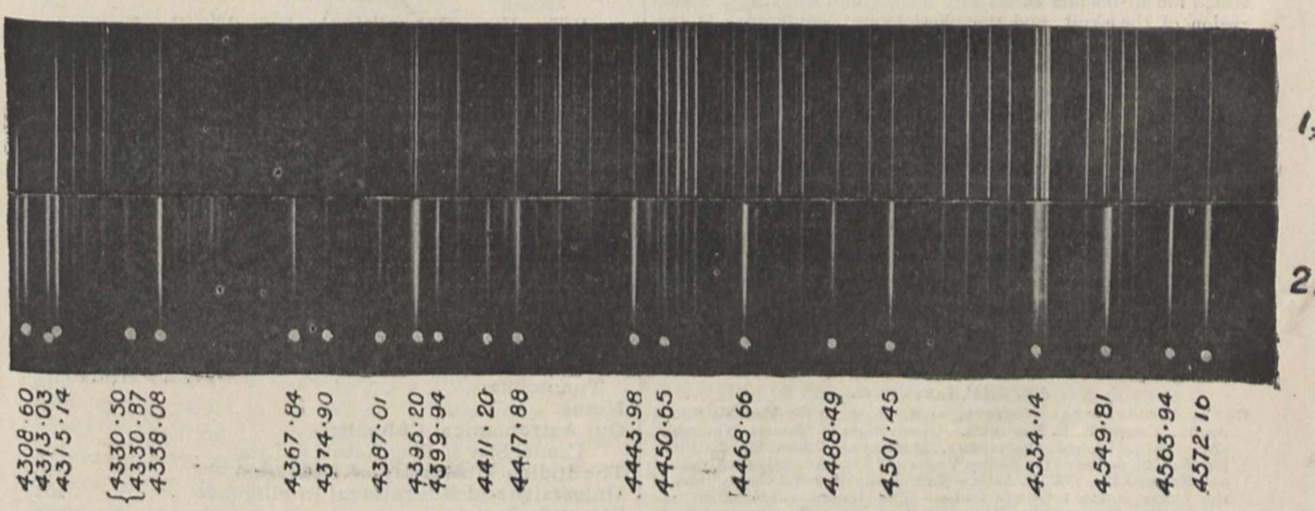
November 23, 1899.—"Preliminary Table of Wave-lengths of Enhanced Lines." By Sir Norman Lockyer, K.C.B., F.R.S.

The important part which the enhanced lines of the element play in the study of stellar spectra cannot be over-estimated, but a great advance can only be made in this direction by a systematic examination of the spectra of all the elements. Such an undertaking as this involves considerable time and labour. The author has been fortunate enough to have the use of the large 42-inch Spottiswoode coil, made by Apps, for a short space of time, and employed it in this work, for which it is specially adapted, as the brilliancy of its spark shortens the time of exposure.

The elements which have been dealt with in this investigation are the following:—"Aluminium, bismuth, chromium, copper, iron, magnesium, manganese, titanium, and vanadium."

For each of these elements the spark and arc spectra were photographed and compared, and the wave-lengths of the enhanced lines, that is, those lines which are intensified in passing from the temperature of the electric arc to that of the spark, were determined, and tables are given of their wave-lengths.

An illustration shows the enhanced and arc lines in the spectrum of titanium.



Titanium.—Enhanced Lines.
1. Arc. 2. Spark.

Chemical Society, December 21, 1899.—Prof. Thorpe, President, in the chair.—The following papers were read:—On the refractive and magnetic rotatory powers of some aromatic hydrocarbons, and on the refractive powers of mixtures, by W. H. Perkin, senr. The replacement of hydrogen in an aromatic nucleus by methyl is accompanied by a greater increase in molecular refraction, and a smaller increase in magnetic rotation, than is the replacement of hydrogen in a side chain by a methyl group.—Formation of α- and β- acrose from glycollic aldehyde, by H. Jackson. Tetrosazone and α- and θ- acrosazone are obtained from the condensation product formed by the action of soda on a dilute glycollic aldehyde solution at 0°; on prolonged condensation at 0°, the quantity of tetrosazone obtainable decreases.—The interaction of mercurous nitrite and ethyl iodide, by P. C. Rây. Mercurous nitrite and ethylic iodide react to form nitroethane and ethylic nitrite.—On mercurous nitrite, by P. C. Rây.—The action of alkyl iodides on the mercuric iodide sulphides of the fatty series, by S. Smiles. The alkylic sulphides combine with mercuric iodide to form compounds of the type R_2SHgI_2 containing tetrad sulphur; these substances when treated with methylic iodide yield compounds of the type R_3SIHgI_2 which possibly contain hexad sulphur.—On brasilin and hæmatoxylin, Part III., by A. W. Gilbody and W. H. Perkin, junr. The acid $C_{15}H_{16}O_6$ previously obtained from brasalin yields metahemipinic acid on oxidation; the latter acid is also formed during the oxidation of tetramethylhæmatoxylin. It is shown that brasilin is a derivative of resorcinol and catechol, whilst hæmatoxylin is a derivative of pyrogallol and catechol.—The action of alcoholic potash on monobromoglutaric ester, by N. E. Bowtell and W. H. Perkin, junr. Monobromoglutaric ester is converted by alcoholic potash into transtrimethylenedicarboxylic acid.—Luteolin, III., by A. G. Perkin.—The action of chloroform and potassium hydroxide on orthoamidobenzoic acid, by W. J. Elliott. Orthoamidobenzoic acid yields an aldehydoorthoamidobenzoic acid on treatment with chloroform and potash.—Azo- and hydrazone compounds differentiated by bromine, by H. E. Armstrong.

Linnean Society, Dec. 21, 1899.—Dr. A. Günther, F.R.S., President, in the chair.—Mr. W. G. Freeman exhibited a tree of *Hevea brasiliensis* (Parà Rubber), showing the method of tapping adopted in Ceylon.—Dr. R. Braithwaite exhibited specimens of *Hypnum Hochstetteri*, Schimp., collected by him on the Isle of Barra, Outer Hebrides, the only known locality for it in Europe, though found in the Azores and Canary Islands.—The Zoological Secretary communicated a paper, by Prof. T. W. Bridge, on the air-bladder and its connections with the auditory organs in the *Notopteridae*. The anatomy of the air-bladder, auditory organ, and associated parts was described in detail in *Notopterus borneensis*, it being shown that their condition was essentially the same for that species and *N. Pallasii*, and that Cuvier and Valenciennes had erred in regard to the latter by confusing the auditory cæca-containing and cranial cavities. Comparison was instituted with other Teleosteans in which the air-bladder enters into relationship with the occipital region of the skull, and the physiological significance of the facts was discussed.—Mr. F. Chapman read a paper on some new and interesting Foraminifera from the Funafuti Atoll, Ellice Islands. The specimens described, and illustrated by means of lantern-slides, comprised the larger forms found at Funafuti and on coral-reefs generally, together with a new genus (*Haplocatenia*) and eight new species.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 11.

MATHEMATICAL SOCIETY, at 8.—A Problem in Resonance, illustrative of the Mechanical Theory of Selective Absorption of Light: Prof. Lamb, F.R.S.—Elementary Distributions of Plane Stress: J. H. Michell.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Report of the Institution's Visit to Switzerland. The Report will be taken as read, and the discussion will be opened by Mr. Crompton by a Comparison between British and Continental Practice in Electrical Engineering.

FRIDAY, JANUARY 12.

ROYAL ASTRONOMICAL SOCIETY, at 8.—Note on the Variable Star η Argûs: Colonel E. E. Markwick.—Observations of Meteors, November, 1899: Royal Alfred Observatory, Mauritius.—Tables for Facilitating the Calculation of the Radius Vector and True Anomaly for Orbits of any Eccentricities: W. S. Aldis.—Note on the Physical Constitution of the Lunar Surface: George Forbes.—The Determination of Selenographic Positions and the Measurement of Lunar Photographs: S. A. Saunder.——*Probable Paper*: On the Unpublished Observations made with the Transit Instrument and Quadrants at the Radcliffe Observatory, Oxford, between the Years 1774 and 1838: Prof. A. A. Rambaut.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Theory of Structures and Strength of Materials: Prof. T. Claxton Fidler.

MALACOLOGICAL SOCIETY, at 8.—On some Recent Gastropods referred to the Family Turritellidæ and their Supposed Relationship to the Murchisoniidæ: Miss Jane Donald.—On the Anatomy of *Turritella communis*: W. Randles.—Note on *Strombus belutschiensis*, Melvill: E. A. Smith.—Descriptions of New Land Shells from Costa Rica, South and Central America: S. I. DaCosta.—On some Forms of *Cypraea* Mrs. A. F. Kenyon.

MONDAY, JANUARY 15.

VICTORIA INSTITUTE, at 4.30.—Notes on Oriental Congress, Rome, 1899 Theophilus G. Pinches.

TUESDAY, JANUARY 16.

ROYAL INSTITUTION, at 3.—Structure and Classification of Fishes: Prof E. Ray Lankester, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Papers to be further discussed*: The Purification of Water after its Use in Manufactories: Reginald A. Tatton.—Experiments on the Purification of Waste Water from Factories: W. O. E. Meade-King.——*And, time permitting, Paper to be read*: Swing-Bridges over the River Weaver at Northwich: J. A. Saner.

ROYAL STATISTICAL SOCIETY, at 5.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Screen Gears for Half Tone: W. Gamble.

WEDNESDAY, JANUARY 17.

SOCIETY OF ARTS, at 8.—Ventilation without Draughts: Arthur Rigg.

ROYAL METEOROLOGICAL SOCIETY, at 7.45.—Annual General Meeting.—Address on "A New Discussion of the Greenwich Meteorological Observations, 1848–1898": F. Campbell Bayard.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Annual Address by the President.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.—Address by the President, Mr. George Henry Verrall.

THURSDAY, JANUARY 18.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Upon the Development of the Enamel in certain Osseous Fish: C. S. Tomes, F.R.S.—Further Observations on "Nitragin" and on the Nature and Functions of the Nodules of Leguminous Plants: Miss Maria Dawson.—On the Innervation of Antagonistic Muscles, Sixth Note: Prof. Sherrington, F.R.S.—On the Behaviour of the Becquerel and Röntgen Rays in a Magnetic Field: Hon. R. J. Strutt.—On an Experimental Investigation of the Thermo-dynamical Properties of Superheated Steam by Prof. Osborne Reynolds' Method: J. H. Grindley.

ROYAL INSTITUTION, at 3.—The Senses of Primitive Man: Dr. W. H. R. Rivers.

SOCIETY OF ARTS (Indian Section), at 4.30.—Our Work in India in the Nineteenth Century: Sir William Lee-Warner, K.C.S.I.

LINNEAN SOCIETY, at 8.—On the Existence of Nasal Secretory Sacs and of a Nasopharyngeal Communication in the Teleostei: H. M. Kyle.—On the Origin of the Basidiomycetes: George Massee.

CHEMICAL SOCIETY, at 8.—Nitrogen Halogen Compounds: Julius Steiglitz and E. E. Slosson.—Chlorine Derivatives of Pyridine. Part V. Synthesis of αα′-Dichlorpyridine and Constitution of Citrazinic Acid: W. J. Sell and F. W. Dootson.—Action of Fuming Nitric Acid on α-Dibromocamphor: Dr. A. Lapworth and E. M. Chapman.—Electrolysis of Nitrogen Hydrides and of Hydroxylamine: Dr. E. C. Szarvasy.

FRIDAY, JANUARY 19.

ROYAL INSTITUTION, at 9.—Flight: Lord Rayleigh.

EPIDEMIOLOGICAL SOCIETY, at 8.30.

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