THURSDAY, OCTOBER 21, 1897.

GEOLOGY FROM AN AMERICAN POINT OF VIEW.

An Introduction to Geology. By William B. Scott, Blair Professor of Geology and Palæontology in Princeton University. Pp. xxvii + 573. 8vo. (New York: The Macmillan Company, 1897.)

IT is always well to keep in touch with the methods and conclusions of workers in other countries; and in a general way this can only be done by text-books. In this respect the present work will be found of considerable service to British students of geology. It is intended especially for American students, and has been written both for those who desire to pursue the subject exhaustively, and for those who seek only to learn the principal results of the science. To satisfy the needs of these different classes is a task that it would be impossible fully to attain in any work, for the details required by some would be apt to repel others. Nevertheless, the author has well succeeded in his main endeavours.

We may pass over that usual stumbling-block to the general reader, the chapter on rock-forming minerals, which, as the author says, "is intended rather for reference than for actual learning." It might perhaps have found place in the appendix, alongside the table of European strata and the classificatlon of animals and plants. It is essential, however, that something be said on the subject, and the author treats it concisely and without needless detail. He then proceeds to give a full and very interesting account of the changes which are now in progress on the surface of the earth, admirably illustrated with photographic reproductions, and embodying the results of the most recent researches.

The igneous and stratified rocks, their structure and dislocations, are next described in a similar manner, with photographic and diagrammatic illustrations; and of much interest to British students is the account of various kinds of folds and displacements to which American geologists in particular have assigned special names.

In the part relating to physiographical geology again we have very useful illustrations of many phenomena and of terms now largely used in geological literature, but not as yet so clearly explained in other text-books. The chapter on the adjustment of rivers, dealing with antecedent and superimposed rivers and subsequent streams, as explained by Prof. W. M. Davis, cannot fail to be of service. The treatment of the many subjects causes here and there some repetition, as in the case of soil (pp. 76, 124, and 217), and a little condensation might be made in a future edition in reference to this and a few other matters.

The least satisfactory part of this volume is that dealing with stratigraphical palæontology. Something should have been said about geological zones and of their importance in correlating strata belonging to distant regions. As it is, we have to be content with a lithological account of the leading formations developed in America, and of the extent of these in other parts of the world; we are told something about their method of formation, but as regards the life-history we have simply a statement of the genera of Ordovician or Devonian, as the case may be, and figures of some of the characteristic American species. There is but a meagre hint that rocks of Devonian and Old Red Sandstone type have been recognised in America. We are informed that along the eastern shore of the Chemung Sea (Upper Devonian), there was accumulated an immensely thick sandstone (7500 feet), which was formerly supposed to represent a distinct series, and called the Catskill. Again, it is stated that "the so-called Catskill of New York is very like the Old Red, and contains similar fossils." Surely it would have been of interest to state that the rocks of this type in America contain *Holoptychius* and *Bothriolepis*. The lack of special palæontological information is felt when we read that "in North America the passage from Silurian to the Devonian is very gradual, the former drawing to its close without disturbance; and there is still some difference of view as to just where the line between the two systems should be drawn." Moreover, "in many parts of North America the Devonian was followed so quietly by the Carboniferous, that it is very difficult to draw the line between them; but in other regions notable geographical changes occurred." These indications of a gradual passage are so similar to those met with in this country, that a few further materials for comparison would have been very welcome.

The author's general scheme of classification is a happy one. He uses the term Archæan to include the most ancient rocks, often spoken of as the "basement or basal complex." Between this Archæan complex and the Cambrian comes the Algonkian period, termed Eozoic, though at present the indications of former life are mainly inferred from the presence of limestones and graphite. Above the Cambrian we have the Ordovican, Silurian, and other periods. The Permian is grouped with the Palæozoic, as it is on the whole distinctly connected with it, although "it has several features which mark it out as transitional to the Mesozoic." In following through the account of the various formations we find many matters of considerable interest, and we are also introduced to the various terms applied to subdivisions of the geological series in North America. Among these the "Clear Fork Beds" of the Permian and the "Goodnight Stage" of the Pliocene, sound somewhat strange when compared with British terms.

There was a time when Eskers and Kames were considered to be synonymous. American geologists have for some time recognised a difference—*Kames* being considered as "hillocks or short ridges of stratified drift, formed by the deposition of materials from subglacial streams as they escape from under the margin of the ice," while *Eskers* or *Åsar* are "long, winding ridges of sand and gravel," which follow the general direction of the moving ice, and may have been laid down in channels or tunnels in the ice. These and other explanations are interesting and useful. In some instances the references are far too meagre, as in the case of Cherts, where their organic origin through sponge-spicula and radiolaria is not sufficiently indicated.

The numerous photographic illustrations are very beautiful and instructive; indeed, they lend additional charm to this pleasantly written book. The diagrammatic figures are also well executed; the only one which we notice as not clear is that of a fissure-spring (Fig. 31). A spring issuing from the spot indicated would surely be an overflow from the inclined beds of conglomerate and sandstone. A diagram showing an artesian well might be added in a future edition.

Students and teachers should bear in mind the advice given by the author, to look not too impatiently for definite and final opinions on vexed questions. Evidence must be weighed and judgment often suspended. As he quaintly puts it, "An open-minded hospitality for new facts is essential to intellectual advance."

H. B. W.

AN ANATOMY OF THE HORSE.

Topographische-Anatomie des Pferdes. By Dr. W. Ellenberger and Dr. H. Baum, of the Veterinary School, Dresden. 3 vols. Pp. 951. (Berlin: Parey, 1897.)

THE first volume of this work contains 271 pages, and appeared in 1894; it comprises a description of the anterior and posterior limbs, with some beautifully executed plates, some few in colours. The nomenclature is, for the most part, that used in human and comparative anatomy, so that this book, unlike many other veterinary works on this subject, may be read and appreciated by all who have a knowledge of human anatomy, and who are interested in the anatomy of the horse from a comparative point of view.

The muscles, blood-vessels, and nerves are well described and depicted in the numerous and excellent illustrations. The names used are generally those of their homologues in the human subject: it may be noticed that the triceps in the fore limb is called a coneus. In the hind limb the rudimentary soleus is delineated, as is also the considerably developed plantaris. The strongly developed internal obturator, which in the horse is in two portions, one part arising in the usual place, the other from the internal surface of the ilium—this latter being often wrongly called pyriformis in this country—is here correctly described and named. A prominent feature in this work is the numerous sectional diagrams (several in each segment of the limbs being given), which the student will find most helpful in assisting him to understand the correct relations of the various structures. The contents of the hoof is dismissed in about ten pages, and the subject well, though not too verbosely, treated; the text being illustrated by two transverse sections and one side view.

The second volume, which also appeared in 1894, consists of about 350 pages of well-written text. It treats of the head and neck, and contains sixty-seven diagrams, among which are many transverse and longitudinal sections, as well as some good dissections. The eye, ear, and brain are thoroughly described, the text everywhere suitably illustrated.

The third volume, which only appeared early this year, contains 330 pages and sixty-six illustrations and diagrams; it commences with the chest and its relations to the fixed portions of the fore limbs, and the text is illustrated by a series of transverse sections. The thoracic viscera are next described, and their relations, both to the surface and to the great vessels and nerves within the cavity, are well described and illustrated by finely-coloured plates. The abdominal and pelvic cavities are treated on similar lines; the arrangement of the peritoneum and its relations to the contained viscera is shown by many transverse and longitudinal sections, and the volume is concluded by eight full-page drawings which illustrate in a diagrammetic manner the right and left aspects of the trunk, showing the viscera in their relations to the bones and soft parts. The other plates illustrate the intestinal relations to the abdominal floor, the internal abdominal rings, and contents, as seen from the front; and, finally, a front and side view of the horse with surface markings of the various muscles and bony prominences as seen through the skin.

We have no hesitation in recommending this work to all requiring a precise and accurate treatise on the anatomy of the horse, and we feel sure that it will be widely read by all veterinary students possessing a knowledge of the German language; and it will be found useful to the English student, particularly for its numerous illustrations and diagrams, which, with some knowledge of the subject, can be easily understood without more than an ordinary acquaintance with the language.

OUR BOOK SHELF.

First Stage Physiography. By A. M. Davies, A.R.C.S., B.Sc., F.G.S. Pp. viii + 238. (London: W. B. Clive 1897.)

As the author of this book points out, the scope of physiography has changed very considerably since the word was first introduced. Always intended as an introductory course of science, it has been modified from time to time with the view of better adapting it to the needs of the system of national examinations controlled by the Department of Science and Art. Last year the changes were very considerable, and new text-books of the type before us may be regarded as a natural consequence. The first six chapters deal with the subject-matter of Section I. of the revised syllabus, on which a separate examination is now held. While apparently not intended for the use of students taking this section as a distinct subject, this portion of the book may meet the needs of such, providing the detailed syllabus itself is also utilised, and the necessary experiments carefully performed. It is, however, sufficiently comprehensive for students taking the ordinary elementary stage, and has the merit, in a subject where so much ground has to be covered, of conciseness without sacrifice of clearness. The treatment of the other well-known branches of the subject follows closely the lines of the official syllabus. Though showing but few new features, the book appears likely to meet the requirements of both teachers and students.

La Plaque Photographique. Par R. Colson. Pp. 165 + iv. (Paris: Georges Carré et C. Naud, 1897.)

GREAT is the number of photographers, but how few are those who have any conception of the action of the rays of light on the photographic plate? Every one who dabbles in the "black art" should try to make himself or herself acquainted with some of the rudiments of this side of the subject, for a knowledge of principles helps not only to render the results more perfect, but to add an additional interest to the pursuit of this science.

The book which we have before us is suitable for those even not very advanced in the subject, and is well worth reading. The author commences by bringing to the reader's notice the properties of the sensitive plate, the principles involved in its preparation and use, dealing further on with the several rays which influence it, namely chemical, light, electrical, mechanical, &c The Röntgen rays are, of course, elaborately dealt with, and their action on the photographic plate, as far as is known, is discussed.

Another chapter is devoted to the old experiments of Niepce de Saint-Victor, which were made in 1857 with the object of investigating whether light could be stored up in bodies apart from the phenomena of phosphorescence and fluorescence: several interesting abstracts are here made from the originals. The succeeding chapter deals with the more recent experiments made on the above lines, while the subject of the last one consists of the precautions which must be taken in the preservation and employment of photographic plates.

Luce e Raggi Röntgen. By Oreste Murani. With a preface by Prof. R. Ferrini. Pp. x + 392. (Milan: Ulrico Hoepli, 1898.)

15 *Lezioni Sperimentali su la Luce.* By A. Garbasso. Pp. iv + 259. (Milan: Office of *L'Elettricità*, 1897).

PROF. MURANI'S volume upon light and Röntgen rays does credit to Italian science. It may be described as a work on light with special reference to Röntgen rays. The general phenomena of light—such as reflection, refraction, diffraction, decomposition, polarisation, &c., are first explained, and then the character of the electric discharge in rarefied gases and high-vacuum tubes are described. This naturally leads to Lenard's and Röntgen's investigations, and once launched in the sea of X-ray literature the author has no difficulty in finding material upon which to exercise his powers of composition. The work of English investigators is frequently referred to, and an attempt has been made to include the best of what has been done and thought in connection with Röntgen rays. The illustrations are fairly numerous (there are 157, and 15 plates), but they are no better than those published in other works on the same subject. As is common in continental publications, the book is published without an index.

Dr. Garbasso's book contains a number of experiments on light considered as an electro-magnetic phenomenon. It is a little volume from which teachers and demonstrators of physics may obtain information upon many experiments, and which gives readers of Italian an instructive view of electric oscillations. The first four chapters of the book are devoted to descriptions of the fundamental principles of electricity and magnetism, and the remainder is devoted to the work of various investigators of electric waves.

Waste and Repair in Modern Life. By Robson Roose, M.D., LL.D., F.R.C.P. Edin. Pp. 364. (London: John Murray, 1897.)

THE book before us consists of twelve essays which have already been published elsewhere, and are now brought up to date and collected, making a thickish book. The subject-matter of these essays is very various, the title of the book being apparently taken from the first two essays. Amongst others the following questions are considered:—The art of prolonging life; the alcohol question; fasting and its physiology; the London water supply, &c. The book cannot be regarded as a serious contribution to any of the subjects dealt with, and will hardly appeal either to the medical profession or to the readers of NATURE. It is, however, written in a chatty style, and that section of the public which is interested in the acquisition of medical superficialities will find it certainly readable, and probably instructive.

F. W. T.

Missouri Botanical Garden. Eighth Annual Report. Pp. 236. (St. Louis, Mo.: Published by the Board of Trustees of the Missouri Botanic Garden. London: W. Wesley and Son, 1897.)

THE scientific papers in this report of the Missouri Botanical Garden are as follows:—"The Mosses of the Azores" and "On some Mosses collected in Madeira by William Trelease in June 1896," by M. J. Cardot; and "Botanical Observations on the Azores" by the Director of the Garden, Mr. W. Trelease (see NATURE, p. 551). As there is a prospect that the sum at present available for the purposes of the Garden will be increased, the Director has drawn up a general plan for the extension and development of the institution, to bring it into full conformity with the intentions of its founder, Henry Shaw. One of the clauses in Mr. Shaw's will stated "that scientific investigations in Botany proper, in vegetable physiology, the diseases of plants, the study of the forms of vegetable life, and of animal life injurious to vegetation, experimental investigations in horticulture, arboriculture, &c., are to be promoted." This clause has never been lost sight of, and a number of scientific papers have been prepared by Mr. Trelease and his assistants. The new scheme provides further facilities for research work. "I hope," says the Director, "to live to see the income of the Garden so ample that it shall claim among its regular employees men recognised as the equal of any in the country, if not in the world, in horticulture, vegetable physiology, morphology, paleo-botany, phanerogams, pteridophytes, bryophytes, fungi, algæ, and lichens. Ultimately it is very possible that the money available for research work will admit of the employment in the same manner of an entomologist, and there is a possibility that in coming generations other branches of zoology may be represented." It is to be hoped, for the sake of scientific progress, that the plans which are at present only on paper will all be materialised in the near future.

Year-Book of the United States Department of Agriculture for 1896. Pp. 686. (Washington: Government Printing Office, 1897.)

THIS Year-Book is in many respects a unique publication. Consisting of a bound volume of more than six hundred pages, published annually at Government expense in an edition of half a million copies, and for free distribution, it is a standing testimony to the encouragement given to scientific agriculture in the United States. The first part of the volume contains a brief general report on the operations of the Department of Agriculture, but this only occupies fifty pages, the remaining portion being taken up with papers, by agricultural experts, discussing the result of investigations in agricultural science and farm practice. In imparting this information, technical language is avoided, so far as possible, in order that the papers may be easily understood by the class for whose interests they have been prepared. Among the subjects dealt with are: the extermination of noxious insects by bounties, the use of steam apparatus for spraying, influence of environment in the origination of plant varieties, potash and its function in agriculture, irrigation on the great plains, insect control in California, diseases of shade and ornamental trees, migration of weeds, agriculture education and research in Belgium, olive culture in the United States, and ambrosia beetles. Several of these papers have already been noticed in NATURE, having been received in the form of excerpts from the present volume.

Practical farmers in the United States, and students of agriculture and related sciences, should be grateful to the Government which so freely publishes information of the kind contained in this Year-Book.

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.*]

On the Meaning of Symbols in Applied Algebra.

ON reading the correspondence in NATURE (vol. lv.) on this subject, my sympathies were with the physicists as typified by the Professors Lodge; but I think that the mathematicians as typified by Messrs. Jackson and Cumming have a legitimate grievance.

The following statement is "abhorrent" to the mathematicians. The horizontal intensity of the earth's magnetic field at a certain point is

$$\cdot 200 \frac{\sqrt{\text{gm.}}}{\text{sec.} \sqrt{\text{cm.}}}$$

$$= \cdot 200 \frac{\sqrt{\cdot 00220 \text{ lb.}}}{(\text{min.}/60) \sqrt{\cdot 0328 \text{ ft.}}}$$

$$= 3 \cdot 11 \frac{\sqrt{\text{lb.}}}{\text{min.} \sqrt{\text{ft.}}}$$

The physicist attaches a definite-enough meaning to this statement, and to the result of this little piece of generalised arithmetic. This is that if an observer go through the well-known process of finding H with two different sets of instruments: (1) a balance with gramme weights, a clock counting in seconds, and a scale divided to centimetres; and (2) a balance with lb. weights, a clock counting in minutes, and a scale divided to feet; then if his results on reduction give $H = \cdot 200$ in the first case, they will give $H = 3 \cdot 11$ in the second.

The mathematician will not for a moment dispute this result, and he will not deny that precisely similar processes will always give correct results. But he is, nevertheless, inclined to take up the position that no meaning can be assigned to the combination $(\text{gm.})^{\frac{1}{2}}\ \text{sec.}^{-1}\ (\text{cm.})^{-\frac{1}{2}}$. And his legitimate grievance is that nobody has placed these convenient processes on a general logical basis. (I believe this last is a fact.)

There is nothing illogical or mathematically immoral in the following simple assertions. In ordinary algebra there is no meaning attached to a length × another length, or to a length ÷ a time. We may, therefore, assert that a length × another length *shall mean* a certain area, viz. that of a rectangle, two of whose adjacent sides are the lengths; and a length ÷ a time *shall mean* the velocity of a body which covers the length in the time. We are at perfect liberty to make these definitions, even if it should turn out that the ordinary laws of algebra will not hold for the new kind of multiplication and division. But if, as it turns out is the case, those laws should hold, we have extended the meaning of algebraic results, which is a great gain; and we have provided ourselves with a new physical instrument of thought, which is a greater gain.

How to put all such mathematical processes, which the physicist is constantly employing, on one general logical basis? The following definitions hint a sketch of one way of proceeding.

In the definitions "number" will be taken to mean any real algebraic quantity—positive or negative, rational or irrational.

The algebraic definition of variation is applicable equally to numbers and to physical quantities. Let A and B be either two numbers or two physical quantities, possibly of different kinds. The ordinary algebraic definition of variation may be expressed thus:—$A \propto B$ if A depends on B in such a way that when B is multiplied by *any* number, A is multiplied by the same number. For instance, if the base of a triangle be given the area ∝ the altitude. The first of the following definitions includes the above as a particular case.

Definition 1. *$A \propto B^n$ if A depends on B in such a way that when B is multiplied by any number x, A is multiplied by x^n.* For instance,

$$\text{Edge of cube} \propto (\text{volume})^{\frac{1}{3}};$$

and in a race over a given course

$$\text{Runner's average velocity} \propto (\text{his time})^{-1}.$$

Definition 2. *If X is determined by, and depends in a specified manner on, the independent physical quantities (or numbers) A, B, C, . . ., in such a way that $X \propto A^a$ when B, C . . . are constant, and $X \propto B^b$ when A, C, . . . are constant, &c., then*

$$X = A^a B^b C^c \ldots$$

The words "in a specified manner" are important. For instance, an area can be made to depend on two independent lengths in an infinite variety of ways. The specified manner *might* be as follows:—The area X is the area of a triangle whose base is A and altitude B. Then according to the definition $X = A B$. But this is not the conventional specification. For that of course we must read "rectangle" for "triangle." Again an acceleration X may be made to depend in the way described in the definition on an independent length A and time B as follows:—X is the acceleration with which a body must move from rest to describe the length A in the time B. According to the definition we should then have $X = A B^{-2}$. But this again is not the conventional specification. For the latter we must read "X is half the acceleration," for "X is the acceleration."

With these definitions it is not hard to show (1) that *all the laws of ordinary algebra* which have any meaning under the new circumstances *are true*, and (2) that *all such laws are true generalisations of the ordinary laws* in that the latter are particular cases.

ALEX. MCAULAY.

University of Tasmania, Hobart, June 19.

Dog Running on Two Legs.

THE following instance shows how easily and well a four-legged animal can adapt itself to run on two legs only.

Last July a beautiful black and white shepherd's dog, on the Downs farm, near here, was caught amongst the knives of a reaping machine. Both the legs on the dog's right side were dreadfully mangled, and the animal almost bled to death. The right hind leg was so torn that one long piece and several small pieces of bone dropped from the wound. The dog lay for some time senseless and practically bloodless and lifeless. The kind-hearted shepherd, however, to whom the dog belonged, would not allow it to be at once destroyed; he bound up its terrible wounds, put it carefully in a wheelbarrow, wheeled it home, and nursed it. After two or three weeks the animal had so far recovered as to be able to crawl and move about on its two left legs with a little assistance from its crushed right fore-leg.

This dog now lives with the shepherd at Dunstable, and runs backwards and forwards to Downs farm—a mile off—every day. The greater part of the journey is performed on the two legs of its left side, as the dog can do nothing whatever with its right hind-leg, and the right fore-leg is so damaged as to be only useful as a slight occasional prop. In starting to run, the dog quickly gets up, jerks his ruined right fore-leg over the left leg, balances itself on its two left legs only, and very rapidly hops off in the style of a large agile bird, both right legs hanging useless. With this strange mode of rapid progression it now attends to sheep exactly in the way of an ordinary uninjured dog. It is a most affectionate animal, and is now apparently full of life and health. When I went to see it this morning, it sprang up and happily bounded to me balanced on its two left legs.

WORTHINGTON G. SMITH.

Dunstable.

Foraminifera in the Upper Cambrian of the Malverns.

IN the early part of this year, whilst engaged in researches in the *Sphærophthalmus* zone of the Upper Lingula Flag Series, Prof. Theodore Groom, of Cirencester, found a shaley limestone which, when examined superficially under a fairly high power, showed indications of Foraminifera. Dr. Groom had a thin section prepared from this rock, and detected in it undoubted remains of Foraminifera. This preparation, together with specimens of the rock, he has courteously placed in my hands for further investigation, the results of which will be embodied in an appendix to Dr. Groom's paper on these beds.

The Foraminifera, for the most part, belong to the genus *Spirillina*, which has hitherto never been found below Jurassic strata, and these organisms make up at least 20 per cent. of the bulk of some specimens of the rock. The other genera present appear to be *Lagena*, *Nodosaria* (*Dentalina*), *Marginulina*, and *Cristellaria*.

This occurrence of Foraminifera is of great interest, taking into consideration the age of the beds; for, so far as I am aware, excepting the occurrence of the remains recorded by Dr. Cayeux from Pre-Cambrian beds in Brittany, and the foraminiferal casts in the Lower Cambrian of the Baltic Provinces described by Ehrenberg, these are more ancient than those of the well-known discoveries of Brady, Blake, Ulrich, and others, in beds of Ordovician and Silurian ages. So well preserved are these Upper Cambrian Foraminifera that the finely perforate structure can be seen here and there, which leaves no doubt as to their position as members of the Hyaline group of the Foraminifera. FREDERICK CHAPMAN.

Acquired Immunity from Insect Stings.

IN connection with this subject (see NATURE, vol. lv. p. 533, *et alibi*), it may be interesting to quote the following passage from "An Account of a Journey to Leetakoo," performed by a Dutchman, named Truter, in 1801 (appended to Sir John Barrow's "Voyage to Cochin China" (London, 1805), wherein the passage occurs on p. 382): "It was remarked that . . . the sting of a scorpion, which to Europeans and colonists is always attended with dangerous consequences, . . . has no ill effect on this people [the Bosjesmans], which they endeavoured to explain by saying that while children being accustomed to be stung by these insects, the poison in time ceases to have any effect on them, as the small-pox-virus loses its action on a person who has had the disease." KUMAGUSU MINAKATA.

October 11.

A NEW CLASS OF ORGANIC ACIDS.

A RECENT paper by Prof. Claisen in *Liebig's Annalen* (297, 1–98) is interesting, not only because it is one of a series of valuable contributions which he has published during the last few years, but also because it contains important observations on the occurrence of strongly marked acidic properties in certain hydroxymethylene derivatives.

Ever since Lavoisier attributed to oxygen the *rôle* of "acidifying principle," attempts have been made to assign a similar function to particular atoms or groups; and at the present time we say, that a substance possessing the properties of an "acid" contains, in addition to hydrogen or hydroxyl, some so-called acid-forming or electronegative atom or group of atoms. Consequently when we meet with an organic substance having in any degree the characters of an acid, we immediately associate these properties with the presence of this or that "acidifying principle." We account for the readiness with which the phenolic hydrogen atom is displaced by alkalis by saying that the hydroxyl group is influenced by combination with the electro-negative or acid-forming phenyl radicle; and we say that the reason why the alkali derivatives of phenol are decomposed by carbonic acid, whilst those of the nitrophenols are not so decomposed, is because in the latter the acid character of the hydroxyl group is further enhanced by the presence in the molecule of the nitro-group.

Phenol (carbolic acid) and nitrophenol, however, we do not usually call "acids," and we cautiously speak of their metallic "derivatives" and not of their "salts" in order to avoid the use of terms which might be misleading. Similarly we speak of the metallic "derivatives" of nitromethane, of ethylic malonate, of ethylic acetoacetate, &c., but we do not call the parent substances "acids."

It appears, however, that the time has now come when we must admit a new class of substances, namely, the hydroxymethylene derivatives recently prepared by Prof. Claisen, to the distinction of being called "acids." The substances in question may all be referred to the type $\begin{matrix}R.CO\\R.CO\end{matrix}>C = CH.OH$, where R represents either an alkyl-group (CH_3—, C_2H_5—, &c.) or an alkyloxy-group (CH_3O—, C_2H_5O—, &c.), and they are described by Prof. Claisen as follows:—They are all strong monobasic acids. They can all be accurately estimated by titration with normal alkali in aqueous alcoholic solution. They dissolve freely, even in the cold, in aqueous solutions of alkali acetates, liberating acetic acid. The determination of the electrical conductivity gave a value for K greater than that obtained for acetic acid. Among substances composed of carbon, hydrogen, and oxygen only, and not containing a carboxyl-group, they are doubtless the first which approach the monocarboxylic acids (excepting formic acid) in strength, and even surpass some of them.

The acid character of these compounds may of course be accounted for in the usual way, and, as Prof. Claisen points out, the substances may be regarded as formic acid, O = CH.OH, in which the oxygen atom has been displaced by the group $\begin{matrix}R.CO\\R.CO\end{matrix}>C =$, which itself contains the two electronegative radicles $(R—CO—)_2$; nevertheless the possession of such strongly acidic properties by compounds of this kind is a fact of extraordinary interest and almost as disturbing to our preconceived ideas as was the discovery of an acid containing only nitrogen and hydrogen. F. STANLEY KIPPING.

DRAINAGE AND IRRIGATION WORKS IN MEXICO.

THE valley in which Mexico is situated is almost unrivalled for its beauty, and is encompassed on all sides by great mountain ranges clothed with cedars and pines. The land is extremely fertile, notwithstanding its elevated position of 7000 feet above the level of the sea. Although thus beautifully placed, and at such a great elevation, Mexico was considered one of the most unhealthy cities in the world, the death-rate amounting as high as 40 per thousand; the cause being the want of proper drainage. The valley forms an immense basin covering 2220 square miles, hemmed in with solid walls of rock, and having only two or three high passes out of it. The valley thus shut in formed at one time an inland sea, but owing to earthquakes and other causes the water gradually subsided until it became confined to six great lakes. Each of these lakes is fed by streams from the mountains, which in winter frequently cause the lakes to overflow and inundate the adjoining land. It was in the middle of this valley that the Aztecs founded their city of Tenochitlan, building their houses and temples on piles. Subsequently as the water lessened and the fear of inundation became less, the dwellings were placed on the water-logged ground.

This was the condition of the country when Cortez chose this site as the capital of New Spain. The old canals were filled up, the city was extended, and great walls built to keep out the water. The city, however, was subject to frequent inundation. In the seventeenth century, after a great flood, the water stood at the level of the second story of the houses for several years. Various attempts were made to obtain an outlet for the water, and in the seventeenth century a canal 10 miles in length, with a tunnel 10 miles long through the mountains, was constructed, in which 15,000 Indians were engaged, which partially answered the purpose for which it was intended. The tunnel subsequently became blocked after an earthquake by the sides falling in, owing to their having been only supported by timber.

The tunnel having become useless, it was determined by the Spaniards to open it out, but 150 years were allowed to elapse before this was finally accomplished in 1789. The excavation is 14 miles long, and measures about 300 feet in width and 180 feet in depth. Through this cut, which has assumed the appearance of a natural gorge, the Mexican Central Railway now runs. During the time the work was in hand the locality became depopulated, owing to the insatiable demands for labourers, and finally these had to be imported from other places. This cutting, although it provided an outlet for the flood water, gave only partial relief to the drainage of the city, the general level of which is about $6\frac{1}{2}$ feet above the surface of the water in Lake Texcoco, into which the main outfall discharges; while the water in the other lake varies from 4 to 13 feet above the pavement of the streets. When the level of the water is raised in the lake, it is backed up the sewers into the city, and the whole surface of the ground has become saturated with sewage.

For a very long period, schemes were under consideration for effectually draining the city, and works were begun from time to time, and then suspended, and it was not until 1849 that a definite plan was determined on. The works recently completed were commenced in 1866, but owing to the revolution were stopped, and remained in abeyance until 1885. The City Council then contracted a loan for 2,400,000*l.*, which, however, was expended without finishing the work, and the Mexican Government had to appropriate further funds for the purpose. The contract was first let to an American firm, but was subsequently taken out of their hands and completed by Messrs. Pearson and Son, the well-known English contractors.

The works now carried out consist of a canal starting at the city gates, and running 22 miles to the mountain, through which it passes by means of a tunnel $6\frac{1}{4}$ miles in length and 14 feet in diameter, driven principally through sandstone, and at the highest point being 300 feet below the surface. The canal varies in depth from 17 feet to 65 feet, and is 20 feet wide at the bottom.

This canal will take the storm water and sewage of the City of Mexico, and discharge it into the Valley at Tequixquiac. It will also control the height of the water in the lakes, but not drain them. The cutting of the canal involved a considerable amount of structural work where it crossed the railways and high roads, and in providing for the drainage of the district through which it passes.

While the work above described consists of works for "unwatering," another project of great magnitude recently carried out is for rendering land fertile by bringing water on to it. There are evidences to show that irrigation has been practised in Central America before the time of historical record. When the Spanish invasion of Mexico took place, the Indian inhabitants were dependent on irrigation for raising the crops of grain and cotton which they cultivated, and Mexican landowners have continued to follow in many cases the methods of their predecessors, but in others have brought to bear on their operations the principles of engineering science, and have applied them to very large tracts of land which otherwise would have remained practically barren. In some cases the streams have been dammed and the water carried on to the land by irrigating channels, while in other cases the water is raised by pumps driven by windmills or steam power. The crops grown on these irrigated lands consist of corn, cotton, tobacco, oranges, and other fruit. The description given below applies to the largest enterprise yet undertaken, but which is typical of many others.

The great plain of Northern Mexico is bounded on the east and west by the sierras of the Pacific and Gulf coasts, and is situated at a height of 4000 feet above the level of the sea, covering an area of about 240,000 square miles. This basin receives the drainage from several rivers which run into large shallow lakes, whence the water gradually evaporates during the dry season. The alluvial matter brought down during long periods has completely filled some of these lagoons with a deposit of the finest alluvial soil of unknown depth. About fifty years ago tracts of this fertile land bordering on the river Nazas, and covering about 250,000 acres, were brought under cultivation by a system of ditches and banks, and on this was produced a great part of the cotton grown in Mexico.

Separated from the river by a tract of 30 miles of barren desert land, is one of the richest districts in Mexico, being the site of an ancient lake called Tlahualilo, but until the present enterprise was undertaken the conveyance of the water from the river to this land presented an obstacle to its cultivation. In 1889 a company was formed, and works carried out for irrigating this district extending over 210 square miles. The concession of the water rights having been obtained, a dam was constructed across the river Nazas, and the water conducted from there across the desert by means of a canal, 39 miles in length, and 72 feet wide at the bottom, and $6\frac{1}{2}$ feet deep, to the entrance of the area to be irrigated, when it branched off into two other canals, one 15 miles and the other 13 miles long. These side canals were prolonged down each side of the basin, meeting at the further extremity, and enclosing an area of 57,000 acres. The irrigated area was laid out in separate tracts or "sitios," containing 4338 acres, the area controlled by each subsidiary drain being 134 acres. The total length of the main drains and ditches was 479 miles. The difficulties encountered in carrying out this work were very great. For 25 miles of the distance along which the main canal was carried, all the water for the men and animals employed had to be carted, as well as the supply of food for the 2000 to 3000 Indians employed. On the completion of the canal, on the "sitios" were erected the buildings necessary for forming villages, with houses for the men and their families engaged on the land, together with magazines, farm buildings, storehouses, and reservoirs for water, each "sitio" being placed under the control of a separate manager and staff. At the central station, in addition to the above, were erected a steam cotton-gin and press, oil mills, soap factory for utilising the oil product, and electric light plant. There were also built a church, public schools for the children, a market, hospital and other conveniences for the welfare of the population. The number of steam-engines employed on this estate aggregate over 300 horse-power, the fuel for which consists principally of the hulls of the cotton-seed and the wood derived from clearing the bush. The engines and machinery are operated by native labour, the peons being found quick and apt in acquiring mechanical knowledge.

The result of this enterprise has been very satisfactory, and six years' experience shows that irrigation when applied to fertile land in a systematic manner renders agriculture in the climate of Mexico highly remunerative, and reduces the uncertainty and hazard of obtaining crops to far less proportions than where their successful cultivation is dependent on rainfall. There is a very large area of similar good land not used in Mexico owing to lack of water, the risk of depending on the rainfall being considered too great.

RIDGWAY'S BIRDS OF THE GALAPAGOS.[1]

IT was Darwin, in his "Naturalist's Voyage," who first called attention to the peculiarities of the fauna of the Galapagos, and urged the importance of its more accurate study. Wallace, in "Island Life," has devoted a whole chapter to the discussion of the curious phenomena of distribution which it presents, and which are in no case better exhibited than in the class of birds. The National Museum of Washington has of late years acquired a very fine series of Galapagan birds, principally through the exertions of the naturalists of the *Albatross* in 1888 and 1891, and from the collections made by

[1] "Birds of the Galapagos Archipelago." By Robert Ridgway. R.U.S. Nat. Mus. xix. Pp. 459–670. (Washington, 1896.)

Messrs. Baur and Adams in 1891. Although the subject is by no means as yet exhausted, Mr. Robert Ridgway, the able and energetic Curator of the Department of Birds at Washington, has thought it expedient to collate the knowledge thus far secured, and to facilitate future investigations by the preparation of the memoir now before us.

The last complete account of the avifauna of the Galapagos was that given by Mr. Salvin in the *Transactions* of the Zoological Society of London in 1876, in which he showed that fifty-seven species of birds were then known to occur in the Galapagan group, of which thirty-eight were peculiar. Mr. Ridgway's revised list proves that good progress has been made in our knowledge of the birds of these islands during this past twenty years. He shows us that 105 species are now known to be included in the Galapagan avifauna. These he refers to forty-six genera, of which five (*Nesomimus*, *Certhidea*, *Geospiza*, *Camarhynchus* and *Nesopelia*) are peculiar to the group. The first four of these, besides some others, are represented in many of the islands by peculiar species. Mr. Ridgway treats of all the Galapagan species one after another in a most complete manner, stating their specific characters, synonyms and distribution, and adding a list of the specimens contained in the National Museum of the United States. Moreover, the ranges of the different species are clearly shown in a series of outline maps.

As regards the explanation of the fact that the species of the Galapagan fauna are mostly confined to certain islands of the group, Dr. Baur, in his biological lectures delivered in 1894, put forward the view that at a former period the islands were connected with one another and formed a single large island, of which all but the higher points (which now constitute the islands) have been since submerged. Mr. Ridgway does not positively adhere to this view, although he pronounces it to be "at least worthy of serious consideration."

THE LATE PROFESSOR ROY, M.D., F.R.S.

FOR some long time past Prof. Roy, of Cambridge, has been in very serious ill-health. On Monday, the 4th of this month, death somewhat suddenly removed him from among us. He was only forty-three years of age. The news of the loss of so gifted a worker, and so enthusiastic a leader in investigation, will come as a heavy blow to many throughout the civilised world who have at heart the progress of scientific pathology. His adopted University had already had to deplore its loss in his failing health and powers.

Prof. Roy—Charles Smart Roy—was a native of Arbroath. His education was received at first in that town, then in the University of St. Andrews, then in that of Edinburgh. At the last-named he graduated in medicine as a Bachelor in 1875, and was subsequently appointed a resident physician at the Royal Infirmary in the wards of Dr. Balfour, well known as an authority on valvular lesions of the heart. On the completion of the term of that office Roy migrated to London, and opened original research work on the contagious pleuropneumonia of cattle. However, at the outbreak of the Turkish-Servian war he volunteered for service. As a Surgeon-Major in the Turkish army he was given charge of the large garrison hospital at Janina in Epirus. Epirus remained untouched by the active fighting of the campaign, and during his period of service Roy in spare hours designed an instrument for recording changes in the volume of the frog's heart—his frog-cardiometer. At the close of the war he returned to London and finished his investigation into pleuro-pneumonia, conducting it at the Brown Institution, where Prof. Burdon-Sanderson was then superintendent. This work is the only one by him which deals mainly with morbid anatomy. He proceeded next to Berlin. At that time he had the intention of devoting three years on the continent to improvement of his medical knowledge, with a view to returning ultimately to medical practice. At Berlin he studied pathology in Prof. Virchow's laboratory, but he also commenced in Du Bois' laboratory an investigation into the physiology of the heart, chiefly with use of the cardiometer already alluded to. He was thus one of the earliest workers in Du Bois-Reymond's new and palatial Physiological Institute, where Prof. Kronecker was then chief assistant. The results of his research were embodied in a dissertation for the degree of Doctor of Medicine of Edinburgh: the thesis was awarded a gold medal by the University, and the Doctor's degree was proceeded to in 1878. In the same year his remarkable paper "On the influences which modify the work of the heart" was published in Foster's *Journal of Physiology*, a paper based chiefly on the work done for his thesis.

In the course of the next year Roy was appointed assistant at the Physiological Institute of the Strassburg University, under Prof. Goltz. As assistant there, his time could be given practically entirely to research, and was so with noteworthy results. He devoted himself to "Observations on the form of the pulse-wave as studied in the carotid of the rabbit." The paper showed more clearly than either of his previous the advent of an investigator of originality and power. An instrument was invented for the research—the sphygmotonometer, an ingenious plethysmograph adapted to record the changing volumes of the free but unopened blood-vessel. Specimens of the original tracings obtained by it hang now as models of reference in more than a few laboratories both at home and abroad. It was also about this date that he devised his instruments for measuring and recording graphically the measurements of the extensibility and elasticity of the walls of blood-vessels. These latter are the subject of his second paper in Foster's *Journal*, and the data he obtained are now incorporated as part of text-book knowledge in physiology. The chief instrument he used presents points of similarity to the myographion, the principle of which was suggested to Prof. Blix by the late Fritjof Holmgren; but Roy's instrument preceded the Holmgren-Blix instrument, and was evolved altogether independently of that.

In the same year (1879) appeared his work, done in conjunction with Dr. Graham Brown, on capillary blood-pressure, published in Foster's *Journal*. The research carried out, we believe at odd hours in the dwelling-room of the two friends, furnished more trustworthy measurements than any pre-existing. By an ingenious apparatus these absolute measurements, very important for the physiology of the circulation, were unexceptionably obtained. It was in the same, or in the previous, year that Roy devised the ether-freezing microtome. The instrument came into use largely in Great Britain and on the continent, and his original pattern, little modified, is still employed in many laboratories.

Roy now, always keen to apply his work to practical medicine, moved from the physiological to the pathological laboratory at Strassburg; but he soon left v. Recklinghausen's to attend Cohnheim's institute at Leipzig. There, in personal communication with Cohnheim, his attention was attracted especially to problems concerning vascular changes in the kidney. He devised the instrument by which perhaps his name is best known, the renal oncometer, for the study of the variations of the blood-flow through the kidney. The observations accessible by this instument have become familiar to every physiologist and pathologist. The research which by its aid its inventor, with Cohnheim, prosecuted on the renal circulation remains a classic in the literature of the circulation. The acquaintanceship of the two workers rapidly ripened into intimate friendship. Kuhne in his memorial sketch (1885) of Cohnheim wrote: "Once only did his name appear in actual association with that of a pupil, to wit in association with that of the present Professor of General Pathology at Cambridge, Charles Roy, in the 'Researches on the Circulation in the Kidneys.' These exact and laborious researches, through which the younger worker and the elder must go down to posterity together, were the last that Cohnheim ever edited himself, and in their prosecution it was a delight to him to admire the extreme skill and the happy facility of his younger colleague, well suited as those gifts were to prosecute scientific pathology in the very direction in which he himself believed it could prosper best." Cohnheim's death in 1884, at the early age of forty-five, was felt by Roy as a severe personal loss. He often spoke of Cohnheim in terms of enthusiastic admiration. He looked upon himself as in a way representing in this country the leadership which Cohnheim held as a pathologist of a new school in Germany. Roy stayed at Leipzig nearly a year. While there he received the G. H. Lewes studentship for research in physiology. This studentship had just been founded by "George Eliot" in memory of her deceased husband, and Roy was its first recipient.

In tenure of this studentship he worked in Prof. Michael Foster's laboratory at Cambridge, and thence issued his paper "On the Physiology and Pathology of the Spleen" (*Journal of Physiology*, vol. v.). This communication contains his discovery of an autochthonous rhythmic tonicity in the mammalian spleen; the vasomotor reactions of the organ were also elucidated. In 1880 he was elected a member of the Physiological Society. While then at Cambridge he lectured to advanced students of physiology on the elasticity of animal tissues. In 1882, on the election of Prof. Greenfield to the Edinburgh chair of General Pathology, Roy was chosen to succeed him as Professor Superintendent of the Brown Institution. There he plunged into the work on the action of the mammalian heart, which he never relinquished until nervous breakdown divorced him from his laboratory.

Soon after his installation at the Brown Institution, Roy was commissioned to investigate in the Argentine Republic a disease which was devastating the herds in the province of Entre Rios. He succeeded in alleviating the mischief by a preventive inoculation. He used the viscacha as medium for attenuating the intensity of the virus. The year 1884 was especially eventful for him. Early in that year he published his valuable method for measuring the specific gravity of the blood, a method suitable for and used with great success in conducting clinical observations. In May he was elected a Fellow of the Royal Society, and soon after that he was elected to the newly-instituted chair of Pathology in the University of Cambridge. He was elected a member of the Alpine Club almost in the same week. He was then in his thirtieth year. In the following summer, 1885, Asiatic cholera having appeared in a very severe epidemic form in Spain, he spent the middle and autumn of the year in prosecuting investigations into the bacteriology of the epidemic with his friends Dr. Graham Brown and Prof. Sherrington. The report of the observations obtained was presented to the Royal Society in the year following.

Although his activity at Cambridge during the later tenure of his chair has suffered under his failure of health, and in the early period was hampered by want of adequate accommodation in the matter of buildings and equipment, Roy's work for his department in the short time that it had free scope was marked by conspicuous success in many ways. In 1887, with the co-operation of Sir Richard Webster, he succeeded in securing the foundation of the J. Lucas Walker Studentships in Pathology. These have been of the greatest benefit, both in furthering discovery and in training investigators in scientific pathology. The selection of the candidates for these studentships lay largely with the Professor of Pathology; in his laboratory the whole or main part of their work was accomplished; in it and in them he always took the keenest interest, following their progress with eagerness. The mere recital of their names (Dr. William Hunter, Prof. Adami, Prof. Kanthack, Dr. Lorrain Smith, Prof. Wesbrook, Dr. Cobbett) suffices to indicate the sterling success Roy achieved in this department of his office. The lectures on pathology were on Roy's appointment at first delivered in the old theatre, for the Regius Professor of Physic, adjoining the Medical Museum; the work of research and teaching at that time was carried on in rooms lent by Prof. Foster from the physiological laboratory. It was there that the research on the "Mechanism of the Circulation in the Brain," undertaken in conjunction with Prof. Sherrington, was carried out (*Journal of Physiology*, vol. x.). But in 1889 buildings vacated by the Chemistry School were transformed and refitted to receive the department of Pathology. In the better laboratory several able pupils joined him—Griffiths, Rolleston, Hankin, Keng, Hardy, and Barlow; Prof. Arthur Gamgee, and Prof. Filehne of Breslau also for some time worked there. A rapid output of excellent work in experimental pathology resulted: researches on endocardic pressures, on the relation between heart-beat and pulse-wave, on the specific gravity of the blood, on the seat of production of hæmoglobin, on mechanisms protective against infection, on the causation of "shock," on the formation of lymph—in all these he actively interested himself, encouraging them absolutely unselfishly. Although his interest in biology was strikingly catholic, problems connected with the circulation had perhaps a paramount attraction for him always; and in 1892 appeared in the *Philosophical Transactions* the long work on the mammalian heart, carried out with Prof. Adami. Instruments were to a large extent specially devised for this research, and some of these have already become means of investigation in other laboratories besides those at Cambridge. The cardiac plethysmograph, and the cardiomyograph, and the automatic counter, were each examples of ingenuity that never failed to meet with resource the mechanical difficulties of a subject numerously beset by them.

Prof. Roy was one of the earliest—perhaps the earliest one—to originate that movement that has resulted in the foundation of the British Institute of Preventive Medicine. To furtherance of the project he devoted much time and work. He advocated its obtaining a site at or near Cambridge: that his advice was not followed on this point, was always to him a matter of deep regret. In 1893 he was President of the Section of Pathology at the annual meeting of the British Medical Association at Newcastle. He took as the subject for his brief but vigorous address the defensive mechanisms exhibited by the animal body under the assault of disease. In 1894 he attended the Section of Physiology at the meeting of the British Association at Oxford, and took an active part in its sessions. The flight of birds, the possibility of flight by man, the construction of flying machines formed a favourite theme with him, and one in which he had made some original observations and experiments: in connection with it he contributed an essay on Flight to Prof. Newton's Dictionary of Ornithology. On coming to reside at Cambridge he became attached to Trinity College. In 1887 he married Violet, daughter of Sir George Paget, the late Regius Professor of Physic in the University. Nearly a year before Prof. Roy's death the condition of his health had led to the appointment of a Deputy-Professor, Prof. A. A. Kanthack.

A man of strong convictions, almost impetuous in his determination to act upon them, Roy, as a pathologist, had the firm belief that the future science of pathology was most surely and most quickly to be reached along the same lines of advance as physiology has followed with signal success, especially since Ludwig and Bernard. The inferences to be drawn from the mere anatomical study of structural changes induced by morbid processes he considered to be practically exhausted. Indeed, he thought much time had been wasted in pushing such observations into confines of hair-splitting minuteness and detail. It would be, however, wrong to suppose he took little interest in microscopy. On the contrary, new methods of staining tissues, and colouring bacteria, and of following appearances of phagocytosis appealed to him strongly and immediately, and he was early to follow them. It was rather that the laborious unravelling of an individual autopsy by prolonged histological search and anatomical induction seemed to him unfruitful labour, and he gave little time to it. He turned to physical and, especially, to mechanical methods. His ingenuity in devising and his manual skill in the using of mechanical apparatus was, as Kuhne wrote, quite "extraordinary." Indeed, it was to a certain extent harmful to the quality of his work. It limited the scope with which he undertook and the depth to which he pursued a subject. It continually tempted him to wander from investigations toward which he had already accomplished the preliminaries, to open fresh ground in some other direction. A plan usual with him in his own work was to set before himself the obtaining of some particular measurement, *e.g.* the volume of an organ under certain conditions; the more difficult the experiment, the more attraction had it for him; he devised appropriate apparatus, tried it, altered it, made it successful, obtained a certain number of complete experiments, and then moved to another problem often not cognate with that previously taken up. The accuracy and rapidity with which he dissected were surprising, and for dexterity as an operator in the laboratory he had no rival in this country. His scientific papers were all written in a brief, simple and direct style, without repetition of statement, and usually without even any final recapitulation. Protocols of experiments were almost always excluded from them.

As a teacher his career commenced with his advent to Cambridge. His lectures were marked by striking and suggestive thoughts. The matter of them suffered somewhat from the rapid manner of their delivery. He cherished an intention to publish a volume of lectures on the pathology of the circulation; many of his lectures on this subject were brilliantly original. He did not illustrate his lectures by any experiments performed in the lecture hour. In the ordinary students who attended his classes simply for examination purposes he took curiously little interest; whether they passed or failed, attended or did not attend, seemed to go unnoted by him. To those who came to him to pursue research, even of the most unambitious kind, he was a different man. These he treated almost at once as personal friends, and he attached them to him by many ties of kindness and respect. In regard to their work, he was always absolutely sympathetic, equally so in failure and in success. In facing difficulties with them in the experiments they might have in hand, he encouraged with an undaunted cheerfulness of manner, and gave time and thought completely unstintingly in their companionship. He had been heard to confess an ambition to create a school of work in his laboratory somewhat on the lines of that formed in Ludwig's laboratory at Leipzig. Had his original strength been maintained, the results that his life had already produced are earnest, we think, that his ambition would not have been unfulfilled. As it is, his contributions to the study of the mechanisms concerned with the circulation of the blood can of themselves assure to him a lasting place in the esteem of all biologists.

Prof. Roy was buried at Cambridge on Friday, the 9th inst. The first portion of the burial service was held in the chapel of Trinity College, and was attended by many office-bearers of the University and other members of the Senate. The chief mourners were Mr. James Roy, of Arbroath (brother), Mr. Edmund Paget, Mr. Meyrick Paget, Dr. and Mrs. Hans Gadow, Prof. J. J. Thomson, Prof. Sherrington, Prof. Kanthack, Dr. Lazarus-Barlow, Mr. Cobbett, Mr. Graham Kerr, and Miss Kingsley (niece of the late Charles Kingsley). The clergy officiating in the chapel were the Master of Trinity (Dr. H. Montagu Butler), the Senior Dean (Rev. A. H. F. Boughey), and the Rev. L. Borissow (Precentor). The interment took place at the Mill Road Cemetery, where the Rev. Dr. Thomson, of Oxford, officiated. The proceedings at Trinity were attended by the Vice-Chancellor (Dr. Hill), the Master of Sidney, the Master of Christ's, the President of Queens', Prof. Allbutt, Prof. Macalister, Prof. Bradbury, Prof. Forsyth, Prof. Newton, Prof. Cowell, Prof. Mayor, Prof. Ewing, Prof. Stanton, Dr. Gaskell, Dr. L. Humphry, Dr. Jackson, Dr. Ruhemann, Dr. William Hunter, Dr. Griffith, Dr. Cunningham, Dr. Langley, and Dr. Postgate.

NOTES.

AT the annual general meeting of the London Mathematical Society, which will be held on November 11, the following names will be proposed for election on the Council of the ensuing session:—President, Prof. Elliott, F.R.S.; Vice-Presidents, Major MacMahon, R.A., F.R.S., Dr. Hobson, F.R.S.; Treasurer, Dr. J. Larmor, F.R.S.; Hon. Secretaries, R. Tucker, A. E. H. Love, F.R.S. Other members: Lieut.-Colonel Cunningham, R.E., Dr. Glaisher, F.R.S, Prof. Hill F.R.S., Prof. Hudson, M. Jenkins, A. B. Kempe, F.R.S., F. S. MacAulay, D. B. Mair, G. B. Mathews, F.R.S., W. D. Niven, C.B., F.R.S.

SIR PETER LE PAGE RENOUF, the eminent Egyptologist, and for several years keeper of the Egyptian and Assyrian antiquities at the British Museum, died last week, at the age of seventy five.

DR. VICTOR HORSLEY, F.R.S., has been returned at the head of the poll in the recent election for a direct representative on the General Medical Council.

THE Queen has conferred upon Dr. H. Hicks, F.R.S., president of the Geological Society, the Jubilee medal in commemoration of the sixtieth anniversary of her Majesty's reign.

REUTER's Agency reports that the Imperial Russian Geographical Society is fitting out an expedition to Abyssinia for the purposes of anthropological research. The expedition, which will be under the leadership of M. Dmitrieff, will start during the present autumn.

THE death is announced of Mr. James Heywood, who took an active part in the movement for the abolition of theological tests at universities. Mr. Heywood was elected a Fellow of the Royal Society as long ago as 1839; he was also a Fellow of the Geological Society, and published several works on geological subjects.

WE regret to announce the deaths of Mr. William Scott, Director of the Royal Gardens and Forests, Mauritius; Dr. F. W. Barry, senior medical inspector to the Local Government Board; Dr. Hjalmar Heiberg, professor of pathological anatomy in the University of Christiania; Dr. Hermann

Welcker, sometime professor of anatomy in the University of Halle, and a distinguished anthropologist; Dr. R. Branchat, professor of hygiene in the Medical Faculty of Granada; Dr. Leopold Auerbach, assistant professor of physiology in the University of Breslau; Mr. Percy Lund Simmonds, the author of numerous works on various branches of technology.

THE International Leprosy Conference was opened at the Imperial Board of Health, Berlin, on October 11. Prof. Virchow was elected President of the Conference, and on his proposal Prof. Lassar (Berlin) and Dr. A. Hansen (Bergen) were elected Vice-Presidents, and Dr. Ehlers (Copenhagen) Secretary-in-Chief. The Conference has appointed a commission composed of twenty members, with power to add to its number, to confer and prepare the way for an International Leprosy Society.

PHYSIOLOGICAL chemistry has just lost one of its most diligent and capable workers in the person of Dr. Edmund Drechsel, professor of physiological and pathological chemistry and of pharmacology in the University of Berne. At the time of his sudden death, Dr. Drechsel was at Naples working in the Zoological Station there at some of those problems in the chemistry of the invertebrates which have recently absorbed much of his attention. On September 22 he died suddenly of disease of the heart, at the age of fifty-four. The *British Medical Journal* gives the following particulars of the career of this distinguished exponent of the chemistry of physiology:—Born in Leipzig in 1843, he studied chemistry at the University there with such success, from 1863 onwards, that in 1865 he became assistant to Kolbe, who was then professor of chemistry. He took his Doctor's degree in Philosophy in 1865. In 1872 Ludwig appointed him his assistant in the Chemical Department of the Physiological Institute, where he carried on many researches, and aided Ludwig and his numerous pupils when they required assistance in matters chemical. In 1878 he was elected Extraordinary Professor in the Medical Faculty, and remained at Leipzig under Ludwig until he was called to Berne to fill the chair of Physiological Chemistry there. In 1883 the University of Leipzig conferred upon him the degree of M.D. Much to his regret, Drechsel did not follow a medical career. He entered upon the study of physiology purely from the chemical side, so that his work—always of the highest class and carefully done—dealt rather with problems of a distinctly chemical nature. He was a laborious and painstaking worker, and whatever he did was done thoroughly. Drechsel made many contributions to physiological chemistry, and he was a perfect encyclopædia of knowledge regarding chemical problems.

IT is so commonly assumed that poetry and science are antagonistic, that an address delivered by the Poet Laureate, Mr. Alfred Austin, at the opening of a new school of science and art last week, deserves a wide publicity. Macaulay, with his well-known love of antithesis, once endeavoured to show that as civilisation advances, poetry almost necessarily declines; and taking science as one of the most important factors in the civilising process, the inference is that a poet with a knowledge of scientific facts labours under a disadvantage. Now, however, we are able to give a Poet Laureate's opinion that science and art are complementary to one another and not rivals. Science, said Mr. Austin, is exact knowledge—that and nothing more. But exact knowledge is the foundation of all the arts, and no man ever achieved real greatness in any of them who did not have the firmest grasp of the permanent facts which underlie them. Music, the most intangible and fantastic of the arts, cannot move one step, nor excite a single emotion without submitting to the severe discipline of numbers. Finally, the matter of a poet's verse is not of much account unless it be animated by the scientific spirit of close and wide observation and of loving accuracy. There is thus no means of getting away from exact knowledge or science if one aspires to be an artist. It must be obvious to any one who has read the "Divina Commedia" that the greatest poet of the middle ages, than whom there was none greater in any age, was thoroughly familiar with all the science or exact knowledge of his time; and Leonardo da Vinci, who might have equals, but had no superior in the realm of painting, was not more fascinated by artistic conceptions than by what are called scientific problems; and at these he laboured indefatigably. Alike, therefore, by necessity and choice, art exhibits a sympathetic kinship with science. The scientific spirit, far from being hostile to the artistic spirit, is ancillary to it, for, as Dryden said, "Genius is perfected by science." The noblest manifestations of both have always occurred in one and the same epoch. Athens produced Euclid as well as Praxiteles; the vigorous old age of Michael Angelo overlapped the precocious youth of Galileo; and Bacon was the contemporary of Shakespeare. And though the century now drawing to a close has been pre-eminently a scientific century, the locomotive and the telephone will not be more enduring than the verse of Byron and Tennyson, or than the pictures of Turner and Watts. The reasoning intellect is the foundation alike of science and of art; but, concluded Mr. Austin, while reason alone suffices to science, art is reason transfigured by emotion.

THE Harveian Oration was delivered before the Royal College of Physicians on Monday by Sir William Roberts, F.R.S., who considered Harvey's life and work, not so much as they concern special studies, but as symbolising the commencement of a new era in human progress—the era of exact science—which, in the present age, is slowly but surely transfiguring the aspects and prospects of civilised society. He remarked that, speaking broadly, the older civilisations rested essentially upon art and literature (including philosophy), while modern civilisation rests, in addition, upon science and all that science brings in its train. A sharp distinction must be drawn between the so-called science of antiquity and the science of to-day. The ancients had a large acquaintance with the phenomena of nature, and were the masters of many inventions. They knew how to extract the common metals from their ores; they made glass; they were skilled agriculturists; they could bake, brew, and make wine, manufacture butter and cheese, spin, weave, and dye cloth; they had marked the motions of the heavenly bodies, and kept accurate record of time and seasons; they used the wheel, pulley, and lever; and knew a good deal of the natural history of plants and animals, and of anatomy and practical medicine. This store of information had been slowly acquired in the course of ages—mostly through haphazard discovery and chance observation—and formed a body of knowledge of inestimable value for the necessities, conveniences, and embellishments of life. But it was not science in the modern sense of the word. None of this knowledge was systematised and interpreted by coordinating principles; nor illuminated by generalisations which might serve as incentives and guides to further acquisitions. Such knowledge had no innate spring of growth; it could only increase, if at all, by casual additions—as a loose heap of stones might increase—and much of it was liable at any time to be swept away into oblivion by the flood of barbaric conquest. It is quite obvious, from the subsequent course of events, that there came into the world of natural knowledge about three centuries ago, in the time of Galileo and Harvey, a something—a movement, an impulse, a spirit—which was distinctly new—which Bacon, with prophetic insight, termed a "new birth of time." This remarkable movement did not originate with any startling revelation; it consisted rather in an altered mental attitude, and a method. There arose a distrust in the dicta of authority, and an increasing reliance on ascertained facts. These latter came to be regarded as the true and only data upon which natural knowledge could be securely founded and built up. Doubt and question took the place of false certainty. The hidden meaning of phenomena was sought out by observing them under artificially varied conditions—or, to use the words of Harvey, "the secrets of nature were searched out and studied by way of experiment." *A priori* reasoning from mere assumptions, or from a few loosely observed facts, fell into discredit. Observations were repeated, and made more numerous and more exact. These were linked together with more rigid reasoning to stringent inductions. Hypotheses (or generalisations) were subjected to verification by experiment; and their validity was further tested by their efficacy in interpreting cognate problems and by their power to serve as guides to the acquisition of fresh knowledge. The invention of instruments and appliances for assisting research was an essential and invaluable feature of the "new philosophy." Physiology and practical medicine have profited immensely by the general advance of the sister sciences, and by the adoption of scientific methods in the prosecution of research. Optical science gave birth to the achromatic microscope. The microscope has laid bare the minute structure of plants and animals, and introduced zoologists and botanists to a vast sub-kingdom of minute forms of life previously undreamt of. The microscope also, in conjunction with chemistry, founded the new science of bacteriology. Bacteriology has inspired the beneficent practice of antiseptic surgery; it has also discovered to us the parasitic nature of zymotic diseases, and opened out a fair prospect of ultimate deliverance from their ravages. Thus have the several sciences advanced, and are still advancing, in concert, step on step, by mutual help, at an ever-increasing speed—pushed on by that irrepressible forward impulse which has characterised the scientific movement from its inception.

MR. ARNOLD PIKE has been cruising this summer in the eastern part of the Spitsbergen archipelago, and, owing to the sea being exceptionally free from ice, was able to make some interesting observations. Stor Fiord was found to be open in the beginning of August, and Mr. Pike's whaler, the *Victoria*, was able to pass northward through Helis Strait, which at the same date last year was closed by fast ice, into Hinlopen Strait. Mr. Pike succeeded in getting as far east along the north coast of North East Land as Charles XII. Island. The ice was there jammed against the shore, and prevented the circumnavigation of North East Land. The *Victoria* then returned down Hinlopen Strait, and steamed eastward to Wich's Land and King Charles' Land. They searched for the islands reported in 1884, by Johannesen and Andreassen, which Captain Robertson earlier this year showed to be non-existent. Mr. Pike adds a reasonable explanation of the source of the error. No old pack ice was seen during the whole voyage, and these exceptional conditions appear to have prevailed throughout the whole of the Greenland and Spitsbergen seas.

THE Meteorological Reporter to the Government of India has just published his annual summary of the *India Weather Review* for 1896, which completes the discussion of the meteorology for that year. In this work the data are presented from two different points of view: (1) for the discussion of the prevalence and spread of disease, and (2) in connection with agricultural questions. For the comparison of medical and meteorological statistics, India is arranged into eleven provinces, the data for each of which are given in a tabular form, while for the second purpose the whole area is divided into fifty-seven meteorological districts. The volume contains a very large amount of useful information, from which we abstract a few general remarks. The mean temperature of the whole of India was normal, or in excess, throughout the year, being more than 2° in April, May and November. The absolute maximum of the year was 123°, at Jacobabad. The year was the driest on record during the past twenty-two years, the mean humidity being 3 per cent. below the normal; this was chiefly owing to the high temperature, as the mean aqueous vapour pressure was only ·01 inch below the average. The rainfall of the year averaged 4·83 inches (or 12 per cent.) below the normal; the deficiency was greatest in Berar (34 per cent.), and in the North-west Provinces and Central India (31 per cent.), and was chiefly due to persistent weakness of the south-west monsoon, and its withdrawal from those parts, from three to seven weeks earlier than usual. The deficiency in 1896 was much more serious than in 1895, and led to the partial failure of the crops over an unusually large area.

AN interesting instance of the effect of geological structure upon local values of magnetic declination is described in the *Journal* of the Franklin Institute (October) by Mr. Benjamin S. Lyman. It appears that about the year 1883 a number of determinations of the compass variation in the counties of Bucks and Montgomery, Pennsylvania, were made, and a chart showing curves of equal declination for every tenth of a degree was constructed from the observations. A striking feature brought out by this magnetic map was that all the isogonic lines had a sharp bend, the convex side of which pointed north-eastward towards New Hope and Lambertville, on the Delaware. The curves are so extremely at variance with the simple, nearly straight lines of earlier maps, that the observations upon which they were based were suspected of being incorrect; they have, however, now been beautifully confirmed by geology. The geological survey of the two counties, begun at the end of 1887, has now proved beyond question the existence of an enormous fault, of about 14,000 feet, in the rock beds, almost precisely on the line of the Delaware River end of the axis of the bend in the curves, and following the same course from there westwards. In other words, the axis of the bend in the magnetic curves lies directly above the line of fault determined by geological observations. The topography of the region shows no strongly-marked ridge following the course of the axis of the curves, neither does the form of the out-cropping rocks, sedimentary or igneous, correspond in any way with them; but there is no doubt that the remarkable magnetic peculiarity of the region is related to the equally remarkable and completely corresponding geological structure. This confirmation of one set of observations by another of a different character, and made quite independently, furnishes a striking instance of the connection between different branches of scientific investigation.

MR. W. F. LLOYD, in giving a brief description of experiments made by him to determine the specific heat of human blood, in the *British Medical Journal*, mentions that this physical property appears not to have been previously investigated in this country. The results obtained in his experiments give 0·710 as the specific heat of human blood. Having determined this value, the amount of heat required to raise the temperature of a certain quantity of blood can, of course, be easily calculated. Suppose that the temperature of a patient whose weight is 65 kilogrammes is 37° C., and twelve hours after this the temperature has gone up 3° C. The weight of the patient's blood would be $\frac{1}{13}$ of 65, or 5 kilogrammes, and the amount of heat required to raise the temperature of 5 kilogrammes 3° C. will be: $5000 \times 0{\cdot}71 \times 3 = 10{,}650$ heat units, the mechanical equivalent of which is 4,515,600 grammetres. This amount of work represents the chemical energy which must be required to raise the temperature of the blood of the patient 3° C. in twelve hours, so that in every second the chemical changes going on are represented by the amount of energy required to lift 104·5 grammes 1 metre high against the force of gravity. From this it will be seen that the amount of energy going on in the tissues of a patient whose temperature is rising must be very considerable, and about thirteen times greater than the above figures, for these figures apply only to the blood. Mr. Lloyd suggests that the difficult problem with regard to the number of atoms in the molecule of protoplasm, which has hitherto baffled physiologists, may be finally solved by an accurate determination of the specific heat of living protoplasm.

WE are sorry to learn that Mr. Alfred Allen, of Bath, finds it necessary to discontinue the *Journal of Microscopy and Natural Science*, which he has edited for the last sixteen years, in consequence of the circulation being slightly too small to cover the cost of publication. The last number is one of the best that we have seen, and contains articles by Dr. Jabez Hogg on "The so-called Jumping Bean of Mexico," by E. Steinhouse on "How Plants live and work," and a reprint of an important paper by Dr. August Forel, of Zürich, on "Ants' Nests." The Postal Microscopical Society, with which the *Journal* was semi-officially connected, will still be continued.

THE problems of the liquefaction of the more permanent gases has always aroused a considerable amount of scientific interest, and this has been especially the case with fluorine, in which there is the added difficulty of the extraordinary chemical activity of the gas. The successful issue of this problem was first announced by Profs. Moissan and Dewar in May last (see p. 126), and in the current number of the *Comptes rendus* of the Paris Academy of Sciences, there is a further contribution to this subject by the same authors. In the preliminary account, especial interest was excited by the description of a white explosive substance, apparently a compound of fluorine and oxygen; it is now shown, however, that liquid fluorine and liquid oxygen mix in all proportions if the oxygen is perfectly dry, and that it is the presence of moisture which determines the formation of the white explosive body, which would appear to be simply a hydrate of fluorine, decomposable with detonation by a slight rise of temperature. In the earlier experiments it was found that fluorine could not be liquefied by oxygen boiling under atmospheric pressure, but it is now shown that freshly prepared liquid air, boiling under the same conditions, can effect the liquefaction. The boiling point of fluorine is found to be $-187°$ C., and there is no sign of solidification nor even of loss of mobility at $-210°$ C. The density of fluorine, as determined by the flotation of solids of known density, is 1·14, and the liquid is devoid both of magnetic action and of any absorptive effect upon the spectrum. The chemical reactions of the liquid are curious, as although at $-210°$ there is no action upon water or mercury, it still combines violently with hydrogen and essence of turpentine. A little of the liquid fluorine, accidentally spilt, set fire to the wooden floor.

THE subtropical garden of Mr. Thos. Hanbury, at Palazzo Orengo, La Mortola, near Ventimiglia, is well known to all visitors to the Riviera. Mr. Hanbury has just issued an alphabetical catalogue of plants growing in the open air in the garden, compiled by K. Dinter. It occupies fifty-three quarto pages. The native country is given of each species.

THE current number of the *Journal* of the Royal Statistical Society contains the Howard Medal Prize Essay, by Dr. James Kerr, on "School Hygiene, in its Mental, Moral, and Physical Aspects." The subject for the medal to be awarded in 1898 (with 20*l*. as heretofore) is "The Treatment of Habitual Offenders, with special reference to their Increase or Decrease in various Countries."

THE Physical Society of London meets on Friday, October 29, at the rooms of the Chemical Society. Prof. Stroud will exhibit and describe the Barr and Stroud naval range finder, and also a telemetrical focometer and spherometer; Mr. Ackermann will exhibit a surface-tension experiment.

AT the meeting of the Chemical Society on Thursday, November 4, the following papers will be read:—"The Properties of Liquid Fluorine," by Profs. Moissan and J. Dewar; "The Liquefaction of Air and the Detection of Impurities" and "The Absorption of Hydrogen by Palladium at High Temperatures and Pressures," by Prof. Dewar.

A NEW instalment of the second edition of Dr. W. Ostwald's "Lehrbuch der allgemeinen Chemie" has just been published by Engelmann of Leipzig. The first volume of the new edition was completed in 1891, and the first part of the second volume appeared in 1893. These portions of the work have already been reviewed in NATURE (vol. xlviii. p. 49, 1893). We announced nearly a year ago the publication of the first section of the second part of the second volume, dealing almost entirely with the history of chemical affinity, and now the second section has appeared. In this section chemical dynamics is treated under two heads—chemical kinetics and chemical statics. It is announced that the remaining parts of the work will be published in the course of next year, and we propose to defer our review until the work is completed. At the present time we will only say that chemists will be glad when the second volume is finished; for, to repeat the opinion already expressed in these columns, "its appearance will serve to complete a work which goes further than any other to show how chemistry and physics must be united in the endeavour to arrive at the real nature of material phenomena."

"THE Bibliography of X-Ray Literature and Research, 1896–1897," will be published in a few days by *The Electrician* Printing and Publishing Company. The book is edited by Mr. C. E. S. Phillips, who has also contributed an historical retrospect, and a chapter on "Practical Hints on Röntgen Ray-Work." The same Company will also issue at the end of October a new work by Messrs. Fisher and Darby, entitled "The Student's Manual to Submarine Cable-Testing." Mr. Young J. Pentland announces:—"Text-Book of Physiology, by British Physiologists," edited by Prof. E. A. Schäfer, F.R.S., two vols., illustrated; "Text-Book of Medicine, by British Teachers," edited by Dr. G. A. Gibson, illustrated; "Manual of Operative Surgery," by H. J. Waring, illustrated; "Manual of Diseases of Women," by Dr. J. Clarence Webster, illustrated; "Diseases of the Heart and Circulation," by Dr. G. A. Gibson, illustrated; "The Principles of Treatment," by Dr. J. Mitchell Bruce; "Diseases of the Kidneys," by Dr. Robert Maguire; "Manual of Midwifery," by Dr. R. Milne Murray, illustrated; "Examination of the Eye," by Simeon Snell, illustrated; "Edinburgh Hospital Reports," edited by Drs. G. A. Gibson, C. W. Cathcart, John Thomson, and D. Berry Hart, vol. v.; "Diabetes Mellitus: its Symptoms, Pathology, and Treatment," by Dr. R. T. Williamson.

A SHORT historical account of the Royal Society of Canada, and the work it has accomplished, is contributed to the *Canadian Magazine* by the honorary secretary, Dr. J. G. Bourinot, C.M.G. The Society was established on the initiative of the Marquis of Lorne, then Governor-General of Canada. The first meeting was held in May 1882, under the presidency of the distinguished geologist, Dr. (now Sir) J. W. Dawson. The membership to begin with amounted to eighty Fellows, who had written—to quote the constitution—"memoirs of merit or rendered eminent services to literature or science"; a number subsequently increased to a hundred, or twenty-five each to the four sections of (1) French Literature and History; (2) English Literature, History and Archæology; (3) Mathematical, Physical and Chemical Sciences; (4) Geological and Biological Sciences. From the very commencement the Canadian Royal Society has been composed of men who have devoted themselves with ability and industry to the pursuit of literature, science and education in the Dominion. Thanks to the encouragement given by the Canadian Government, the Society has been able, year by year, to publish a large volume of the proceedings and transactions of its members. The papers and monographs therein contained embrace a wide field of literary effort—the whole range of archæological, ethnological, historical, geographical, biological, geological, mathematical and physical sciences; and they bear witness to fifteen years of creditable work for the intellectual welfare of the Dominion of Canada.

THE additions to the Zoological Society's Gardens during the past week include a White-collared Mangabey (*Cercocebus collaris*, ♀) from West Africa, presented by Miss Daisy Kendall; a Beisa Antelope (*Oryx beisa*), a Caffer Cat (*Felis caffra*) from Somaliland, two Arabian Gazelles (*Gazella arabica*, ♂ ♂) from Arabia, presented by Mr. J. Benet Stanford; a Zanzibar Antelope (*Nesotragus moschatus*, ♀), an Augur Buzzard (*Buteo augur*) from East Africa, presented by Mr. Cavendish; a Red River Hog ((*Potamochœrus penicillatus*, ♀) from West Africa, presented by Captain Smith, s.s. *Boma;* a Leopard (*Felis pardus*, ♂) from West Africa, presented by Captain Humfrey; a Chinchilla (*Chinchilla lanigera*) from Chili, presented by Mr. J. A. Wolffsohn; an Egyptian Ichneumon (*Herpestes ichneumon*) from Egypt, presented by Mr. Ernest A. Dixon; a Spotted River Turtle (*Emyda vittata*) from India, presented by Mr. A. Felix; a Geoffroy's Cat (*Felis geoffroii*), a Matamata Terrapin (*Chelys fimbriata*) from Brazil, presented by Mr. W. Brice; a Spotted Eagle Owl (*Bubo maculosus*), a Delalande's Lizard (*Nucras delalandii*), three Lineated Snakes (*Boodon lineatus*), eleven Rough-keeled Snakes (*Dasypeltis scabra*), four Crossed Snakes (*Psammophis crucifer*), ten Rufescent Snakes (*Leptodira holambœia*), two Rhomb-marked Snakes (*Trimerorhinus rhombeatus*) from Port Elizabeth, South Africa, presented by Mr. J. E. Matcham; a Wapiti Deer (*Cervus canadensis*, ♂), two Collared Fruit Bats (*Cynonycteris collaris*), born in the Gardens; a Great Wallaroo (*Macropus robustus*, ♀) from South Australia, purchased; a Cape Zorilla (*Ictonyx zorilla*) from South Africa, deposited.

OUR ASTRONOMICAL COLUMN.

THE LAW OF SPECTRAL SERIES.—Previously in this column (vol. lv. p. 137) we have referred to some of the work which has been done with the object of finding satisfactory formulæ for the computation of the wave-lengths of lines which form spectral series. Two further interesting communications have recently been published, which are important in that they suggest that the formulæ at present in use are only roughly approximate for the series as a whole, and that the anomalies which here and there are found may eventually be satisfactorily explained. The first of these communications is due to Prof. T. N. Thiele (*Astrophysical Journal* for August), who has for some time been occupied with investigations on the law of spectral series, and whose remarks are of considerable importance. The problem, as he states, is a very troublesome one, and those who occupy themselves with it cannot hope to make, so far as his experience goes, those little discoveries which relieve tedious investigations. In fact, one's fundamental assumptions often give way before the constant criticism to which they are exposed. The general law of series is, however, still wanting, although the more or less complete resolution of spectra into series may be now approximately accomplished. Prof. Thiele's work has proved that the law, which expresses the wave-lengths of the lines in a spectral series, must have the form

$$\lambda = f[(n+c)^2]$$

when λ is the wave-length, and c a constant which he calls the phase of the series: all other formulæ are only special cases of this general one. Accepting this formula and all its consequences some very interesting points arise, the most important being that it is necessary to take into account not only the lines corresponding to positive values of n, but those when n is less than 0. This involves that a *series* must in general be composed of *two groups of lines*, each of which would ordinarily be called a series, or, as Prof. Thiele calls them, two branches, but cases may arise when the two branches coincide. It does not necessarily follow that both series will always be seen, as the intensity of one may be much less than that of the other. In cases where there are three, four, or more branches, the pairs of branches must be separated out. Another point which arises from this new idea is the question as to whether the double series, ordinarily found in metallic spectra, may not also be regarded as constituting a single series in which both the negative and positive values of n are used. In the same paper Prof. Thiele gives a modification of Prof. Pickering's formula for use in more precise investigations. As an illustration of the question of the relation between sharp and diffuse series as branches of a single series, Prof. Thiele works out the lines in the spectrum of helium, and he is led to the conclusion that "in spite of the remarkable correspondence of these two series I must therefore (*sic*) deny their unity." The second paper, which we can now only briefly refer to, is that by L. Rummel, read before the Royal Society of Victoria in 1896, November 12 (vol. ix.). The author practically obtained a formula independently but similar to that given by Balmer for computing the wave-lengths of the spectral lines of the alkalis, working out the substances lithium, sodium, potassium, rubidium, and cæsium. In another paper, communicated by the author to the same Society in 1897, June 10 (vol. x.), he gives the result of his investigation on the relationship between the spectra of the alkalis and their atomic weights.

THE VARIABLE STAR η AQUILÆ.—In the *Memorie della Società degli Spettroscopisti Italiani*, Prof. A. Belopolsky describes some preliminary researches which he has made with respect to the motion of the variable star, η Aquilæ, as determined by movement in the line of sight. Up to the present time he has been able to secure twelve photographs, the duration of exposure in all cases being less than an hour. The measures were made relatively to the solar spectrum, which was superposed on the spectrum of the star with the help of the artificial spectrum of iron. Twelve prominent lines were used, and three systems of readings were obtained; namely, those given by comparing the stellar and solar spectrum, the solar and artificial spectrum, and the stellar and artificial spectrum. By means of a graphical process the author determines the required and the direct displacement.

The following summary gives in tabular form the times of observation, the intervals of time between the minimum and the moment of observation, the radial velocity, and the velocity relative to the sun.

1897.	Mean time Pulkova. h.	Interval from minimum. d. h.	Radial velocity.	Vel. rel. to ☉.
July 10	12	2 14	−4·485	−3·86
11	12	3 14	−4·454	−3·89
12	13	4 15	−3·196	−2·70
13	12	5 14	−2·022	−1·58
17	12	2 10	−3·629	−3·44
21	12	6 10	−1·228	−1·29
22	12	0 6	+0·146	+0·02
25	11	3 6	−4·016	−4·32
25	12	3 7	−3·604	−3·91
26	11	4 8	−2·930	−3·29
30	12	1 2	+1·195	+0·58
Aug. 2	11	4 1	−2·856	−3·65

Plotting the curve of velocities, after the method of Rambaut and Lehmann-Filhés, Prof. Belopolsky finds that the period 7d. 4h. is sufficiently satisfied on the supposition that the changes of the radial velocity are due to orbital movement of the star. A computation of the orbit, after the method described in *Astronomische Nachrichten* (No. 3242), leads the author to the conclusion that the variation of light cannot be attributed to an eclipse, as the time of eclipse ought to take place 2d. 0h. or 5d. 11h. after the minimum, which is not in accordance with the actual facts. This result is interesting in that it tends to corroborate the conclusion arrived at by Dr. W. J. S. Lockyer ("Resultate aus den Beobachtungen des veränderlichen Sternes η Aquilæ," 1897, Dulau and Co., London) in the latest discussion of all the available observations of this star up to the year 1894 relatively to the form and changes of the light curve.

COMET PERRINE.—We have received a telegram from Prof. Kreutz, Kiel, dated October 18, in which we are informed that Comet Perrine on October 16, at 9h. 38·8m., Lick mean time, appeared of the eighth magnitude, and was situated in R.A. 3h. 36m. 8s. and N.P.D. 23° 13′ 16″. It was observed to have a small tail.

A later telegram, dated October 19, gives the following position and magnitude: October 18, 11h. 31·1m., Pola mean time, R.A. 3h 25m. 31s., N.P.D. 20° 34′ 44″, magnitude 10·0.

HEREDITARY COLOUR IN HORSES.

MY attention has been drawn to a collection of data on the hereditary transmission of colour in horses, which appeared in the last Christmas Number of the *Horseman*, a newspaper published in Chicago, U.S. It is signed with the pseudonym of "Tron Kirk." I corresponded with the author, who is noted for his knowledge of horse-breeding, and he assures me of their substantial correctness. His statistics are chiefly obtained from breeders' catalogues, and, however valuable in other ways, fail seriously through the great disproportion which must exist between the number of the different sires and that of the dams, a single sire in the polygamatous arrangements of a stud begetting a numerous offspring from nearly as many dams. It is stated that no less than 3100 foals were begotten by only 46 different bay sires, or more than an average of 67 foals by each sire. Now the number of offspring of the 16 different forms of colour union registered in Table I. is, with one exception, by no means large; in 9 cases it is less than 100, and in one of these it is only 6. Consequently the prepotencies, or the reverse, of individual sire will fail to balance each other, and are sure to produce anomalous results.

The data I propose to use are those contained in Table I.; they have been extracted from the memoir in the *Horseman*, but are newly arranged both in line and column. I have omitted grey altogether, no grey stallions being recorded, and all the grey foals coming from grey dams.

TABLE I.

No. of observations	Colour of		Per cents. of colours in offspring				Totals
	Dam	Sire	Chestnut	Bay	Brown	Black	
68	Ches	Ches	100	—	—	—	100
1900	Bay	Bay	10	81	6	3	100
19	Brn	Brn	—	42	52	5	99
25	Blk	Blk	—	4	28	68	100
407	Ches	Bay	33	61	4	2	100
366	Bay	Ches	30	63	3	4	100
52	Ches	Brn	—	86	11	2	99
69	Brn	Ches	16	65	10	9	100
72	Ches	Blk	6	76	15	3	100
57	Blk	Ches	30	40	—	30	100
221	Bay	Brn	1	79	14	6	100
450	Brn	Bay	6	66	18	10	100
156	Bay	Blk	3	60	30	7	100
268	Blk	Bay	7	53	16	24	100
55	Brn	Blk	—	22	38	40	100
6	Blk	Brn	—	16	50	33	99

My first inquiry was to determine whether the sire or the dam exercises the larger influence in transmitting his or her own colour to the offspring, this being a point on which different breeders express contradictory opinions. The truth in the present instance is easily arrived at by means of Table II., where the percentages of the offspring who resemble their Dam are compared with those that resemble their Sire. This is done in each several pair of "reciprocal" unions, such as that which consists of [*Dam*, bay—*Sire*, brown]; and of [*Dam*, brown—*Sire*, bay]. The table shows a total of 394 cases of resemblance

TABLE II.

Colour of the Dam	Per cent. of offspring who in colour resemble their Dam						Totals
	Sire	p.c.	Sire	p.c.	Sire	p.c.	
Chestnut ...	Bay	33	Brn	0	Blk	6	39
Bay	Ches	63	Brn	79	Blk	60	202
Brown ...	Ches	10	Bay	18	Blk	38	66
Black ...	Ches	30	Bay	24	Brn	33	87
							394

Colour of the Sire	Per cent. of offspring who in colour resemble their Sire						Totals
	Dam	p.c.	Dam	p.c.	Dam	p.c.	
Chestnut ...	Bay	30	Brn	16	Blk	30	76
Bay	Ches	61	Brn	66	Blk	53	180
Brown ...	Ches	11	Bay	14	Blk	50	75
Black ...	Ches	3	Bay	7	Brn	40	50
							381

in the one set, to 381 in the other; in short, it proves that the potency of the dam in transmitting colour is substantially the same as that of the sire.

The intention of the second inquiry was to test an important part of my recent theory on "The average contribution of each several ancestor to the total heritage of the offspring" (*Proc. R. Soc.*, June 3, 1897, and NATURE, July 8, 1897). According to this theory each of the two parents contributes *on the average* one quarter of the total heritage, each of the four grandparents one sixteenth, and so on. If this be strictly true, and if the potency of the two sexes be the same, one half of the varied offspring from the [bay—bay] pairs added to one half of those of an equal number from the [brown—brown] pairs, would be identical in character with the same number of the offspring of [bay—brown], also with those of [brown—bay]. The same holds true for every other form of union between sires and dams of different colours. However, the statistics in Table I. run so roughly that this particular comparison would fail to lead to trustworthy results. It is true that reciprocal unions are seen to give rise to similar results in [chestnut and bay], to fairly similar ones in both [bay and brown], and in [brown and black], and to not very dissimilar ones in [bay and black], but each of the two remaining sets is incongruous. Moreover, the figures contained in them run wildly; thus in the line [black—chestnut] the sequence of the numbers, 30, 40, 0, 30, is a statistical impossibility, and in the line [chestnut—brown] the sequence of 0, 86, 11, 2, is very suspicious. It is obvious that a more trustworthy interpretation of the true state of the case might be deduced from these rude data, if the four entries in each line could be appropriately consolidated so as to be expressed by a single number. It occurred to me that a good way of doing so would be to determine the amount of red pigment corresponding to each entry in the same line, and to sum those amounts. Guided at first by the judgment of the eye, and afterwards by observing how nearly each successive assumption satisfied the observed facts, I fixed on the following allowances, supposing full red pigmentation to count as 1. For chestnut, 0·8; for bay, 0·7; for brown, 0·4; and, recollecting the considerable amount of red pigment in the blackest human hair, I fixed the allowance for black at 0·1.

There are twelve equations in which these four values appear; so if all are fairly well satisfied by the above assumptions, we may rest content. I did not take pains to have the red pigment extracted and weighed from equal quantities of hair of the four several colours, because there is room for doubt as to the medium tints of those colours, and because those mediums may not be precisely the same in America as here. It seemed better to work the problem backwards, in the way to be easily understood from the following example. The [bay—bay] unions, according to Table I., produce 10 per cent. of chestnut offspring, 81 per cent. of bay, 6 per cent. of brown, and 3 per cent. of black. Therefore the quantity of red contained in each hundred offspring of [bay—bay] parents should be reckoned at

$$10 \times 0{\cdot}8 + 81 \times 0{\cdot}7 + 6 \times 0{\cdot}4 + 3 \times 0{\cdot}1 = 67{\cdot}4 \text{ units.}$$

Since this is the amount of red contributed by the *two* bay parents, the contribution from either bay parent singly will be only half as much, or 33·7.

Similarly the contribution of red from a single chestnut parent will be found to be 40·0; of a brown, 25·3; and of a black, 10·4. Consequently the quantity of red in each hundred offspring of [bay and brown] unions will, according to the theory, be reckoned at

$$33{\cdot}7 + 25{\cdot}3 = 59 \text{ units.}$$

This number has been entered in its proper place in Table III. as the "calculated" value, and may there be compared with the "observed" value obtained from the reciprocal unions of [*Dam*, bay—*Sire*, brown], and of [*Dam*, brown—*Sire*, bay]. Now, the former of these is seen in Table I. to have produced 1 per cent. of chestnut, 79 per cent. of bay, 14 per cent. of brown, and 6 per cent. of black, yielding by the method just described, 62·3 units of red; by a similar treatment the latter of these unions, namely [*Dam*, brown—*Sire*, bay] will be found to yield 59·2 units. The mean of 62·3 and 59·2 being 60·75, that is 61 when reckoned to the nearest integer, is also entered in a separate column in Table III.

TABLE III.—*Amount of Red in Offspring, observed and calculated.*

No. of cases	Offspring of Dam	Offspring of Sire	Red observed	No. of cases	Offspring of Dam	Offspring of Sire	Red observed	Mean observed	Calculated	Differences
407	Ches	Bay	71	366	Bay	Ches	70	70	74	+ 4
52	Ches	Brn	65	69	Brn	Ches	63	64	65	+ 1
72	Ches	Blk	64	57	Blk	Ches	55	60	50	− 10
221	Bay	Brn	62	450	Brn	Bay	59	61	59	− 2
156	Bay	Blk	57	268	Blk	Bay	52	54	41	− 13
55	Brn	Blk	35	6	Blk	Brn	35	35	36	+ 1

The general result of the comparisons is that calculation agrees with observation as closely as the rudeness of the statistics could lead one to expect. The average error between each of the six calculations and the corresponding means of each of the six pairs of reciprocal observations is about 5 per cent., while the greatest error barely exceeds 10 per cent. I therefore consider these results to corroborate that part of my theory of inheritance which they were intended to test.

Permit me to take this opportunity of removing a possible misapprehension respecting the scope of my theory. That theory is intended to apply only to the offspring of parents who, being of the *same variety*, differ in having a greater or less amount of such characteristics as any individual of that variety may normally possess. It does *not* relate to the offspring of parents of different varieties; in short, it has nothing to do with hybridism, for in that case the offspring of two diverse parents do not necessarily assume an intermediate form.

I am further desirous of drawing attention to an absurd error in my recent memoir quoted above, through the accidental transposition by me of the words Dam and Sire in the side columns of the Table II. of that memoir (which Table was constructed out of the Table I. that preceded it). The result was that the potency of the Dam to that of the Sire in transmitting colour was stated to have come out as 6 to 5, whereas the fact is the exact converse, namely, as 5 to 6. I ought to add that this strange blunder, which was detected and obligingly pointed out to me by two separate correspondents, had no effect upon the general conclusions of the memoir, because the ratio of 6 to 5 was treated as an insignificant disproportion, and the two sexes were dealt with on equal terms.

FRANCIS GALTON.

AERONAUTICAL ASCENTS FOR MEASURING THE ELECTRICAL FIELD OF THE AIR.

ON September 11, M. Lecadet, astronomer of the Lyons Observatory, made his fifth aeronautical ascent for testing the electricity of the air at high altitudes. This system of observation was invented by Dr. Exner, a member of the Vienna Academy of Sciences, who sent into the atmosphere a balloon directed by Lechner, on June 6, 1885. The balloon reached only an altitude of 600 metres, and the results of the reading, taken by an inexperienced observer, were of no value.

On September 27, 1892, M. Andrée, director of the Lyons Observatory, determined to ascend himself, with M. Lecadet as his assistant. The ascent ended in a total wreck.

In the following year M. Lecadet made two ascents at Meudon with the Government balloon, after having procured permission from the War Office. In the first trip (August 1893) the balloon was conducted by Captains Paul Renard and Julian, and ascended only to a very moderate altitude. The second experiment took place on August 9, and only one officer, Captain Hugot, was sent up with M. Lecadet. The experiments showed that the electrical field of the air gradually diminished, though the measures were executed with the cumbersome instrument designed by Dr. Exner.

In the following month, in September 1893, two ascents were made from Tempelhof, with the balloons of the Prussian Government, by Dr. Bornstein, a member of the Berlin Society for Aerial Navigation. The results were about the same as those observed by Lecadet.

After carrying out these experiments, M. Lecadet devised a new instrument. The readings are taken with an Exner electrometer, but instead of being placed in equilibrium with the electricity of the air by two jets of water at a vertical distance of five metres from each other, the effect is obtained by two cylinders of paper impregnated with nitrate of lead, which, once being lighted, are burning without flame. They are placed each to the extremity of one single wire, whose length can be varied at will. The apparatus weighs 3 or 4 kilogs., instead of at least 50. Many experiments made at Lyons Observatory proved that there was no danger of ignition of the gas issuing from the balloon, but the Minister of War declined the proposal of authorising ascents from its balloon arsenal.

The first experiment with the new system was tried at Lyons a few months ago with M. Boulade, an able local aeronaut. The experiments were conducted with great care and success up to 1000 metres, and the electric field of the air was again found to gradually decrease.

As Lyons is in close vicinity with the Alpine district, it was considered unsafe to try an ascent at a great altitude under these circumstances. M. Lecadet therefore went to Paris, and secured the assistance of M. Besançon, a member of the international committee for the *Ballons Sondes*. The balloon had a capacity of 1700 cubic metres; it was a new one, in China silk. There was no cloud in the sky, and only some vapour near the earth's surface. The two aeronauts reached an altitude of 4200 metres. The wind was rather strong, as in five hours they ran about 220 miles in a W.S.W. direction. They landed at Aubigne (Marne et Loire) in a regular gale, but escaped unhurt, owing to the use of a special grapnel and tearing-rope invented by M. Besançon.

The readings taken were very numerous—about 300—and the results are a continuous decrease of the electric field from the level of the ground. Through the courtesy of M. Lecadet, we are enabled to give the summary of results, which will be laid before the Academy of Sciences by M. Mascart when all the calculations have been completed, which will require some time.

Altitude	$\frac{\Delta v}{\Delta x}$
Close to the earth	120 volts
1000 metres	39 "
4200 "	11 "

The results show that at about 6000 metres the $\frac{\Delta v}{\Delta t}$ will be almost 0. Then the balloon will have reached the surface of electrical equilibrium.

If the electrical tension at this altitude is supposed to be 0, the potential of the earth $\Sigma \frac{\Delta v}{\Delta x} = -160{,}000$ (about). The eminent director of the French Meteorological Service has expressed his satisfaction at the results obtained, and has suggested that another experiment should be tried in winter time, with clear and cold weather. He has also promised to direct to these experiments the attention of the Parisian Committee for Scientific Aeronautical Ascents. But it is likely that funds will be supplied by Lyonnese scientific men and capitalists. The expense of this ascent was borne by M. Jacquemet, a country gentleman, whose estate is in the vicinity of the Lyons Observatory. It is but fair to add that these all-important investigations should not be conducted with electrical kites, as used so cleverly in America for obtaining the temperature of the air. W. DE FONVIELLE.

BOTANY AT THE BRITISH ASSOCIATION.

THE business of the Section was opened by the presentation of reports (1) on the preservation of plants for exhibition, and (2) the fertilisation of the Phæophyceæ. Since the interim report on the preservation of plants (B.A. Report, 1896), the Committee have continued their inquiries and investigations, and the result of their work has been largely to confirm the statements contained in their previous report. They express the opinion that alcohol on the whole yields the best results as a liquid medium for the preservation of specimens. Drying in sand, in cases where the specimens are not intended to be handled, is recommended as a method by which admirable results may be obtained.

The Committee appointed to conduct experiments on the fertilisation of the Phæophyceæ presented an interim report on the favourable progress of the work. In the course of the meeting a cablegram was received by Prof. Farmer, the Chairman of the Committee, from Mr. J. L. Williams, of Bangor, announcing the discovery of motile antherozoids in the genera *Dictyota* and *Taonia*.

PHYSIOLOGY.

A preliminary account of a new method of investigating the behaviour of stomata, by Francis Darwin, F.R.S. The instrument used by the author in the present researches is a hygroscope depending for its action on the extreme sensitiveness to watery vapour of certain substances. The best material consists of thin sheets of horn treated in a special manner, and known as "Chinese sensitive leaf." The other is what is used for the toys described as "fortune-telling ladies," "magical fish," &c. When either of these membranes is placed on a damp surface it instantly curves with the concavity away from the source of moisture. If one end of a strip of the material is fixed to the lower surface of a block of cork, and is placed on the stomatal face of a leaf, it is clear that only the free end can rise. It is on this principle that the hygroscope is constructed, the angle to which the hygroscope tongue rises being a rough indication of the degree of transpiration. Thus on a leaf having stomata only below, the index of the hygroscope remains at zero on the upper surface of the leaf, while on the lower side it instantly rises to an angle varying with the condition of the stomata. If they are widely open the angle will be 30° or 40° to a horizontal line; if the stomata are closed the reading will be zero on both surfaces of the leaf. The author is engaged in a general investigation of the behaviour of the stomata under varying conditions.

Some considerations upon the functions of stomata, by Prof. C. E. Bessey. Prof. Bessey summarily reviewed the structure of stomata, and discussed the needs of aquatic, terrestrial, and aerial plants as to their getting of food, and the means by which they resist the drying of their tissues. The author concludes (1) that one of the functions of stomata is the admission of carbon dioxide to the chlorophyll-bearing tissues of the plant, for use in the formation of the carbohydrates. (2) That the loss of water by terrestrial plants was originally hurtful, and is so now in many cases. (3) That if plants have utilised this constant phenomenon, it is for the supply of food matters of secondary importance, as the salts in solution in the water of the soil.

Report upon some preliminary experiments with the Röntgen rays on plants, by Prof. G. F. Atkinson. The experiments were conducted for the purpose of testing the effect of the Röntgen rays on plants exposed during a considerable period of time. After a few preliminary experiments with leaves of *Caladium*, flowers of *Begonia*, and various seedlings exposed for one to ten hours, in which no perceptible injury resulted, a run was made in which several seedlings were exposed for a total of forty-five hours in a dark room. The plants behaved exactly as plants grown in a dark room. On removing the seedlings from the dark room they all became slowly green, but those which were under the influence of the Röntgen rays recovered the green colour more slowly; this suggests that the rays may have a slightly injurious effect on the chloroplastids. No other influence could be detected. Experiments were made on the absorption of the Röntgen rays by plants. Species of *Mucor*, Bacteria, and *Oscillatoria* were exposed to the action of the rays, but no influence was exerted on their growth or movement.

One morning session was devoted to a joint discussion with Section I, on the chemistry and structure of the cell. Prof. Meldola contributed an important paper on the rationale of chemical synthesis, and Prof. J. R. Green gave an account of his investigations on the existence of an alcohol-producing enzyme in yeast.

Dr. Armstrong exhibited a series of diagrams, which showed in a comparative manner the principal results of fifty years experimenting on the growth of wheat at Rothamsted.

Dr. Saunders, the Director of the Dominion Experimental Farms, contributed a paper on the results of some experiments in cross-fertilisation. He dealt chiefly with the efforts that had been made to introduce fruits suitable for the climate of the North-west Territories of Canada. Experiments were described on hardy apples from Northern Russia, and other regions; and Dr. Saunders referred to two forms of Siberian crab-apples from which promising crosses have been obtained. The author expressed the opinion that it will be possible in a few years to supply the North-west Territories with apples capable of withstanding the severe climate.

On the structure of a hybrid fern and its bearings on hybridity in general, by Prof. J. B. Farmer. This paper dealt with the characters, both macro- and micro-scopic, of *Polypodium Schneideri*, a hybrid between *P. aureum* and *P. vulgare*, var. *elegantissimum*. The facts elicited from a study of this plant were compared with those of analogous cases, and served as the basis for a discussion as to the nature of hybrids and of hybridisation.

THALLOPHYTA.

Prof. Marshall Ward (President) contributed a paper on *Stereum hirsutum*, a wood-destroying fungus.

The author cultivated this fungus from the spores, on sterilised wood blocks, and traced the action of the mycelium week by week on the elements of the wood. He obtained spore-bearing hymenia, and worked out the life-history very completely. Hartig, in his "Zersetzungserscheinungen des Holzes," examined the wood-destroying action of this fungus, but used material growing in the open, and therefore not pure. Brefeld attempted its culture, but failed to make it develop any fructification or spores.

The fertile hymenium arises in about three to four months. The author examined the development very thoroughly, and referred to discrepancies in the existing descriptions. The details of its destruction of the wood were fully described; the fungus delignifies the inner layers of the walls of the wood-elements, and in three months' cultures and upwards these turn blue in chlor-zinc-iodine, and are shown by other reagents to undergo alteration to cellulose-like bodies before their final consumption by the fungus.

On the mycelium of the witches' broom of Barberry caused by *Æcidium graveolens*, by Prof. P. Magnus. The author of the paper criticised the work of Dr. Eriksson on this parasitic fungus. The intracellular mycelium, described by Eriksson in the cambium cells of the host-plant, is regarded by Magnus as the plasmolysed cell contents. The latter author finds that the mycelium is always intercellular, and that it puts out branches into the cells of the pith, medullary rays, and cortical parenchyma of the host.

The nucleus of the yeast plant, by Harold Wager. In *Saccharomyces cerevisea* the nucleus can be easily demonstrated by careful staining in hæmatoxylin, Hartog's double stain of nigrosin and carmine, or by staining in aniline-water solution of gentian violet. It appears to consist, in the majority of cases, of a homogeneous substance, spherical in shape, placed between the cell-wall and the vacuole. On the whole, it resembles more than anything else the fragmenting nuclei in the older leaf-cells of *Chara*; that is, it consists of deeply-stained granules embedded in a slightly less stainable matrix.

The process of budding in a yeast cell is accompanied by the division of this nucleus into two. The division is a direct one, and does not take place in the mother-cell, but in the neck joining it to the daughter-cell. When about to divide, the nucleus places itself just at the opening of this neck, and proceeds to make its way through it into the daughter-cell, until about half of it has passed through, when it divides completely, and the two nuclei thus formed separate from each other towards the opposite sides of their respective cells.

The nuclei of *Saccharomyces Ludwigii* and *S. Pastorianus* were also described.

The process of spore-formation was observed in *S. cerevisea*. In a cell about to sporulate the nucleus is found in the centre of the cell, and appears to be homogeneous in structure. When the nucleus divides its outline becomes irregular, and the granules arrange themselves in the form of a short rod surrounded by the other portion of the nucleus, which stains differently and appears to form a structure of the nature of a spindle. The granules separate into two groups, and each group becomes a nucleus. The two nuclei thus formed again divide, and four nuclei are produced, each of which becomes the nucleus of a spore. A small quantity of protoplasm accumulates round each nucleus, spore membranes appear, and four spores are thus formed, standing in the remainder of the protoplasm, from which ultimately the thick spore membranes are produced.

The author referred to the process of nuclear division in spore-formation as probably a simple form of karyokinesis.

A disease of tomatoes, by W. G. P. Ellis. From diseased tomatoes received in August 1896 from Jersey, the associated fungi and bacteria were isolated and cultivated on nutrient gelatine, and the mycelium was traced in sections of the fruits. On removing the fruit skin with carefully sterilised instruments the mycelium within the fruit formed in a short time the well-known sporangiophores of *Mucor stolonifer*. Though late in the season, infection of sound plants at the University Botanic Gardens, Cambridge, from pure cultures caused a disease resembling that of the fruits received in August and September from the grower. Experiments are in progress to determine (1) whether the fungi obtained, other than *Mucor stolonifer*, cause disease, and (2) the site of infection.

Note on *Pleurococcus*, by Dorothea F. M. Pertz. Cultures of *Pleurococcus* in nutritive solutions were made during the winter months, from November to April. They did well in Knop's solution, ·2 per cent., in sterilised glass dishes and flasks, which were placed in different situations: in the laboratory, in a greenhouse, and out of doors.

Separate clusters of *Pleurococcus* in hanging drops of the same solution were also observed as continuously as possible. These drops were suspended in carefully sterilised moist chambers, which were kept for several weeks, in one case for two months.

The chief difficulties met with were, first, to obtain the *Pleurococcus* in absolutely pure condition, and then to keep it sufficiently aërated without running any risk of making the culture impure. Both the "globular sporangia" and those of "elongated or quadrangular form," observed by Chodat, occurred frequently, and they seem undoubtedly to be produced by the transformation of normal *Pleurococcus* cells. Individual sporangia were repeatedly selected for special observation, and the process by which they break up into separate spores was noted at all its stages.

The filamentous form described by Chodat never occurred.

Prof. Farmer, in referring to Miss Pertz' experiments, announced that he had succeeded in obtaining the filamentous form of Chodat from *Pleurococcus* cells.

Prof. Crookshank read a paper on *Streptothrix actinomycotica* and allied species of *Streptothrix*, and Prof. Macallum, of Toronto, contributed a paper on the origin of intracellular organs.

VASCULAR CRYPTOGAMS AND PHANEROGAMS.

The gametophyte of *Botrychium virginianum*, by E. C. Jeffrey. The author's researches were conducted on prothallia of *Botrychium* obtained from several localities in the province of Quebec and other parts of Canada.

The gametophyte of *B. virginianum* is of flattened oval shape, 2–18 mm. in length and 1·5–8 mm. in breadth. The middle of the upper surface is occupied by a well-defined ridge which bears the antheridia. The archegonia are found on the declivities which slope away from the antheridial ridge. The lower part of the prothallium is composed of yellow tissue rich in oil, the upper portion, on which the sexual organs are situated, is white in colour and free from oil. An endophytic fungus, probably a *Pythium*, occurs in the oily tissue. The antheridia originate behind the growing-point from a single superficial cell. The spermatozoids are large in size, but otherwise resemble the ordinary fern type. This development appears to agree closely with that described in the Marattiaceæ and Equisetaceæ. A young archegonium consists of three cells: the most external gives rise to the neck, the middle cell to the neck-canal-cell and the ventral cell, and the internal cell constitutes the basal cell. The first division of the oospore is across the long axis of the archegonium, the next division is parallel to the long axis of the prothallium, and the third cross-wall is in the transverse direction of the prothallium and at right angles to the other two. The organs appear very late, and only after the embryo has attained a large size.

Remarks on changes in number of sporangia in vascular plants, by Prof. F. O. Bower, F.R.S. Comparison shows that in certain cases a progressive increase in number of sporangia has taken place, in others a decrease. The changes may be classified as follows:—

Increase in Number of Sporangia.

- Directly
  - (*a*) by septation of sporangia.
  - (*b*) by interpolation of sporangia.
- Indirectly
  - (*c*) by continued apical or intercalary growth of the part bearing the sporangia, with or without branching.
  - (*d*) by branchings in the non-sporangial region

Decrease in Number of Sporangia.

- Directly
  - (*a*) by fusion of sporangia.
  - (*b*) by abortion of sporangia.
- Indirectly
  - (*c*) by reduction or arrest of growth or branching of part bearing the sporangia.
  - (*d*) by suppression of branchings in the vegetative region, resulting in fewer sporangial shoots.

The author pointed out that the physiological condition of the plant during development may largely determine the greater or less prominence of any one factor; he maintained that an analytical study, such as the above, may afford assistance in solving the problem of the origin of homosporous Pteridophyta.

On spermatozoids in *Zamia integrifolia*, by H. J. Webber. Mr. Webber gave a short account of his recent discovery of the existence of large multiciliate spermatozoids in the pollen-tube of *Zamia integrifolia*, a cycad which he investigated in Florida. The facts brought forward by the author of the paper were of exceptional interest; he described the development of an unusually large antherozoid from each of the daughter-cells formed by the division of the generative cell in the pollen-tube, each antherozoid being encircled by a spirally disposed ciliate band which the author believes to be developed from the fragments of a centrosome-like body. Mr. Webber observed the discharge of the antherozoids from the pollen-tube, and followed the passage of the motile male-gamete into the archegonium. "The entire antherozoid swims into the archegonium, passing between the ruptured neck-cells." Several antherozoids commonly enter each archegonium, but only one of them takes part in fecundation. The method of antherozoid formation in *Zamia* is regarded as similar to that in *Cycas* and *Ginkgo*.

Prof. Campbell gave an account of some recent work on the genus *Lilæa*, a member of the Juncaginaceæ, and Prof. Coulter read a paper on the life-history of *Ranunculus*. The formation of endosperm prior to fertilisation, and other points of interest in connection with reproduction and embryogeny, were dealt with by these authors.

NATURAL HISTORY, &C.

On the chimney-shaped stomata of *Holacantha Emoryi*, by Prof. Bessey. This prickly leafless shrub, known as the "Sacred Thorn," "Crucifixion Thorn," &c., is a native of the arid regions of Southern Arizona. It possesses remarkable breathing pores, which are evidently designed to enable the plant to obtain carbon dioxide, while at the same time preventing the loss of water from its interior tissues. The epidermis is extremely thick, and the stomata have long chimney-shaped openings above them, terminating in hollow papillæ, which project some distance above the surface.

Prof. Bessey also contributed a paper on the distribution of the native trees of Nebraska.

Messrs. Pound and Clements presented a communication on the vegetation-regions of the Prairie Province. A portion of the paper was devoted to a critique of the treatment accorded by various authors to the floral covering of the North American continent. The authors endeavoured to demonstrate the integrity of the Great Plains as a single vegetation province, and summarised the most salient floral features.

Mr. F. E. Clements also contributed a paper on the zonal constitution and disposition of plant formations.

On the species of *Picea* occurring in the North-Eastern United States and Canada, by Prof. D. P. Penhallow. Since the time of Pursh, the validity of the red spruce as a distinct species has been generally denied by systematic botanists. In 1887 Dr. George Lawson maintained that the red and black spruces are distinct species. This view has been sustained during the last year by Britton in his illustrated "Flora of North America." Prof. Penhallow's studies have led him to the conclusion that there are abundant reasons for the separation of *Picea rubra* as a distinct species. Incidentally, attention was directed to a form of the white spruce characterised by its fœtid odour, and its strongly glaucous, rigid and often cuspidate leaves, which are commonly broadened at the base. The name of *fœtida* is suggested for this form.

PALÆOBOTANY.

Notes on fossil Equisetaceæ, by A. C. Seward. The author of these notes gave examples of the difficulty of distinguishing between certain Palæozoic fossils referred to *Equisetites* and the genus *Calamites*. He expressed the opinion that the fused leaf-segments usually regarded as characteristic of *Equisetites* may not afford a trustworthy distinguishing feature. Reference was made to *Equisetites Hemingwayi*, Kidst, from the English coal-measures as a species of which the precise affinity remains doubtful. Evidence was brought forward that the Jurassic species originally described by Bunbury as *Calamites Beanii*, and referred by some authors to the Monocotyledons, should be referred to *Equisetites*. Another Jurassic species, *Equisetites lateralis*, was also described, and reasons were given for regarding this species as a true *Equisetites* rather than a form of *Phyllotheca* or *Schizoneura*.

On Monday afternoon, August 23, a lecture was delivered by Mr. A. C. Seward, on fossil plants. The lecturer gave illustrations of the bearing of Palæobotany on the problems of plant evolution, and special reference was made to the genera *Ginkgo*, *Bennettites*, *Lyginodendron*, and others.

ON OBTAINING METEOROLOGICAL RECORDS IN THE UPPER AIR BY MEANS OF KITES AND BALLOONS.[1]

A KNOWLEDGE of the physical conditions which prevail up to the highest cloud levels, five to nine miles above the earth, is of great importance to meteorologists, who until recently have been studying principally the conditions existing near the floor of the aerial ocean, and from that standpoint have endeavoured to formulate the laws which control the pressure, temperature, humidity, and currents in the great volume of air above them. Continued and systematic observations on mountains in different parts of the world latterly have contributed much to our knowledge of the approximate conditions of the atmosphere, under various circumstances, up to a height of more than three miles above sea-level; but the mass and surface of the mountain, even when this is an isolated peak, influence very considerably the surrounding air. Recognising, then, the value of the determination of the true conditions of the free air, let us consider what methods are available for this investigation, which must necessarily be sporadic and of shorter duration than if conducted on mountains. In the writer's opinion, free balloons with aeronauts cannot be recommended on account of the large cost in money, and sometimes the loss of life, which attend their frequent use, while without artificial aids to respiration the aeronaut cannot rise much above five miles. Captive balloons, with observers, have been used in England, and more recently, with self-recording instruments, in Germany; but their height is limited to about two thousand feet by the weight of the lifted cable, and a wind which is sufficient to overcome their buoyancy drives them down and occasions violent shocks to the suspended instruments. A kite-balloon on trial in the German army is intended to combine the advantages of a kite and a balloon; but the cost and the moderate height attainable render it inferior to the simple kite for meteorological researches, except during calms which sometimes occur at the earth's surface, but rarely extend aloft.

There remain kites and unmanned balloons, both recording graphically and continuously the chief meteorological conditions, and these it is my intention to describe in this paper. The recent development of the kite for meteorological purposes has taken place in the United States, while the use of the automatic balloon for obtaining data at very great altitudes has hitherto been confined to Europe.

Kites appear to have been first applied in meteorology by Alexander Wilson, of Glasgow, who in 1749 raised thermometers attached to the kites into the clouds (*Trans. Roy. Soc. of Edinburgh*, vol. x. part ii. pp. 284–286). Three years later, Franklin performed in Philadelphia his celebrated experiment of collecting the electricity of the thunder-cloud by means of a kite (Sparks's "Works of Benjamin Franklin," vol. v. p. 295). Although kites have served a variety of purposes, their first systematic use in meteorology was probably in England between 1883 and 1885, when E. D. Archibald made differential measurements of wind velocity by anemometers raised by kites fifteen hundred feet (NATURE, vol. xxxi.). In 1885, A. McAdie repeated Franklin's kite experiment on Blue Hill, using an electrometer (*Proceedings* of the American Academy, vol. xxi. pp. 129–134), and in 1891 and 1892 made simultaneous measurements of electrical potential at the base of Blue Hill, on the hill, and several hundred feet above it with kites as collectors (*Annals. Astr. Obs. Harv. Coll.*, vol. xl. parts i. and ii., Appendices A and C). The invention of light-weight self-recording instruments made it possible to obtain graphic records in the air by means of kites, and after W. A. Eddy had introduced tailless kites into America, and had attached a minimum thermometer in 1891 (*Am. Met. Journal*, vol. viii. pp. 122–125), a thermograph reconstructed of lighter materials by S. P. Fergusson, of the Blue Hill Observatory, was raised on August 4, 1894, 1430 feet above the hill (*ibid.* vol. xi. pp. 297–303). It was no doubt the first instrument, recording continuously and graphically, to be lifted by kites, and it permitted simultaneous observations to be obtained in the free air and near the ground. This method of studying the meteorological conditions of the free air has ever since been in regular use at the Blue Hill Observatory; but notwithstanding the general interest which has recently been aroused in kites, it is not known by the writer that meteorographs have elsewhere been raised by them.

The details of the work, as now carried on at Blue Hill, are as follows. The kites, which have no tails, are of Eddy's Malay, or of Hargrave's cellular types, the former presenting a convex surface to the wind, and the latter two pairs of superposed planes, each pair being connected by side planes. In addition to the two leading kites, others are attached by independent cords to various points of the line, which is a steel music wire, 0·033 inch in diameter, having a tensile strength of three hundred pounds, and weighing fifteen pounds per mile. The meteorographs are composed mostly of aluminium and weigh less than three pounds each, the one constructed by J. Richard, of Paris, recording on a single clock cylinder atmospheric pressure, air temperature, and relative humidity (*La Nature*, 8 Février, 1896), while that made by Mr. Fergusson similarly records wind velocity and air temperature. One of these instruments is hung to the wire between two kites, in order to ensure its safety in case of breakage of the wire or of one kite, or the failure of the wind to support the latter. The wire is coiled upon the drum of a windlass, which may be turned by two men, and a measuring device registers the amount of wire uncoiled, while the angular elevation of the meteorograph, when not hidden by clouds, is observed from time to time with a surveyor's transit at the windlass or at the ends of a base line. From these data, or from the barometric record, the altitude of the meteorograph is calculated. Kites may be flown in all kinds of weather, whenever the wind's velocity is between fourteen and thirty-five miles an hour: and since on Blue Hill the average velocity is more than eighteen miles an hour, days are frequent when flights are possible.

Probably the greatest elevation yet attained by kites, and certainly the highest level to which kites have lifted a meteorograph, is 8740 feet above Blue Hill. This was accomplished, October 8, 1896, by the aid of nine kites, having a total area of 170 square feet, which gave a maximum pull at the ground of

[1] By A. Lawrence Rotch. (Reprinted from the *Proceedings* of the American Academy of Arts and Sciences, vol. xxxii. No. 13, May 1897.)

about 100 pounds (*Science*, November 13, 1896, p. 718). The meteorograph remained during several hours higher than a mile, and good records of the indications of the barometer, thermometer, and hygrometer were brought down. More than one hundred records of atmospheric pressure, temperature, and relative humidity of the air, or wind velocity, at intermediate heights up to the extreme altitude just stated, have been obtained, and they are being discussed for publication with the Blue Hill observations for 1896, in the "Annals of the Astronomical Observatory of Harvard College." A few general conclusions may be mentioned. At the height of about a mile the diurnal changes of temperature in the free air nearly disappear, although in fair weather the days are damper than the nights. "Cold and warm waves" commence in the upper air, as is proved by the temperature decreasing faster than normal, or even increasing abruptly, with altitude before the fall or rise of temperature commences at the earth's surface. Several ascents through clouds have shown the air above them to be usually warmer and drier than the air below. Kites furnish a ready and accurate method of measuring the heights of certain low and uniform clouds, which could not easily be measured otherwise in the day-time. It is interesting to note that this method was used by Espy, about 1840, to verify his calculations of the height at which condensation begins ("Philosophy of Storms," 1841, p. 75). Changes of wind direction in the different air strata are determined from the azimuths of the kites, and this change sometimes amounts to 180°. The wind velocity usually increases with altitude, and vertical currents commonly prevail near cumulus clouds. During high flights the wire is strongly charged with electricity, but no measurements of its kind or potential have lately been attempted.

The writer is glad to acknowledge his indebtedness to his assistants, Messrs. Clayton and Fergusson, who have devised and constructed improved kites and apparatus, and during his absence have taken entire charge of the work. To them and to another assistant, Mr. Sweetland, is largely due the success which has been attained in this novel branch of research. For still higher ascents there will be required a steam engine to operate the windlass, and a meteorograph with a lower pressure scale. With these appliances, for whose purchase a grant has been asked from the Hodgkins Fund of the Smithsonian Institution, it is probable that records can be obtained three miles above Blue Hill, and possibly higher.

To reach much higher altitudes, unmanned free balloons, or "ballons sondes" as they are called, have been considerably used both in France and Germany. These balloons, which carry self-recording apparatus, rise until equilibrium is attained in the rarefied air. When they lose their buoyancy and fall to the earth, most of them have been recovered, with the instruments and records uninjured, by the senders, who have been notified by the finder of the place of descent, which is often at a great distance from the starting point. The altitudes are calculated from the barometric pressure, according to Laplace's formula, but the impossibility of knowing the mean temperature of the whole mass of air makes the determination inexact. Theoretically, in order to ascend ten miles above the earth, where the pressure is about one-ninth that at the earth, the balloon must lift itself from the ground when one-ninth filled with gas. Therefore a relatively large balloon is required, and its initial velocity of ascent is great, because it is found advantageous to fill the gas-bag completely. The greatest difficulty has been to protect the thermometers from insolation, and to ensure records being made, notwithstanding the great cold to which the instruments are exposed.

The first systematic experiments of the kind were made in Paris, in 1893, by G. Hermite, who was later associated with G. Besançon. There have been six high ascents from Paris of the three balloons called *L'Aérophile*. The second one of the name had an envelope of gold-beaters' skin, with a capacity of 6360 cubic feet, which when nearly filled with coal-gas gave an initial lifting power of 235 pounds, in excess of its own weight of 49 pounds, and the instruments and screens, which weighed 12 pounds. With this balloon, in October 1895, at an approximate height of 46,000 feet, a temperature of − 94° Fahrenheit was recorded, which is the lowest noted in a balloon, and probably the lowest natural temperature observed on the earth. The average decrease of temperature was 1° Fahrenheit for 320 feet of height. The instruments used are of the well-known Richard type, and have been tested in a chamber whose pressure and temperature are lowered to the limits which it is expected may be reached by the balloon. They are placed below the balloon in a wicker tube six feet high, lined with silver paper to ward off the sun's rays. It is believed by Hermite, that during the rapid ascent of the balloon the draught of air through the tube is sufficient to neutralise the heating of the enclosed air by the sun. It is admitted that when equilibrium is nearly reached this may not be true, and that the temperature recorded near the highest point may be too high. To avoid freezing of the ink the registration is now made on smoked paper, and to protect the instrument from shocks it is hung by springs in a closed basket, which is itself suspended in the tube already mentioned. An apparatus for obtaining samples of air at high altitudes has been carried by the balloon, but as yet without success, owing to difficulties in hermetically closing the receiver after the air has entered, since mechanically closing the inlet tube and sealing it by heat generated chemically have each proved ineffectual at great heights.

By means of a grant from the German Emperor to the Deutsche Verein zur Förderung der Luftschiffahrt, R. Assmann, A. Berson, and others in Berlin, have been able to carry on an extensive series of meteorological investigations with manned balloons, and also with a captive and a free balloon, both equipped with self-recording instruments. The latter, called the *Cirrus*, of 8830 cubic feet capacity, when inflated with coal-gas had a lifting force of about 290 pounds, besides its envelope weighing 93 pounds, and the meteorological apparatus weighing nearly 6 pounds. This is more complicated than the French instruments, since the registration is photographic, and a continuous ventilation of the alcohol thermometer in Assmann's aspiration apparatus is effected by allowing a weight to drive the aspirator. Even with these precautions, the temperatures are probably too high, and the registration is often defeotive. There have been seven flights of the *Cirrus*, one of the highest occurring in September 1894, when the unprecedentedly low barometric pressure of about two inches of mercury was recorded, giving a computed height of 60,500 feet. The lowest temperature, which was registered at a somewhat less altitude, was not below − 88° Fahrenheit, giving rise to the supposition that the thermometer was heated by insolation Hence the average decrease of temperature appears to have been but 1° in 409 feet. This balloon rose from Berlin with the great velocity of about 30 feet per second, and travelled 560 miles in an east-north-east direction at a velocity of 83 miles per hour.

For some time past negotiations have been in progress between the French and the Germans for simultaneous ascents of unmanned balloons at night, using identical instruments, whereby the errors due to insolation, and the discrepancies which might be attributed to different instruments, would be avoided. By this co-operation the simultaneous conditions of the upper air over a wide extent of country can be ascertained, just as these conditions near the earth's surface are daily obtained at the meteorological stations in the different countries. The desired result was brought about by the International Meteorological Conference which met in Paris in September 1896. Resolutions were adopted favouring scientific ascents with manned balloons, as well as simultaneous flights of unmanned registration balloons in the different countries. The successful use of kites at Blue Hill to lift self-recording instruments over a mile into the air, led to expressed desire that similar experiments should be tried elsewhere. An international committee was appointed to carry out these resolutions, consisting of Messrs. de Fonvielle and Hermite for France; Assmann, Erk, and Hergesel for Germany; Pomortzeff for Russia; and the writer for the United States. In accordance with the first-named resolutions, a flight of four manned and four registration balloons occurred in France, Germany, and Russia on the night of November 13–14, 1896. Owing to hurried preparations, only the registration balloon liberated from Paris reached a great height; but in presenting a summary of the results to the French Academy (*Comptes rendus*, vol. cxxiii. No. 22, pp. 918, 961), E. Mascart, the director of the French Meteorological Office, remarks that there is reason to hope that this international co-operation will contribute valuable data to our knowledge of the variations of temperature and wind in the upper atmosphere.

As the American representative of the International Aeronautical Committee, the writer hopes that in America a similar exploration of the high atmosphere with registration balloons will be attempted, and he is now preparing an estimate of the cost to submit to the Trustee of the Hodgkins Fund. Since it should supplement his own researches with kites, he has taken the occasion to bring the subject of free registration balloons to the attention of the Academy.

THE AGENCY OF MAN IN THE DISTRIBUTION OF SPECIES.[1]

AMONG the many influences which, during the last century or two, have been affecting that unstable condition of life which is expressed in the words "the geographical distribution of animals and plants," none has approached in potency the agency of man, exerted both purposely and unwittingly or accidentally.

Natural spread was for centuries the rule. Species dispersed under natural conditions along the line of least resistance. Winged animals and seed were spread by flight and by the agency of winds, and at their stopping-places thrived or did not thrive, according as conditions were suitable or not suitable. Aquatic animals and plants and small land animals and plants were distributed by the action of rivers and streams and by the ocean itself. Wonderful migrations have occurred, commonly with birds, more rarely with other animals; ice-floes and driftwood have carried animals and plants far from their original habitats, and even volcanic action has taken part in the dispersal of species. Smaller animals, especially molluscs and insects, and the seeds of plants have been carried many hundreds of miles by birds, and lesser distances by mammals.

With the improvement of commercial intercourse between nations by land and by sea another factor became more and more prominent, until in the present period of the world's history the agency of man in the spread of species, taking all plant and animal life into consideration, has become the predominating one. Potentially cosmopolitan forms, possibly even insular indigenes, have by this important agency become dispersed over nearly all of the civilised parts of the globe, while thousands of other species have been carried thousands of miles from their native homes, and have established themselves and flourished, often with a new vigour, in a new soil and with a novel environment.

It is obvious that this agency is readily separable into two divisions—intentional and accidental.

INTENTIONAL IMPORTATIONS.

Since early times strange plants and animals have been carried home by travellers. Conquering armies have brought back with the spoils of conquest new and interesting creatures and useful and strange plants. With the discovery of America and with the era of circumnavigation of the globe such introductions into Europe of curious and useful species, plants in particular, increased many-fold, while with the colonisation of America and other new regions by Europeans there were many intentional return introductions of Old World species conducive to the welfare or pleasure of the colonists. Activity in this direction has been increasing and increasing. Public botanical gardens and many wealthy individuals in all quarters of the globe have hardly left a stone unturned in their efforts to introduce and acclimatise new plants, particularly those of economic importance and æsthetic quality, not failing occasionally, it must parenthetically be said, to establish some noxious weed, or some especially injurious insect; while it is safe to say that probably the majority of the desirable plants of Europe which will grow in the United States have already been introduced, and that there has been an almost corresponding degree of activity in the introduction of desirable plants from the United States into Europe. In all this host of valuable introductions there have been comparatively few which have turned out badly, aside from failures of establishment. The wild garlic (*Allium vineale*), that ubiquitous plant which gives its taste to milk, butter, and even to beef during the spring and summer months in many States, is said to have been intentionally introduced by the early residents of Germantown, Pennsylvania. The water hyacinth (*Piaropus crassipes*), originally grown for ornament in a pond near Palatka, Florida, escaped into the Saint John's River about 1890, and has multiplied to such an extent as to seriously retard navigation and to necessitate Government investigation. The distribution of the orange hawk-weed (*Hieracium aurantiacum*), a dangerous species which has ruined hundreds of acres of pasture land in New York of recent years, was originally aided by a florist as a hardy ornamental plant. The European woad-waxen (*Genista tinctorium*) was early introduced at Salem, Mass., in fact about thirty years after the settlement of the colony. It has apparently not been used as a dye plant, but for garden and ornamental purposes only. During the last few years it has become a noxious weed throughout Essex and the adjoining counties. Standing recently on a rock at Swampscott, the writer was able to see that the country for miles around was coloured a bright yellow with enormous masses of this plant. Similar instances are fortunately rare, and the majority of our noxious weeds have been accidental introductions.

Intentional introductions of animals, however, have by no means resulted as advantageously as intentional introductions of plants, with the exception of the truly domesticated species, such as the horse, ass, cow, sheep, pig, dog, cat, poultry, honey-bee, and silk-worm of commerce. Even with such species, the grazing ranges of Australia have been overrun by wild horses to such an extent that paid hunters shoot them at a small sum per head, and the European rabbit has become a much worse plague on the same island continent.

Intentional introductions of wild species, however, have almost without exception resulted disastrously

At various intervals between 1850 and 1867 a few pairs of English sparrows were introduced into the north-eastern States to destroy canker-worms, and to-day this species is an ubiquitous and unmitigated pest throughout all the austral and transition regions of North America, finding its limit only at the borders of the boreal zone, while the place of the injurious insect it was imported to destroy has been taken by another and worse insect pest which it will not touch.

In 1872 Mr. W. Bancroft Espeut imported four pairs of the Indian mongoose from Calcutta into Jamaica for the purpose of destroying the "cane-piece rat." Ten years later it was estimated that the saving to the colony through the work of this animal amounted to 100,000*l.* annually. Then came a sudden change in the aspect of affairs. It was found that the mongoose destroyed all ground-nesting birds, and that the poultry as well as the insectivorous reptiles and batrachians of the island were being exterminated by it. Injurious insects increased in consequence a thousand-fold; the temporary benefits of the introduction were speedily wiped away, and the mongoose became a pest. Domestic animals, including young pigs, kids, lambs, newly-dropped calves, puppies and kittens, were destroyed by it, while it also ate ripe bananas, pine-apples, young corn, avocado pears, sweet potatoes, cocoas, yams, peas, sugar-cane, meat, and salt provisions and fish. Now, we are told, nature has made another effort to restore the balance. With the increase of insects, due to the destruction by the mongooses of their destroyers, has come an increase of ticks, which are destroying the mongoose, and all Jamaicans rejoice.

The flying-foxes of Australia (*Pteropus* sp) are animals which are very destructive to fruit in their native home. Frequently some well-meaning but misguided person will arrive on a steamer at San Francisco with one or more of those creatures as pets. While it is not probable that any of the flying-foxes will thrive in northern California or, in fact, in austral regions, the experience is too dangerous a one to try, and the quarantine officer of the California State Board of Horticulture has always destroyed such assisted immigrants without mercy.

Less than thirty years ago (in 1868 or 1869) Prof. Trouvelot imported the eggs of the gypsy moth (*Porthetria dispar*) into Massachusetts. The insect escaped from confinement, increased in numbers, slowly at first, more rapidly afterwards, until in 1889 it attracted more than local attention, with the result that in 1890 the State began remedial work. This work has steadily progressed since that time, and the State has already expended something over a half-million of dollars in the effort to exterminate the insect, and it is estimated that one million five hundred and seventy-five thousand dollars more must be used before extermination can be effected.

Contrast with this a single intentional importation which has had beneficial results. The Australian ladybird (*Vedalia cardinalis*) was introduced into California in 1889 with the result of saving the whole citrus-growing industry of the State from approaching extinction through the ravages of the cottony-cushion scale (*Icerya purchasi*). Later importations of the same insect into South Africa and Egypt also resulted beneficially.

We have thus had sufficient experience with intentional importations to enable us to conclude that while they may often be beneficial in a high degree, they form a very dangerous class of experiments, and should never be undertaken without the fullest

[1] Abridged from an address by Dr. L. O. Howard, printed in *Science* of September 10.

understanding of the life-history and habits of the species. Even then there may be danger, as with a new environment habits frequently change in a marked degree.

Accidental Introductions.

The agency of man, however, has been more potent in extending the range of species and in changing the character of the faunas and floras of the regions which he inhabits by means of accidental importations.

The era of accidental importations began with the beginning of commerce, and has grown with the growth of commerce. The vast extensions of international trade of recent years, every improvement in rapidity of travel and in safety of carriage of goods of all kinds, have increased the opportunities of accidental introductions, until at the present time there is hardly a civilised country which has not, firmly established and flourishing within its territory, hundreds of species of animals and plants of foreign origin, the time and means of introduction of many of which cannot be exactly traced, while of others even the original home cannot be ascertained, so widespread has their distribution become.

These accidental importations would at first glance seem to have been more abundant with plants than with animals, since the opportunities for the carriage of seed, especially flying or burr-like seed, and especially when we consider the vitality of this form of the plant organism, are plainly manifold, but possibly even this obvious generalisation must be modified in view of the multitudinous chances for free travel, which the smaller insects have under our modern systems of transportation.

The agencies which have mainly been instrumental in the accidental distribution of plants are:

(1) Wind storms. It is obvious that light-flying seeds may be carried many hundreds of miles by hurricanes, and may fall in new regions.

(2) Water. This is a very important agency in the distribution of plants upon the same continent, but less important as affecting intra-continental distribution. Still, they may be carried by this means from one island to another adjoining island, and when lodged in the crevices of the driftwood they undoubtedly travel greater distances.

(3) Birds. Seeds are frequently carried great distances by birds. Many of the larger seeds will germinate after passing through the alimentary canal of a bird, and may thus be eaten at one point and voided with the excrement at a widely distant point. It has been shown, for example, that the local distribution of *Rhus toxicodendron* is greatly affected by the carriage and distribution of the seed in this way by the common crow. Smaller seeds are carried in earth on the feet of birds. Darwin's example of a wounded red-legged partridge which had adhering to its leg a ball of earth weighing 6½ ounces, from which he raised thirty-two plants of about five distinct species, is an evidence of the possibilities of this agency, while his experiment with 6¾ ounces of mud from the edge of a pond which produced 537 distinct plants, an average of a seed for every six grains of mud, is still more conclusive.

(4) Ballast. This is the first of the distribution methods which may be combined under the head of "agency of man." The discharge of earth ballast by vessels coming from abroad has been a notable means of distribution of plants by seed. We have just seen how many seeds may germinate from a very small lump of earth, and the possibilities in this direction of the many thousands of pounds of discharged ballast are very great. In fact, the ballast grounds in the neighbourhood of great cities are invariably favourite botanical collecting spots; they have usually a distinctive flora of their own, and from these centres many introduced plants spread into the surrounding country.

(5) Impure seed. The great industry in the sale of seed which has grown up of late years is responsible for the spread of many plant species, principally, it must be said, undesirable species. Mr. L. H. Dewey says: "It may be safely asserted that more of our foreign weeds have come to us through impure field and garden seeds than by all other means combined."

(6) The packing material of merchandise. The hay or straw used in packing crockery, glassware, or other fragile merchandise, is a frequent carrier of foreign seeds. Such goods frequently reach the retailer without repacking, and the hay or straw is thrown out upon the fields, or used as bedding for domestic animals and carried out with the manure.

(7) Nursery stock. Plants are often accidentally introduced by means of seeds, bulbs and root stocks attached to nursery stock, or among the pellets of earth about the roots of nursery stock. The extraordinary development, of late years, of commerce in nursery stock has undoubtedly been responsible for the intra-continental carriage of many species of plants in this way.

Instances of the accidental spread of larger animals by man's agency are necessarily wanting. Of the smaller mammals the house rat and the house mouse have been accidentally carried in vessels to all parts of the world, and have escaped and established themselves, the former practically everywhere except in boreal regions, or only in its southern borders, and the latter even as far north as the Pribyloff Islands, as I am informed by Dr. Merriam. Small reptiles and batrachians are often accidentally carried by commerce from one country to another; but although there are probably instances of establishment of such species, none are known to me at the time of writing.

Land shells are often transported accidentally across the ocean in any one of the many ways in which the accidental transportation of plants and insects may be brought about, and by virtue of their remarkable power of lying dormant for many months are able to survive the longest journeys. The conditions which govern the establishment of species in this group, however, seem somewhat restricted, whence it follows that comparatively few forms have become widespread through man's agency, although Binney mentions a number of European species which have been brought by commerce into the United States and have established themselves there, mainly in the vicinity of the seaport towns of the Atlantic coast.

With the earthworms a striking situation exists. It has been shown that, "without a single exception, the Lumbricidæ from extra-European regions are identical with those of Europe; there is not a variety known which is characteristic of a foreign country." Careful consideration of the evidence seems to show that this is due to accidental transportation by the agency of man.

Comparatively little has been done in the study of the geographical distribution of insects.

The insects which are accidentally imported are carried in three main ways. Either (1) they are unnoticed or ignored passengers on or in their natural food, which is itself a subject of importation, such as nursery stock, plants, fresh or dried fruit, dried food-stuffs, cloths, lumber, or domestic animals; or (2) their food being the packing substances used to surround merchandise or the wood from which cases are made, they are thus brought over; or (3) they may be still more accidental passengers, having entered a vessel being loaded during the summer season, and hidden themselves away in some crevice. The coleopterists (Hamilton and Fauvel) make a distinction by name among these classes, calling the first group "insects of commerce," and the latter "accidental importations."

The practical point to which we must come, after summarising all that has been shown, is that since so many species have been imported by pure accident, and have succeeded perfectly in becoming acclimatised, may not much be accomplished by wisely-planned and carefully-guarded introductions? The work of Mr. Albert Koebele, first for the United States Government, afterwards for the State of California, and now for the Hawaiian Government, is certainly an indication, taken in connection with what we have shown, that thorough experimental work with predaceous and parasitic insects promises, in especial cases, results of possibly very great value.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—The announcements of professors, readers, University teachers, and lecturers for Michaelmas term include the following:—A course of lectures on elementary pathology by the Regius Professor of Medicine, Dr. J. Burdon-Sanderson. A practical course of instruction in general pathology by the University lecturer, Dr. Ritchie. The Lichfield Lecturer in Clinical Surgery, Mr. W. L. Morgan, will lecture on elementary surgery. The Professor of Human Anatomy, Prof. A. Thomson, will lecture on human osteology. The Lecturer in Materia Medica, Mr. J. E. Marsh, will give at the University Museum a practical course of organic chemistry. The Savilian Professor of Geometry, Prof. W. Esson, will lecture at Merton College on (1) the theory of plane curves; (2) synthetic geometry. The Savilian Professor of Astronomy, Prof. H. H. Turner, will lecture at the University Observatory on elementary mathematical astronomy. Mr. H. H. Champion will conclude his lectures on lunar theory. The Sedleian Professor of Natural Philosophy, Rev. Bartholomew Price, will lecture at Pembroke College on optics, physical and geometrical. The Waynflete Professor of Mineralogy, Prof. H. A. Miers, will lecture at the University Museum on elementary crystallography. The Waynflete Professor of Pure Mathematics, Prof. E. B. Elliott, on the theory of numbers. The Linacre Professor of Comparative Anatomy, Prof. E. Ray Lankester, on the Mollusca. Dr. W. B. Benham, on the flat worms; Mr. G. C. Bourne, on Von Baer's Law; and Mr. J. B. Thompson, on the morphology of the Ichthyopsida. The Professor of Experimental Philosophy, Prof. R. B. Clifton, on experimental physics. The Clarendon Laboratory will be open daily, from 11 a.m. to 4 p.m., for instruction in practical physics, under the superintendence of Prof. Clifton, Mr. Walker, Mr. Alsop, and Mr. Hudson. The Lecturer in Mechanics, Rev. F. J. Jervis-Smith, on elementary mechanics and the structure of simple machines. The Waynflete Professor of Chemistry, Prof. W. Odling, on elementary organic chemistry. The Aldrichian Demonstrator, Mr. W. W. Fisher, on inorganic chemistry; Mr. J. Watts, on organic chemistry; Mr. V. H. Veley, on physical chemistry; Mr. J. E. Marsh, on the history of chemical theory; Mr. J. A. Gardner, on aromatic compounds, other than benzene derivatives. The laboratory is open daily for instruction in practical chemistry from 10 a.m. to 4 p.m. The Waynflete Professor of Physiology, Prof. F. Gotch, will give (1) a general course of physiology; (2) advanced course on muscle. There will also be courses in histology, practical histology, and elementary physiological chemistry. The Professor of Geology, Prof. W. J. Sollas, will lecture on stratigraphical and physical geology. The Sherardian Professor of Botany, Prof. S. H. Vines, will give at the Botanic Garden (1) an elementary course (with practical work); (2) an advanced course (with practical work). The Professor of Anthropology, Prof. E. B. Tylor, will lecture at the University Museum on the anthropology of social, moral, and religious institutions.

Dr. J. R. Magrath, Provost of Queen's College, has been re-admitted as Vice-Chancellor for the ensuing year.

Mr. H. F. Pelham, Fellow of B.N.C., and Camden Professor of Ancient History, has been elected President of Trinity College in place of the Rev. Dr. Woods, resigned.

The following elections to Natural Science Scholarships and Exhibitions were made during the Long Vacation:—Merton College—to a Scholarship, Mr. F. W. Charlton, of Rugby School; to an Exhibition, Mr. E. L. Edlin, of Wyggeston Boys' School, Leicester. New College—to a Scholarship, Mr. E. H. J. Schuster, of the Charterhouse. Corpus Christi College—to a Scholarship, Mr. R. Stansfield, of Manchester Grammar School. Non-Collegiate Students—to a Shute Scholarship, Mr. C. H. Barber, of Wyggeston Boys' School, Leicester.

Mr. A. F. Walden (Magdalen College) has been appointed Lecturer in Natural Science at New College.

Mr. J. A. Gardner (Magdalen) has abandoned his work in Oxford for a post as Consulting Analytical Chemist in London.

Prof. W. J. Sollas delivered his inaugural lecture on Tuesday last. The lecture, which was of great interest, dealt principally with the part played by Oxford in the history of geology.

CAMBRIDGE.—The election of a Professor of Pathology, in the place of the late Prof. Roy, will take place on Saturday, November 6. The electors are Dr. Bradbury, Dr. Gaskell, Dr. Foster, Dr. Payne, Dr. Allbutt, Sir James Paget, Dr. D. MacAlister, and Dr. Latham.

Mr. J. Graham Kerr, of Christ's College, has been appointed Demonstrator of Animal Morphology in the place of Prof. E. W. Macbride, now of Montreal.

The University Lecturer in Geography announces two courses of lectures for this term. One on the geography of Europe will be suitable for history students; the other will be on physical geography.

THE late Sir J. C. Bucknill, F.R.S., has by his will left one-third of the residue of his estate, after paying certain legacies, to the president and treasurer of University College, London, for the purpose of founding a medical scholarship, to be called the Bucknill Scholarship, and to be awarded at least once in three years.

AT a meeting of the West Riding County Council, on Wednesday in last week, the Marquis of Ripon, in moving that a grant of 400*l*. be made to the Yorkshire College, stated that the debt on the institution, which a year ago amounted to 34,000*l*., had been reduced to 28,000*l*., and expressed a hope, not only that the whole of the remaining debt would soon be liquidated, but also that a permanent endowment would be secured. The motion was unanimously adopted.

DR. HANS REUSCH, director of the geological survey of Norway, has been appointed for the session 1897–98 to the Sturgis-Hooper professorship of geology in Harvard University, left vacant since the death of Prof. J. D. Whitney a year ago. Prof. Reusch will lecture on Vulcanism during the first half-year, treating volcanoes and eruptive rocks in general, earthquakes, and movements of the earth's crust. In the second half-year he will lecture on the geology of Northern Europe, and its relations to general geology.

A COURSE of twenty-five lectures on coal-tar distillation will be given, on Wednesday evenings, at the Goldsmiths' Institute, New Cross, by Mr. W. J. Pope, commencing on October 27. Special attention will be paid to methods of analyses, and to the plant used both in this country and abroad. The course will be fully illustrated with the aid of experiments and the optical lantern. Lectures of this kind, in which the subject is treated scientifically, do more to advance technical education than many courses of instruction in which manufacturing devices are described while the principles underlying them are left out of consideration.

THE following recent gifts to educational institutions in the United States are announced in *Science*:—Harvard College and the Massachusetts Institute of Technology will each receive about 750,000 dollars from the estate of the late Mr. Henry M. Pierce, under whose will they are, together with three other institutions, the residuary legatees.—The will of the late Eliza W. S. P. Field gives 80,000 dollars to the University of Pennsylvania, and makes the University residuary legatee of her estate.—Mrs. Esther B. Steele, of Elmira, N.Y., has given 5000 dollars towards the cost of a physical laboratory for Syracuse University. The building, which will cost about 25,000 dollars, will be erected shortly.—Furman University, at Greenville, S.C., has been given by Dr. and Mrs. F. A. Miles real estate valued at 20,000 dollars.—The will of the late Mr. Theodore Lyman bequeaths 10,000 dollars to Harvard University, and a collection of valuable books to the Museum of Comparative Zoology.—Ex-Governor Flower has given 5000 dollars to Cornell University for the purpose of a library for the Veterinary College.—By the will of the late Dr. Antoine Ruppaner the Harvard Medical School will receive 10,000 dollars, to be called the Dr. Ruppaner Fund.—Mr. H. H. Hunnewell has given 5000 dollars towards the endowment of the Surgical Laboratory of the Harvard Medical School.

THE Michigan College of Mines is the only technical school in the United States in which a full and elective system is adopted for its engineering instruction. The only subjects which are compulsory for all students are the principles of geology and the principles of mining; beyond these the student is allowed unrestricted freedom of choice in his studies, provided only that he shows that his preparatory knowledge is sufficient to enable him to take advantage of the instruction given. The following extract from the prospectus of the College for 1897–98 should be known to the managing committees of those of our technical schools and colleges which aim at filling students with heterogeneous knowledge, while leaving the intellectual and reasoning faculties undeveloped:—"If students are to achieve success here, it is imperative that they be able to collate facts, reduce them to order, draw sound conclusions from them, and use with facility the knowledge thus gained. All subjects of study, whether taught here or required for entrance, are regarded by the College as merely so many tools which the student, in proportion to the excellence of his training, can use to advantage in shaping his future. The necessity for a daily drill in reasoning out fully, and applying through varied methods, the fundamental principles of each subject of study cannot be too strongly impressed upon teachers; without it no educational results of sterling value can be obtained."

AT King's College, London, in conjunction with the Technical Education Board of the London County Council, advanced evening science classes are now being held on Civil Engineering, by Prof. Robinson, on Mondays, from 7 to 9; Mechanical Engineering, by Prof. Capper, on Tuesdays, from 7 to 9; Architecture, by Prof. Banister Fletcher, on Wednesdays, from

7 to 9; Natural Philosophy, under the direction of Prof. W. Grylls Adams, F.R.S., on Wednesdays, from 6 to 8.30; and on Pure Mathematics, by Prof. Hudson, on Thursdays, from 6 to 8 These courses are designed for students who have, by attendance at other classes, already reached an advanced stage in their technical work. Intending students should communicate by letter with the professors, taking the class they propose to attend, and giving particulars of their previous training. The courses of instruction afford an opportunity to students who can study only in the evenings to obtain instruction in well-equipped University laboratories, and make available to evening students the same advantages as are enjoyed by University day students, but they are only intended for those who are practically engaged during the day in some trade, business, or occupation. There are also held at King's College, the following free Saturday morning classes for teachers:—(1) Physics, on Saturday morning from 10 to 1, under the general superintendence of Prof. W. G. Adams, F.R.S. (2) Mathematics, by Prof. Hudson, on the teaching of elementary mathematics, on alternate Saturdays, at 10 a.m. (3) Strength of Materials (Saturdays, 10 a.m.), by Prof. Capper. (4) Principles of Practical Physiology (Saturdays, 11 a.m.), by Prof. Halliburton, F.R.S. The Saturday morning classes, we understand, are full, but there are still vacancies at some of the evening classes.

THE encouragement given to higher scientific instruction by the London Technical Education Board is shown in the latest number of the Board's *Gazette*, which contains a list of the principal public institutions of London at which instruction adapted to the requirements of the London University examinations above the matriculation will be given during the session just commencing. In the case of most of the institutions referred to in the list, evening as well as day classes are held in pure and mixed mathematics, experimental physics, chemistry, botany, zoology, biology, physiology, and geology. No institutions are included in the list except institutions of recognised university rank and polytechnics. Another list in the *Gazette* shows the principal evening classes in science, art and technology, to be held in London during the session 1897–98. The most noteworthy addition since last year to the supply of technical instruction is the scheme of instruction provided by the Northampton Institute in Clerkenwell. This institution has drawn up a very comprehensive series of courses especially adapted to the workers in the building and engineering trades and in artistic crafts, such as watchmakers, jewellers, goldsmiths, silversmiths and electrotypers. It is interesting to notice that this institution offers for the first time, together with the Regent Street Polytechnic, special instruction in cycle making. The electrochemical department is one that should be capable of considerable development in the future. The Northern Polytechnic also enters on its first full session. Admirable provision is made in this institution for the study of chemistry and physics, and the polytechnic is also provided with good carpentering and engineering workshops. The Borough Polytechnic is erecting new buildings for giving additional accommodation to classes in printing, bookbinding, boot and shoe making, carpentry, and wheelwrights' work. A model bakery is also in process of erection. The Battersea Polytechnic is providing additional accommodation for the teaching of chemistry and biology. The Bolt Court Guild and Technical School offers instruction in various branches in lithography and photo-process work. The classes at St. Thomas' Charterhouse School have been to some extent remodelled and placed on a new basis, and considerable additions have been made to the laboratory accommodation. The classes are being organised into a definite institution under the name of the St. Thomas' Charterhouse and Rogers' Institute.

SCIENTIFIC SERIALS.

Meteorologische Zeitschrift, September.—Investigations respecting wind velocity, by Prof. G. Hellmann. Our knowledge of wind direction over the globe is fairly satisfactory, but as regards the velocity it is defective, owing to the paucity of good anemometrical observations until within a few years. These observations are also affected by several causes, such as differences of height above ground, the exposure of the instrument, methods of reduction, and instrumental errors. The author has deduced the yearly period of wind velocity for all stations for which he could find a series of ten years' observations, for all parts of the world. The paper is accompanied by tables and diagrams, showing the mean velocity in metres per second for each month and for the year, and contains a valuable discussion of the results. The general conclusions are: (1) That the velocity increases with latitude, and decreases from the coast inland. (2) In the yearly period, the maximum in higher latitudes and exposed coasts occurs during the cold season, while in the interior of the continents it occurs between March and July. (3) The period of maximum velocity generally corresponds with that of the stormy season. (4) The minimum velocity generally occurs in August or September at those inland stations which have a spring maximum, while at coast stations which have a winter maximum, the minimum takes place in June or July. (5) The amplitude of the yearly period is greater on the coast than inland, but greatest in districts subject to strong periodical winds and monsoons.—Meteorology and terrestrial magnetism in Finland, by A. Heinrichs and E. Biese. The paper contains a summary of the meteorological observations made during the last 150 years, and which furnish good materials for investigations into secular changes of climate. The magnetic observations date from 1780. The organisation and discussion of these valuable observations during the last half of the last century and the first part of this, were principally due to the encouragement given by the University of Åbo.

The *Journal of Botany* for October reports a very remarkable addition to the British flora, in *Stachys alpina*, found by Dr. C. Bircknall in Gloucestershire, apparently wild. Mr. G. Murray gives an interesting account of his observations on the minute free-floating vegetation of the west coast of Scotland, carried on at the request of the Fishery Board of Scotland, with a description of the method used for the capture of the minute organisms.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, October 6.—The Rev. Canon Fowler, Vice-President, in the chair.—Mr. W. H. Bennett aud Mr. B. Tomlin were elected Fellows of the Society.—Mr. Merrifield exhibited specimens of *Aporia cratægi* and *Argynnis paphia*, subjected to high and low temperatures during the pupal stage. In both species the examples which had been cooled were much darkened. Mr. Tutt showed for comparison the extremes of over 500 examples of *A. cratægi* bred or captured in Kent between 1860 and 1868, but none were so marked as those which had been artificially treated.—Mr. Tutt showed a remarkable melanic aberration of *Nemeophila plantaginis*, in which all trace of the pale ground colour of the hind wings was lost; also a series of *Abraxas ulmata* captured during the past summer by Mr. Dutton in the neighbourhood of York. Previously aberrations of the species had been rare, but a large number of this series were suffused with blue-grey or smoky-ochreous. Many of the aberrant forms were cripples. He also showed for Dr. Riding bred specimens of both broods of *Tephrosia bistortata* from Clevedon, Somerset, and bred specimens of *T. crepuscularia* and its ab. *delamerensis* from York. Hybrids were exhibited between *T. bistortata* (♂ and ♀) and *T. crepuscularia* (♀ and ♂), between the former and the form *delamerensis* (♀ and ♂), and between the two latter crosses. The offspring of the first crosses were roughly divisible into two groups following the parent forms, those of the second tended to become mongrel in appearance. Hybridisation led to the production of continuous broods, and certain broods tended to produce mlaes only. The colouration became more intense with increase in the duration of the pupal stage.—Dr. Dixey drew attention to the experiments on hybridisation recorded in Dr. Standfuss's "Handbuch der Paläarktischen Gross-Schmetterlingen," and gave a summary of the results.—Mr. Champion showed for the Rev. J. H. Hocking an example of the long-bodied moth *Satacoma agrionata*, from New Zealand; also one of *Protopaussus walkeri*, Waterh., from China, the subject of a later communication; and specimens of the rare *Emblethis verbasci*, F., from the Scilly Isles.—Mr. Jacoby showed a Halticid beetle with a singular abnormality, the side-margin of the prothorax being split to embrace a long process.—Dr. Chapman exhibited and described varieties of *Spilosoma lubricipeda* and *Acronycta psi* bred by Dr. Riding and himself. In the latter species the characters of the different races were very stable.—Mr. Burr exhibited a Mantis, *Phyllocrania illudens*, from Madagascar, with a close resemblance to the dead leaves among which it lived, some of which were shown with it.—A new British coccid, *Kermes variegatus*, from Kent, was exhibited by Mr. Waterhouse.—Mr. G. C. Griffiths read a paper on "The Frenulum of the Lepidoptera," Mr. Kirkaldy communicated a "Preliminary Revision of the Notonectidæ, Part I.," and Mr. Waterhouse a "Description of a new Coleopterous Insect of the family Paussidæ."

PARIS.

Academy of Sciences, October 11.—M. A. Chatin in the chair.—New experiments on the liquefaction of fluorine, by MM. H. Moissan and J. Dewar (see p. 596).—The direct transformation of heat into electric energy, by M. Marcel Deprez.—An application of the remarkable magnetic properties of the nickel-steel alloys discovered by M. Guillaume. For these alloys a rise of temperature of about 50° causes the change from a strongly magnetic to a non magnetic state.—On the spectra of the coloured components of double stars, by Sir William Huggins.—On the spectra of the principal stars of the trapezium of the Nebula of Orion, by Sir William Huggins.—Note relating to the saprophytic aptitude of the tubercle bacillus, to its relations with the bacilli of typhoid and *Coli communis*, and to the immunising and therapeutic properties which are possessed by the bacillus in its saprophytic state, by M. J. Ferran. By gradually modifying the culture medium, the tubercle bacillus was finally induced to multiply readily in ordinary meat broth at temperatures between 10° and 20° C. The bacillus during this time had undergone notable changes, so that morphologically it might be taken for the typhoid bacillus. Its pathogenic properties, however, remained unimpaired, but injections of the dead cultures proved to have an immunising effect upon guinea pigs.—On orthogonal systems and cyclic systems, by M. C. Guichard.—On the geodesic lines of certain surfaces, by M. Émile Waelsch.—On a new algorithm, by M. Lémeray.—On a new mixed platinous salt, by M. M. Vèzes. By the action of oxalic acid upon potassium platinonitrite a crystalline platino-oxalonitrite is obtained, $K_2Pt(C_2O_4)(NO_2)_2 + H_2O$. This salt is very stable, and being but slightly soluble in cold water, it may be of service in the separation of platinum from its congeners. Above 240° it breaks up quantitatively into platinum, potassium nitrite, and carbon dioxide.—Method for the separation and distillation of bromine from a mixture of alkaline bromide and chloride, by MM. H. Baubigny and P. Rivals. The bromine is set free by the addition of sulphate of copper and potassium permanganate, and removed by a current of air at 100°.—Reversible transformation of styrolene into metastyrolene under the influence of heat, by M. Georges Lemoine. After a sufficiently prolonged heating, for a given temperature the final equilibrium is the same whether the starting point be styrolene or metastyrolene, provided that the volume be the same. The quantity of unaltered styrolene depends upon the volume open to the transformation.—On the temperature of maximum density of solutions of barium chloride, by M. L. C. de Coppet. The molecular lowering of the temperature of the point of maximum density is practically proportional to the weight of barium chloride dissolved in the litre of water.—On two colour reactions of pyruvic acid, by M. Louis Simon.—Action of nitric acid upon potassium cobalticyanide, by M. E. Fleurent. Indications of the existence of a nitrocobalticyanide analogous to the nitroprussiates.—Contribution to the biological history of phosphates, by M. L. Jolly. Prolonged maceration of muscular tissue in dilute nitric or acetic acids does not remove the phosphoric acid, the muscle still showing a strong reaction with the molybdic reagent.—On the reversal of the respiratory current in the Decapods, by M. Georges Bohn. The reversal of the current of water in the branchial chamber appears to be a general phenomenon in this group of Crustaceæ. The frequency of the reversal varies somewhat with the species, but is usually about two per minute.—On the systematic position of the genus *Ctendrilus* (Clap.) and its relations with the Cirratuliæ, by MM. Felix Mesnil and Maurice Caullery.—On the segmentation of the egg of *Tethys fimbriata*, by M. Viguier.—On the evolution of the primary sieve-tubes, by M. G. Chauveaud.—Influence of the spring frost of 1897 upon the vegetation of the oak and beech, by M. Ed. Griffon. In the oak, the shoots destroyed by the frost were frequently replaced by new shoots. This was also sometimes the case with the beech, but more rarely. These new shoots showed a marked inferiority in the supporting and protecting tissues, certain fibres being completely wanting. The leaves also showed deviations from the normal.—On the invasions of black rot, by M. A. Prunet.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Applied Mechanics: Prof. J. Perry (Cassell).—An Elementary Course of Infinitesimal Calculus: Prof. H. Lamb (Cambridge University Press).—The Wealth and Progress of New South Wales, 1895-96, Vol. 1 (Sydney, Gullick).—The Facts of the Moral Life: Prof. W. Wundt, translated by Profs. Gulliver and Titchener (Sonnenschein).—Smithsonian Institution, Report of the U.S. National Museum, 1893 and 1894 (Washington).—A Text-Book of Physics: Prof. E. H. Hall and J. Y. Bergen, new edition (New York, Holt).—Steam Boilers: G. Halliday (Arnold).—The Living Substance as such and as Organism: G. F. Andrews (Boston, Ginn).—Allgemeine Erdkunde: Hann Brückner and Kirchhoff, Fünfte Auflage, ii. Abtg. (Wien, Tempsky).—The New Man: E. B. Oberholtzer (Philadelphia, Levytype Company).—Laboratory Directions in General Biology: Dr. A. Randolph (New York, Holt).—Elements of Comparative Zoology: Prof. J. S. Kingsley (New York, Holt).—The Local Distribution of Electric Power in Workshops, &c.: E. K. Scott (Biggs).

PAMPHLETS.—A Bibliography of Norfolk Glaciology: W. J. Harrison.—The Great Meteoric Shower of November: W. F. Denning (Taylor).—Humanitarian Essays (W. Reeves).

SERIALS.—Mind, October (Williams).—Journal of the Royal Statistical Society, September (Stanford).—Bulletin de l'Académie Royale des Sciences, 1897, No. 8 (Bruxelles).—Records of the Geological Survey of India, Vol. xxx Part 3 (Calcutta).—Annals of the Institute of Jamaica, September (Kingston, Jamaica).—Canadian Magazine, October (Toronto).—Indian Weather Review, Annual Summary, 1896 (Calcutta).—Engineering Magazine, October (222 Strand).—Zoologist, October (West).—Bulletin de la Société Impériale des Naturalistes de Moscou, 1897, No. 1 (Moscou).—Himmel und Erde, October (Berlin).

CONTENTS.

PAGE