THURSDAY, OCTOBER 27, 1904.

HALLER'S COMPARATIVE ANATOMY.

Lehrbuch der vergleichenden Anatomie. By B. Haller. Pp. viii+914. Erste Lief., pp. vi+424, price 8 marks; Zweite Lief., pp. viii+425 to 914, price 12 marks; illustrated. (Jena: Gustav Fischer, 1904.)

IN his preface the author explains that his aim in writing this book was to produce a modern work on the lines of the second or last edition of Gegenbaur's "Grundriss der vergleichenden Anatomie," which was published twenty-four years ago. The book deals in a concise manner with the structure of all animals from the Protozoa to the highest Vertebrata. The character and mode of treatment of the subject will be sufficiently described by the statement that the author closely follows in Gegenbaur's footsteps. For his material he has drawn very largely from Gegenbaur's recent "Vergleichende Anatomie der Wirbelthiere" (1898 and 1901); but as he devotes much more space—almost half the book—to the Invertebrata than is given to this branch of the subject in the latter work, he has freely used the facts and illustrations found in the great treatises of A. Lang and Korschelt and Heider in compiling the first part.

The whole book, with the exception of the part dealing with the structure of the brain of vertebrates, concerning which the author has published some original memoirs ("Morphologisches Jahrbuch," 1898 and 1900), is obviously a compilation, and not from the original writings, but from such books (themselves of necessity largely compilations) as have already been mentioned. The result is what one would naturally expect. The book reproduces many of the mistakes of the works from which it is derived, and adds not a few misinterpretations which do not occur in these; the information is not up to date. The author is, for example, unaware of J. P. Hill's discovery of a placenta in the Marsupialia, and is apparently ignorant of Willey's work on Balanoglossus; the descriptions are disjointed and difficult to understand, such as would be written by one who has no adequate practical acquaintance with the facts, or has not digested the mass of pabulum with which he is dealing. Anyone who has had occasion to make use of the last edition of Gegenbaur's "Vergleichende Anatomie" knows to how great a degree this work fails to reach the high level of the first edition, which was written when the author was in his prime. In the last edition Gegenbaur relied in too many cases upon the immature work of young contributors to the "Morphologisches Jahrbuch" in preference to more trustworthy researches published elsewhere. All such faults are reproduced in Haller's book.

The attempt to cover so vast a field as the entire animal kingdom is such a colossal undertaking in the present state of knowledge that one hesitates before hastily passing judgment on the work as a whole. In such circumstances the reviewer naturally turns for an estimate to those parts of the book in which the author might claim to write as an expert. The portion dealing with the brain of the Vertebrata is almost entirely original.

The difficulty of understanding the author's meaning which characterises the greater part of the book is greatly increased in the case of the nervous system by his frequent abuse of terms and the needless invention of new names for structures which already have designations familiar to all anatomists. But, in addition, his account of the brain is so studded with inaccuracies that the mere enumeration of them would fill the whole space devoted to this review. It is sufficient to quote only a few from among many others equally astounding. While he correctly locates the caudal limit of the forebrain on the dorsal side at the posterior commissure, he places it on the ventral side at the junction between the mid- and hind-brain, which he calls "sulcus interencephalicus" (p. 623 and elsewhere). In reptiles, birds, and mammals he calls the paraterminal body (which in mammals becomes converted into the septum lucidum and the precommissural area) by the name "gyrus fornicatus"—a term which is employed by all other anatomists to designate a strip of neopallium above the corpus callosum (pp. 633 and 638 *inter alia*). To add to the confusion, he labels the fascia dentata in a marsupial brain "gyrus fornicatus" (p. 640). In figures of the brains of reptiles, birds, and a mammal (rabbit), he labels as "sulcus coronarius" furrows which are certainly not homologous the one with the other; and even in the mammal it is not the "coronary" but the "lateral" sulcus on which he has placed the label. On p. 638 he refers to the hippocampus as "part of the occipital lobe," and on the preceding page he states that the occipital lobe is separated from the frontal lobe in Echidna by the Sylvian fissure; by the latter term he refers to a furrow (*f*, Fig. 629), which resembles the Sylvian fissure neither in form nor in position. But the most erroneous and hopelessly muddled parts of his account of the brain are his numerous references to the cerebral commissures. He seems to imagine that the "fimbria" and "fornix" (names applied by anatomists to different parts of the *same* series of hippocampal fibres) are independent structures, and he refers to the fornix-commissure by the term "fimbria-commissure," and applies the former term in one place to a part of the anterior commissure, which has no connection whatever with the fornix, and in another place to the corpus callosum! To this amazing confusion he adds the further error of attributing to Phascolomys a corpus callosum like that of Erinaceus, and representing an utterly different state of affairs in Didelphys, whereas all marsupials lack a true corpus callosum.

His spelling of many terms is somewhat peculiar. As examples I might quote "thalam*o*cephalon" (p. 636), "rhin*o*cephalon" (p. 638), "*th*ela" (p. 637), and "corpus callos*i*" (in several places).

If we judge the whole work by the part to which the author has devoted his chief attention no condemnation of it can be considered too harsh. It is confused, inaccurate, and difficult to understand.

The book has one great redeeming feature in its numerous illustrations. They are, on the whole, well

chosen, clearly and yet artistically drawn, and excellently reproduced. The sources from which they were derived are indicated in some cases only, although a number of the unacknowledged figures will be familiar to the readers of zoological literature.

There is an unduly large number of misprints in the book, especially in the lettering and the inscriptions of the various figures. There is no bibliography.

G. E. S.

LIQUID CRYSTALS.

Flüssige Kristalle: sowie Plastizität von Kristallen im Allgemeinen, Molekulare Umlagerungen und Aggregatzustandänderungen. By Dr. O. Lehmann. Pp. vi+264; atlas of 39 photographic plates. (Leipzig: W. Engelmann, 1904.) Price 11. net.

WHATEVER may be the ultimate conclusion of physicists concerning the explanation of the interesting phenomena described by the author of this volume under the term "liquid crystals," and however diverse may be the views entertained as to their bearing on current molecular theories, there can be no difference of opinion as to the value of the work before us, in which the description of these phenomena is so clearly set forth and so fully illustrated.

It was in 1889 that Dr. Otto Lehmann, the professor of physics in the Technical High School of Karlsruhe, and the author of many memoirs dealing with the application of microscopical methods to physical research, first suggested the use of this term "liquid crystals." The acceptance of the term by physicists and crystallographers has not been by any means universal or unqualified, and in certain quarters it has been received with something like ridicule. The general attitude which, with our present knowledge of the subject, it may be wise to preserve was well expressed by Prof. Miers in an article upon the subject which he contributed to *Science Progress* of January, 1897:—

"It will be wise to retain the names crystal and crystalline in their old significations, rather than to extend them so as to include the birefringent liquids whose existence has been established by Lehmann. It may be that these remarkable drops are examples of liquid matter in which particles while free to move are compelled to preserve the same orientation, and differ in this respect from ordinary liquids. But whether this peculiarity of structure, whatever may be its nature, is really analogous to that of solid crystals is a question in which it will be better not to commit ourselves to an answer by applying the same name to both until more is known about the structure both of liquids and solids."

It is not probable that the present volume will materially affect the cautious verdict pronounced by Prof. Miers, seven years ago, on behalf of crystallographers and physicists, for although many new and interesting observations are added to those announced in Prof. O. Lehmann's earlier memoirs, there is nothing in the work before us which can be regarded as supplying absolutely conclusive or crucial evidence on the subject.

In his original memoir Dr. O. Lehmann was able to confirm the observations of Reinitzer and of Gattermann that certain organic compounds possess two melting points, and he showed that, at temperatures between these two melting points, the substances, though possessing the freedom of motion of liquids, affect polarised light like crystals, and, like crystals, exhibit the phenomenon of dichroism.

In the treatise under review the list of organic compounds exhibiting these remarkable properties is considerably augmented, though all the newly described substances are closely allied in their chemical nature to those previously known. Dr. O. Lehmann proposes to divide them into two classes—"Fliessende Krystalle," in which between the two melting points the crystal retains something of its original form, modified by the rounding of the edges and angles, though two of them brought into contact have sufficient mobility to enable them to unite; and true "Flüssige Krystalle," in which, although the original crystal form is wholly lost and the substance forms rounded and very mobile drops, the double refracting and other optical properties of the crystal are nevertheless retained. It is, however, admitted by Lehmann that the distinction between these two classes of substances is neither very definite nor of fundamental character.

It is impossible in the space at our command, even if such a course were desirable, to enter upon the discussion of the physical relations of solids and liquids which the author bases on his observations. On many points he arrives at conclusions in marked opposition to those maintained by Butschli, Nernst, Ostwald, and other physicists.

By the aid of the beautiful photographs, so admirably reproduced in the plates, and the numerous diagrammatic figures in the text, the reader will find it possible to follow and understand the very interesting observations of the author. The value of the photographs would certainly have been increased if, in every case, the degree of magnification had been indicated; and a detailed description of the plates with a good index would have added to the value of this very important treatise.

THE TESTING OF STEELS.

Relations between the Effects of Stresses Slowly Applied and of Stresses Suddenly Applied in the Case of Iron and Steel. Comparative Tests with Notched and Plain Bars. By Pierre Breuil. Pp. vii+152+23 plates. *Jour.* Iron and Steel Inst. Supplement, vol. lxv. (London: Iron and Steel Institute, 1904.)

CONSIDERATION of the subject of tests and testing should be approached with a very open mind, not only because it is the common meeting ground of the engineer and the metallurgist, but because it is a difficult subject of compromise, where the selected method is practically never ideal. Steel is necessarily as often submitted to tests which it is hoped will give a measure of its qualities as to those stresses to which it will be exposed in practice. The latter is the practical ideal test short of behaviour in actual use, which is seldom feasible, as often the finish of the test would require to be left to another generation. Thus the real purpose of tyres or rails is to wear well without breaking; nevertheless, they are often tested

to destruction by a falling weight, and the material invariably so in tension.

Again, some members of a girder are in tension, others in compression, while practically all are passed on the measure of their qualities given by the tensile test. For a certain elastic limit and maximum stress the highest elongation and reduction in area are assumed to indicate the toughest steel. For materials where great toughness is of paramount importance, the tensile, cold bending, and even quenched bending are typical tests, and on the whole they have served well; but in perhaps one case out of many thousands mild steel snaps in use without elongation after satisfying all ordinary tests for ductility. Cases such as these, which, though rare, may entail great loss of life or, as in the case of certain parts of vessels of war, might mean disaster to a whole crew, have probably been the exciting cause which has set men on the search for some means of detecting these rare cases where the risk would justify the extra expense.

It is evident that this case of one in thousands cannot be touched by experiments on (to quote the author) "no less than five tons of various kinds of specially manufactured metal," for that particular one must be found by the real test of failure in ordinary use and experiments made on it. The author's unconditional advocacy of the plain tensile and bending tests, and scornful reference to the others, indicates either that he is happy in a paradise which need not be specified or that many eminent practical and scientific engineers and metallurgists are at the present day unnecessarily anxious. No one would advocate the abolition of the tensile tests, as they are required for the engineer's calculations, and are generally a sufficient guarantee of trustworthiness. The sole contention is that in certain special cases something more is necessary.

The reviewer has been engaged during the last two years with Prof. Arnold on this very matter, subjecting steels known to have failed in use to Arnold's alternating stress and other tests with a view to find a practical system which will eliminate those possessing this curious brittleness. Two steels, one the best modern make of boiler plate, the other a steel which gave passable tensile tests and bent close double without a sign of distress, yet broke during the official hydraulic tests, gave very different results under the special alternating stress test. These statements having reference to facts, no study of comparative tests on specially manufactured steels can strike at the root of the matter. Although to certain mechanical testers and men of figures the variations in some of the results from the newer methods may look somewhat formidable when presented as percentages, the fact remains that these tests have picked out dangerous steels which had satisfactorily passed tensile and bending tests. Therefore some such new system of testing claims the special attention of the designer of high-speed and other work where large issues, and possibly loss of life, would be involved by the failure of a member.

This volume is the Carnegie gold medal thesis for the year, and deals with experiments on tensile tests, on plain and on notched bars, slowly applied. Many figures are given on the effect of size and form of notch. Plain and nicked bends slowly applied and as impact tests are also considered, but excuse is made that the subject is so large that it could not be adequately dealt with. The present writer is firmly convinced that it would count more for real solid progress if the Carnegie scholars were encouraged to take a smaller field and explore it more thoroughly, for to a steel metallurgist a brief paper embodying definite and concrete results is far more valuable than a voluminous and indefinite thesis. It is worthy of note that the 0·7 per cent. and 0·4 per cent. carbon steels contained 0·34 per cent. and 0·22 per cent. silicon respectively, amounts that would debar their acceptance under British specifications, not on account of the tensile tests, but because of their suspected greater liability to break under vibration. A. McW.

CHEMISTRY OF THE PROTEIDS.

Chemie der Eiweisskörper. By Dr. Otto Cohnheim. Zweite Auflage. Pp. xii + 313. (Brunswick: Vieweg und Sohn, 1904.) Price 8.50 marks.

ALTHOUGH only four years have elapsed since the first edition of this work appeared, the great advances made in our knowledge of the chemistry of the proteids have necessitated a considerable revision of the book. The author, however, has found it possible to avoid any enlargement of the work by altering the order of subjects treated, and by stating the facts more concisely than in the previous edition. Some of the alterations in arrangement appear somewhat difficult to justify. Thus, for example, in the earlier edition the physical characters were dealt with prior to the consideration of the more purely chemical properties of the proteids, while in this edition the order is reversed. As the first edition has been already reviewed in NATURE, only a brief account of the chief additions to the second will be necessary.

Perhaps the most important recent additions to our knowledge have consisted in the more complete separation and identification of the products of the hydrolytic decomposition of the proteids. Dr. Cohnheim gives an excellent account of the results obtained in this field by E. Fischer and his pupils by means of the method of fractional distillation under reduced pressure of the ethyl esters of the amino-acids. This method has secured a much more complete separation of the amino-acids than any methods previously employed, although the results obtained are still far from quantitative. By its use E. Fischer has been able to prove that certain amino-acids, namely, α-amino-valerianic and α-amino-β-oxypropionic acids, are much more widely distributed products of proteid hydrolysis than has been hitherto supposed. Fischer has also succeeded in separating two acids, namely, α-pyrrolidincarboxylic and oxy-α-pyrrolidincarboxylic acids, which were hitherto unknown as products of the decompositions of proteids. The latter acid was isolated from the residue remaining after distilling off the esters of the amino-acids. A full account is also given of recent work on the more complete chemical characterisation of the amino-acids, including the separation of several into optically active isomers.

The isolation and determination of the probable constitution of tryptophane by Hopkins and Cole, and that of oxyphenylæthylamine by Langstein and Emerson, may also be mentioned as some of the most important additions to our knowledge of the products of the hydrolysis of the proteids by the action of trypsin. Dr. Cohnheim appears to have omitted to mention the discovery of the latter substance.

Our knowledge of the chemistry of the diamino-acids and other basic products of hydrolysis has not been so markedly increased. The constitution of histidin has not yet been determined, although the evidence so far obtained points to it being a pyrimidine derivative. The discovery by Herzog that it gives the biuret reaction is of much importance in view of the fact that this test has been used to distinguish between the more complex products of proteolysis which still retain proteid characters and the simpler chemical bodies resulting from more complete decomposition.

The tables compiled by Dr. Cohnheim which give the nature and quantity of the products of hydrolysis of various proteids and albuminoids form a very useful addition to the book.

The third chapter of the general part of the work gives an interesting account of the chief views held with regard to the constitution of the proteids. The most interesting advance in this field is due to E. Fischer, who has shown that the amino-acids possess in a marked degree the power of reacting with one another to form more complex bodies. The prototype of these substances—glycylglycin—results from the union of two molecules of glycin with the elimination of the elements of water, the amine group of the one molecule reacting with the carboxylic group of the other to form an amide. By extending this synthesis Fischer has succeeded in preparing compounds of three or more molecules of various amino-acids to form compounds which he terms polypeptides. Some of the more complex polypeptides resemble peptones in many of their chemical properties.

In the special part of the work the section on the proteids of plants has been much extended. The section on nucleoproteids gives a good account of recent work elucidating the constitution of the pyrimidine derivatives, uracil, thymin, and cytosin. Considerable additions, embodying the work of Nencki and Zaleski, and of Küster on the decomposition of hæmatin, have also been made to the chapter on the blood pigments.

The second edition of the work well maintains the high standard for completeness and accuracy secured by the first one.

OUR BOOK SHELF.

Elements of General Radio-Therapy for Practitioners. By Dr. Leopold Freund, Vienna. Translated by Dr. G. H. Lancashire. Pp. xix+538; illustrated. (New York and London: Rebman, Ltd., 1904.) Price 21*s.* net.

Dr. Freund is so well known to English workers in electrotherapeutics that any work written by him will be welcome. To his earliest writings the profession is largely indebted for the first experimental work in radio-therapy, and the results were sufficient to indicate the possibilities of X-rays in therapeutic work as well as in diagnosis. The work before us shows that Dr. Freund has based his experimental research upon a thoroughly scientific knowledge of what has been done by others as well as by himself, and consequently all workers with X-rays will feel indebted to him for his book and gratefully acknowledge this.

In his preface Dr. Freund states that he has attempted to bring the essential features of a recent form of treatment before the notice of a larger circle of medical men, that he has tried in a comprehensive way to explain the technique, the indications for treatment and the results to be expected, while at the same time tabulating and arranging the fundamental physical laws so as to explain the physiological effects. That he has succeeded no one will doubt who reads the work, and that the views of others have not been forgotten is made evident by the fact that he quotes more than eight hundred writers upon the subject. The author admits that this branch of science can hardly be said to be more than in its infancy, that there are gaps in our knowledge to be filled in and errors to be corrected; but notwithstanding the doubt expressed in some quarters we have already achieved brilliant theoretical and practical results which lead him to hope that radio-therapy will obtain an acknowledged place among our methods of treatment. In support of this view he says one need only refer to the undeniable and astonishing results already achieved in skin disease.

After a short but expressive introduction referring to the physical aspect of the question, Dr. Freund divides the work into five sections. The first deals with the elements of electricity, and this section should be useful to medical practitioners who are desirous of obtaining the acquaintance with physics necessary to understand this special branch of surgery. The second part treats fully of high-frequency currents, the third section is devoted to X-rays, the fourth to Becquerel rays, and the fifth to treatment with heat and light rays.

A careful perusal of the different chapters will convince anyone that Dr. Freund has fully succeeded in his aims; and that the text-book under notice will become a popular one is certain. That it will be regarded as one of the standard works on the subject no one can doubt.

English workers are largely indebted to Dr. Lancashire for his excellent translation of the work, and to Mr. Clarence A. Wright for his notes on instrumentation published in connection with the English edition, which are introduced at the end of the book.

The whole is clearly and scientifically written. There are one hundred and seven illustrations taken from the original text, and the author, translator, and publisher are to be congratulated upon the success of their efforts.

Physiography. An Introduction to the Study of Nature. By T. H. Huxley. Revised and partly rewritten by Prof. R. A. Gregory. Pp. xi+423; with 301 illustrations. (London: Macmillan and Co., Ltd., 1904.) Price 4*s.* 6*d.*

The task of revising and bringing up to date Huxley's inspiring text-book of physiography was one not to be lightly undertaken, but it could not well have been placed in better hands than those of Prof. Gregory. In spite of the many fine qualities of the original volume, and of the author's belief that its methods could be adapted with little difficulty to any locality by an intelligent teacher, it can scarcely be questioned that the usefulness of the book was somewhat restricted by its special reference to the Thames and its basin.

In its new form, however, the book no longer specially appeals to those who dwell in this neighbourhood, but is equally applicable to any river basin.

While the value of the book is undoubtedly much enhanced by the judicious additions which have been made to the text, the most notable feature of the new edition is the abundance of excellent illustrations. The majority of these are from actual photographs, and depict a great variety of natural objects and phenomena, among which are clouds, glaciers, volcanoes, earthquakes, and geological structures. This unique collection of photographs, each of which is of real value, makes the book of quite exceptional interest, and it is pleasant to learn that many of the pictures have been generously contributed out of regard for the memory of Huxley. The scope of the subject, as here set forth, is such as to make it the natural complement of the "nature-study" which refers chiefly to the various forms of life. That is to say, it is regarded entirely as an introductory subject, dealing with inanimate nature; and it may be remarked that it does not unduly encroach on the domains of physics, chemistry, or astronomy. We are glad to note that instructions for practical work, which is obviously essential to make the study of the greatest educational value, are in course of preparation. Meanwhile, the present book will be heartily welcomed as a clear, attractive, and trustworthy introduction to the study of science. A. F.

Die Theorie der Direkten Anpassung und ihre Bedeutung für das Anpassungs- und Deszendenzproblem. Versuch einer methodologischen Kritik des Erklärungsprinzipes und der botanischen Tatsachen des Lamarckismus. By Dr. Carl Detto. Pp. 214; mit 17 Abbildungen im Text. (Jena: Gustav Fischer, 1904). Price 4 marks.

Of two well-known tenets of Lamarckism, the inheritance of acquired characters, and the power of "direct adaptation" on the part of the individual organism, the consideration of the former is relegated to a few pages at the end of the present work, which is mainly concerned in combating the latter. This pro-Darwinian book is, in fact, occupied in an endeavour to prove that individual organisms possess no mysterious and inexplicable power of adjusting themselves to their surroundings, and that from this point of view the theoretical basis of Lamarckism is unsatisfactory. The first two chapters largely deal with psychological considerations, terminology, and definitions. The third chapter quotes and considers the views of Lamarck, H. Spencer, Eimer, Warming, von Wettstein, and others, so far as they relate to "direct adaptation." The fourth chapter (pp. 81–188) is devoted to the discussion of the facts and phenomena that are usually cited as demonstrating the power of direct adaptability on the part of individual organisms, and to alternative explanations of these. It is this chapter that will appeal most to the busy botanist, who, after ascertaining the meaning of the two new terms "œcologism" and "œcogenesis," may find it advisable to commence the book at this point. The following selected headings suffice to illustrate the kind of subjects dealt with:—methods of interpretation of the facts of "direct adaptation"; direct adaptation in bacteria, fungi (including a discussion of a biological species of Uredineæ), and Euglena; physiological adaptation among highly organised plants (races produced by nutrition, climatic adaptation in respect to duration); structural adaptations among highly organised plants (œcological convergence of types; parallel variation in xerophytes, hydrophytes, halophytes; shade-leaves).

The Photographic Reference Book. Edited by J. McIntosh. Second edition. Pp. 344. (London: Iliffe and Sons, Ltd., 1904.) Price 1*s.* 6*d.* net.

The first edition of this book was chiefly compiled by using the columns devoted to answers to correspondents of *Photography* as a basis, the work being undertaken by Messrs. W. A. Watts and Henry Sturmey. In the present issue the material has been largely rewritten and much new matter added, so that the book may be considered as practically a new one. The editor has, however, confined himself to the original object for which the book was written, namely, a worker's handbook, and as such the reader will find that the present volume is a handy and useful *vade mecum.* The great point about a work of this character, if it is to be useful, is the facility with which any information that is desired can be found and correctly given. Both these desiderata are here, for a capital index supplies the former and the paragraphs under the different headings complete the latter. Many subjects were chosen at random, and in each case the facts required were easily found and fully given. As a book of reference this issue should be the companion of many photographers.

Transactions of the South African Philosophical Society. Vol. xiii. Part i. Pp. 1–293; plates 1–4 (43–46 of the whole series). Descriptive Catalogue of the Coleoptera of South Africa (Lucanidæ and Scarabæidæ). By L. Péringuey. (Cape Town, 1904.)

An exceedingly valuable synopsis of South African Coleoptera, chiefly by Mr. Péringuey, the worthy successor of Mr. Trimen in the South African Museum, is at present being published in the above named *Transactions.* Vol. xii. was devoted to the descriptive catalogue of Lucanidæ and Scarabæidæ, and vol. xiii., a goodly instalment of which now lies before us, continues the subject. It includes the subfamilies Sericinæ (tribes Sericini and Ablaberini) and Melolonthinæ (tribes Pachypodini, Sparrmannini, and the first four groups of the Melolonthini). Many of the species figured are very handsome, resembling in miniature the magnificent Goliath beetles of the west coast of Africa. The work is too highly technical for detailed notice here, but the excellent tables and descriptions of genera and species will render it very useful to students of South African Coleoptera. We hope in time to possess equally elaborate works on the insects of all the British colonies. W. F. K.

Toning Bromides and Lantern Slides. By C. Winthrope Somerville, F.R.P.S. Pp. 72. (London: Dawbarn and Ward, Ltd., 1904.) Price 1*s.* net.

This is a collection of formulæ for many methods, practically, perhaps, all the methods in use, for toning "bromide" prints. Lantern slides do not appear to be mentioned in the text, and it can hardly be supposed that all the processes given are available for them, as, for example, the "hypo and alum, or 'boiling' process." Perhaps in future editions this part of the subject will receive more attention. The author is enthusiastically in favour of the choice of bromide printing rather than the other methods of photographic printing available. To him it is "the ideal of the present day." He actually compares it with platinum and carbon printing to the disadvantage of these for fineness of result, and claims for it an equal permanency. Of course many will not agree with the author in this, but it is an advantage to have the formulæ preferred by one who thoroughly believes that the process treated of is altogether the best, and to have the results of his experience.

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.]*

Further Discovery of Dodos' Bones.

SINCE the astonishing discovery, in 1865, of innumerable bones of the dodo in the peat of the Mare aux Songes by Mr. George Clark, of Mahébourg, in Mauritius (*Ibis*, 1866, pp. 141–146), whereby Prof. Owen was enabled to describe the greater part of the skeleton of that remarkable bird (*Trans.* Zool. Soc., vi. pp. 49–80), and the subsequent researches at the same place of Mr. Sauzier in 1889, the results of which, when worked out by Sir Edward Newton and Dr. Gadow (*Trans.* Zool. Soc., xiii. pp. 281–302), almost wholly completed our knowledge of its osteology—besides affording evidence of the former existence of other contemporary species now extinct—nothing more has been recorded on the subject.[1] It was therefore with great interest that, just five years ago, October, 1899, I received a letter from M. E. Thirioux informing me of his having found, in the preceding month of August, some remains of at least two dodos in a small, partly collapsed cave, about 800 feet above the sea, and about two miles and a half from Port Louis. Encouraged by this success M. Thirioux continued his operations, a matter of some difficulty, not to say danger, from time to time, and was good enough to keep me acquainted with many of the results, sending me photographs of the bones which he was fortunate in disinterring from the soil. They were not all dodos' bones, but some belonged to other extirpated forms of birds—as the brevipennate parrot (Lophopsittacus), the "Poule Rouge" (Aphanapteryx), and the coot—and reptiles—as Didosaurus and one or more of the land tortoises—all of which are very imperfectly known, while some of the small dodo bones are of great rarity, and at least one of them (the pygostyle) had not been seen before. From that time until very recently M. Thirioux has been continuing his researches, and has consequently formed a very considerable collection, which he now writes to me he has disposed of to the Museum of Mauritius, and I can but express the fervent hope that some competent person may be found to work it out and publish a memoir on it which will be a worthy successor to those that I have already mentioned. ALFRED NEWTON.

Cambridge, October 20.

The Forest-pig of Central Africa.

THERE are two good mounted specimens of the forest-pig in the Museum of the Congo Free State at Tervueren, near Brussels, where I had the pleasure of examining them in July last. M. A. Dubois, conservator of the Royal Museum of Natural History at Brussels, told me that he intended to describe the animal in conjunction with Dr. Matschie, of Berlin, but I am not aware that their description has yet been published, so that I hope the forest-pig may remain known by the excellent name Hylochœrus, proposed for it by Mr. Thomas.

As regards the "third mysterious animal" of the Congo Forest alluded to by Sir Harry Johnston in his letter on this subject (NATURE, p. 601), I have little doubt that it was the fine antelope of the genus Tragelaphus, lately described by Mr. Thomas as *Bacocephalus euryceros isaacsoni* (*Ann. Nat. Hist.* (7), v. p. 310, and *Proc.* Zool. Soc., 1902, ii. p. 319). The first pair of horns of this species was obtained by Mr. F. J. Jackson in 1897 (see *Proc.* Zool. Soc., 1897, p. 455), but it is only recently that the perfect specimen which now adorns the mammal gallery of the British Museum was procured.

The "abnormally developed horns of the cow eland" referred to by Sir Harry Johnston have nothing to do with this antelope. They will be found fully described and figured in the "Book of Antelopes" (vol. iv. p. 209).

P. L. SCLATER.

[1] Some reputed dodos' bones, said to have been found in a cavern (*Proc.* Zool. Soc., 1885, p. 719), turned out to be turkeys' (*op. cit.*, 1890, p. 402).

Average Number of Kinsfolk in each Degree.

THE letter you forward to me from Prof. G. H. Bryan gives an opportunity of discussing the question somewhat more thoroughly than space allowed in my brief memoir of September 29.

The writer says:—"Is Dr. Galton's deduction of $d-\frac{1}{2}$ correct? I should have thought that if a parent had d male and d female children, each female child would have $d-1$ sisters and d brothers."

The objection holds good only on the erroneous supposition that each and every family of $2d$ children consists of d boys and d girls; it does not hold good on my supposition that each such family contains *on the average* d boys and d girls. The inclusion of the omitted word introduces a new set of considerations. They depend on the variety of the possible forms of combination of boys and girls in $2d$ children, which are $2d+1$ in number, and on the frequency of each of these forms, which is given by the $d+1$ terms of the binomial expansion of $(1+1)^{2d}$. The exact character of the process concerned is clearly appreciated by thoroughly working out some particular case, say that of $d=2\frac{1}{2}$, where the number of children, $2d$, in each family will be 5. There are then 6 possible combinations of boys and girls, forming 6 different classes, shown in the first three lines of the table.

(1)	Classes	I.	II.	III.	IV.	V.	VI.	
(2)	Boys in each family	5	4	3	2	1	0	
(3)	Girls in each family	0	1	2	3	4	5	
(4)	Sisters in each family ...	—	—	2	6	12	20	Totals
(5)	No. of families in each class	1	5	10	10	5	1	32
(6)	Girls in all the families ...	—	5	20	30	20	5	80
(7)	Sisters in all the families...	—	—	20	60	60	20	160

In line (4) is shown the number of sisters in any *one* family of each of these classes ($n.(n-1)$ sisters to n girls). Thus in each family in class vi. there are 5 girls, consequently $5\times4=20$ sisters, in class v. there are 4 girls, and $4\times3=12$ sisters, and so on. The total number of combinations of boys and girls in a family of 5 children $=2^5=32$, which are distributed into six classes according to the familiar binomial fashion as above; these are shown in line (5). Multiplying each entry in (5) with that in the same column in (3) we obtain line (6), which shows that the total number of girls in the 32 families is 80 ($=2\frac{1}{2}\times16$, as it should be). Multiplying similarly the entries in (5) by those in (4) we obtain line (7), which shows that the 80 girls have between them 160 sisters; consequently each girl has on the average 2 sisters. This is identical with my $d-\frac{1}{2}$.

I have made similar calculations for values of $d=1$, $1\frac{1}{2}$, 2, $2\frac{1}{2}$ (above), and 3. In each case the result is that a girl has on the average $d-\frac{1}{2}$ sisters. It may therefore be assumed that the reasoning by which I originally arrived at that deduction is correct.

Before concluding, I should like to direct attention to a slip of the pen in the last line but one of my memoir, which somehow escaped correction; the term $d=5$ should have been $2d=5$. The context corrects the mistake, which may nevertheless puzzle the reader for a while.

FRANCIS GALTON.

Mendel's Law.

IN his letter of last week detailing his most interesting experiments on cross-bred maize, Mr. R. H. Lock makes the following statement:—"I see from the published account of a recent discussion at the Cambridge meeting of the British Association that the facts of Mendelian segregation are still disputed by the biometric school of evolutionists." Now it is easy to make a general statement about some vaguely defined group of men, and I have no right to speak for biometricians as a body. But as inventor of the term *biometry*, I may perhaps be allowed to say what I understand by it as a science, and to restate what I said with some emphasis at the Cambridge meeting. Biometry is only the application of exact statistical methods to the problems of biology. It is no more pledged to one hypo-

thesis of heredity than to another, but it must be hostile to all treatment which uses statistics without observing the laws of statistical science. The criticism which has been published in *Biometrika* upon Mendelian work has attacked its too frequent want of method and of logic, and I think no one can have read recent literature without seeing that the criticism has been effective in its aim. Even Prof. Tschermak now allows a large influence to ancestry, although he asserts that the offspring are not distributed "in the proportions of Galton and Pearson." As I have never distributed the offspring in *fixed* proportions, I may perhaps be content with the admission.

I have headed my letter "Mendel's Law," but the difficulty is to know what is understood by this term. Mr. Lock reproves me in his "Studies in Plant Breeding in the Tropics" because I distinguished a theory of the pure gamete from pure Mendelianism, for I thought, and still think, Mendel himself considered "dominance" an essential part of his system. Another Mendelian protagonist, Prof. Castle, in his last paper writes:—"The basic principles of Mendel's law are two, the principle of dominance and the principle of segregation." Which view is the correct one? If Mendel's law be limited to its earliest form, then it may cover Mendel's own observations and Mr. Lock's maize, but there are many other cases of segregation which it does not cover. So far as I am aware, the only attempt to carry out any form of Mendelianism to its logical conclusion was produced by one biometrician at the suggestion of a second. I refer to my memoir in the *Phil. Trans.*—"A Generalised Theory of Alternative Inheritance with Special References to Mendel's Laws." Even then we did not succeed in making the fundamental hypotheses wide enough to cover the case of man, but we did show—what must be obvious on consideration—that a *description* by modern statistical methods of actual observations need not, as such, be itself opposed to any physiological hypothesis. Out of Mendelianism came on analysis the condemned "law of regression" and the diminishing correlations of the "ancestral law" whenever a population springing from hybrids mated at random.

One might at least have hoped that this result would have demonstrated how idle it is to contrast a school of "Mendelians" with one of "Ancestrians." It is, I fear, however, vain for the biometrician to try and right himself with the non-mathematically trained biologist. Notwithstanding that in every generation dealt with in my memoir the fundamental idea of Mendel is accepted and the recrossing of the parental forms with each member of the generation occurs and is treated as giving its Mendelian result, Mr. Lock in his "Studies in Plant Breeding" states that I entirely ignore Mendel's demonstration of the truth of his hypothesis by the process of recrossing with the parental form. The only ignoration seems to be one on Mr. Lock's part of what lies behind the mathematical symbols. What, then, is the Mendel's law for which Mr. Lock provides a "crucial experiment"? The mere fact of segregation? Two grey-eyed human parents will produce blue- and brown-eyed children; this has been long known, and is equally crucial. The segregation of *recessives* in certain cases in the proportion of a quarter? This is a fact, but, accepting the fact, is it needful to accept Mendel's theory to describe it? For Mr. Lock's maize, as for mice, we may fairly ask where the other homozygote is before we accept the experiments even as complete cases of the old simple Mendelianism. But Mr. Lock tells us that not even in 1900 did Mendelians suppose Mendel's law to hold good for all characters in all species. The experiment is therefore clearly not "crucial" for heredity at large. It is of interest, great interest, as adding to the number of things in which a Mendelian proportion of 1 in 4 holds for recessives. Will anyone explain why the absence of colour bulks at present so largely in the characters for which this proportion holds? There must be some physiological ground for it.

KARL PEARSON.

The Formation of Polonium from Radium.

THE idea has for some time been afloat that the polonium found in radio-active minerals is a product of the radium that they contain. I have recently made an experiment which seems to afford considerable evidence that this is the case. Some radium salt of quite low activity (barely sufficient to produce fluorescence), which has been in my possession four years or more, was dissolved in water, and some cupric chloride added. The solution was precipitated with sulphuretted hydrogen (the copper served to give a manageable quantity of precipitate).

The sulphide was very active. It was dissolved in nitric acid, and a plate of bismuth immersed in the solution, in order to collect polonium, after Marckwald. This plate became intensely active, giving α rays only. The activity was sufficient to light up a blende screen. The rays showed diminished penetrating power the further they had penetrated; their initial penetrating power was exactly the same as that of the rays of the polonium from pitchblende.

I think it will be agreed that the activity of this bismuth plate may be regarded as due to polonium. Its activity has not yet diminished. The question remains, was this polonium part of the original mineral, or has it been generated since? It is difficult to believe that the radiferous barium could have been freed from copper, bismuth, and the other metals in pitchblende, without being freed from polonium too.

I am making fresh experiments to see whether the formation of polonium can be traced in a radium solution initially quite free from it.

R. J. STRUTT.

Terling Place, Witham, Essex.

Misuse of Words and Phrases.

UNFORTUNATELY a good style of writing English is not a strong point among men of science, especially mathematicians. The chief defects may, I think, be classed under three heads. First, grammatical errors, such as *Bessel functions, the Faraday effect, an uniform density* instead of *Bessel's functions, Faraday's effect* and *a uniform density*. Secondly, the use of uncouth, inelegant, and inaccurate phrases, such as *coal-stuff-gas, stretch-squeeze ratio, non-singular cubic or quartic curve*. Thirdly, a vague, obscure and slovenly mode of constructing sentences, whereby the author envelops his meaning in a cloud of mystery instead of enlightening the understanding of his readers. In fact, the sentences of some authors are so inartistically worded as to produce the impression that they labour under the delusion that a vague and obscure style of writing is evidence of profundity, whilst a clear and lucid one betokens shallowness.

The English language is by no means an easy one to write clearly and concisely, which is due to various causes, amongst which may be mentioned the absence of declensions. In Latin the nouns to which two pronouns respectively refer are always known if (as frequently happens) their genders are different; but in English considerable care is often required in the arrangement of a sentence so as to avoid ambiguity.

As regards the choice of language, there are two cardinal rules to be observed. In the first place, words are to be construed according to their natural and literal meaning unless there is something in the context to show that they are used in an artificial or secondary sense; secondly, lucidity and brevity ought always to be aimed at, and circumlocution and verbosity avoided.

October 22. A. B. BASSET.

The British Association and Referees.

THE correspondence in NATURE some time ago respecting referees induces me to send you the following singular example of their unbusiness-like ways in the hope that greater care may be exercised in the future.

I submitted a radium paper to Section B for the Southport meeting. It was accepted; the usual proof was printed, revised by me and returned. *At* Southport it was decided by a joint committee of Sections A and B that the radium papers held by the latter should be handed over to Section A. This was done. It appears that my paper, now in new hands, was submitted to a referee and condemned. At the close of the meeting I was informed of the fact by the assistant general secretary. In the meantime, however, in reply to my personal inquiries, I had become acquainted with the state of things, and ventured partly to express my views on radio-activity at the discussion in Section A. In the sub-

sequent report of this discussion in your Journal these views were suppressed. The abstract of the rejected paper was printed in the annual report of the British Association, just issued, among the Section B papers, from the officers of which section I had received uniform courtesy and consideration throughout the transaction.

Now such a joint resolution as I have mentioned ought to have precluded any referee from rejecting a paper which had already been approved, and I have to suggest that a by-law be framed to render an occurrence of this kind impossible in the future. WILLIAM ACKROYD.

Striped Hawk-moths in Sligo.

THERE has been a letter or two in recent numbers of NATURE on the finding of rare moths in England. It may be of interest to the writers to know that in the middle of last September there was caught in the town of Sligo a specimen of the striped hawk-moth. It was captured in the printing office of the *Sligo Independent*, its great bulk first attracting attention and then its beautiful markings. I know but very little about insects, the honey bee excepted, but I carefully compared the living object with a description and coloured plate in a work on Lepidoptera, and have no doubt but that it was the very thing your correspondents are making so much ado about. It is now preserved in a little collection of Mr. Irvine (Ratcliffe Street), but the gorgeous colouring has all gone, and the striping is barely traceable. I have been told that another exactly similar moth was found last year a few miles from Sligo along the sea coast.

I never noticed one of these insects before, but if it be such a rarity in the British Isles as your correspondents seem to hold, it is easy enough to account for its presence in the present instance. Sligo is a sea-port town, and in August last a cargo of timber from, I was told, South America was discharged. Most likely the eggs came over in the timber and were here hatched out.

JOSEPH MEEHAN.

Creevelea, Drumkeeran, co. Leitrim.

THE SIMPLON TUNNEL.

AS the Simplon Tunnel is rapidly approaching completion, natural curiosity is aroused as to the extent to which the accuracy of the alignment has been attained. This is a riddle which can only be answered when the last metre of rock has been removed and the two headings unite.

It was hoped that this international meeting of Switzerland and Italy, under Mont Leone, would take place in October, but in consequence of unexpected difficulties which occurred early in September, it is probable that the actual junction will not occur so soon.

The setting out of the centre line of the tunnel is done every month by the company and contractors, but, in addition to this, the work is checked several times in the year by the Government engineers. On these occasions the work in the tunnel is entirely suspended, so as to ensure that the atmosphere for the entire length shall be bright and clear. A small slit of light is thrown into the tunnel by means of a powerful lamp, and by the aid of theodolites this is taken right up to the working face. It is anticipated that when the actual meeting occurs the error in level will be nil, and that the error in direction will be under eighteen inches.

As our readers know already, the length of the tunnel will be 12¼ miles, all of which has been penetrated with the exception of a short distance of about 260 yards near the middle. The work consists of two single line tunnels 50 feet apart, axis to axis, and the object of having two tunnels in place of one has been fully justified by later experience, and for the following reasons. The ventilation is much more efficient, one tunnel being used as an "intake" for fresh air, which is blown in by powerful high-speed fans working with a water-gauge of nearly 9 inches, the other being the outlet; in case of derailment of a train occurring it cannot possibly run into a train in the opposite direction; when repairs are required one tunnel can be closed for a time, the traffic being conducted in the other; and finally, which is most important, the crushing weight of the material overhead is much more easily dealt with than it would be in a double line tunnel. When it is remembered that the overlying rocks extend to a height of 7005 feet, and that the workmen are at the enormous distance of nearly 1½ miles below the surface, or 50 per cent. more than man has ever been heretofore, it will be realised that not only is the pressure enormous, but the heat is also great; in fact, the pressure which has been encountered is so great that in one place the arching, consisting of granite blocks, is 2 metres in thickness. The tunnel is arched throughout, as it was deemed advisable that no risk should be incurred of even a

FIG. 1.—The Great Spring, 12,000 gallons per minute.

FIG. 2.—The Brandt drill at work at the "face." Daily progress 18 feet. Size of heading 10 feet × 6 feet.

small fragment of rock falling on to the permanent way.

In order that the present condition of the work may be better understood, a longitudinal section along the line of the tunnel is given, drawn to a small scale; and, with a view to illustrate the facts better, the gradient is very considerably exaggerated.

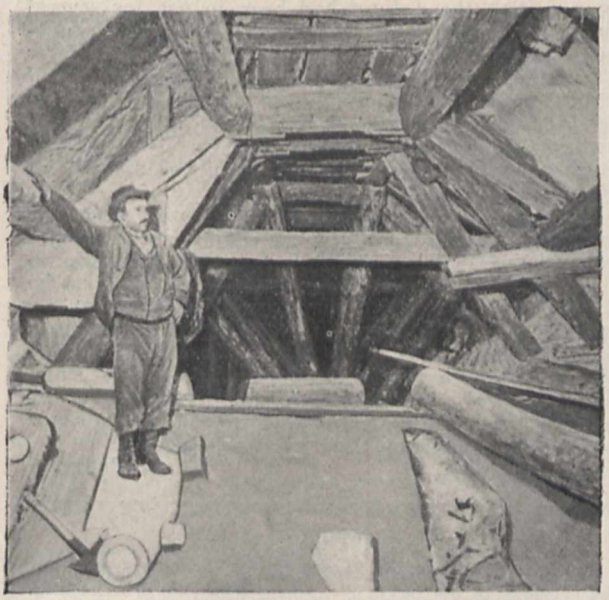

FIG. 3.—The timbering of the tunnel—six miles from the entrance.

It will be noticed that the gradient rises from each end of the tunnel towards the middle, the object of which has been to provide efficient drainage from the face, and it is an instance of the prudence which has been exemplified throughout the entire work that this system was adopted from the commencement. In driving a heading forward under a mountain, it is a matter of very common occurrence that springs of water are encountered; consequently, on the ascending gradient, the water flows away by gravity from the workmen; but should the work be carried out on a descending gradient, then the water accumulates where the men are working, not only causing them inconvenience and delay, but requiring to be pumped out over the highest point of the rails. In order to prevent delay, this was done for some considerable distance; but in consequence of a hot spring being encountered at the "face" on the Swiss side it was deemed necessary to withdraw the workmen, and the tunnel between points A and B has become filled with hot water.

At each end of the tunnel—Brigue at the north portal, and Iselle at the south or Italian entrance—a large and well equipped installation is provided for carrying on the works, and each of these is provided with machinery of sufficient capacity and power to serve for half the distance, that is, to the summit of the tunnel at A.

The work of actual perforation at Brigue and Iselle began in August, 1898, by hand, and by Brandt drill in December, 1898. When, however, the advance from the Italian entrance had reached a point between 15 and 16 kilometres, the great spring of 12,000 gallons per minute was encountered. This caused a delay of several months, thus throwing back the progress very considerably. In the meantime, the advance from Brigue proceeded rapidly, the summit A being reached in the month of December, 1903. Then arose the question, as already explained, in order to save time, of driving the tunnel downhill in order to meet the workmen coming up from Italy.

Meanwhile, the work on the Italian side has been pushed forward until the distance remaining to be pierced, as already mentioned, is only some 260 yards; but a serious difficulty has arisen, for again a hot spring has been encountered, and the temperature of the rock in the advance gallery is 108° F.

The system adopted for dealing with hot springs is very ingenious—and at the same time very simple. It was at first proposed to conduct the hot water out of the tunnel through pipes, but the simpler and more efficient method, which was adopted, is to play a jet of cold water into the fissure from which the hot water is escaping, and thus to cool it down to such a degree that the workmen are not seriously incommoded; they are then able to continue the drilling and blasting.

A channel or canal is being excavated at one side of the tunnel to carry the hot water from the spring to the outside, and this will be covered over with non-

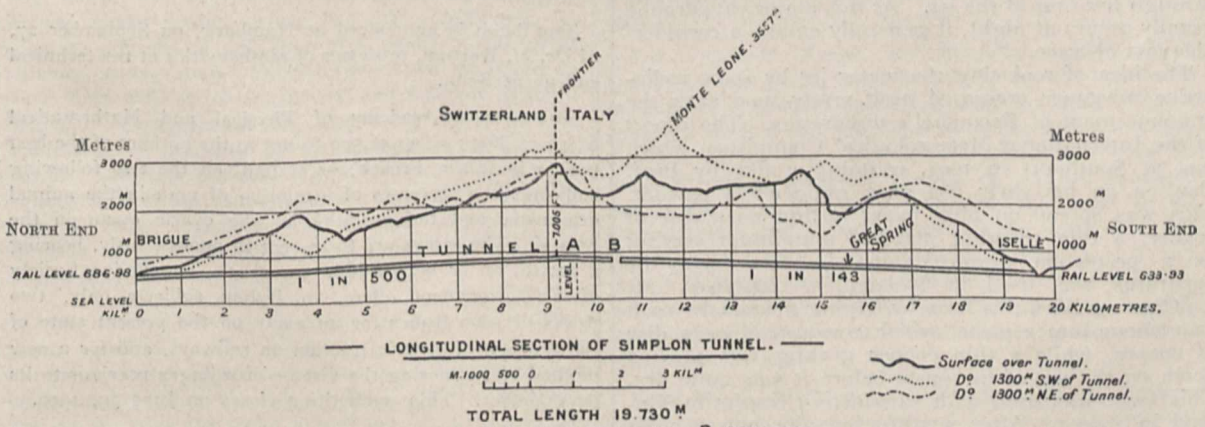

FIG. 4.—Longitudinal section of Simplon Tunnel.

conducting material to prevent the heat rising into the tunnel.

The question arises from whence this great heat comes, for although observations made in various wells and borings in all parts of the world give an approximate figure of 1° F. rise in temperature for each 70 feet of vertical depth, this is insufficient to account for

what has been encountered, and one is driven to the conclusion that some portion of the thermal result is due to the internal heat of the earth arising from volcanic agency.

The energy and skill of those in control, amongst whom are Colonel Locher, Herrs Brandau, Pressel, Kager, Sulzer, and many others, are surmounting these difficulties, and it is anticipated that without any very great delay the junction of the headings will be effected.

Certainly no tunnelling operations in any part of the world have been exposed to such vicissitudes and difficulties, and when the arching of the tunnel is fully completed little will be left to show how hardly earned has been the victory over physical obstructions.

It is expected that within three months of the piercement trains will be running, and the railway will prove to be a most important link in the line of communication between Rome, Genoa, and Milan with Lausanne, Berne, and mid-Europe. FRANCIS FOX.

WATER-DROPPERS AND RADIUM COLLECTORS.

IT is more than forty years since Lord Kelvin commenced a new era in measurements of atmospheric electric potential by devising the water-dropper. Though marking a great advance, and simple in its construction, the water-dropper has not increased the happiness of those responsible for the conduct of self-recording meteorological instruments. It has weaknesses which it takes some time to discover, and which, when undetected, may lead to serious error. Some of the earlier forms had their water reservoirs so constructed that the pressure under which the jet issued varied considerably with the time since the reservoir was filled. Punctuality in filling the reservoir had in this case the disadvantage of accentuating a subsidiary diurnal variation not due to nature. The misdirected attention of spiders, variations of moisture, and other meteorological conditions, produce changes of insulation in the water tank; choking of the jet occasionally happens through impurities in the water, and in severe winters there may be complete stoppage through freezing of the jet. As this major catastrophe usually occurs at night, it generally entails a considerable loss of trace.

The idea of replacing the water jet by some radio-active substance presented itself pretty soon after the announcement of Becquerel's discoveries. The report of the International Meteorological Committee, which met at Southport in 1903, contains a note by Prof. Paulsen on his early use of a radio-active powder. This was spread on filter paper resting on a disc of copper, a thin covering plate of aluminium serving as a protection against rain. In this form the apparatus was used in Iceland in 1899–1900. M. La Cour modified this form by mixing the powder with caoutchouc into a paste, which was spread on a disc of copper, while a thin copper grating was pressed down on the top of the paste before it was quite dry. This form was used with satisfactory results in Finland in 1900–1. After wetting by rain, however, its efficiency was temporarily lessened. The same report also describes an instrument which M. Moureaux had had in use for some time at Parc St. Maur Observatory, Paris. It employs as collector chloride of radium in a shallow copper vessel, over which is soldered a plate of aluminium 0·1 mm. thick to keep out rain. Chloride possessing 5000 times the activity of uranium was not sensitive enough, but chloride with 30,000 times the activity of uranium gave good results. M. Moureaux so arranged matters that he could at pleasure record the electric potential, practically at a fixed point, either by the radium collector or a water jet. In this way he obtained an electrogram, successive portions of which were obtained in immediate sequence by the two collectors. Unless the times of the change had been indicated, one could not have told by inspection of the curve—which is reproduced in the report—which collector was being used. When M. Moureaux's note was written the radium had been in use for several months with satisfactory results. A foot-note, however, of later date, mentions that some months later the radium was found to have produced a number of minute holes in the aluminium, and that it was intended to dispense with the aluminium and protect the radium against rain by coatings of varnish. It was further hoped that this would admit of the use of cheaper chloride of less radio-activity.

The employment of radium is thus hardly out of the experimental stage, and any one adopting it at present would be well advised to check the action from time to time by recourse to a water jet. It would also be desirable to make sure before final adoption that the radium does not itself modify the potential which it is desired to record, more especially in calm weather. Whatever the final outcome may be, it is at least satisfactory that M. Moureaux's experiments showed agreement between the water jet and the radium collector when both were upon their good behaviour.

C. CHREE.

NOTES.

THE friends of Prof. G. Carey Foster, F.R.S., are taking the occasion of his recent retirement from the principalship of University College, London, as an opportunity of showing their appreciation of him by promoting a fund with the object of having his portrait painted for presentation to the council of the college, and a replica for presentation to Mrs. Foster. The president of the movement is the Right Hon. Lord Reay, G.C.S.I., and the vice-presidents are Sir Norman Lockyer, K.C.B., Sir Oliver Lodge, and Sir Arthur Rücker. Further information with regard to the scheme may be obtained from the secretaries of the fund, University College, Gower Street, W.C.

THE death is announced at Hamburg, on September 27, of Dr. H. Kortum, professor of mathematics at the technical college at Bonn.

THE Naples Academy of Physical and Mathematical Sciences offers prizes of 500 francs to the authors of the best papers in Latin, French, or Italian on the two following subjects: the processes of formation of urea in the animal organism, and the evolution of the ovaric ovum in the Selacii. The essays are to be sent in anonymously, bearing a motto, on or before June 30, 1905. The Padua Society of Encouragement offers, to Italian subjects only, two prizes of 5000 francs for an essay on the present state of the problem of electric traction on railways, and for a new method of diagnosing the disease of pellagra previous to its development. This competition closes on June 30, 1906.

A PETITION has been presented to His Majesty in Council asking for the grant of a charter of incorporation to the South African Philosophical Society under the name of "The Royal Society of South Africa."

MR. WILFRED MARK WEBB has accepted the honorary secretaryship of the Selborne Society.

THE death is announced of Dr. Tillaux, professor of surgery in the University of Paris, president of the Academy of Medicine, and Grand Officer of the Legion of Honour.

DR. DOYEN is stated by the Paris correspondent of the *Daily Chronicle* to have succeeded in isolating a micro-organism in cancer, and to have prepared a curative serum for the disease. It is proposed to institute a committee to investigate Dr. Doyen's claims and reputed cures.

AN appeal to the Danish people was issued at Copenhagen on October 18 for contributions to defray the cost of a monument to the late Prof. Niels Finsen, the discoverer of the light cure, and also for the establishment of a fund to be devoted to scientific and humanitarian purposes in accordance with his wishes.

ACCORDING to the *Daily Chronicle* of October 17, a specimen of the water-warbler (*Acrocephalus aquaticus*) has been taken at Clay-next-the-Sea, Norfolk. Up to the year 1894, at any rate, only three specimens of this warbler were definitely known to have been taken in Britain, one of these being now in the museum at Dover.

MR. A. W. ITTER informs the *Times* that while an artesian well was being sunk on his property near Aylesbury, at a depth approaching 500 feet, the whole tackle was blown out of the bore-hole, and after a "noise like thunder," lasting for several minutes, natural gas rushed out, and on being ignited burnt with a brilliant light. He states that when he wrote, on October 19, the gas had been issuing for forty-eight hours, and was still pouring out at a pressure of more than 50 lb. to the square inch.

THE *Times* correspondent at Copenhagen reports that shocks of earthquake were felt at 11.15 a.m. on October 23 throughout the Scandinavian countries. Disturbances occurred almost simultaneously at Stockholm, Christiania, Gothenburg, the northern part of Jutland, Malmö, and Copenhagen. The severest shock was in the Danish town of Aalborg. The earthquake was felt at Skagen, Frederikshavn, Hjörring, and Brönderslev, and in the Island of Laesö, but no serious damage was done. Telegrams from Christiania show that there was a great panic in the city.

THE British Fire Prevention Committee's programme for the new winter session, which has just commenced, includes the preparation and issue of a report on the great Baltimore conflagration. Further reports will be issued on various tests with sprinklers, lamps, and different forms of partitions. Arrangements are also being made for the organisation of branches of the committee in Canada, Australia, and New Zealand. The committee will assist in the preparation of the "International Technical Dictionary," which is being issued by the German Institution of Engineers, so far as technical terms regarding fire prevention are concerned.

MAJOR POWELL COTTON is about to start on another African expedition. The object of the journey, which is expected to occupy eighteen months, is to explore the extensive country lying between the Nile and the Zambesi. After investigating the Great Forest and the district to the west of Lake Kivu, the region to the west of Tanganyika will be traversed, and the expedition will then proceed south towards Katauga. Major Cotton expects to come out in British territory in Nyasaland, whence he will travel to the coast by the Zambesi. Every facility will be given to Major Cotton by the Belgian Government, and as he will travel the entire length of the Congo State, there is every reason to hope that much may be added to the knowledge of the natural history of this part of Africa.

A CORRESPONDENT suggests a means of obviating, in the ordinary form of Atwood's machine, the difficulty that the acceleration of the moving system is not constant, but increases continuously as more and more of the string passes over the pulley to the descending side. He proposes to connect the masses on both sides of the pulley to an endless cord, and so to ensure that the total length of string remains the same throughout.

A REPORT has been received from the members of the sleeping sickness expedition of the Liverpool School of Tropical Medicine. Writing from Lisala, on the Upper Congo, they state that they believe they are leaving the districts where sleeping sickness is rife. Investigations have been made into cattle disease in the Congo Free State, and measures have been devised which, it is hoped, will enable stock to be raised there without difficulty.

IT is stated that craw-craw, a common skin affection on the west coast of Africa, has made its appearance in Birmingham. The disease is due to a nematode worm allied to the filaria, and it is reported that Mr. J. D. Whittles, lecturer on dental histology and pathology in the University of Birmingham, has detected the worm in the blood of several persons. Confirmation of this observation will be awaited with interest.

WE have received the report of the Glasgow Municipal Commission on the Housing of the Poor. Among the many recommendations contained in it, one suggests that, with the view of encouraging private enterprise to erect suitable, sanitary, and cheap rented houses for the poorer classes, some relaxation of the provisions of the Building Regulations Act should be favourably considered by the corporation under proper safeguards.

IN the *Scientific Memoirs of the Government of India* (No. 11) Lieut. Christophers, I.M.S., gives additional particulars respecting the Leishman-Donovan body or parasite (see NATURE, vol. lxx. p. 534). He states that the bodies described by Wright in tropical ulcer are indistinguishable from those found in cases of enlarged spleen in Madras. The bodies may occur in the leucocytes in the peripheral blood, but have not been detected in the red blood cells.

THE "General Report and Statistics of Mines and Quarries," part ii., for 1903, is in many respects interesting reading. The general death rate from accidents of those employed in coal and metalliferous mines shows a steady decrease, having fallen from an average of about 2·25 per thousand during the years 1873–82 to 1·25 per thousand during the years 1898–1903. On the other hand, in the Cornish mines, and probably elsewhere, the death rate from phthisis among men from twenty-five to forty-five has very greatly increased during the last few years, and is attributable to the use of rock drills, which cause much dust. Reference is also made to the outbreak of ankylostomiasis in the Cornish mines.

FROM Mr. J. Wheldon, of Great Queen Street, we have received a catalogue of books and papers on invertebrates (other than insects).

IN the October number of *Nature Notes* the editor commences a series of papers on the geology of scenery, dealing in this instance with stratification.

ACCORDING to the annual report for 1903–4, the rate of additions to the industrial section (inclusive of ethnology) of the Indian Museum, Calcutta, is such that it is increasingly difficult to find space for the accommodation of

the new specimens. The superintendent has to report the theft during the year of a quantity of gold jewellery, of which no trace has been discovered.

ZOOLOGICAL papers received from America in our last week's batch include a treatise on Acarina, or mites, by Mr. N. Banks; notes on Hawaiian reptiles, by Mr. R. C. McGregor; on reptiles from Missouri, by Mr. J. Hurter; two molluscan papers by Mr. F. C. Baker, and a third, by Mr. T. L. Casey, on the gastropods of the family Pleurotomatidæ. The first two are published in the *Proceedings* of the U.S. National Museum, the rest in the *Transactions* of the St. Louis Academy.

THE *American Naturalist* for July and August contains a report of the proceedings of the first annual meeting of the eastern branch of the American Society of Zoologists, held in Philadelphia in December last. Of its other contents, perhaps the most interesting is a paper, illustrated with a coloured plate, by Mr. M. M. Mayland, on the colour-variation displayed by a small local form of the common marine gastropod *Neritina virginea*, which inhabits "Salt Pool," near Port Henderson, Jamaica, and is also found in a fresh-water stream in the same island. In the one instance the dwarfing is attributed to the extra salinity of the water, in the other to its freshness. The diversity in colour and colour-pattern of both the normal and the dwarf forms is extraordinary, and perhaps unparalleled, but all the variations intergrade.

MR. H. INGLE, who recently went from the Yorkshire College to take charge of the chemical work of the Transvaal Department of Agriculture, contributes a short paper to the department's Journal on the composition of Transvaal soils. About a dozen typical soils from different parts of the country have been examined by him. He finds that, as compared with English soils, Transvaal soils are somewhat markedly deficient in nitrogen and phosphoric acid, but he very properly points out that their fertility cannot be judged of entirely by European standards. The soils are in reality much better than analyses made in the ordinary way would lead us to suppose. When Dyer's method was employed the proportion of available to total phosphoric acid and potash was found to be high, much higher than is usually the case in this country. As a set-off to the natural poverty of the soils in nitrogen, Mr. Ingle indicates that the receipts of combined nitrogen from the atmosphere are probably higher in South Africa than in England. In February and March of this year, for example, the rainfall collected in Pretoria brought down about 2 lb. combined nitrogen per acre, whereas at Rothamsted the average annual receipts of the soil from this source amount to some $4\frac{3}{4}$ lb. only. In addition to nitrogenous manures, Transvaal soils require compounds supplying phosphoric acid and lime, and of the manures imported basic slag is suggested as likely to be most economical.

AS a contribution to the volume which was prepared in honour of Dr. P. Ascherson's seventieth birthday, Dr. Stapf has written a sketch of the distribution of the grasses in South Africa. Two main subdivisions are distinguished, a smaller group of forms extending into the tropics and a larger endemic South African group, which includes subtropical and temperate forms. The tropical and subtropical species are allied to the palæotropic flora of tropical Africa; the temperate element has affinities with some grasses of Asia Minor and Australia, but how and when they have been connected is not obvious. There is an accumulation of temperate grasses, many of them endemic species, in the Cape district, which suggests that the land formerly extended further south.

ACCORDING to *Circulars* received, the Department of Agriculture in the United States, through the Bureau of Forestry, offers the services of its officers to farmers and landowners as advisers in the matter of tree planting and forest conservation. As for the conditions under which this help is given, preliminary examination is defrayed by the department, but if the undertaking is sufficiently extensive to require a survey and special plans, the owner has to pay actual and necessary expenses; the object is to prove to timber-land owners that conservative methods of lumbering will pay.

IN the *Revue Scientifique* of October 1 Prof. A. Thauziès, of Périgueux, resumes the discussion of the question as to the manner in which carrier-pigeons find their way home. In the same journal for March 24, 1900, Mr. de Cyon expressed the opinion that the sense of smell determines the proper direction, and it is to the refutation of this theory that the portion of the professor's article published in the issue before us is devoted. Among other points cited to disprove the olfactory theory is the fact that young pigeons are frequently unable to discover the whereabouts of their dovecot despite the overpowering odour issuing therefrom. In the concluding portion of his *critique*, published in the issue of October 8, Prof. Thauziès discusses the theory that homing pigeons orientate by a "sense of attitude." That is to say, they preserve a sense of direction by the number of times they have turned *en route*. After urging several strong and apparently fatal objections against this theory, Prof. Thauziès suggests that it may nevertheless contain a germ of truth. For the present, however, the "homing instinct" must remain a puzzle.

THE current number of the *Annals* of the Royal Botanic Gardens, Peradeniya, contains several papers of interest, and helps to emphasise the necessity for a thorough study of the problems presented by tropical vegetation. A paper by Mr. R. H. Lock is of particular value in this connection. By a careful study of the rate of growth of giant bamboos, Mr. Lock has found that the difference in rate of growth between day and night is due, not to the alternation of light and darkness, but to the change in the conditions of moisture, the air being damper at night. The curve of rate of growth follows that of moisture and rainfall with most surprising closeness. The second part of Mr. Herbert Wright's paper on Diospyros contains figures of the flowers, &c., in this genus, and shows the great need for study of tropical plants in the field as well as in the herbarium. The number also contains a paper by Dr. Svedelius on *Enalus acoroides*, the life-history of which he studied in the straits between Ceylon and India. The floral mechanism shows a very interesting difference from that of Vallisneria, correlated with the fact that Enalus is a marine plant. The male flowers are caught at low water and drawn under as the tide rises, pollination taking place subsequently. Another paper by Mr. R. H. Lock contains a preliminary statement of the results of the first "Mendelian" breeding work carried on in the tropics, and gives a number of interesting results with peas and maize, mentioned in last week's NATURE (p. 601).

THE report of the Meteorological Commission of Cape Colony for the year 1902 shows that the interest taken in the progress of meteorology by the public is increasing. Rainfall is observed at 500 stations; this number includes 58 second order (barometric) stations and 27 third order (thermometric) stations. The report also contains sum-

maries at a large number of stations in neighbouring colonies and in German South-West Africa. At the request of the Admiralty circulars were issued to all observers at second order stations south of 30° south latitude asking them to take observations at Greenwich noon, in connection with the National Antarctic Expedition.

THE U.S. Hydrographic Office has issued a handy pamphlet of instructions, prepared by Mr. J. Page, for the use of the voluntary meteorological observers who contribute information for the U.S. Monthly Pilot Chart; it will also be found very useful for all observers at sea. The number of vessels regularly engaged in its service exceeds 1800, and the list embraces the merchant marine of all nations, all the vessels of the U.S. Navy, and many foreign cruisers. The form of weather-register now in use was adopted in 1888; it provides only for a single daily observation, to be made at Greenwich noon, instead of the old form recommended by the International Maritime Congress held at Brussels in 1853, which provided for observations at several hours. The registers are generally returned by post in a foolscap envelope at the end of each month, and supply the information required for laying down tracks of storms, and for the preparation of mean values for each month, published in the valuable monthly pilot charts, to which notice has frequently been directed in our columns.

AN interesting article on the development of the theory of electrolytic dissociation is contributed to the *Popular Science Monthly* (September) by Prof. Svante Arrhenius.

IN the *Transactions* of the Academy of Science of St. Louis, Prof. Francis E. Nipher discusses the speed of the trotting horse as a function of the time, and applies the empirical equation $s=a+be^{-kt}$ to connect the speed s with the time t in the problem or problems, of which he gives numerical illustrations.

IN a short but suggestive paper contributed to the *Popular Science Monthly* (September), Dr. Allan McLaughlin discusses the problem of Hebrew, Magyar, and Levantine immigration. The first part deals with the persecution of the Jewish race in Europe, and the serious problem which America has to face in the building up of large ghettos in towns like New York by the overflowing stream of immigrants. Of the Magyar race only 27,124 subjects were landed in America in 1903, and these appear to be ideal immigrants but for their tendency to return to Europe. In regard to Levantine races, we are told that "the Greeks are the best of this rather bad lot."

SEVERAL interesting papers on radio-activity are contained in recent numbers of the *Atti dei Lincei* (xiii., 3, 4, 5). In the first of these numbers Drs. G. Martinelli and A. Sella give measurements of the radio-activity of the pozzolana from the neighbourhood of Rome. In the next Dr. G. Martinelli describes experiments to ascertain whether the reactions involving loss of weight (according to the theories of Landolt, Sanford, Ray, Heydweiller and others) are accompanied by radio-active phenomena. A figure is given of the apparatus, in which the reactions were produced inside a closed vessel in a dish placed under the electroscope; but though each experiment was continued for two hours no positive results were obtained. Lastly, Messrs. G. Pellini and M. Vaccari discuss the chemical actions produced by radium. They find that there are many chemical reactions produced by light on which radium has no effect, and that, as a general rule, the actions most affected are those provocated by ultra-violet light or Röntgen rays.

WE have received a reprint of a paper by Prof. H. Geitel which is published in the *Jahrbuch der Radioaktivität und Elektronik* under the title "Elektrizitätszerstreuung und Radioaktivität." It forms a valuable summary of the development of the study of terrestrial electricity from the time of Coulomb to the present.

IN No. 7 of the *Bulletin* of the Royal Academy of Belgium M. H. Gillot publishes an experimental investigation of the properties of mixtures of the sugars and of the polyhydric alcohols. Melting-point curves are given for binary mixtures of saccharose, lactose, glucose, mannitol, and dulcitol, which are of importance because they indicate the non-existence of isomorphism between these substances. On the other hand, the presence of more than one eutectic point in many of the curves probably means that in these cases definite compounds are produced.

A PROSPECTUS has been issued by the Berlin Wireless Telegraphy Company, "System Telefunken," which describes the organisation and scope of the company and the character of the apparatus covered by its patents. The company is an amalgamation of Messrs. Siemens and Halske and the Allgemeine Elektricitäts-gesellschaft of Berlin, and its system a combination of the Braun-Siemens and the Slaby-Arco systems. The company has already equipped more than fifty German warships with its appliances, and its system has been adopted by the United States Navy. An especial feature of the prospectus, which is excellently illustrated, is the description of a portable apparatus designed for military field service. The transmitter and receiver are arranged so that a variation of several hundred per cent. in the wave-length of the electric waves can be rapidly made; in this manner disturbances caused by the enemy may be eliminated.

MR. H. J. GLAISHER, of Wigmore Street, will shortly publish "X-Rays: their Treatment in Cancer and other Diseases," by Mr. R. J. Cowen.

PROF. MELDOLA has completed vol. i. of "The Chemical Synthesis of Vital Products and the Inter-relations between Organic Compounds," which is to be published by Mr. Edward Arnold on November 1.

THE syllabus of meetings for the session 1904–5 of the Hampstead Scientific Society gives full particulars of the subjects for the general meetings and for the separate meetings of the natural history, photographic, and astronomical sections.

A NEW edition of Mr. Joseph Y. Bergen's "Elements of Botany" has been published by Messrs. Ginn and Company. A more careful study has been made in this edition of typical cryptogamic forms, and an outline of the ecological classification of plants has been added, as well as chapters on the ecology of leaves and the evolutionary history of plants.

MESSRS. HEFFER AND SONS, Cambridge, have in the press a book by Mr. S. W. Cole entitled "Exercises in Practical Physiological Chemistry." The book, which is written for the use of medical students, is essentially a laboratory book, only those exercises being included which the author has found can be carried through in ordinary class work.

MR. W. B. CLIVE has published a revised and rewritten edition of "First Stage Magnetism and Electricity," by Dr. R. H. Jude. The section dealing with electrostatics has been curtailed and simplified, and a more practical

character given to the part on voltaic electricity. Under magnetism a brief account has been included of tubes of force, magnetic flux, permeability, and reluctance.

NEW editions of three standard works on botany have just reached us from Germany. One volume is the third edition of Prof. G. Haberlandt's "Physiologische Pflanzenanatomie" (Leipzig: W. Engelmann), the second edition of which was reviewed in NATURE of March 18, 1897 (vol. lv. p. 457). About sixty pages have been added to the work, and the number of figures has been increased from 235 to 264. Mr. Engelmann has also published the twelfth edition of Prantl's "Lehrbuch der Botanik," revised by Prof. F. Pax. The additional matter has enlarged the book by twenty-two pages, and twenty-five new figures have been included. The fourth revised edition of Prof. A. Engler's "Syllabus der Pflanzenfamilien" has been issued by the firm of Borntraeger Bros., Berlin. The work is a summary of systematic botany, with special reference to medicinal and useful plants, and a survey of kingdoms and regions of flowering plants; it is of particular value to students of special and pharmaceutical botany.

OUR ASTRONOMICAL COLUMN.

A NEW VARIABLE STAR.—A telegram received at the Kiel Centralstelle from Prof. E. C. Pickering, on October 7, states that the object discovered by Mr. Stanley Williams on September 20 is, according to its spectrum, a long period variable star.

On a plate obtained by Herr P. Gotz at Heidelberg on August 8·4 the star was fainter than B.D.+29°·4653, which has a magnitude of 9·2 (*Astronomische Nachrichten*, No. 3971).

EPHEMERIS FOR TEMPEL'S SECOND COMET.—In No. 3971 of the *Astronomische Nachrichten* M. J. Coniel publishes a continuation of his daily ephemeris for Tempel's second comet, extending from October 25 to January 1.

Abstracts of the previous portions have already appeared in these columns, and the following is from the present publication:—

Ephemeris 12h. (M.T. Paris).

1904	α app. h. m. s.	δ app. ° ′	log. Δ	1 : r²Δ²
Oct. 25 ...	17 25 44 ...	−22 11 ...	0·2584 ...	0·156
,, 29 ...	17 39 37 ...	−22 50 ...	0·2608 ...	0·155
,, 31 ...	17 46 40 ...	−23 8 ...	0·2621 ...	—
Nov. 2 ...	17 53 46 ...	−23 25 ...	0·2634 ...	0·154
,, 4 ...	18 0 57 ...	−23 40 ...	0·2648 ...	—
,, 6 ...	18 8 11 ...	−23 54 ...	0·2662 ...	0·152
,, 8 ...	18 15 29 ...	−24 6 ...	0·2677 ...	—
,, 10 ...	18 22 49 ...	−24 17 ...	0·2692 ...	0·150

Although the comet was unsuccessfully sought during August and September, and, theoretically, its light should commence to diminish towards the end of the present month, the fact that at previous apparitions the light has been sensibly stronger after perihelion than before leads M. Coniel to hope that the object may yet be observed during its present return. As before mentioned in these columns, the feeble light of the comet, combined with its southerly declination, will render it a difficult object for observers in the northern hemisphere.

PHŒBE: SATURN'S NINTH SATELLITE.—The promised extended discussion of the observations of Phœbe by Prof. W. H. Pickering appears in No. 3, vol. liii., of the Harvard College Observatory *Annals*.

The discoverer of the satellite therein describes the first discovery of, and the subsequent searchings for, the object, explaining in detail the examination of the plates and the difficulties experienced in recognising the satellite's image.

Sixty photographs of Saturn have, so far, been obtained with the Bruce telescope, and of these twelve were taken when the planet was moving rapidly, and were therefore useless in locating the satellite's position. Several others were, for various reasons, useless, but the object sought is to be seen on forty-two plates, which are used in the discussion.

After preparing the description of the observations and results for the press, Prof. Pickering received information from Arequipa which considerably modified his ideas of the satellite's orbit. An approximate ephemeris had been sent to Prof. Bailey, at Arequipa, in March of this year, but he was unable to find the image of the satellite in the computed positions. Subsequent research has shown that the motion of this body in its orbit is probably retrograde, an unlooked-for possibility, since the other eight of Saturn's satellites all have direct motions. Consequently Prof. Pickering gives the details of the reductions for both retrograde and direct motion.

The elements, as determined for the case of retrograde motion, are as follow:—

Semi-major axis at a distance of 10 units measures 29′·62. This corresponds to a distance of 0·0862 astronomical unit, or 7,996,000 miles.

Eccentricity ... ... =0·22
Inclination to ecliptic ... ... =5°·1
Longitude of ascending node =220°
,, ,, perisaturnium.. =289°·7
Epoch of perisaturnium ... =1900 Mar. 28·0 (G.M.T.)
Period ... ... =546·5 days.

The inclination of the orbit of Phœbe to that of Saturn is, therefore, 6°·0, and the longitude of the ascending node is 170°·0.

The eccentricity is remarkable as being greater than that of any other satellite or major planet in the solar system.

The brightness of Phœbe is judged as two magnitudes fainter than that of Hyperion, which is assumed to be of the fourteenth magnitude. From photometric considerations the diameter of the satellite is thought to be about 200 miles.

In conclusion, Prof. Pickering gives a table showing the differences between the computed and the observed places of the satellite, and then discusses the deviations and gives an ephemeris for 1904.

FAINT STARS NEAR THE TRAPEZIUM IN THE ORION NEBULA.—The lists of stars in the Orion nebula recently published by Profs. Wolf and Pickering included none of the stars near the Trapezium, because, with the short-focus cameras used in obtaining their plates, the images of the stars in that region were blotted out by the bright nebula.

On the plates obtained by Prof. Ritchey in 1900 and 1901, using the Yerkes 40-inch telescope with a yellow screen placed immediately in front of the plate, these fainter stars are easily seen, therefore Mr. J. A. Parkhurst has measured their coordinates from θ' Orionis, and gives these, together with the magnitudes of the stars, in a list published in the September number of the *Astrophysical Journal*. The list contains forty-two stars, all within two minutes of arc of the trapezium star θ' Orionis, of which twenty-three were observed visually by Bond—these include ten observed photographically by Prof. Pickering—whilst nineteen are presumably catalogued for the first time.

PHOTOGRAPHIC DETERMINATION OF PARALLAX.—Encouraged by the successful photographs obtained by Prof. Ritchey with the Yerkes 40-inch telescope, Mr. Frank Schlesinger tried several exposures with the same instrument for the determination of several stellar parallaxes. The yellow screen used in the former work was found to be unnecessary, and, as it introduced several troublesome errors, it was dispensed with.

The great focal length of the instrument renders errors in measuring the plates much less important than when smaller instruments, such as those used in the production of the astrographic chart, are used, and Mr. Schlesinger computes the probable error for one exposure to be only ±0″·030.

Among the results obtained there occurs the parallax of the star *Krueger* 60 (R.A.=22h. 24m., dec.=+57° 10′), which was placed on the working list because Prof. Barnard suggested that it has a large parallax. The result shows that the suggestion is probably correct, and, if confirmed by other measures, it places the star as one of our nearest neighbours, its parallax being +0″·278. This value was obtained as the result of measuring eight plates, containing twenty exposures, and using five comparison stars (*Astrophysical Journal*, No. 2, vol. xx.).

THE CLASSIFICATION OF THE STARS ACCORDING TO THEIR TEMPERATURE AND CHEMISTRY.[1]

II.

THE temperature relationships of the various groups in the classification of stars described in the previous article are further illustrated in a diagram which is reproduced in Fig. 6, from which it will be seen that the stars

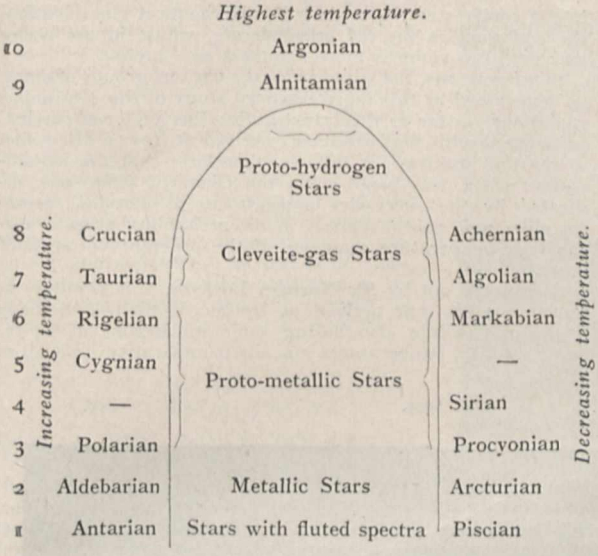

FIG. 6.—Temperature relationship of stellar groups.

are arranged in sixteen groups along a temperature curve having its apex in the middle. Apart from the inferences as to low temperature which may be drawn from the occurrence of flutings, it will be remembered that while the evidence for temperature was primarily based on the strength of the continuous radiation in the violet, this detailed arrangement of the stellar groups depended upon the chemical sequence revealed by the successive predominance of metallic, proto-metallic, and "gaseous" lines in the different stars.

This chemical sequence, however, so far as could be judged from the photographs then available, was identical with that derived from the investigation of the violet radiation, thus showing that the apparent chemical differences resulted from changes of temperature. The simplest explanation of the chemical changes is that afforded by the dissociation hypothesis, according to which the step from metallic to proto-metallic vapours is to be regarded as a breaking up of complex molecular groupings into simpler ones still retaining characteristics which permit the parent substance to be distinguished, while the continuation of the process results in the reduction of all substances to the finer forms of hydrogen and helium. The classification of the stars on a temperature basis is therefore of the utmost importance, not only for the indications which it gives as to the processes of stellar evolution, but also on account of the light which it throws on the dissociation hypothesis and the evolution of the chemical elements. Adopting the foregoing temperature sequence of the various stellar groups, this side of the question has already been fully dealt with by Sir Norman Lockyer in his work on "Inorganic Evolution" (Macmillan and Co., Ltd., 1900).

[1] Continued from p. 614

In view of the important issues depending upon the correct determination of relative stellar temperatures, Sir Norman Lockyer has endeavoured to confirm his previous results by another piece of work, of which an account was recently communicated to the Royal Society.[1] The previous conclusions involving the intensity of the violet radiations depended upon photographs taken with optical appliances composed of glass, which has a marked absorption for these rays, and the relative intensities were judged by noting the limits of the spectra in photographs which were of the same intensity in the region about H7. Although there was no reason to suppose that the general laws of continuous radiation would be modified in still more refrangible parts of the spectrum, it was possible to test the results further by including this region in the discussion. An instrument which was transparent to the ultra-violet radiations was necessary for this research, and the one devised for the purpose was a prismatic camera having a 2-inch 30° calcite prism mounted in front of a 2½-inch quartz lens of 18 inches focal length (Fig. 7). The prism is so cut that its first face is perpendicular to the optic axis of the crystal, and it is so arranged that the incident rays are normal to this face. All the rays, therefore, pass through the prism parallel to the optic axis, and there is consequently no double refraction.

By this means it became possible to utilise not only the length of the spectrum in the violet, but the relative brightness of the different parts to a greater extent than before.

To make the matter clear, it may be pointed out that the temperatures of most of the stars are too high to permit of their determination from the actual limits of the continuous radiations towards the violet, as might conceivably be done in the case of a red-hot poker, since these limits lie beyond the wave-length for which our atmosphere is transparent. The principle involved in the method employed, however, is clearly indicated by Sir Norman Lockyer in a quotation from Sir George Stokes,[2] the substance of which has been fully borne out by more recent work, namely, that

"When a solid body such as a platinum wire, traversed by a voltaic current, is heated to incandescence, we know that as the temperature increases, not only does the radiation of each particular refrangibility absolutely increase, but the proportion of the radiations of the different refrangibilities is changed, the proportion of the higher to the lower increasing with the temperature."

In the case of stars, the radiation is of course modified by the continuous absorption of the stellar gases and vapours; but, so far as we know, the greater absorption is always associated with reduced temperature[3] and increased density, and regularly diminishes in intensity from the ultra-violet towards the red.

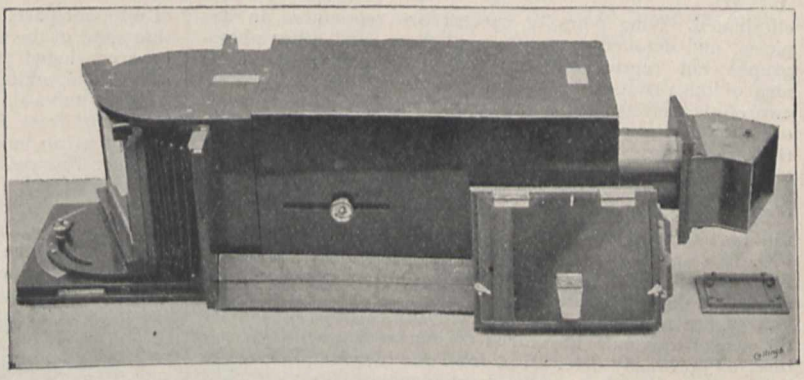

FIG. 7.—Quartz-Calcite Prismatic Camera.

Conclusions as to the temperatures of the stars, as was suggested by Crova in 1878,[4] may therefore be based on

[1] Roy. Soc. *Proc.*, vol. lxxiii. p. 227 (1904).
[2] Roy. Soc. *Proc.*, vol. xxiv. p. 353 (1876).
[3] It has been observed that various metals, including iron, produce a continuous absorption at the blue end of the spectrum when reduced to the state of vapour in the relatively cool oxy-hydrogen flame (Lockyer and Roberts-Austen, Roy. Soc. *Proc.*, vol. xxiii. p. 344, 1875).
[4] *Comptes rendus*, vol. xvii. p. 981.

the relative intensities of different parts of the continuous spectrum. While this was in reality what had already been done in the case of spectra photographed with glass prisms, the new apparatus permitted comparisons over a much longer range. In each case the limits of the spectra towards the ultra-violet in the photographs are determined by the intensities of the spectra in that region and the duration of the exposures.

To eliminate as far as possible the varying effects of atmospheric absorption, to which the ultra-violet rays are specially sensitive, and the errors which might arise from differences in photographic treatment, each selected pair of stars was photographed on the same plate when the stars had approximately the same altitude, and if any change in the atmospheric conditions were suspected the result was discarded. In each case an attempt was made so to expose the photographs that in every pair the intensity of the spectrum was as nearly as possible the same in both stars in the region between Hβ and Hγ. This condition was very difficult to fulfil in actual practice, owing to the different magnitudes and declinations of the stars compared, and the consequent need for very careful adjustment of the clock rate. The difficulty was further increased on account of the different actinism of the stars in this part of the spectrum. The work, however, has resulted in a series of comparison photographs from which all variable conditions except the natural variations in radiation have, so far as possible, been eliminated. Nine pairs of spectra are reproduced in the paper, and detailed descriptions of these, and other photographs not reproduced, are given. A sufficiently clear idea of the results may be gathered from Fig. 8, showing two of the selected pairs of stars. It is necessary to point out that as the plates employed were but little sensitive to the green rays, there is a break in each spectrum from about λ 486 to λ 550, followed on the less refrangible side by a further portion of the spectrum having its centre about "D." The numbered "stages" in the description refer to the ten horizons of mean temperature already shown in Fig. 6, stage 1 corresponding to the fluted spectra of the Antarian and Piscian stars, and stage 10 to the simplified spectra of the γ Argus type.

A glance at the photographs will suffice to show that in the case of each pair the star at the higher stage of temperature, as previously determined from the investigation of the line spectra, has the greater development of the violet end of the spectrum, and that the difference is more marked the greater the temperature difference. In the first example it will be seen that, while the maximum intensity of the spectrum of Vega is in the blue, that of Arcturus is obviously much further towards the red end; the differences at the extremities of the spectrum are also very marked, Vega having the greater extension into the ultra-violet, and a relatively reduced intensity at the red end as compared with Arcturus. Again, in the second pair, in spite of relative over exposure, the spectrum of Capella is notably less extended towards the ultra-violet than that of η Ursæ Majoris, and the maximum intensity is much nearer the red end.

The general result of this research is thus stated:—"Taking the stars assumed to be hottest in the chemical classification, we find that in all cases the relative length of the spectrum is reduced, and the relative intensity of the red is increased, as a lower temperature is reached. That is to say that where two spectra having their intensities about the region Hβ–Hγ equal are compared, we find that in the cooler stars, according to the chemical classification, the emissions in the red preponderate, whilst in the hotter star the ultra-violet is more extended and intense."

In other words, the sequence of the various groups of stars, as determined by this more extended study of the continuous radiations, so far as the investigation has yet been carried, is identical with that previously arrived at from a discussion of the line spectra. It follows, therefore, that the classification which was based upon the chemical differences indicated by the successive appearances of metallic, proto-metallic, and gaseous lines, in all probability reveals also the true temperature sequence of the different varieties of stars.

As pointed out by Sir Norman Lockyer, this result is at variance with that arrived at by Sir William and Lady Huggins. While also basing their conclusions as to relative stellar temperatures on the comparative intensities of different parts of the continuous spectra, and recognising that some of the stars must be getting hotter, these observers have concluded that the highest temperature is to be found not in the white stars, but in stars resembling the sun. They write[1]:—"If the relative intensity of this part of the spectrum, from about K onwards to about λ 3400, be regarded as an indication of temperature, we should have to consider Procyon as at a hotter stage than Vega, and that the highest stage of temperature is reached in the true solar stage, of which Capella is typical. Then a fall of temperature sets in, as is shown in the advancing enfeeblement of this part of the spectrum in Arcturus, Betelgeuse, and Aldebaran." Special stress is laid by these observers on "the rather sudden fall of intensity of the continuous spectrum at about the place of the end of the series of dark hydrogen lines" in such stars as Vega (a feature which is well brought out in the photograph of the spectrum of this star reproduced in Fig. 8), but Sir Norman Lockyer states that this in no way affects his results, and promises another paper dealing with this and similar points. The precautions taken by Sir Norman Lockyer to secure equal treatment for the stars compared would seem to give his results greater weight than those of the other observers, whose photographs appear to have been obtained in the course of more or less routine work on the spectra of individual stars.

It should also be noted that the occurrence of proto-metallic lines has not been accepted as evidence of the

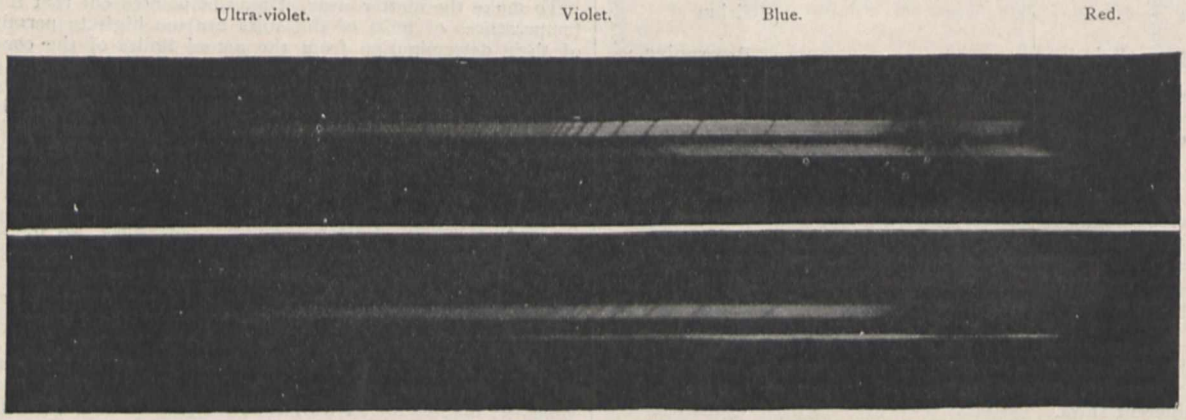

FIG. 8.—Comparison of the spectra of pairs of stars at different temperature stages. Enlarged 3½ times from the original negatives taken at the Solar Phy ics Observatory, South Kensington. (1) Vega, stage 4; Arcturus, stage 2. (2) η Ursæ Majoris, stage 8; Capella, stage 2.

[1] "Atlas of Representative Stellar Spectra," p. 85.

relatively high temperature of a star by some observers, in consequence of the production of these lines in arc spectra under certain special conditions. The recent work of Mr. C. de Watteville[1] on flame spectra in relation to spark spectra obtained with and without self-induction, however, appears to be entirely in harmony with the result derived from stellar inquiries by Sir Norman Lockyer.

At present, then, the evidence available appears to favour the view that the chemical differences indicated in the different groups of stars are due to differences of temperature, and that successively higher stages of heat are indicated by the predominance of metallic, proto-metallic, and gaseous lines. Thus, although further researches on some points are needed, it is very probable that the new classification correctly exhibits the relative temperatures of the various stellar groups, besides giving exhaustive definitions and providing a convenient nomenclature. At the same time, the sequence of phenomena indicated in the classification seems strongly to support the dissociation hypothesis. A. FOWLER.

THE FALKLAND ISLANDS AND THEIR FAUNA.

MR. RUPERT VALLENTIN, who has spent many years in the Falklands, where he has been an assiduous observer and collector of the fauna and flora, contributes an excellent account, illustrated by photographs, of those remote islands to the third part of vol. xlviii. of the *Memoirs* of the Manchester Literary and Philosophical Society, of which his article forms No. 23. The author alludes in the first place to the celebrated stone-rivers, which consist of slowly moving blocks of quartzite between banks of peat. In Mr. Vallentin's opinion the stones forming these "rivers" had approximately attained their present position before the formation of the peat, and the "rivers" have been produced by the denudation of the peat. In every "stone-river" islets of vegetation remain near the margins, these being most luxurious where the denudation has been recent. Where the denudation is of long standing, the sole remnant of the covering of vegetation is a mass of bog-balsam (*Bolax globaria*), as shown in Fig. 1, which, owing to its long tapering root, can obtain nourishment after the soil which supported other plants has been washed away. Very similar "stone-rivers" exist in parts of the Himalaya.

FIG. 1.—A mass of Bog-balsam near the edge of a Stone-river in the Falklands.

Apparently the Falklands are by no means the desolate

FIG. 2.—Gentu Penguins on the Falklands. The birds in the background are running to the shore.

spots we are often prone to imagine, the vegetation being locally abundant, and the shores of the estuaries and coves on part of West Falkland being fringed with bushes of the attractive Falkland box (*Veronica decurrata*), which has a beautiful and highly scented flower. With the aid of abundant manure, many English vegetables can be grown in sheltered spots.

With regard to the fauna, the most interesting statement is the one to the effect that, so far as the author could ascertain, the Falkland Island wolf (*Canis antarcticus*) is now completely exterminated. This latest addition to the list of animals extirpated in recent years by human agency is the more to be regretted seeing that this wolf, or fox as it used to be called by the settlers, is an extremely interesting animal from the point of view of geographical distribution, and one that is probably very insufficiently represented in our museums. According to Prof. Huxley's paper on the dentition of the Canidæ, published in the Zoological Society's *Proceedings* for 1880, the Falkland Island wolf is closely allied to the North American coyote, the remarkable feature connected with this resemblance being that there are no true wolves in either Central or South America. The British Museum has one mounted skin of the Antarctic wolf in the exhibition galleries, and there are two skeletons in the store collection. Strychnine poisoning appears to have brought about the extermination of this wolf, the last survivor of which seems to have been killed so long ago as 1876.

Birds form by far the most important portion of the terrestrial vertebrate fauna of the Falklands, and among these penguins, of three species, and "mollymauks," or lesser albatrosses, are numerically the most abundant. Mr.

[1] Roy. Soc. *Proc.*, vol. lxxiv. p. 85 (1904).

Vallentin's article is illustrated by a photograph of a "rookery" of rock-hopper penguins (*Eudyptes chrysocome*), showing the myriads in which these birds congregate on the coasts, and by a second (herewith reproduced) of a much smaller assemblage of gentu penguins (*Pygosceles taeniata*). An interesting fact in connection with the habits of the rock-hoppers is that the smooth surfaces of the hard igneous rock over which these penguins have passed for generations are not only highly polished, but are marked by irregular groovings made by their claws. These scratches are usually about 3 inches in length, and may be as much as a quarter of an inch in depth. Apparently such a polished and striated rock-surface might well be attributed to ice-action. A striking feature about such a rookery is the number of dying and maimed birds to be met with; such injuries appear to have been inflicted by seals or sea-lions. The enormous number in which the "molly-mauks" frequent the Falkland and other Antarctic islands may be inferred from the statement that on one occasion a vessel arrived at the main port with a cargo of 10,000 eggs of this species. Mr. Vallentin found these beautiful birds so tame and confiding that they allowed themselves to be stroked by his hand as he admired the softness of their plumage and its spotless condition. How these birds keep themselves clean amid the liquid filth of a rookery is little short of a marvel. R. L.

THE ST. LOUIS INTERNATIONAL ELECTRICAL CONGRESS.

THIS congress, during its five working days, considered about 160 papers on electrical subjects. In fact, so large was the number of papers and so wide the range of subjects of which they treated, that it may be said that there is no branch of electrical science which was not referred to at one time or another during the meetings. Nevertheless, the chief scientific interest in the proceedings centred round a few subjects, namely, units and standards, radio-activity, wireless telegraphy, and the electric arc. Of the engineering papers, those on the alternating current motor, the steam turbine, and high tension transmission attracted most attention. There were also numerous papers on electrochemical and electrotherapeutical subjects, which will not be referred to here.

The joint discussion by Section A, general theory, and Section B, general applications, on units and standards was opened with papers by Prof. Ascoli (systems of electric units), Profs. Carhart and Patterson (absolute value of the E.M.F. of Clark and Weston cells), and Dr. Wolff (international electric units). The subject divided itself into two parts:—(1) the true value of the volt and ampere; (2) which of these should be represented by a material standard, and the nature of that standard. During the discussions the naming of the magnetic units was also considered.

Upon the question of the true value of the volt and ampere there was practical unanimity of opinion that the true value of the volt (10^8 C.G.S. units) is such that the E.M.F. of a standard Clark cell at 15° C. is very much nearer 1·433 volts than 1·434, the present legal value. Profs. Carhart and Patterson, in describing the dynamometer with which they are making a re-determination of the ampere, stated that though the experiments were not sufficiently advanced to give a definite value, the results so far obtained made the E.M.F. of the Clark cell about 1.433 volts, accepting the ohm as correct. In this connection Mr. Trotter's results, mentioned by Dr. Glazebrook, are of great interest. Mr. Trotter has recently made a determination of the E.M.F. of the Clark cell at the Board of Trade laboratory in terms of the standard ampere and standard ohm, and finds the value to be 1·4329 volts at 15° C. It would thus appear that the voltage of a normal Clark cell, determined in terms of our standard ampere and ohm, is nearly 1/10 of 1 per cent. less than the legalised value. The Reichsanstalt take the value of the Clark cell at 1·4328 volts. It is of interest to note that the present legal value of 1·434 appears to be almost exactly correct at 14° C. instead of 15° C.

Mr. Barnes, in his paper on the mechanical equivalent of heat measured by electrical means, which contains a very careful comparison of the results obtained both by the electrical and mechanical methods, takes the Clark cell as 1·43325 volts, and then finds that the "results by the *continuous* electrical method is brought into absolute agreement with the *mean* of the mechanical measurements," and he gives the value of the mechanical equivalent as 4·186 joules in terms of the mean calorie between 0° and 100°.

The standards which are to represent the fundamental electrical units raised quite another set of questions, the main desiderata for these standards being that they should be both permanent and reproducible to a high degree of accuracy. No one appeared anxious to quarrel in any way with the standard mercury ohm, and the agreement of the standards lately made by the National Physical Laboratory, both with one another and with those constructed by the Reichsanstalt, shows that this standard is reproducible to a few parts in 100,000. Accepting the present ohm standard, it is only necessary to legalise a standard for either the ampere or the ohm, as the three units are connected by Ohm's law. Prof. Carhart and Dr. Wolff urged the desirability of defining the volt in terms of a cell, preferably the cadmium cell, and the ampere in terms of the volt and ohm, the advantages being that the standard cell is very generally used in practical measurements both of potential difference and current, and that the cells are reproducible to a high degree of accuracy. Dr. Glazebrook pointed out that the greater simplicity of the chemical changes in the deposition of silver gave promise of its being an even more accurate standard for the ampere.

Prof. Carhart and Mr. Hulett, in their paper on a study of the materials used in standard cells and their preparation, trace the difficulties with cells both of the Clark and Weston (cadmium) type to the mercurous sulphate; they describe an electrolytic method of preparing it, and they strongly emphasise the importance of avoiding hydrolysis of the mercurous sulphate. In a table in the paper they give the results obtained with fourteen cadmium cells made according to their method, from which it appears that the maximum difference between the voltages of individual cells and between the voltages of the cells during the whole seven months that the tests lasted did not exceed 5 parts in 100,000, so that, taking any cell at any time during the tests, its voltage could be depended on to within ±0·03 millivolt of the mean voltage. Similar excellent results have been obtained by Mr. Smith at the National Physical Laboratory (report to British Association, Cambridge).

In view of the large amount of work which is now being carried out on the preparation of standard cells and the re-determination of the ampere, the general feeling of the meeting seemed to be that international action to correct the error in the volt should be postponed, although one speaker urged that the error of 0.1 per cent. in the volt had become of serious commercial importance in the life tests of incandescent lamps.

Prof. Wolff's paper, which dealt largely with the legal definitions of the fundamental units adopted by various nations, pointed out the great differences which exist, and the necessity of rendering them all uniform.

On the subject of naming the magnetic units there was very little discussion; the question of 4π, of course, came up, and was discreetly left on one side, most of the meeting agreeing with Dr. Kennelly that it is better to let well alone, and that no very great practical advantage would result from the change. The views of the I.E.E. delegates, that if any magnetic units were named they should be those proposed by Dr. Kennelly, viz. the C.G.S. units of magnetic potential (already called the Maxwell at the Paris congress), total magnetic flux, and magnetic reluctance, met with pretty general acceptance. The other proposal made by Dr. Kennelly, namely, to add the prefix "ab" or "abs" to the names of the practical units to form names for the corresponding C.G.S. units in the electromagnetic and electrostatic systems, so that "abvolt" would be the name for the C.G.S. unit of difference of potential in the electromagnetic system, and absampere for the C.G.S. unit of current in the electrostatic system, led to no discussion, the I.E.E. delegates simply expressing their disapproval of this proposal, which made the same prefix have different numerical values according to the name it preceded.

The chamber of Government delegates, to which Great Britain appointed at the last moment Colonel Crompton,

Dr. Glazebrook, and Prof. Perry as delegates, also considered the questions of units and standards, and at the concluding meeting of the congress the announcement was made that the chamber of Government delegates had decided to advise their respective Governments to appoint a permanent international commission, consisting of two members from each Government, to secure uniformity in units and nomenclature, and a second committee to deal with the international standardisation of machines, this latter to act by correspondence.

The most interesting paper on radio-activity was that of Prof. Rutherford, who traced one step further his remarkable disintegration theory of radio-activity. Starting with the radium emanation, he traced its disintegration through three stages, which he called radium A, B, and C, the latter producing by its disintegration α, β, and γ rays. These changes take place fairly rapidly, and the activity dies away approximately following a logarithmic law. There remains behind, however, in the tube which contained the emanation a deposit the activity of which dies away very much more slowly. By dissolving this deposit in sulphuric acid, it can be separated into two parts, the one of which will deposit on a bismuth disc immersed in the liquid, and the second part will remain behind. That which remains behind is found to give out β rays only, and is called by Rutherford radium D, while that which is deposited on the bismuth disc gives α rays only, and he calls it radium E. He also finds that there is another way of separating these two substances, namely, by heating the deposit on platinum to 1000° C., at which temperature the radium E is volatile and driven off. Regarding the rate of decay of the activity of these two substances, Rutherford estimates that the activity of radium D will fall to half value in about forty years, while that of radium E will require only about one year. By a comparison of the properties of radium E with polonium, Rutherford deduced strong arguments in favour of their identity, and he also considered that radio-tellurium was the same. The product radium D is more uncertain, though it may be radio-lead. If these results are confirmed, and it is proved that polonium, radio-tellurium, and radio-lead are all products of the disintegration of the radium atom, a considerable simplification will result, and a step forward in our knowledge of radio-activity has been made.

The papers by Elster and Geitel concerning natural radio-activity of the atmosphere and the earth, and by Prof. McLennan on the radio-activity of mineral oils and natural gases, gave the results of large numbers of tests on the radio-activity of various waters, oils, muds, &c., from different parts of the earth's surface and from different depths, and they go far to show the omnipresence of radio-activity in the crust of the earth, though they are not yet sufficiently advanced to settle the important question as to whether there exists a large number of radio-active minerals in the earth which have not yet been isolated. McLennan deduces from the rate of decay of the emanation the conclusion that the active substances in natural gases, petroleum, spring-water, and mercury are very probably identical with the emanation from radium, and he also mentions that there appears to be present in some samples of crude petroleum an active substance more persistent than the emanation from radium. Is this the radium D and E of Rutherford?

It was unfortunate that, whereas three important papers on the arc were taken together in one section, the same time was selected for Prof. Child to read his arc paper in a different section, so that those interested in arc phenomena could not hear all the papers; added to this, three out of the four arc papers were not in print at the time of the congress, and the acoustical properties of the rooms in which the meetings were held were of the very worst, making it almost impossible to hear the speakers. Prof. Child attempted to explain the phenomena of the arc on a purely ionic basis, which he summarised as follows:—"The current is carried by ions. These ions are produced, first, either within the kathode, because of its high temperature, or at the boundary surface by the impact of the positive ions; second, through the gas by the impact of the atoms on the negative ions at high temperature; and third, at the boundary surface of the anode by the impact of the negative ions." The theory is, however, not very satisfying, as it throws but little light on many important points, more especially the actions going on at the surfaces of contact of the vapour column and electrodes, as he admits. He also does not attempt to explain the extraordinary effect of slight traces of impurities, which is so marked in the case of the carbon arc that the present writer is of the opinion that with perfectly pure carbon electrodes the carbon arc, as we know it, could not exist.

One of the most interesting facts brought out in Prof. Child's paper is the great importance of the temperature of the *kathode*, and, as he says, "the essential condition appears to be that the kathode shall be very hot." Prof. Steinmetz entered very fully into the importance of the kathode, and he described the stream of particles which he considered as issuing from it. The existence of this stream, and Steinmetz's view that the re-lighting of the alternating arc is a disruptive phenomenon, received striking confirmation from Prof. Lombadi's stroboscopic photographs of the arc.

Prof. Steinmetz deduced an equation for the relation between the arc-length, P.D., and current from theoretical reasoning, which took the form $V=a+b(l+c)/\sqrt{A}$, where V is the P.D., A the current, and l the arc-length; he applied this equation to the volt-ampere characteristics of the magnetite arc, but the agreement between the observed and calculated values seemed as if it would have been better if Mrs. Ayrton's form of equation had been adopted. The magnetite arc looks as if it has a large future before it, as its efficiency is high and the rate of consumption of the electrodes extremely slow. In this connection Prof. Steinmetz said that he had obtained an efficiency of 0.15 watt per mean spherical C.P. with a titanium arc, but that it was not in a commercial form yet. Mr. Blondel, in his paper on impregnated arc light carbons and lamps, gave (if the figures were not misquoted in the reading) an equally extraordinary result with his new lamp and carbons, namely, a mean *hemi*spherical C.P. of 4800 for a 500 watt 9 ampere lamp, as against 700 C.P. for an ordinary open arc taking practically the same power.

Dr. Fleming and Dr. de Forest each contributed papers on wireless telegraphy, and Dr. Guthe gave one on coherer action; there was also a highly mathematical paper on the theory by Mr. Stone Stone. Dr. Fleming's paper gave a good general *résumé* of the subject, but contained very little new matter. The chief interest in de Forest's paper centred in the experiments he describes to prove that the action of his electrolytic receiver is due to polarisation, and not to a heating of the electrolyte as alleged by Fessenden. The electrolytic receiver consists essentially of a very small electrode dipping into an electrolyte, the second electrode being large and connected in series with a cell and telephone. Normally, a very small current flows through the receiver, which is greatly increased directly the oscillations pass through it. Dr. de Forest maintains that this is caused by the oscillations destroying the polarisation at the small electrode, and one of the most conclusive statements he makes in favour of this view is that the small electrode must be made the *anode*, and that the receiver is practically inoperative if it is connected to the negative of the local battery. This would certainly not be the case if the action depended on the heating of the electrolyte, which should be independent of the direction of the local battery.

Dr. Guthe treated at length the theory of the action of the coherer, especially from the electronic point of view. The first step is assumed to be an electrostatic attraction between the metallic particles. The electrons are carried over from the negatively charged metal to the other side, and we have a current carried entirely by the electrons. An increase in the electrical energy produces an increase in the number of electrons, *i.e.* the current increases while the difference of potential remains constant. This passage of electricity is accompanied by a pressure at right angles to the flow, which pushes aside the molecules of the dielectric which may have been between the metallic particles, and there remains what may be considered as a continuous metallic conductor. Dr. Guthe further extends this theory by considering the ionisation of the gas or dielectric surrounding the metallic particles. Both Dr. Guthe's and Dr. Fleming's papers contain numerous bibliographic refer-

ences. Dr. Fleming also proposes the name "kumascopes" for all forms of Hertz wave detectors, but it is not a very pleasant sounding term.

Telegraphy over wires was not neglected by the congress, and Dr. Kennelly gave both an excellent theoretical paper on the transmission speed over submarine telegraph cables, and a practical one on high frequency telephonic circuit tests. To test the telephone circuit for effectiveness a known sinusoidal E.M.F. is applied, and the corresponding received current strength is measured; the ratio of these quantities Dr. Kennelly calls the "receiving end impedance" of the circuit at the frequency used (600 ~ in the tests). If this impedance exceeds a certain value, then the circuit will be defective or inoperative. The interesting part of the apparatus is that used for the measurement of the received current; this is accomplished by passing it through a small platinum wire (Fessenden barretter), which it heats, and the change in its resistance is measured.

By this means, using a 3 micron wire, 23 microamperes can be measured, and with a 1·7 micron wire *in vacuo* 3 or 4 microamperes is said to be measurable. For practical tests on telephone switchboards the use of a sensitive reflecting galvanometer, which the above arrangement involves, is not very convenient, so the change in resistance of the platinum wire is observed by putting it in series with a sensitive milliameter and cell. A complete portable apparatus of this kind was described, with which one scale-division change in deflection of the Weston milliameter corresponded to 1·4 milliamperes of superposed alternating current. Curves are given in the paper showing tests of different lengths of cables.

The improvement of telephonic communication by increasing the self-induction of the circuits is receiving considerable attention in the States, and Dr. Hammond Hayes gave some most striking curves illustrating the reduction in attenuation which has been produced by the use of uniformly spaced loading coils on long circuits. The improvement is very much more marked in the case of cables than air wires. The most striking results are those obtained with a standard telephone cable which was heavily loaded so that the added inductance amounted to about 0·6 henry per mile. In this case, from Dr. Hayes's curves the received current was reduced to about ½ per cent. of the transmitted value at a distance of fifty miles with the cable unloaded, whereas with the loaded cable the received current was 7 per cent. Further, the great importance of terminal reflection where the loaded cable joins the transmitting and receiving apparatus is most marked, as by reducing the self-induction of the end loading coils so as to taper it off and avoid a sudden change in the self-induction the received current was increased to about 18 per cent.

It is also very interesting to note how the curves cross one another, so that short lengths of cable give better results without loading, whereas the cable with loading and terminal taper above six miles long produces less attenuation than the unloaded cable, the advantage in favour of the loaded cable increasing with its length.

There were many other papers of great scientific interest; among these may be mentioned Dr. Pender's paper on the magnetic effect of moving charges, which clears up many of the differences which existed between his results and those obtained by Crémieu, and suggests several other interesting problems; Prof. Wilson on condensation nuclei; two papers on the theory of conduction by Prof. Drude and Prof. Richards; and Prof. Arrhenius's paper on the electric charge of the sun.

In conclusion, it must be said that the congress was a complete success, perhaps more so than might have been expected, considering the great distance many of the members had to travel to attend its meetings, and this was greatly due to the indefatigable energy of its organisers, and especially to Prof. Elihu Thomson, the president, Dr. Kennelly, and Mr. Weaver. The attendance at the meetings was good, and if the discussions were not always as full as could be wished, this was not from lack of interest in the papers, but from lack of time. All the foreign members of the congress, irrespective of nationality, were received and entertained in the most hearty manner by their American *confrères*, fully bearing out the world-wide reputation that America has for hospitality.

W. DUDDELL.

PHYSIOLOGICAL CHEMISTRY IN THE UNIVERSITY OF GLASGOW.

TOWARDS the close of his introductory lecture to the course of physiology in the University of Glasgow on October 13, Prof. McKendrick said:—

I think there can be little doubt that the next great advance in physiology will be from the side of physiological chemistry. The phenomena of vital activity depend on chemical processes in which there are either the building up of complex substances by the union of simpler ones, or the decomposition of complex bodies into simpler ones—in other words, processes that are of a synthetical or of an analytical nature. These chemical phenomena lead, on the one hand, either to the locking up, or, on the other, to the liberation of energy, and the energy in a living being may appear as mechanical motion, heat, electricity, and to some small extent, and in special cases, as light and sound. During the last sixty years many of the physical phenomena of the living being have been investigated by special methods. It seems to me that we cannot expect much more from the application of the graphic method of registration, nor from the examination of the phenomena of electrical action in living tissues. The microscope and the methods of histological research have left little to be desired as to our knowledge of the structure of the elementary tissues and the structure of organs. A new departure must be made. No method of research seems so inviting or so promising as the rigid and methodical investigation of the chemical phenomena happening in living matter.

Hence the extreme importance of the chemist and the physiologist working hand in hand for the future advancement of physiological knowledge. At one time it was supposed that the chemical phenomena happening in the living body were of a different order from those occurring in dead matter. In 1824, however, Wöhler pointed to the first example of a synthetical process discovered within the animal organism. He showed that when benzoic acid is introduced into the stomach it appears as hippuric acid in one of the excretions, after coupling, probably in the liver, with amido-acetic acid or glycocoll. About the same time Hennell effected the synthesis of alcohol, and Wöhler formed urea from ammonium cyanate. As urea was then known only as a product of the animal organism, its synthesis from inorganic substances, and in the laboratory, was a feat of the first importance. This synthesis was the precursor of many others, so that we have now, at the lowest estimate, between two and three hundred chemical substances found in plant and animal tissues that can also be built up synthetically by the organic chemist. Year by year we are adding to this extensive list. Some of these syntheses are striking examples of the knowledge and skill of the chemists of the present day. Such, to mention one brilliant series, are the artificial productions of the sugars by the labours of Fischer and his pupils. Take, again, the formation of the highly complex body camphor, realised by Komppa and Vorländer. It may not be a day-dream if we contemplate the time when even the starches, fats, and proteids we use in our food may also be artificially formed. Physiological chemists have also done much in the way of studying the chemical changes happening to a substance during its passage through the body, but this is a much more difficult branch of physiological chemistry than even the synthetic production of organic bodies.

And yet we are far from solving the mystery of what we may call vital chemistry. When we think, for example, of the synthetical processes by which the chemist constructs complex bodies hitherto only found in the tissues of plants and animals, the question naturally occurs: how does nature produce these complicated molecules without the use of strong reagents and high temperatures? This aspect of the question has been well discussed by my friend Prof. R. Meldola, first, in an address as president of the chemical section of the British Association at the Ipswich meeting in 1885, and, second, in an important work, soon to be published, the proof sheets of which he has kindly allowed me to peruse, entitled "The Chemical Synthesis of Vital Products." It is clear from a study of the examples given by Prof. Meldola that the synthetical processes worked out by the chemist in his laboratory are quite unlike those occurring in plant and animal tissues, and yet the result is the

same, namely, the production of a complex organic compound. We have been too much in the habit of supposing that when we could represent the process followed by the chemist by an equation, that this equation represented what occurred in the plant or animal tissue. Physiologists more than chemists have erred in this direction, and many of the statements in our text-books are either superficial or grossly misleading. The chemist attains his end by violent means and with considerable rapidity, whereas, in the silent laboratory of the plant and animal cell, molecular processes are slowly carried on of which we know at present next to nothing. It is strange, for example, that we cannot yet follow all the steps of the process by which, under the action of sun-light, the green colouring matter in a vegetable cell can fix the carbon of the carbonic acid of the air and liberate the oxygen. Nor can we follow satisfactorily the steps of the synthesis by which the carbon is built up into such a substance as starch or sugar. Yet this is a synthesis accomplished every day by every green plant. Such phenomena in all probability are accomplished through the agency of enzymes or ferments, but their real nature is still obscure.

I have said enough to show you the vast importance of chemical investigation in the physiology of the future. Chemistry is but a highly specialised branch of physics. In these days all the new discoveries in physical chemistry, such as the true nature of solution, the facts of dissociation as exemplified by such a common phenomenon as the splitting up of common salt into the ions chlorine and sodium, the charging of each ion during electrolysis, and the laws of osmotic pressure, which no doubt regulate nutrition and the interchanges of blood and lymph, must be taken into account by the physiologist. Such research demands adequate laboratory accommodation and highly trained specialists. I am glad to say our university will soon be in a position to take her share in this new development of physiological science. The splendid laboratories now being built for physiology, public health, and materia medica will be a home for work of this kind, and the endowment of a lectureship in physiological chemistry by the trustees of the late Dr. John Grieve (who left 8000*l.* for the foundation of a lectureship in connection with the medical faculty of the university) will enable us to obtain the services of a trained specialist, who will give his undivided attention to this department of physiology. No subject more than physiology illustrates the truth that all science is one. Physics, chemistry, physiology, and all the others are only different ways of investigating the phenomena of nature. The phenomena of life are, however, the most difficult of all to investigate, and it may safely be asserted that the highest skill in experimental research and the deepest knowledge of chemistry and physics are required for such work. Throughout the scientific world physicochemical researches are now in progress into physiological and bacteriological processes, lectureships and laboratories are springing up here and there, and it is gratifying to be assured that the University of Glasgow will be able to take her share in this work.

CONDENSATION NUCLEI.[1]

A FAMILIAR experiment was first shown illustrating the action of ordinary dust particles as condensation nuclei. From a large globe, which had been allowed to stand for some hours, some of the air was removed by opening communication with an exhausted vessel. Only a very few drops were formed as a result of the expansion. On allowing air to enter the globe through a cotton-wool filter, so that the pressure was brought back to its original value (that of the atmosphere), and allowing the air to expand as before, the drops formed were again very few. The ordinary air of the room was now admitted; an expansion of the air in this case resulted in the production of a thick fog.

When air has been freed from dust by filtering, or by repeatedly forming a cloud by expansion, and allowing it to settle, the vapour which, in the presence of the nuclei, would have separated out in drops, must be in the "supersaturated" condition immediately after the expansion is completed.

[1] Discourse delivered at the Royal Institution on Friday, February 19, by C. T. R. Wilson, F.R.S.

Another method of producing clouds was now shown. Air was allowed to escape through a fine orifice into an atmosphere of steam; the mixed air and steam were then passed through a Liebig's condenser, where the greater part of the steam was condensed, and then into a large glass globe, where the clouds were observed. From this vessel the air was drawn off by a pump which maintained the pressure in the globe and condenser at a considerable number of cms. of mercury below that of the atmosphere. Before reaching the jet the air of the room had to pass through a cotton-wool filter, and then through a long tube containing water; finally it was led through an aluminium tube to the orifice. The latter was about half a mm. wide. The fall of pressure in passing through the orifice was about 15 or 20 cm. In the absence of the filter, the air being admitted directly to the water tube through a tap turned just sufficiently to give the same flow as with the filter, a dense fog poured out from the end of the condenser tube; on closing the tap and letting the air enter through the filter the fog rapidly cleared, and only a fine rain continued to be produced. While the apparatus was in this condition an X-ray tube was set in action near the aluminium tube; the rain was succeeded by fog, which continued to pour out from the end of the condenser so long as the X-rays were kept in action. Condensation nuclei are, as this experiment proves, produced in air exposed to Röntgen rays. Later experiments will, however, show that they have entirely different properties from the ordinary dust nuclei.

When air has been completely freed from dust particles, so that a slight expansion of the air (initially saturated with water vapour) does not result in the formation of any drops, it is found that quite a high degree of supersaturation may be brought about without the appearance of a single drop. There is, however, a limit to the supersaturation which can exist without condensation of the vapour in drops resulting. To study this condensation in dust-free air, and to measure the expansion required to produce the necessary degree of supersaturation, a special form of expansion apparatus is required. The lantern slide thrown on the screen shows the construction and mode of working of the apparatus. The second slide is a photograph of the machine in action, the exposure having been made immediately after an expansion; the cloud formed (in this case on nuclei produced by the action of radium) is plainly visible along the path of a concentrated beam of light from a lantern.

Let us now try an actual experiment with the expansion apparatus. On making a slight expansion a cloud forms on the dust particles which are present; this slowly settles to the bottom of the vessel. The air is allowed to contract to its original volume, and a second expansion of the same amount is made. The drops formed are on this occasion comparatively few, and they fall rapidly; the dust particles have nearly all been carried down with the drops formed by the previous expansion. The fewer the nuclei on which water condenses the larger will be the share of water available for each drop, and the more rapid will be the fall. The next expansion produces no drops. While the air is in the expanded condition, the piston being at the bottom of the expansion cylinder, air is removed from the cloud chamber by opening the connection to the air-pump until the pressure is about 13 or 14 cm. of mercury below that of the atmosphere; the piston is again allowed to rise by putting the air space below it in communication with the atmosphere. The next expansion is thus comparatively large, the pressure after the expansion has taken place and the temperature has risen to its original value being 13 cm. or more below the initial pressure. Yet, in spite of the high degree of supersaturation reached, not a drop of water is seen. Making the fall of pressure 16 cm., however, we see on expansion a shower of drops; and although these drops are few and large, falling therefore rapidly, yet, however often the same expansion be repeated, the drops produced on expansion show no diminution in number. Thus the nuclei removed with the drops are continually replaced by others manufactured within the apparatus itself.

To produce the necessary supersaturation to cause condensation in the form of drops in dust-free air, the air must be allowed to expand suddenly until the final volume is 1·25 times the initial volume. The condensation is rain-like in form, and, moreover, the number of drops remains small although the expansion considerably exceeds this lower limit.

Expansions exceeding the limit, $v_2/v_1 = 1{\cdot}38$, however, give fogs, which increase rapidly in density, *i.e.* in the number of the drops, as the expansion is increased beyond this second limit. The expansions required for the rain-like and cloud-like condensations correspond to a fourfold and eightfold supersaturation respectively.

A further experiment will throw light on the nature of the nuclei associated with the rain-like condensation. Let us expose the moist air to the action of X-rays before causing it to expand. First let us try an expansion very slightly less than that required to give the rain-like condensation without the rays. You observe no drops are formed. Now let the expansion be slightly greater than the critical value 1·25. A fog is seen on expansion. Thus the X-rays produce in the air immense numbers of nuclei having the same properties, so far as their power of assisting condensation goes, as the comparatively few nuclei which the rain-like condensation makes visible. Now a gas exposed to X-rays conducts electricity, and the otherwise complicated phenomena of this conduction are all reduced to comparative simplicity by the theory that under the action of the rays equal numbers of freely moving positively and negatively electrified bodies (the ions) are produced from the originally neutral gas. It is at once suggested that the condensation nuclei produced by X-rays are simply these ions.

Let us now impart conducting power to the gas by exposing it to the action of the radiation from radium. Again we have the same result; no drops are produced if the expansion be less than 1·25, fog if the expansion exceeds this limit.

If we substitute for the glass shade, which has thus far formed the cloud-chamber, a glass cylinder with a horizontal metal top, we have the means of testing whether the condensation nuclei produced by Röntgen or radium rays are really electrically charged, whether, in fact, it is the ions themselves which act as condensation nuclei or other particles produced by the rays. If, for example, the roof of the cloud chamber be kept positively charged, the floor negatively, the negatively charged ions will travel upwards and the positively charged ones downwards. In the absence of an electric field the positive and negative ions produced by the action of the rays will go on increasing in number until as many are neutralised by recombination with ions of the opposite kind, or by coming in contact with the walls of the vessel, in each second as are set free in that time by the rays. If the rays be cut off, the removal of ions by recombination and diffusion will continue, and the number of ions in the vessel will diminish rapidly.

Experiment shows that, while in the absence of an electric field, quite a considerable fog is formed when an expansion, slightly exceeding 1·25, is effected ten seconds after the rays have been cut off, with 200 volts between the upper and lower plates the same expansion, allowed to take place three or four seconds after the stopping of the rays, produces only a very slight shower. Or, again, if the rays be kept on all the time the resulting fog is very much less dense with the electric field acting than without it. These results are easily explained if we assume that the condensation nuclei are the ions, and apply the result obtained by purely electrical methods, that the ions travel about 1·6 cm. per second in a field of 1 volt per cm. The nuclei causing the rain-like condensation without exposure to Röntgen or radium rays are also removed by the action of an electric field; we have thus the direct proof that they also are ions. Recent experiments have proved that a charged conductor suspended within a closed space loses its charge by leakage through the air, and that the conduction shows all the peculiarities of that met with in an ionised gas; and, indeed, it appears that this ionisation is due to the action of radiation of the radium type from the walls of the vessel and from outside the vessel. The condensation method of detecting ions is, it may be pointed out, a very delicate one; a single ion if present in the vessel will be detected.

The positive and negative ions are not alike in their power of acting as condensation nuclei. In most of the experiments shown to-night the negative ions alone have in fact come into action. The positive require a considerably greater expansion in order that water may condense upon them. The final volume must for the positive ions be about 1·31 times the initial instead of only 1·25, corresponding to a sixfold instead of a fourfold supersaturation.

To demonstrate the difference between the positive and negative ions the same form of apparatus is used as in the previous experiment. Instead, however, of a difference of potential of 200 volts, only 2 or 3 volts are applied between the plates; and in this experiment only a thin layer close to the lower plate is exposed to the action of the rays. Under these conditions, if the upper plate is the positive one, the negative ions will be attracted upwards out of the ionised layer, and will occupy the greater part of the volume of the vessel, while the positive ones will have only a short distance to travel before reaching the lower plate. If the rays be cut off before the expansion is made it is easy to arrange the interval to be of such a duration that all the positive ions have been removed, while only a small fraction of the negative ions have reached the upper plate before the expansion takes place. Thus we can try the effect of expansion when the vessel is charged with practically negative ions only. By reversing the electrical field the action of positive ions, almost free from negative ions, can be studied. When the expansion is between 1·25 and 1·31 a fog or a mere shower is obtained, according as the direction of the field is such as to drive negative or positive ions upward.

The ions are by no means the only nuclei which can be produced within moist air from which the dust particles have been removed. Among the most interesting of such apparently uncharged nuclei are those produced in moist air exposed to ultra-violet light. It is impossible in the time available to do more than allude to them here.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The reader in animal morphology (Mr. Sedgwick) gives notice that a special course of advanced lectures on certain general aspects of zoology will be given at the zoological laboratory during the Michaelmas and Lent terms, beginning Friday, October 28. The course will include lectures by the following, and will be given as nearly as possible in the order indicated:—Michaelmas term: Mr. Doncaster, the nucleus and heredity; Mr. Lister, Foraminifera and Mycetozoa; Mr. Punnett, metamerism. Lent term: Mr. Gardiner, the œcology of aquatic animals; Mr. Brindley, certain aspects of regeneration; Mr. Hopkins, animal pigments; Mr. Fletcher, cell-structure, cell-division, and maturation of germ-cells; Mr. Heape, some problems connected with the comparative physiology of the generative system.

Dr. Donald MacAlister, St. John's, who has represented the university on the General Medical Council since 1889, and is now chairman of the British Pharmacopœia Committee, was re-elected for a fourth period of five years on October 24.

A university lectureship in applied mathematics is vacant by the appointment of Mr. H. M. Macdonald to be professor of mathematics in the University of Aberdeen. The readership in botany is vacant by the resignation of Mr. Francis Darwin. These offices will be filled up during the present term.

The Gedge prize in physiology has been awarded to Mr. K. Lucas, fellow of Trinity, for his paper on "The Augmentor and Depressor Effect of Tensions on the Activity of Skeletal Muscle."

The number of students of the first year matriculated on October 21 was 884, or for the whole year up to that date 923.

The late Mr. Henry Evans, of Trinity College, bequeathed to the university his collection of British Lepidoptera.

The following examiners have been appointed for the natural sciences tripos:—Physics, R. T. Glazebrook and W. C. D. Whetham; chemistry, H. O. Jones and Prof. A. Smithells; mineralogy, Prof. W. J. Lewis and L. J. Spencer; geology, A. Harker and Dr. F. A. Bather; botany, A. C. Seward and H. Wager; zoology, A. Sedgwick and Prof. W. A. Herdman; physiology, W. M. Fletcher and Prof. E. Waymouth Reid; anatomy, Dr. E. Barclay Smith and Prof. A. Robinson.

LORD KELVIN will be installed as Chancellor of the University of Glasgow in the Bute Hall on Tuesday, November 29.

PROF. WINDLE, Dean of the Medical Faculty at Birmingham University, has been appointed to the presidency of Queen's College, Cork, in succession to Sir Rowland Blennerhassett.

PROF. HARRY E. CLIFFORD has been appointed acting head of the department of electrical engineering at the Massachusetts Institute of Technology, Boston, in succession to Dr. Louis Duncan, resigned.

AT a meeting of the governors of the South-Eastern Agricultural College at Wye, held on Monday, October 24, it was decided to develop further the forestry department, for which a grant will be sought from the Board of Agriculture.

MR. SIDNEY H. WELLS and the Rev. James Went have accepted the invitation of the President of the Board of Education to serve on the consultative committee in place of Prof. Henry E. Armstrong and the Rev. Dr. Gow, who retire in accordance with the terms of the Order in Council by which the committee was constituted.

YALE University, it is reported, will receive by the will of Mr. Levi Clinton Veits the sum of about 40,000*l.* We learn further from *Science* that the veterinary department of the University of Pennsylvania has received an anonymous gift of 20,000*l.*, Columbia University a gift of 3250*l.* from Mr. H. E. Garth for the establishment of a scholarship, and 2000*l.* from an anonymous donor for the purchase of books.

A WELSH national conference on the training of teachers is to be held at Shrewsbury on November 10 and 11. Representatives from the Court and Senate of the University of Wales, from the Council and Senate of each of the Welsh university colleges, from the local education authorities, the local governing bodies, as well as from the educational associations throughout Wales, are expected to be present. The conference will be fully representative, and is expected to have important results.

BY the will of the late Dr. Isaac Roberts, the reversion of his residuary estate, probably between 30,000*l.* and 35,000*l.*, is to be divided equally between the University of Liverpool and the University Colleges of North and South Wales, for the purpose of founding scholarships. In the award of the scholarships preference is to be given to persons studying or intending to study astronomy, biology, zoology, botany, chemistry, electricity, geology, and physics, under conditions determined by the councils.

NEW physical and engineering laboratories were opened at the York Railway Institute of the North-Eastern Railway Company on October 20 by Sir Edward Grey. During the course of an address, Sir Edward Grey said he was convinced that no country was more qualified by nature and brains to make use of good scientific training than our own, and, therefore, there was all the more reason why there should be good opportunities of acquiring it. In the great struggle for success everything depended on the use made of scientific discoveries.

DR. C. POMERANZ has been appointed assistant professor of chemistry in the University of Vienna, Dr. Johannes Königsberger assistant professor of theoretical physics at Freiburg, and Dr. Paul Rabe, of Jena, has been raised to the standing of assistant professor at Jena. Profs. H. Joly (mathematics) and A. Dommer (mechanics), of Lausanne, have been raised from the rank of assistant to that of ordinary professor. Dr. Sommer has been appointed professor of mathematics at the Danzig Technical College; Dr. Kurlbaum, of the Charlottenburg National Physical Laboratory, has been appointed ordinary professor at the Berlin Technical College; and Dr. Max Bodenstein assistant professor of chemistry at the University of Leipzig.

THE meeting of teachers engaged in London polytechnics, technical institutes, and schools of art, announced in our last issue, was held at Birkbeck College on October 22, to promote an association of technical teachers for the advancement of technical education generally, interchange of ideas on methods of teaching, and the safeguarding of professional interests. The following resolution was adopted by a large majority:—"That this meeting hereby decides to form an association of science, technological, and art teachers engaged in the London polytechnics, technical institutes, and schools of art, such association to comprise both permanent staffs and evening teachers, other than those engaged in purely secondary work." An executive committee of fifteen members was appointed to draft rules and constitution, and to report to a general meeting to be held in January.

A COPY of the prospectus for 1904–5 of the Leith Nautical College has been received. The college is devoted wholly to technical instruction in subjects directly connected with the sea. It is equipped with physical and mechanical laboratories and appliances for every branch of nautical education. Experimental work is provided in magnetism and electricity in regard to their seafaring application, in the teaching of seamanship, and in shipbuilding. The teaching arrangements are framed to suit the needs of the migratory seafaring community; for students can enter at any time, and can attend for long periods or for recurring short periods, as may be convenient to them. The work of the college, as the programme of instruction shows, is in no way limited by the requirements for the Board of Trade examinations, but every facility is offered in the numerous subjects of a higher naval education. Among courses of study included in this programme may be mentioned those on oceanic meteorology and instruments, with the bearing of meteorological elements on ocean routes, and on ship manœuvring in cyclones; on shipping and commercial law, including the commercial duties of a shipmaster; and on ship surgery, medicine, and hygiene at sea. Special classes have been arranged for fishermen in fisherman's navigation, weather knowledge, knotting and splicing, and in rigger's work.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 17.—M. Mascart in the chair.—On the four first numbers of the photographic catalogue of the heavens published by the Observatory of Toulouse: M. **Lœwy.** The parts now published contain the rectilinear coordinates of 32,275 stars, obtained from 186 negatives. The introduction to vol. ii., by M. Baillaud, also gives a complete account of the method of reduction followed at Toulouse, as well as of the special methods used in the measurements of the coordinates and for the calculation of the constants. An account is also given of the method adopted for measuring the relative magnitudes of the stars and of an experimental study of the photographic objective employed. Statistical studies made at the Observatories of Oxford, Toulouse, and Potsdam have shown that the mean distribution of the star images in the negatives of the catalogue is not uniform, and prove that the focal surfaces of the six objectives studied (Algeria, Oxford, Paris, Potsdam, San Fernando, and Toulouse) have an appreciable curvature. —The study of the third group of air bands with a strong dispersion: H. **Deslandres** and A. **Kannapell.** A detailed description is given of the study of the third group of air bands occupying the more refrangible half of the ultra-violet region (λ 3000 to λ 2000). The general result confirms the conclusions arrived at in 1885, each band under strong dispersion being always formed of eight series of rays in arithmetical progression. A drawing is given for the band λ 2370, in which this structure is clearly shown. —On a new system of micrometers: G. **Millochau.** The wire micrometer, which is attended with certain inconveniences, is replaced by an instrument based on the principle of the heliometer. Two identical plates of glass with parallel faces are placed in a plane perpendicular to the optical axis of the telescope employed, between the objective and the eye-piece. The plates turn round a common axis and give rise to a double image of the star, the distance between the two images being practically independent of small displacements of the telescope.—Observations of the sun made at the Observatory of Lyons with the 16 cm. Brunner equatorial during the second quarter of 1904: J. **Guillaume.** The results are summarised in three tables giving the number of spots, their distribution

in latitude, and the distribution of the faculæ in latitude.—The elements of molecular vibrations in relation with the sense of propagation of sound waves: L. **Bard.** In view of the impossibility of explaining the orientation of sound by the ear by the usual theories, the author propounds two hypotheses to explain this.—Researches on the boiling points of mixtures of volatile liquids: C. **Marie.** The boiling point constants of a given pair of volatile liquids and a non-volatile substance being given, the question is raised as to whether it is possible to calculate, *a priori*, the value of the boiling point constant corresponding to the mixture. This calculation has been made by Nernst, and an experimental study of this formula has been made by the author with mixtures of water and alcohol and resorcinol. The divergence between the theory and the results of the experiments is considerable, and an examination of the fundamental assumptions used in the formula is made to see if the cause of the divergence can be elucidated. Further experiments are required before the theory can be completely made out.—The action of solutions of organomagnesium compounds on the halogen derivatives of phosphorus, arsenic, and antimony: V. **Auger** and M. **Billy.** Phosphorus trichloride reacts violently with solutions of magnesium methyl iodide, giving the chloride of tetramethylphosphonium, phosphorus iodide, and magnesium chloride. With chloride of arsenic the chief product of the reaction is trimethylarsine oxide; with antimony trichloride several substances are formed, from which, by treatment with potassium iodide, the iodide of ethylstibine can be isolated.—On an organic persulphate: R. **Fosse** and P. **Bertrand.** The sulphate of dinaphthopyranol, obtained by treating dinaphthopyranol with dilute sulphuric acid, possesses oxidising properties, setting free iodine from an acidified solution of potassium iodide, and oxidising alcohol to aldehyde. It thus appears to be a true persulphate, analogous in composition with Caro's acid.—The constitution of rosaniline salts and the mechanism of their formation: Jules **Schmidlin.**—Anthracene tetrahydride and octahydride: Marcel **Godchot.** These hydrides have been obtained by applying the method of Sabatier and Senderens. The octahydride is the more stable of the two, and is the main product when the hydrogenation is carried out at 200° C. The oxidation products and the reactions with the halogens have been studied.—On the origin of the carbonic acid of the seed during germination: Edouard **Urbain.** It is established that the carbon dioxide is produced at the expense of the albuminoid materials of the seed.—Study on the successive states of plant material: Eug. **Charabot** and Alex. **Hébert.**—Vital periodicity of animals submitted to the oscillations of level in deep sea: Georges **Bohn.**—The agglutinating cells in the Eolidia: Paul **Abric.**—Description of some new species of trypanosomes and parasitic Hæmogregarina of marine Teleostea: E. **Brumpt** and C. **Lebailly.**—On the auxospores of two pelagic diatoms: J. **Pavillard.**—The geology of the Ortler region: Pierre **Termier.**—On macles: G. **Friedel.**

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 28.

PHYSICAL SOCIETY, at 5.—An Interference Apparatus for the Calibration of Extensometers: John Morrow and E. L. Watkin.—A Sensitive Hygrometer: Dr. W. M. Thornton.—Note on a Property of Lenses: Dr. G. E. Allan.

SATURDAY, OCTOBER 29.

ESSEX FIELD CLUB, at 6.30 (at Essex Museum of Natural History, Stratford).—Fresh-Water Biological Research and Biological Stations: D. J. Scourfield.

TUESDAY, NOVEMBER 1.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Inaugural Address by the president, Sir Guilford L. Molesworth, K.C.I.E.—Presentation of the Council's Awards, and Reception in the Library.

WEDNESDAY, NOVEMBER 2.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Detection and Estimation of Small Quantities of Maltose in the Presence of Dextrose: Julian L. Baker and W. D. Dick.—The Use of Palladium-Hydrogen as a Reducing Agent in Quantitative Analysis: Alfred C. Chapman.—Some Recent Abnormal Milk Results: Sidney Harvey.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 3.

CHEMICAL SOCIETY, at 8.—Note on the Action of Nitric Acid on the Ethers: J. B. Cohen and J. Gatecliff.—The Condensation of Formaldehyde with Acetone (Preliminary Note): E. A. Werner.—Union of Hydrogen and Chlorine. Rate of Decay of Activity of Chlorine: J. W. Mellor.—The Action of Phthalic Anhydride on α-Naphthylmagnesium-bromide: S. S. Pickles and C. Weizmann.—The Constitution of Nitrogen Iodide: O. Silberrad.—The Available Plant Food in Soils: H. Ingle.—The Combustion of Ethylene: W. A. Bone and R. V. Wheeler.—The Decomposition of Methylurea: C. E. Fawsitt.—The Influence of Certain Salts and Organic Bodies on the Oxidation of Guaiacum: Miss E. G. Willcock.—The Influence of Potassium Persulphate on the Estimation of Hydrogen Peroxide: J. A. N. Friend.—The Dynamic Isomerism of α- and β-Crotonic Acids (Preliminary Note): R. S. Morrell and E. K. Hanson.—The Influence of Sunlight on the Dissolving of Gold in an Aqueous Solution of Potassium Cyanide: W. A. Caldecott: (1) The Fractional Hydrolysis of Amygdalinic Acid; (2) Isoamygdaline: H. D. Dakin.

RÖNTGEN SOCIETY, at 8.15.—The Presidential Address: C. Thurston Holland.

FRIDAY, NOVEMBER 4.

GEOLOGISTS' ASSOCIATION, at 8.—Conversazione.

MONDAY, NOVEMBER 7.

ROYAL GEOGRAPHICAL SOCIETY (Albert Hall), at 8.30—The Work of the National Antarctic Expedition: Captain R. F. Scott, R.N.

TUESDAY, NOVEMBER 8.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Coast Erosion: A. E. Carey.—Sea-Coast Erosion on the Holderness Coast of Yorkshire: E. R. Matthews.

FRIDAY, NOVEMBER 11.

ROYAL ASTRONOMICAL SOCIETY, at 5.

CONTENTS.