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INDIAN TREES.

Indian Trees. Being an Account of Trees, Shrubs, Woody Climbers, Bamboos and Palms Indigenous or Commonly Cultivated in the British Empire. By Sir Dietrich Brandis, K.C.I.E., F.R.S. Pp. xxxiv+767. (London: Archibald Constable and Co., Ltd., 1906.) Price 16s. net.

SIR DIETRICH BRANDIS is much to be congratulated on the completion of this very important work on the forest trees and shrubs of British India, and its appearance will be hailed with great satisfaction by all Indian forest officers and by many others who are interested in the botany of that country.

The chief value of this work consists in its comprehensiveness as a classified and descriptive list of all the different kinds of trees and shrubs of actual or possible value to the forester. The inclusion of species belonging to the latter category is of importance, because, as the author remarks:—

"Quite unexpectedly a shrub, a climber, a bamboo or a tree may be found to be of considerable importance from a forester's point of view, and he should then have easy means of identifying the species in question."

Moreover, the value or importance of many trees and shrubs is apt to vary very considerably in different parts of India. The book will also, by reason of its comprehensiveness, be of great assistance as a basis for the preparation of local forest floras. The "Forest Flora of North-West and Central India," which was commenced by the late Dr. Lindsay Stewart in 1869 and completed by Sir Dietrich Brandis in 1874, has always been regarded as a model example of what a local forest flora should be. If on this pattern a series of such works could now be undertaken for the more important forest regions in India, the utility of the present work would be realised in the process of their preparation, and the difficulties in the way of identifying trees and shrubs would be greatly lessened by reason of the limited number of species. The literature of Indian forest botany is very considerable, but local forest floras, with the exception of Gamble's "List of Trees, Shrubs and Large Climbers of the Darjiling District," Kanjilal's "Forest Flora of the School Circle," and Talbot's "Systematic List of Trees, Shrubs, &c., of the Bombay Presidency," are more or less out of date.

The number of trees and shrubs described in this volume amounts to more than 4400, the flora of Ceylon not being included. As this list of woody plants represents about one-fourth only of the total number of flowering species known to occur within this area, some idea can be obtained of the extraordinary richness and variety of the vegetation of British India taken as a whole. The following extract from Sir Joseph Hooker's most interesting "Sketch of the Flora of British India"[1] contains a brief and clear explanation of the manner in which the main characteristic features of the vegetation were brought about:—

"The Flora of British India is more varied than that of any other country of equal area in the Eastern hemisphere, if not on the globe. This is due to its geographical extension, embracing so many degrees of latitude, temperate and tropical; and to its surface rising from the level of the sea to heights above the limits of vegetation; to its climates varying from torrid to arctic, and from almost absolute aridity to a maximum of humidity; and to the immigration of plants from widely different bordering countries, notably of Chinese and Malayan on the east and south, of Oriental,[2] European, and African on the west, and of Tibetan and Siberian on the north."

Mr. Gamble, in his "Manual of Indian Timbers," estimates the total number of trees and shrubs (including woody climbers), which constitute the forest vegetation of the whole of India and Ceylon, to be 4749. If to these were to be added the more or less established species introduced from other countries, and allowing for a certain number of shrubs and woody climbers which have not been included in the estimate, a total of 5000 species would probably be reached.

Some interesting remarks will be found in the introduction to Sir Dietrich Brandis's book on the geographical distribution of forest trees in India, a subject which, by reason of his extensive journeys and practical knowledge of the country, he is fully qualified to deal with. Other important topics are briefly alluded to, chiefly as being problems requiring further investigation, such, for example, as the anomalous wood-structure of some kinds of trees and woody climbers, the tendency of certain gregarious species of trees to form pure forests, the periodic flowering of some gregarious species of bamboo and Strobilanthes, &c.; and another subject which has engaged the author's attention from time to time relates to the production of permanently dwarfed trees and shrubs by the action of periodical jungle fires.

The facilities provided in this book for the identification of the species are:—(1) The synopsis of natural orders on pp. xxv to xxxii of the introduction. As the determination of the natural order is very frequently the most difficult part of the operation in the attempt to identify an unknown plant, it would have been satisfactory if more assistance could have been given by means of keys for each of the larger groups of orders belonging to Thalamifloræ, Calycifloræ, Gamopetalæ, and Monochlamydeæ. (2) The keys to genera and species are quite satisfactory, and will be very helpful; (3) the index to vernacular names on pp. 723–736; and (4) the illustrations, which consist of 201 figures interspersed throughout the book; many of these are very excellent portraits, and cannot fail to be of assistance towards the identification of what they represent.

The natural orders are arranged in accordance with the "Genera Plantarum" of Bentham and Hooker,

[1] See in descriptive volume of the "Indian Empire" in the new edition of the "Gazetteer of India."
[2] In the sense of Boissier's "Flora Orientalis."

with one important exception, viz. that the Gymnosperms are placed after the Monocotyledons. In regard to genera and species, the "Flora of British India" has for the most part been followed.

The descriptions of the commoner and more important species are printed in large type, and the information regarding them is given in three separate paragraphs. The botanical name, the references to other books, and the vernacular names occupy the first paragraph; the second contains the description; and in the third, printed in smaller type, will be found the distribution of the plant in and beyond India, the time of flowering, and other information. The botanical descriptions occupying the second paragraph, though sometimes rather brief, are very much to the point. There is, however, a want of uniformity in the punctuation, which tends in many instances to prevent the essential points of the description from catching the eye. The use of a different type for the names of the principal organs, such as calyx, corolla, stamens, ovary, &c., would have answered the purpose to some extent.

The order Dipterocarpaceæ, which contains some very important timber trees, and others which yield valuable oils and resins, has been specially studied by the author.[1] In this book he describes nine genera and thirty-seven species. Of the large family of Leguminosæ, fifty-one genera are included. The oaks number thirty-seven species, the majority of which are restricted to the eastern Himalaya, Burma, and the Malay Peninsula; only seven extend to the western Himalaya, and not one has been recorded from the western peninsula. Of palms, twenty genera and eighty-nine species are described. The bamboos, which constitute a distinct tribe of the large and important family of grasses, have been very carefully done; fourteen genera and 102 species are mentioned. Of the Coniferæ, nine genera and twenty-one indigenous species are described.

A serious drawback in the get-up of this book is its excessive weight. Having decided to use such a very heavy paper, it might yet have been arranged to divide the book into two equal-sized volumes. This would have made each volume so much more convenient for handling than is the present book.

J. F. D.

A HANDBOOK TO THE MICROSCOPE.

The Principles of Microscopy; a Handbook to the Microscope. By Sir A. E. Wright, F.R.S. Pp. xxii+250. (London: Archibald Constable and Co., Ltd., 1906.) Price 21*s.* net.

THE author of this book is a skilled pathologist, and, therefore, necessarily a practical master of the manipulation of a microscope, at least in the case of transparent objects. He has probably arrived at his views on the microscope by prolonged and varied practice, and by independent thought, rather than by studying the work of others. He thinks the reader may find a grievance in the number of newly-coined words which he employs; but in a special subject no one should object to technical terms, without which science would indeed involve circumlocution, so long as a new technical term is carefully defined.

Sir A. E. Wright labours under heavy self-imposed difficulties. He always seeks to avoid a mathematical sign, the use of which as a substitute for speech can be defended, he says, "only in the case of the inarticulate classes of the learned." He ignores the fact that speech, whether in sound or in black and white, is as much *sign* as mathematical expression is sign, and nothing like so accurate.

The reader of the book may therefore profitably bear in mind that the work is an exposition of the author's own views and explanations of results which often are unquestionably true but sometimes admit of doubt.

The book is full, very full indeed, of beautifully executed diagrams; but conclusions are rather hastily drawn from them, and the reader is often left to derive his proof from due consideration of them rather than from detailed explanation. We can well understand that a beginner will not be quite satisfied, but we recommend him to persevere, as he will certainly find many practical rules as to the use of condensers in variously illuminating microscopic objects, and experiments illustrating these rules in a very complete way, plainly described and easily executed. A small diffraction grating is supplied with the book.

The first five chapters are devoted to the consideration of the object, its visibility, and the differentiation of its details as depending upon its preparation in mounting and staining, and upon its illumination. The author strongly and reasonably urges the view that it is from this side of the microscopic problem that important new discoveries will spring, rather than from improvements in technical optics. To differential staining he prophesies a valuable field of work in the future.

The second part of the book treats, in what seems to us an original way, of the microscope itself and of the optical matters connected with it. The author conceives the passage of light through a lens system as divided up into vistas composed of cones of light. The object, a small one, is at the vertex of a cone the base of which is the aperture of the first lens encountered. The second cone has the same base as the first, but its vertex is in the first image. The vista is completed at the real image, even if two lenses are employed before its formation. We thus have the opening limb and the closing limb, the pole of origin and the terminal pole, and the waist, of a vista, introduced as technical expressions. One vista may succeed another, and we may have a *catena* of vistas. Thus we may have a condenser vista starting with the source of light and terminating at the stage, an objective vista beginning at the stage and ending between the lenses of the Huyghenian eyepiece, and an eyepiece vista starting at the last-mentioned place and ending on the retina of the eye, forming a catena of three vistas.

This plan has the advantage of representing

[1] See in Engler and Prantl, "Pflanzenf." vol. iii., part vi.; also in Journ. Linn. Soc., vol. xxx., p. 1.

graphically many of the properties of a train of lenses, especially points of magnification and aperture, but it must be used discreetly. The author has himself been betrayed into an erroneous conclusion by means of it. If the origin of such a catena is a point of light, and a small opaque disc is inserted in the opening limb, the lane of darkness succeeding it will follow the same rules of formation as the cone of light, *i.e.* it will be a succession of cones having bases at the apertures and vertices at the images. One base is the conical projection merely of the previous one. Now Sir A. E. Wright is rather prone to overrate the resemblance between projections and images. He calls the similitude of a candle shining through a small hole upon a screen an image. That is not the sense in which the word is technically employed. An image is always a focussed image, though the qualification is not invariably stated. But the confusion of the two ideas leads the author into language which cannot be interpreted otherwise, we think, than as implying that every detail in one aperture, say a fleck of dust, is repeated as a genuinely focussed image situated at succeeding apertures. It is only a projection that takes place in such a case, and it would occur equally well at any plane along the line; and when the source of light has finite dimensions, even this strictly defined projection will not occur. This idea that everything in one aperture is *focussed* in succeeding apertures leads the author to more than one conclusion which, if we read him aright, is not sound.

An example of error arising really from the neglect of the focussing idea occurs in the author's justification, for it is not a proof, of the expression for the numerical aperture, in so far as it increases with the index of refraction of the external medium. In one of the diagrams (p. 74) the final surface of a convex lens is drawn as a plane, and in that case the excentric ray of a convergent beam will not intersect the axis, if it finds itself in water or in oil, at a point so close to the lens as if air were the medium in which it emerges. That is true, but it is no proof or even illustration of the point under consideration, which is the effect of the index upon the numerical aperture. This will be manifest by supposing the lens a convex meniscus with the second surface concave, and the origin of light to be at the point which is conjugate to the centre of curvature of the second surface. Then the light, both immediately before and after encountering the final face, will be normal to it, and an emergent ray will intersect the axis at the same point whether the surrounding medium be air or water. But the numerical aperture would still be affected by the medium.

The aperture question seems, indeed, a stumbling-block to the author. He knows as well as others do the connection between the radius of the false disc and the numerical aperture, and he rightly defines the latter, but his proof of the proposition at pp. 110, 111, would make the numerical aperture proportional to the tangent (instead of the sine) of the semi-angle of the cone of light.

The author has constructed an instrument to which he has given the name eikonometer, not a very happy one, for its object is, not to measure images generally, but by measuring certain images to arrive at magnifying powers. The principle, which is not so new as the author supposes, any more than the constructed instrument, is the fact that if two lenses are placed upon the same axis at any convenient distance apart, the first principal focus of one is conjugate to the second principal focus of the other, and the object bears to the image the same linear proportion which the focal lengths of the two lenses bear one to the other. Hence, if the object be of known dimensions, and its image be measured and therefore also known, and if one of the focal lengths be known, the other is also at once determinable. The actual focal length of an entire microscope may thus be, and has been, determined in one observation. The magnifying power is usually taken as the number resulting from the division of 250 by the focal length in millimetres, but this is an arbitrary rule which presupposes that 250 millimetres is the least distance of distinct vision, which is certainly not the case universally. The author does not use the eikonometer quite logically. In finding the focal length of a microscope his instruction is, *first* to focus the microscope in the usual way upon a scale of known dimensions situated on the stage, then to place the eikonometer over the eye end of the instrument and to read off.

The instruction should be *first* to place the eikonometer in position, and *then* by means of the ordinary focussing arrangement of the microscope bring the image of the scale on the stage into position at the scale of the eikonometer, and then read off.

The author thinks himself at issue with Abbe in the conclusion drawn from the grating experiment of the latter. This arises through a misapprehension, and the experiments which the author cites do not affect the conclusions which Abbe reached.

THOMAS H. BLAKESLEY.

THE CRUSTACEA OF DEVON AND CORNWALL.

The Crustacea of Devon and Cornwall. By Canon A. M. Norman, F.R.S., and Dr. Thomas Scott. Pp. xv+232; 24 plates. (London: William Wesley and Son, 1906.) Price 1*l.* 4*s.* net.

STUDENTS of British carcinology owe their thanks to Dr. Norman and Dr. Scott for the first appearance of a volume embracing the wide field of our indigenous crustacean fauna, as hitherto recorded in the Devon and Cornwall area. Dr. Norman's researches in this district, extending over a period of more than fifty years, are too well known to need mention here, and the publication of his records is a welcome addition to our literature. The introduction contains some interesting comparative tables on the distribution of species north and south relative to the area with which the work is concerned. The body of the work comprises an enumer-

ation of the species, with synonymy and records of occurrence, and occasional descriptive notes, with twenty-four plates.

The laborious task involved in gathering together the extant records of those who have in past years contributed to our knowledge of the British Crustacea must not be underestimated; but it is much to be regretted that the authors did not at the outset, in the compilation of such a work, bear in mind more fully the need of the student to whom, if not already an expert, a mere enumeration of our crustacean fauna can be of little assistance in his work. We would much have wished that the authors, with their wide knowledge of the group, had seen well to combine with their work a system of synoptic tabulation, whereby the volume might have been made of more practical service to the student. The portion dealing with the Copepoda bears witness to the extreme care bestowed on this part of the work. Records of occurrence are given in interesting detail throughout, and the many new species for the discovery of which we are indebted to the authors are very fully described, their distinctive characters being well exhibited in the accompanying plates. We would wish that the same careful system had been followed throughout the remainder of the volume, where records of observation are very bare and indefinite, rarely with dates, and distinctive characters are for the most part entirely omitted. There seems, for example, no reason why two succeeding species of Galathea should be dismissed with the bare entry "common," or why, at the opening page, the three species of Ebalia should be passed over without comment, despite the precarious identity of one of them, which some of us still hope to retain.

The retention of errors like "Daphina" (p. 102), "Reptort" (p. 185), and two authors' names, in a footnote to p. 202, both of them mis-spelt, is a disfigurement to the text. *Squalus galeus* and *S. acanthias* (p. 74) are inconsistent with *Galeus vulgaris* and *Acanthias vulgaris* elsewhere. "Whiting-pout (*Gadus fuscus*)," on p. 216, is misleading. On p. 192, for the host of *Asterocheres suberitis* the name *Suberites domuncula* is employed, a sponge which, properly named, does not, so far as we know at present, exist in our fauna.

Including eighty-six inland forms, 808 species of Crustacea are recorded for the area concerned, the marine Copepoda and Amphipoda numbering 274 and 142 respectively. As compared with these figures, Dr. Scott has previously recorded for the Clyde district 855 species, the Sympoda, Amphipoda, and Ostracoda being responsible for the difference.

While feeling a certain sense of disappointment at the general scheme of the work, we are much indebted to the authors for placing at our disposal a valuable record of observation which it is hoped may some day contribute largely to the drawing up of that much-needed work, a handbook to the British Crustacea.

L. R. C.

PALÆONTOLOGY FOR STUDENTS.

Die Leitfossilien aus dem Pflanzen- und Thierreich in systematischer Anordnung. By Dr. Johannes Felix. Pp. x+240; illustrated. (Leipzig: Veit and Co., 1906.) Price 6 marks.

SINCE the publication of the late Prof. Karl von Zittel's exhaustive "Handbook of Palæontology," several smaller books have been compiled on the same plan. The encyclopædic method, which is appropriate enough for a large work of reference, has been adopted in the less pretentious text-books for the use of elementary students who desire only a general acquaintance with fossils. The result is that instead of teaching fundamental principles and broad outlines, these little books provide an overwhelming series of disconnected facts which weary the memory, and palæontology is not only discredited as a mental exercise, but also becomes unpopular with those who really need its guidance while pursuing allied branches of science.

Another of these small books has just been laboriously compiled, with numerous illustrative figures, by Dr. Johannes Felix, the well-known palæontologist of Leipzig. It is neither better nor worse than its predecessors, and illustrates well the disadvantages of the dictionary form for elementary teaching. For instance, among Carboniferous plants, one of the most important groups is that of the Pteridosperms, bearing well-developed seeds in association with fern-like foliage. Dr. Felix's brief catalogue may enable a student to distinguish a Neuropteris from a Pecopteris, and so forth, but it does not give the least clue to the real interest or meaning of these fossils. Again, among vertebrate animals, the theromorphous reptiles are of fundamental value as pointing out the direction in which the cold-blooded land animals passed into the warm-blooded mammals. The book before us, though pretending to deal with fossils at varying lengths according to their degree of importance, does not even mention that the Theromorphs were chiefly land animals. It merely catalogues, with a desultory statement, the skull of the sea-reptile Placodus, which is probably not a Theromorph at all, and certainly gives no conception of the nature of the group in question.

Still worse, this compilation and condensation of matter from previous text-books destroys all effort to bring the subject up to date. It is much simpler to select a few miscellaneous facts from an exhaustive collection, and to purchase a set of electrotypes in a wholesale manner, than to make a judicious use of original memoirs and prepare new drawings to illustrate the science as it is now understood. We therefore look in vain among the "Leitfossilien" enumerated by Dr. Felix for any allusion to the European Lower Palæozoic fishes, the South African Triassic reptiles, the Egyptian Tertiary mammals, and the remarkable discoveries in South America, which have revolutionised many ideas in palæontology during the past two decades. Students may be able to name a few common European fossils if they happen to have

the patience to pore over this new book, but they will not gain much insight into the science these fossils illustrate, and their enthusiasm must be unusual if they retain any desire to proceed with palæontological research when they have completed their course. A. S. W.

THREE ASPECTS OF ELECTRICAL ENGINEERING.

Applied Electricity: a Text-book of Electrical Engineering for Second Year Students. By J. Paley Yorke. Pp. xii+420. (London: Edward Arnold, 1906.) Price 7*s.* 6*d.*

The Electrician Primers. Edited by W. R. Cooper. Three volumes in one. Vol. i., Nos. 1–24, Theory. Vol. ii., Nos. 25–55, Traction, Lighting and Power. Vol. iii., Nos. 56–80, Telegraphy, Telephony, Electrolysis and Miscellaneous Applications. (London: *The Electrician* Printing and Publishing Co., n.d.) Price 10*s.* 6*d.* net.

Electricity of To-day: its Work and Mysteries described in Non-Technical Language. By Charles R. Gibson. Pp. xiv+347. (London: Seeley and Co., 1907.) Price 5*s.* net.

THE three books before us suggest an interesting comparison of three points of view from which any applied science can be regarded. Each covers, or attempts to cover, in a more or less summary fashion, practically the whole subject of electrical engineering, but as each appeals to an entirely different audience, the difference in method of treatment is necessarily very marked. Mr. Yorke's volume is written for the student who proposes to become an electrical engineer, the genuine professional, whose chief assets must be knowledge and brains. The readers of the *Electrician* Primers will mostly be found amongst artisans, amongst the class not unjustly distinguished from electrical engineers by the name of electricians, people who require a fair amount of knowledge, but who can get on with a very limited amount of understanding. Finally, Mr. Gibson's book makes its appeal directly to the general public, or to that section of it which shows an intelligent desire to keep abreast of the times and is not content to utilise the advantages of civilisation without some attempt at appreciating the manner in which they are obtained.

The great necessity for the professional engineer in his college training is to obtain a sound foundation on which to build by means of future experience. Facts are easily learnt and as easily forgotten, whilst even if remembered they are likely to prove of but trifling value in actual practice. No man can say when he is at college what branch of his profession is going to occupy his future, and it should be the aim, therefore, of any second year's course to impart a sound knowledge of the way in which the fundamental physical principles of electricity and magnetism are utilised in the practical applications of electrical engineering. Mr. Yorke has kept this point of view clearly before him in the book under review, and has succeeded on the whole very well in elucidating the connection between theory and practice. There is no question, however, but that the value of a book of this kind depends almost entirely on the lectures and laboratory work that accompany it. Text-books alone are so incapable of giving sound instruction in electrical engineering that one is almost justified in maintaining that to criticise them apart from the course with which they are to be used is idle. The best that can be said is that the book would serve as a very useful model on which to base a second year's course of instruction. It is, perhaps, unwise that manufacturing methods should be described; in one or two instances this has led to mistakes which might have been avoided.

To attempt a detailed criticism of the *Electrician* Primers would be to write a volume as bulky as that which they themselves form. They range over such diversified subjects as "Curves and their Use," "Electric Railways," and "Photo-engraving," to quote but a few examples. Each primer forms a small handbook, and the artisan engaged in any particular branch of work would gain a fair insight into the *raison d'être* of his various operations by the study of those primers dealing specially therewith. As a reference book also the complete set should prove useful. The electrician occupied with tramways may occasionally find it necessary to know something about arc lamps or telephones, and in such cases the rough general information he requires could probably be obtained from these primers. The whole ground of electrical engineering is covered very completely by the series.

The correct person to review Mr. Gibson's book is a member of the general public and not an electrical engineer, as the principal questions to be answered are, Is it intelligible? and Is it interesting?

It is a hard task to describe some of the more complicated developments of electrical engineering in simple, non-technical language, and to avoid incorrectness in the search for simplicity. Mr. Gibson has, however, accomplished this task with remarkable skill, and for many passages deserves to be sincerely congratulated. There is too great a tendency, perhaps, to the relation of amusing little anecdotes which do not teach much, and to what may be described as sensationalism, but this is very natural and perhaps excusable. The interest of the layman, no doubt, requires to be sustained by such illustrations as the photograph of a church wrecked by lightning, or of an attractive young lady making afternoon tea with an electric kettle. But neither of these pictures has much educational value. To cavil is, however, ungracious; the more the public can be interested in electricity the better for the whole trade and profession, and Mr. Gibson's book will undoubtedly help on the work of progress. One is apt to laugh at "popular" science, but Mr. Yorke's students and the *Electrician's* artisans would all be amongst the unemployed without the market which Mr. Gibson helps to provide. MAURICE SOLOMON.

OUR BOOK SHELF.

Penrose's Pictorial Annual. The Process Year Book for 1906–7. Edited by William Gamble. (London: A. W. Penrose and Co., Ltd., n.d.)

THIS valuable and beautifully got-up volume surpasses, if possible, its predecessors. In the last few years the colour process has been rapidly coming to the front, and the present issue of this annual gives the reader an excellent insight into the good quality of the results which may be secured by the best processes of the day. The editor's task has evidently been no light one to include in this volume the wealth of material that is available, but the reader will be more than satisfied when he peruses it himself.

The arrangement of the book is the same as in former years. A most interesting series of articles dealing with process work and allied subjects is contributed, and the names of the authors are a sufficient guarantee for them. Thus, to mention only one or two cases, the editor gives a brief but clear account of the recent progress in process work, while Major-General Waterhouse describes the work of M. Léon Vidal, who, as he says, was a man who "fully recognised the educational value of photography," and who did much for its development, especially in the direction of photomechanical work, and the practical application of permanent printing processes for book illustration. M. Vidal's last contribution to this annual is contained in the present volume, and is entitled "The Future of Colour Photography when Autochrome Plates come into General Use."

Turning from the text to the illustrations, we have here also much food for thought. The frontispiece is an admirable engraving of Charles I. by the Rembrandt Intaglio Printing Co., Ltd. Of the numerous three- or four-coloured illustrations, mention may be made of those opposite p. 8, entitled "Still Life," by Messrs. John Swain and Son Ltd.; opposite p. 128, entitled "Dessert," by Messrs. H. Kollien and Co.; and following p. 136, entitled "Mimosa Blossom," by Messrs. Hood and Co., Ltd.

Einführung in die mikroskopische Analyse der Drogenpulver. By Dr. L. Koch. Pp. viii+174. (Berlin: Gebrüder Borntraeger, 1906.) Price 4 marks.

THE microscopical examination of drugs for the purpose of gaining an accurate knowledge of their constitution and of learning to detect impurities and adulterations is now recognised as a necessary part of the usual courses for pharmaceutical students, and as many chemists endeavour to acquire part of their knowledge during the term of their apprenticeship, they require books of this nature to help them in their independent studies.

Dr. Koch has prepared this elementary manual as an introduction to the specialised vegetable histology that affords the principal means of distinguishing pharmaceutical products with the aid of the microscope. A few examples of well-known drugs selected as specimens of bark, seed, and other plant products are described in detail, and the elements are figured. The instructions are so minute and thorough that a student using the book intelligently should soon become proficient in histological determination. The chapter on methods is not, however, so complete as would be expected. Although powdered preparations are generally used for investigations, it is at least desirable that the student in his training should become efficient in section-cutting. Further, a more extensive account of reagents would be helpful, for while agreeing with the substitution of chloral hydrate in place of potash, there seems no reason for leaving out potash altogether, or sulphuric acid and several other recognised testing solutions.

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.]*

An Occurrence of Helium in the Absence of Radio-activity.

I MENTIONED in NATURE a few weeks ago (January 17, p. 271) that I was engaged in examining the inert gases contained in ordinary (inactive) minerals. A result has been obtained so surprising that it seems worthy of immediate record. I have found that beryl contains a quantity of helium of quite a different order of magnitude from what is found in ordinary inactive minerals. Thus 250 grams of beryl from New Hampshire gave 4·2 c.c. of helium on heating. The mineral appears to be absolutely without radio-activity. A tray of the powder, placed in the case of an electroscope of exceptionally small natural leak, did not increase that leak to any measurable extent.

It seems likely that we have here a case of rayless change. In all probability beryllium is the constituent of beryl which is concerned. It is hoped to test this view further by the comparison of different minerals.

R. J. STRUTT.

Sunnyside, Cambridge, February 19.

The Rusting of Iron.

SEVERAL letters have appeared in NATURE respecting the conditions under which iron rusts. The usually accepted view has been that iron will not rust unless carbonic acid is present. After a very careful investigation of the subject, I was led to the conclusion that provided iron, oxygen, and liquid water are brought together, chemical change takes place with the production of rust, even when every precaution has been taken to exclude even traces of carbonic acid, and that therefore some other explanation must be found for the fact that alkalis inhibit the rusting of iron. An explanation has also to be found for the fact, established in the course of this investigation, that if polished iron is immersed in a solution of potassium dichromate, rusting is completely inhibited, and the surface of the metal remains perfectly bright (Dunstan, Jowett, and Goulding, Journ. Chem. Soc., 1905).

Dr. Gerald T. Moody has recently given (Journ. Chem. Soc., 1906) an account of experiments he has made, from which he concludes that carbonic acid is essential to the rusting of iron, and that rusting does not occur in its absence.

As these experiments were made under somewhat different conditions from mine, they have been repeated. The results obtained are, however, not confirmatory of the conclusion that carbonic acid is essential to the rusting of iron.

This apparently simple chemical change requires additional experimental study, and I hope shortly to be able to make some further contribution to the subject.

February 19. WYNDHAM R. DUNSTAN.

Ionisation and Anomalous Dispersion.

THE experiment recently described in a letter in NATURE by Dr. Schott (January 17, p. 271) does not appear to me to have any very direct bearing upon ionisation. There appears to be no question but that the changes observed in the dispersion curve were due to an alteration in the optical density gradient of the sodium vapour, resulting from local heating by the wire. The experiment is very similar to one which I made two years or more ago, during an examination of the physical properties of the vapour. A wire was stretched through the tube, along its axis, and heated by a current. The vapour was observed to be much less dense around the heated wire. The observations were made by looking through the tube either at a sodium flame, or a lamp behind bluish-green glass (for which light the vapour was very opaque). On heating the wire a clear space appeared around it. If I remember rightly, I never published this result, as the experiment was one of a series which has not, even yet, been completed.

In a sodium dispersion tube the density of the vapour

is very great along the floor, immediately above the surface of the molten metal, falling off very rapidly as the roof of the tube is approached. It has always appeared to me probable that we are dealing with clusters of molecules, though there may be some simpler way of explaining the very steep density gradient. At all events, local heating of the denser portion of the vapour reduces its density, it seems to me, to a much greater degree than would be the case with an ordinary gas. The steep density gradient only occurs when the top of the horizontal tube is cooler than the floor, that is, cool enough to condense the vapour. The tubes I usually exhaust to a pressure of a millimetre or two, and I have always found it difficult to explain how it is possible to have a layer of vapour along the floor so dense that it is deep violet in colour, while along the roof the vapour shows no trace of colour at all. On the kinetic theory, it seems to me that we should expect the vapour to be moving rapidly from the floor to the roof, without, however, showing much difference in density at different points. It may be, however, that the traces of hydrogen which are present may be the cause of the phenomenon. What we call "very dense sodium vapour" along the floor of the tube may be pure sodium vapour at a pressure of only a couple of millimetres. Along the roof we may have nearly pure hydrogen at the same pressure, and at intermediate points mixtures of the two in varying proportion, the sodium working its way up through the hydrogen and condensing on the roof. It will be well to try a very highly exhausted tube.

Upon the whole, I think perhaps this is the most conservative way of looking at the thing, though my impression is that the hot wire produces a greater reduction of density than we should expect on this assumption.

Baltimore, February 5. R. W. WOOD.

A New Chemical Test for Strength in Wheat Flour.

THAT different wheats make flours of very different baking values has been known for a long time, and is emphasised by the fact that English millers are at the present time paying several shillings per quarter more for certain foreign wheats than for home-grown wheat.

Baking value, or strength as the millers and bakers call it, is a subject of much interest, and many workers have tried to connect it with some definite physical or chemical property of the grain or flour. Thus it has been stated to depend on the percentage of gluten, the percentage of gliadin, or the ratio of gliadin to gluten.

None of these explanations has been found to meet all cases, nor is there any likelihood of finding any single factor which is capable of measuring so composite an idea as strength as understood by the miller or baker.

The value of a flour to the baker depends on at least four distinct properties:—(1) the volume of the loaf a given quantity will produce, which may vary more than 30 per cent.; (2) the amount of water which a given quantity will absorb in making a dough of proper consistency for baking, which may vary from one-half to three-quarters of its own weight; (3) the shape of the loaf; and (4) such points as texture and colour of the bread.

The baker, and apparently most of those who have attacked the problem, have confused these widely divergent properties under the single name of strength, and attempted to find one chemical or physical factor which will measure them all at once.

In taking up this subject, it seemed to me that the most hopeful line was to treat each property as a separate problem, and as the question of size of loaf seemed simplest, I have for the most part confined my attention to that aspect of the investigation.

In converting a given amount of flour into a loaf of bread, the flour is mixed with water and yeast, and allowed to ferment for some time. It is then put into the oven and baked. The yeast finds sugar in the flour, feeds on this, and converts it into alcohol and carbon dioxide, and the volume of the loaf must depend either on the volume of carbon dioxide evolved, or on the power of the flour to hold this gas.

To test this a number of flours were obtained from Mr. A. E. Humphries, chairman of the Millers' Association, who had kindly tested them in the bakehouse, and determined their strength. The scale of strength adopted is a purely arbitrary one. The mark 100 is assigned to the best flour on the market, and 0 to a flour which is quite unbakeable.

In each experiment 20 grams of flour were mixed with 20 c.c. of water and half a gram of standard yeast, incubated at 35° C., and the carbon dioxide liberated directly measured. The results are appended:—

Reference No.	Baking value or "strength"	CO_2 evolved cc.
1	96	270
2	90	325
3	73	274
4	68	227
5	65	205
6	45	156
7	36	131
8	20	287

It will be seen that with the exception of Nos. 1 and 8 the order of strength and of carbon dioxide evolved are the same. Perhaps the greatest confirmation of the idea that strength is directly dependent upon the capacity of a flour for acting as yeast food is found in the apparent exceptions. On inquiry from Mr. Humphries, I learned that the high mark assigned to flour No. 1 was based upon bakings made after the addition of malt extract, while the low value given to No. 8 was based on baking tests made some months earlier. The high carbon dioxide value actually found for the latter enabled me to predict that the flour must have changed in composition so as to have gained in strength, and this prediction was verified. On baking again it was marked 40, with the report that it made a large loaf, and would have been marked higher but for the bad shape.

The quantity of carbon dioxide given off by a dough will depend upon two things—the sugar present as such in the flour, and the diastatic capacity. Analysis showed that in the flours experimented with the sugar present varied from 2·56 per cent. in the strongest to 1·60 per cent. in the weakest, and followed very closely the order of strength throughout the series. Diastatic capacity has not yet been thoroughly examined.

The addition of sugar to flour was found always to increase the volume, the weight, and the height of the loaf. In a typical experiment made with household flour the increases were as follows:—volume, 13 per cent.; weight, 2 per cent.; and height, 30 per cent.

These experiments seem to prove conclusively that the volume of the loaf depends in the first instance upon the amount of sugar available in the dough, and a ready test is thus provided for that aspect of strength which is concerned with the size of the loaf. The other factors included in strength are at present under investigation.

T. B. WOOD.

Department of Agriculture, Cambridge.

The Flight of an Elongated Shot.

WITHIN the limits of accuracy of this discussion, it may be assumed that the sections of the shot normal to its axis of figure are circular, that its C.G. is in the axis of figure, and that this axis and all the diameters of the circular section at the C.G. give the directions of the principal axes of inertia at the C.G. Angular momenta will be referred to the C.G., the axis of the shot will be called simply the axis, and all directions will be understood as viewed from behind the shot.

The chief disturbing forces are the normal pressures of the air, the frictional forces being of a secondary order of magnitude. These normal pressures will be at a maximum upon the ogival head of the shot. The areas of such relatively smaller pressures as are due to vortex motion in the air, and to the partial vacua set up behind advancing surfaces directly presented to and against the air, will be situated towards the base of the shot, and upon the upper or the lower side of the shot, according as the axis is pointed above or below the tangent to the path of the C.G., *i.e.* the tangent to the trajectory.

Now, from the first moment of the free motion the tangent to the trajectory falls away more and more from the axis of the shot. The immediate result of this is the

setting up of an area of maximum pressure upon the underside of the ogival head. This gives rise to a resultant disturbing couple, which, by reason of the symmetry of the surface, has its axis parallel to the horizontal principal axis at the C.G., and this axis is directed rightwards. Since this disturbing couple has its axis at right angles to the axis of angular momentum, *i.e.* to the axis of figure, it causes a precessional motion of the axis in the plane of its own axis and of the axis of figure, so that this axis begins to turn itself slightly to the right of the trajectory, the rifling being taken to be right-handed. This action is a very small one, because the couple producing it is very small compared with the couple which is equivalent to the total angular momentum. The axes of angular momentum and of angular velocity being initially coincident with the axis of figure, while the axis of the disturbing couple is at right angles to it and parallel to one of the principal axes at the C.G., this couple has no effect upon the magnitude of either the angular momentum or the rotational velocity. It alters only the orientation of the axis of angular momentum, and leaves it coincident with the axis of figure.

Now this deflection of the axis to the right causes the left side of the head of the shot to experience a greater normal pressure than the right, and so gives rise to a second disturbing couple, of small magnitude relatively to the whole angular momentum, about an axis parallel to a principal axis at the C.G. and directed downwards, very nearly, if not exactly, in the vertical plane through the axis of the shot. The effect of this is to bring about a precessional motion of the axis in this plane, directed downwards, so that the nose of the shot begins to dip towards the tangent to the trajectory. This couple has, otherwise, exactly the same effects on the motion of the axis as the other one, and since both couples are very small in comparison with the total angular momentum, it is permissible to combine their effects after considering them separately. It thus appears that the axis acquires a small precessional motion about the tangent to the trajectory, and that the excess of pressure upon the left of the head will cause the trajectory itself to be bent to the right, bringing about the well-known rightward drift of the shot. If the rifling be left-handed the shot will drift to the left, but the nose of the shot will, as before, dip towards the trajectory.

Any device that throws the C.G. well towards the base of the shot will have the effect of adding to the magnitude of the first of the above two couples. A smaller deviation of the axis from the trajectory will then afford a larger disturbing couple, and the rightward precessional motion will be more quickly established. In consequence of this the rightward drift will be diminished. A long, hollow bullet of thin steel, the rear half having a smaller diameter than the front half, and this rear half being filled with lead, and also coated exteriorly with lead so as to take the rifling, may, on this theory, be expected to have less drift than the ordinary bullet, whereas a bullet weighted towards the head would have more.

J. W. SHARPE.

Woodroffe, Bournemouth.

The Problem of the Random Path.

THE following illustration of Prof. Karl Pearson's "Random Path" problem may be of interest.

Mr. Kipling in his story, "The Strange Ride of Morrowbie Jukes," gives the following directions for finding the safe path across a quicksand, which directions are supposed to have been found by the hero of the story in the coat of an earlier victim :—

"Four out from crow-clump; three left; nine out; two right; three back; two left; fourteen out; two left; seven out; one left; nine back; two right; six back; four right; seven back."

These numbers were probably taken at random, and it will be noted that seventy-five paces are taken, and the final position is only seven paces from the original position.

This is a rather curious confirmation of Lord Rayleigh's solution of the problem.

REGINALD A. FESSENDEN.

SPEECH CURVES.[1]

DR. SCRIPTURE since 1901 has worked with zeal and energy at experimental phonetics, and he has published several valuable papers, as well as a large volume treating generally of the subject. The work has been carried on with the aid of the Carnegie Institution of Washington at Yale, Munich, Berlin, and Zurich. It has been an expensive research, as in addition to costly apparatus a staff of clerks was required for computation. A perusal of this monograph proves that Dr. Scripture has shown great ingenuity in the construction of recorders and in overcoming technical difficulties that can be fully appreciated only by those who have made excursions into this field of research. His experimental method has been to transcribe on smoked paper the curves of speech both from the gramophone of Berliner and the phonograph of Edison.

On the disc of the gramophone the curves produced by sound vibrations are not indentations in the bottom of a groove or furrow, as in the tracing on a phonograph cylinder, but they are horizontal, as if they were drawn on the plane of a sheet of paper. Further, it is interesting to note that in the gramophone record the depth of the groove is constant, whereas in that of the phonograph the downward movement of the recording disc bearing the cutting tool is diminished, in consequence of increasing resistance, in comparison with the upward movement. Each instrument has its own peculiar quality of tone, and, except in very fine modern instruments, natural sounds are more or less falsified. This falsification Dr. Scripture shows is due to a distortion of the waves by the bending of the diaphragm, and not to nodal vibrations such as occur on Chladni's plates. His best tracings were taken from gramophone records, by using either a simple or a compound lever, which at one end travelled slowly over the record, and at the other recorded the waves on a moving strip of smoked paper.

There is no special novelty in this method except that it has been applied to the gramophone, and that the mechanical arrangements have been of the finest quality. It gives one a notion of the delicacy of the method when it is stated that 1 mm. of the tracing = 0·0004 sec. The vertical magnification by the use of a simple lever was 300 times, but Dr. Scripture adds :—"The future of the method lies in the development of a compound lever." Great care was taken to identify any portion of the record on the smoked paper with the corresponding part of the surface of the gramophone plate. This was accomplished by a very ingenious device. The reproduction of the curves for printing was done by etching on zinc. An example of a tracing of the sounds of an orchestra is shown in Fig. 1, and the following is Dr. Scripture's description :—

"The curve in Fig. 32 [Fig. 1] is from the record of a note from an orchestra. The most prominent vibration is one whose wave-length is 3 mm. = 0·0012 sec., that is, about the note $g^2\sharp$. Another prominent feature is the grouping of these vibrations in threes, indicating a tone with a period of 9 mm. = 0·0036 sec., or a note about $e^1\sharp$. There is one which reinforces every sixth vibration of the high note and another that coincides approximately with every ninth; the former would correspond to $c^0\sharp$, the latter to $g^{-2}\sharp$. The combination of all these notes—each comprising a fundamental with overtones—produces a very complicated curve. From such vibrations, however, the ear can pick out not only the component notes, but also the characteristic tones of the piano, violin, &c." (p. 33).

[1] "Researches in Experimental Phonetics: the Study of Speech Curves." By Dr. E. W. Scripture. Pp. 204. (Washington, D.C.: Published by the Carnegie Institute of Washington, 1906.)

In a similar manner Dr. Scripture gives a careful description of a large number of tracings of noises, whistling, various musical instruments, and human speech.

We now approach the most difficult part of the investigation, namely, the analysis of the curves produced by human speech. Dr. Scripture's plan has been to analyse carefully portions of actual speeches,

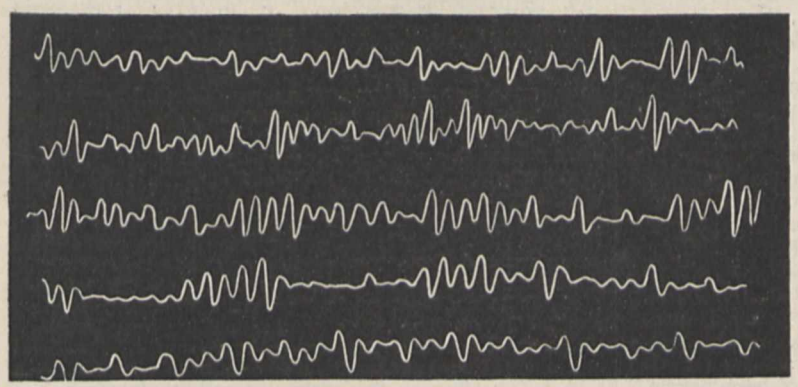


FIG. 1.—Record of a note from an orchestra.

as, for example, that of Chauncey M. Depew on "Forefather's day," when he says "Without regard to race or creed I can," &c.; or from "Cock Robin," "With my little eye I saw him die," &c.; or Joseph Jefferson's speech in proposing Rip Van Winkle's toast, "Come, Rip, what do you say to a glass? That's fine schnapps." As an example, take a small portion of the latter speech:—

Each line contains only a few waves out of the curve for a vowel, and Dr. Scripture gives a careful analysis. It would have been better, I think, if Dr. Scripture, with his fine appliances, had given us an exhaustive examination of each vowel, not as it occurs in such a speech as we are considering, but by itself. The vowels here examined are "American vowels." Would it not have been better to have obtained first-rate gramophone records of clearly sounded vowels, and then to have reproduced the curves of these sounds? However, there can be no doubt Dr. Scripture's analysis teaches us a great deal. One would have expected that the wave forms in a vowel tone would have had the same form or shape for a short time, but it would appear that this is not so.

"So much has been said," writes Dr. Scripture, "of the complexity and the variability of the speech curves that the impression may have been produced that they are hopelessly irregular. This is not true. They are as irregular as the leaves of a tree; no two are alike, yet the individuals of a variety resemble one another, and differ from other varieties" (p. 49). . . . "As already pointed out, no two waves of a vowel are alike; the differences are often so great that we may be sure that one part sounds utterly different from another, although the ear apparently gets only a single general impression" (p. 53).

Dr. Scripture then devised a method "whereby the ear can be enabled to hear the sound of each wave separately." A special apparatus was constructed by which a single selected wave was many times repeated on a strip of zinc, then etched, and then transferred to the gramophone disc. The group of waves reproduced the sound represented by these exactly similar waves, and the ear was appealed to as to the resemblance of the sound to any particular vowel. This is quite a novel method of investigation, and suggests further experimental work. It shows the possibility of transferring any set of curves to a gramophone plate and then listening to the sound and comparing it with other sounds. The writer of this notice, by another method, has obtained many curves of vowels, and he cannot altogether bear out the statement of Dr. Scripture that all the waves differ from each other. At the beginning of a vowel tone, and towards its close, the waves may differ, although of the same general type, but in the middle of the tracing, when the vowel tone is clear and distinct to the ear, the waves appear to be the same in form.

In the analysis of speech curves, Dr. Scripture attaches importance to what may be termed the melody of speech. We have "melody" when sounds of different pitch are heard after one another.

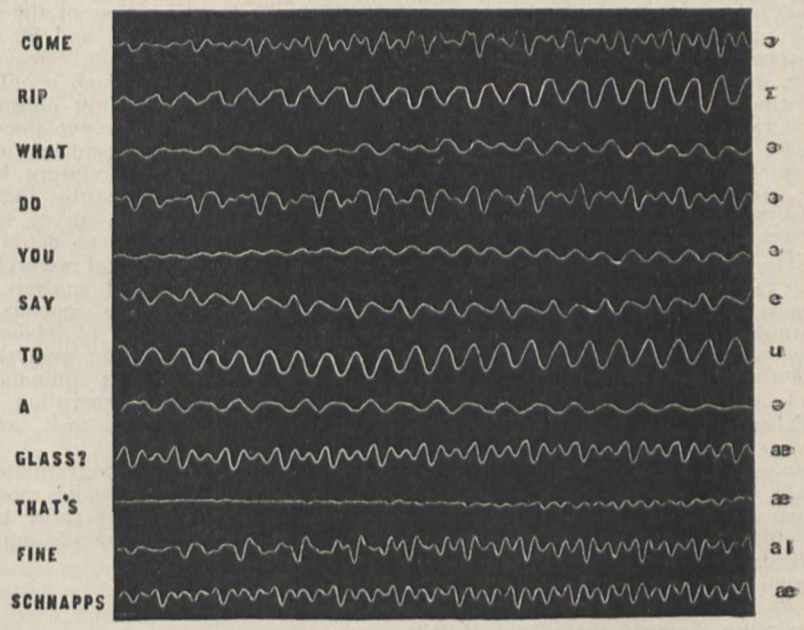


FIG. 2.—Curves showing waves from various vowels spoken by Joseph Jefferson in "Rip Van Winkle's Toast."

"The study of melody is the study of the fluctuations of the pitch of the tone from the glottal lips. Each explosion, puff, or vibration from the glottis arouses a vibrating movement that shows itself in the speech curve as a group of vibrations; this we have called a 'wave-group' or a 'wave.' A 'wave' thus means the whole complicated group of vibrations resulting from a single glottal movement. The study of melody has to do with these waves or wave-groups."

By a special method Dr. Scripture plots a melody curve from a transcribed record, showing, for example, the curve when "Oh" is uttered "sorrowfully," or "admiringly," or "questioningly," &c. He works out the "melody curves" in Depew's speech, and then writes the melody in musical notation. With regard to the emphasis of speech as indicating the emotional condition of the speaker's mind, we must, however, take into account not only melody, or the sequence of tones of different pitch, but also the intensity, the passing from *diminuendo* to *crescendo*, or *vice versa*. Dr. Scripture has not attributed sufficient importance to this element in the analysis. The amplitudes of the wave forms increase or diminish according to the intensity.

Dr. Scripture expounds the principles of harmonic and inharmonic analysis in two chapters at great length and with much clearness. Nowhere have I met with a fuller exposition of Fourier's theorem and its application to acoustical problems. He does not hold, however, that a vowel curve is produced by combining simple sinusoid vibrations in a harmonic series, and he concludes that

"the sounds from the musical instruments are presumably produced in this way, but we dare not assume that the vowels are so produced until the fact has been proven" (p. 78).

He shows how to separate, by the rules of Hermann, harmonic and inharmonic sinusoids from the mixed results of a harmonic analysis. How is one vowel distinguished from another? Are the differences due to the presence of certain tones of definite pitch, as held by both Helmholtz and Hermann? If so, are we to hold with Helmholtz that these tones are harmonic overtones of the glottal tone or that they are inharmonic to it, as stated by Hermann? Dr. Scripture holds that Hermann has completely disproved the theory of Helmholtz. After discussing the method of analysis with frictional sinusoids, as distinguished from simple sinusoids, he states:—

"The vibrations of the voice in speech are . . . composed exclusively of frictional sinusoids and not of simple sinusoids, as has hitherto been assumed. Can a method of analysis into frictional sinusoids be found? Does an analysis into simple sinusoids give false results for the vowel curves?" (p. 101).

He answers the question thus:—

"The treatment of the curves by simple harmonic analysis—the only method that has hitherto been tried—furnishes results that are so wrong as to be utterly misleading when used to indicate the manner in which the vibrations were produced."

I observe that Dr. Scripture states that Prof. Weber, of the Swiss Polytechnicum, along with Schneebeli, was the first to apply the Fourierian analysis to a vowel curve, but he does not give the date when this was done. We must not forget that such an analysis was made by Fleeming Jenkin and Ewing in 1878 ("On the Harmonic Analysis of certain Vowel Sounds," *Trans. Roy. Soc. Edin.*, vol. xxviii., p. 745).

As to the mode of production of vowel tones, Dr. Scripture discards the views of Wheatstone, Grassmann, and Helmholtz that the glottal lips vibrate after the manner of strings or the borders of a membrane on each side of a narrow opening, and he fully adopts the "puff" theory of Willis and Hermann, according to which

"the glottis emits a series of more or less sharp puffs; each puff, striking a vocal cavity, produces a vibration whose period is that of the cavity; a single wave-group shows the sum of these vibrations from all the cavities; the periods of these vibrations may stand in any relation to the interval at which the puffs come, that is, to the fundamental."

There can be little doubt that, at all events in his later days, Helmholtz saw the analogy between the action of the glottis and the "puffing" sounds of a syren, but he undoubtedly held that the overtones were harmonics of the glottal tone. Hermann, however, has conclusively shown that at least some of the tones of the cavities may be inharmonic to the glottal tone, and Dr. Scripture supports this view by many ingenious experiments. His description, however, of the glottis is not either anatomically or physiologically quite satisfactory. It is not in accordance with anatomical detail to write, "Each glottal lip consists mainly of a mass of muscle supported at the ends and along the lateral side," or that "the two masses of muscle close the air passage," or that the air from the trachea "bursts the muscles apart." The glottis is a much more delicate structure than these words would imply. It contains much elastic tissue at the borders which come together, according to the "puff" theory, and the muscular structures are devoted to placing strains on this tissue and to separating or approximating the lips of the glottis. Dr. Scripture's view is that

"the effect of each puff on each element of the vocal cavity is double: first, to arouse in it a vibration of a period depending on the cavity; second, to force on it a vibration of the same period as that of the set of puffs."

The glottal puff produces a frictional sinusoid with large amplitude and a very large coefficient of friction, and the cavity vibrations are also of the frictional sinusoid form. This may explain the failure of a simple harmonic analysis to reveal the real elements of the vowel curve.

In chapter ix. Dr. Scripture gives his views as to the action of the organ of Corti in relation to wave analysis, and he conjectures that portions of it are affected by "groups of stimuli," when complex wave forms reach it. This does not seem very conclusive, and in my judgment the theory of Helmholtz, by which he explained the action of the organ by adopting the principle of resonance, still holds the field.

Dr. Scripture has also attempted a synthesis of vibrations by ingenious mechanisms, by which he obtained curves somewhat similar to speech curves. There is no doubt a great future for this line of experimental research. After fully worked out examples of vowel analysis, with all arithmetical details, Dr. Scripture appends to the end of the monograph a number of elaborate schedules to assist in the Fourierian analysis, namely, schedules of 12 ordinates, 24 ordinates, 36 ordinates, and 72 ordinates. The preparation of these schedules was a very laborious task, and the work will be much appreciated.

We congratulate Dr. Scripture on the production of a splendid monograph. It might have been improved by fuller bibliographical details, and perhaps by a more adequate recognition of the work of others.

JOHN G. MCKENDRICK.

AGRICULTURAL EDUCATION AND RESEARCH.[1]

ONE of the functions of the Board of Agriculture is the administration of a Treasury grant for the purposes of agricultural education, and though the total distributed is not large it has been a potent factor in stimulating the development of the higher forms of agricultural education during the last fifteen years. It is certain that many of the county councils

[1] The Annual Report of the Board of Agriculture and Fisheries on the Distribution of Grants for Agricultural Education and Research in the Year 1905-6.

which now help to maintain colleges giving instruction of a university standard would have never started at all or would have rested content with something in the nature of a farm school had it not been for the advice and practical encouragement provided by the Board of Agriculture.

During the past year we see that seven institutions were in receipt of an annual grant of 1000*l.*, 200*l.* of which was in respect of the farm maintained by the college, while twelve other institutions received sums ranging from 800*l.* down to 100*l.* The University College of North Wales at Bangor and the Armstrong College at Newcastle each received a further 250*l.* for instruction in forestry. It is noticeable that the Board seems to make the amount of its grant depend upon the type of education given, not taking into account the number of the students educated or the extent of local support. Thus Wye College, the total expenditure of which is set at 17,414*l.*, receives the same grant, 1000*l.*, as other colleges the total expenditure of which does not reach 3000*l.* Probably this policy is most adapted to the pioneer work, when it is all important to get the colleges started, but the time is drawing near when some of the colleges supported most liberally by their localities must feel that they should be treated on the principle of the Treasury grants to university colleges, which are given roughly in proportion to the local support received.

In the body of the report nearly all the collegiate centres have the same tale to tell of an increase in the number of students, and that greater use is being made of the college by the farmers in the district. It is not too much to say that the attitude of the general body of farmers towards scientific work has entirely changed during the last ten or twelve years, wherever they have been within the range of influence of one of these permanent centres of instruction. The supply of agricultural intelligence certainly preceded the demand, but now the demand has more than grown up to the supply.

The second part of the present year's report deals with the expenditure of the various county councils on agricultural education of various kinds out of the funds they derive from the "whisky money." From this we learn that in 1905-6 the counties of England and Wales expended very nearly 84,000*l.*, of which about 30,000*l.* went to colleges and schools, the remainder being spent on lectures or instruction in horticulture, bee keeping, poultry keeping, and various manual processes. Useful as no doubt much of this work is, popular as it is made to be by being spread thinly over a wide area and liberally endowed with prizes, it does little or nothing for the advancement of agriculture, though it may be doing something to make life easier for the cottager. The failure of agricultural instruction that is divorced from any permanent teaching centre may be read in the steady decline in the expenditure for such purposes of the counties which are not connected with any of the institutions subsidised by the Board. There are, indeed, several counties content to spend nothing on agriculture, though their only interests are agricultural; West Sussex, for example, spends not a penny, while several others get through on less than a hundred a year.

When one comes, however, to the second part of the title, "Grants for Agricultural Education and Research," this report makes an indifferent show, since the grants for research only total 355*l.*! Of course, some part of the grants to the colleges is available for research, but if we except the fine work that is being done at Cambridge, there is little going on at the colleges which could come under the category of research. The 355*l.* consists in the main of grants to various institutions carrying out a particular experiment on the improvement of poor pastures, and one sum of 50*l.* to the committee which is working at the improvement of English wheat. Rothamsted still remains without a grant.

Account should also be taken of one or two departmental committees which are inquiring into stock diseases; at present, for example, there is one at work on contagious abortion in cattle, and a former inquiry into "louping ill" in sheep has recently reported—the two costing about 3000*l.* But compare this expenditure on research with that of the United States Department of Agriculture: from the appropriations for the fiscal year ending June 30, 1905, we extract the following items for investigation work alone, exclusive of the salaries of the permanent officials of the Department.

	£
Botanical investigations and experiments...	13,500
Entomological investigations	14,000
Vegetable pathological investigations ...	30,000
Biological investigations	6,800
Pomological investigations	8,700
Laboratory, Department of Agriculture ...	27,000
Experimental gardens and grounds, Department of Agriculture	5,000
Soil investigations	34,000
Grass and forage plant investigations ...	8,500
Cotton boll investigations	50,000
Sugar investigations	1,500
Tea culture investigations	2,000
Total	201,000

It is the smallness of the Board's contribution to research, the life-blood of scientific education, which led Mr. J. F. Mason, the Member for Windsor, to move an amendment to the address last week to direct attention to the neglect of agricultural research on the part of the Government. Mr. Mason dwelt upon the prime importance of research to farming in this country where intensive farming is carried on and a large monetary return per acre must be obtained. He instanced the losses that have been occasioned by plant diseases, which could only be dealt with after organised investigation of their causes and origin. He particularly pleaded for assistance to Rothamsted, the one institution for agricultural research of the first rank that this country possesses, but which, deriving its income from private benefactions only, is now handicapped for lack of funds.

The amendment received a sympathetic discussion from members on both sides of the house, and Sir Edward Strachey, for the Board of Agriculture, said "that no one was more anxious than he to see larger sums applied to experiment and research. But scientific investigation had suffered in the past not so much from neglect as from want of appreciation on the part of the public. If the House had omitted to provide sufficient funds for such investigation, it was because the question had not been brought forward. . . . On the other hand, it might very fairly be said that there was a general demand among agriculturists for larger grants from State funds; and the House might rest assured that the President of the Board of Agriculture would make representations to the Treasury as to the general feeling expressed in the debate on that point."

But now that the question is attracting public attention we trust that the Board of Agriculture will be encouraged to make bolder demands on the Treasury. There was a scheme for creating a council for agricultural research which seems to have fallen

through for lack of an initial grant; there are also the recommendations of the Royal Commission on fruit-growing, which seem no nearer realisation; as an advisory body the Board of Agriculture must get itself discredited unless it possesses some machinery for investigation.

THE UNIVERSITY OF TORONTO.

THE very generous provision recently made by the province of Ontario for the financial support of the University of Toronto, as well as the very important changes brought about last year in the constitution of the latter, are of more than local interest, and therefore the following account may be of service to those who watch the development of the colonial universities.

This university, which was founded by Royal Charter in 1827 and began teaching in 1843, had as its original endowment 225,000 acres of Crown lands in the province of Upper Canada, now Ontario, and the amount realised from the sale of these lands gave, with the tuition fees, all the revenue the university had until 1897, when the Legislature granted it 1400*l.* a year and 132,000 acres of wild lands within the unsettled portions of the province. In 1901 the Legislature further undertook to pay the annual charge of the departments of physics, chemistry, and mineralogy and geology. This latter addition to the resources of the university was rendered necessary by the gradual decrease in the revenue from the endowment and by the great increase in the number of students in attendance, taxing the energies of the teaching staff and the accommodation of the class-rooms and laboratories to the utmost. Until 1906 the revenues were spent in supporting two faculties, arts and medicine, as the annual budget of the School of Practical Science (engineering and technical science generally) was met directly out of the provincial treasury.

This provision of 1901 met the situation for about three years, but in 1905 the need of additional laboratories and other buildings, as well as the continually increasing numbers of students, made the question of further financial aid a very pressing one. There was also the question of the advisability of changing the relations which hitherto existed between the State and the university. All appointments to the staff had been made by the Lieutenant-Governor-in-Council, and, though these had been free from political taint, there was the possibility of such being dictated by considerations of party politics. It was also recognised that the constitution of the university was very cumbrous and unadapted for the work it had to do.

The urgent aspect of the situation led the newly installed Whitney Administration to appoint a Royal Commission to examine and report upon the constitution of the university and its constituent colleges and faculties. The commission was a very representative one, and from the first it earnestly set about its task, which was recognised to be a difficult one. It visited the larger American universities, conferred with their presidents and others who could furnish any aid in the form of advice, and patiently heard the views of the staffs of the various colleges and faculties. This commission also took up the financial problem of the maintenance of the university.

The results of their labours were presented in the form of a report to the Lieutenant-Governor of the province in March of last year, and at the same time the commission drafted a bill for introduction into the Legislature to embody, in the form of an Act, the changes which were thought advisable in the constitution. The suggested changes practically involved re-casting the constitution. The Act was accepted by both sides of the Legislature, and only minor modifications were made in its passage through the House.

Some of the changes made were sweeping. The control of the university was vested in a board of governors, twenty in number, eighteen appointed by the Crown, one the chancellor, elected by the graduates, and one the president, appointed by the board. This board was given the management of the endowment and income, but it can make no appointment to the teaching staff except on the recommendation of the president, on whom now devolves the responsibility for the staff of the university. By the Act the School of Practical Science was made an integral part of the university, and its finances were made subject to the control of the board of governors.

By far the most important result of the Royal Commission's labours, and which was embodied in the Act of the Legislature, ensures to the university henceforth adequate financial support. The provision to this end consisted in the granting to the university each year one-half of the annual average amount of the revenues derived by the province from succession duties or death duties, the annual average to be based on the receipts of the preceding three years. The total amount of these duties for the years 1903–4–5 was 304,800*l.*, or annually 101,600*l.* One-half of this latter sum has, as the Act directs, been paid to the university for the academic year 1906–7. As the province is growing wealthy rapidly, and consequently these succession duties are annually increasing in amount, of course the sum to be handed over annually by the province to the university will correspondingly increase. The amount to be thus given for the academic year 1907–8 will be 71,000*l.*, and it is estimated that the university will receive from this same source in 1908–9 about 100,000*l.* What it will be in a few years more cannot be approximately forecasted, but it is not unlikely that within ten years the death duties may average 300,000*l.*, of which the university would receive 150,000*l.*

As the ordinary income of the university, apart from that derived from succession duties, and apart also from interest on scholarship funds, is about 44,000*l.*, it may be seen that the total income from all sources for 1906–7 is 97,400*l.*, and for 1907–8 about 118,000*l.*, but for 1908–9 it will be about 147,000*l.* It is not at all improbable that the income of the university five years from now may be in the neighbourhood of $1,000,000, or more than 200,000*l.*

This is a very large income, but it must be noted that the work that the university has to do is also very great. It has not to undertake instruction in agriculture, for the province already maintains a splendid College of Agriculture at Guelph for which the annual budget is about 30,000*l.* It has, however, to provide adequately for faculties of arts, medicine, applied science, and education, and the task may be gauged from the fact that there are already 2700 students in the first three faculties. It has also to do for Canada what the great American universities are doing for the United States, that is, to meet the demand for advanced teaching and for research in all departments. It is, indeed, the ambition of some to develop the university into as great a representative of learning and research as either Harvard or Johns Hopkins is, and to make it at the same time a centre for the intellectual life of the Canadian nation to be. As it is now, it is the largest and wealthiest colonial university of the Empire. A. B. MACALLUM.

PROF. J. F. W. VON BEZOLD.

IT is with deep regret that we record the death on Sunday last, February 17, of Prof. Wilhelm von Bezold, director of the Prussian Meteorological Institute.

Von Bezold was born at Munich in June, 1837, and was admitted to the degree of Ph.D. at Göttingen in 1860. Thence he returned to Munich as privatdocent in 1861, became extraordinary professor in the University in 1866, and ordinary professor at the Polytechnic in 1868. In 1878 he undertook the organisation of the Bavarian meteorological service as director of the central meteorological station, and remained in charge of the service until 1885, when he was called to Berlin as professor of meteorology in the University, and director of the Meteorological Institute, which was reorganised by him.

The Institute included not only the central establishment in Berlin, which formed the headquarters of the branch in charge of Prof. Hellmann for dealing with the climatology and rainfall of the Prussian kingdom, but also the meteorological and magnetic observatories at Potsdam, in connection with which the names of Sprung, Eschenhagen, and A. Schmidt are so well known, and the aëronautical section at Tegel, which was brought into existence and developed as a branch of the Institute under Prof. Assmann. A year and a half ago the work of the latter institution was transferred to the new and independent establishment at Lindenberg.

In the course of his long and distinguished scientific career von Bezold's activity ranged over a wide field. His writings include papers on colour vision and the retina, and the dust figures of electrical discharge; but he is best known for his contributions to meteorology as the physics of the atmosphere, the aspect of the subject which he found most attractive, and to the theory of terrestrial magnetism. A volume of his collected papers on these subjects was issued as recently as October, 1906, by Vieweg and Son. It includes the papers on the thermodynamics of the atmosphere, contributed to the Berlin Academy, which are the classical memoirs upon that section of meteorology. The last paper in the collection contains his proposal for testing Gauss's theory of terrestrial magnetism by measurements along a complete parallel of latitude. This was before the Association of Academies in London in 1904, when von Bezold was one of the representatives of the Berlin Academy.

All who had the advantage of being associated with him in international work will miss his kindly presence and scientific enthusiasm, as well as his sympathetic and cautious counsel.

PROF. N. A. MENSCHUTKIN.

PROF. NICOLAI ALEXANDROVICH MENSCHUTKIN, who died on February 5, was born in St. Petersburg on October 24, 1842. After finishing his studies at the St. Petersburg University, he went abroad and worked in the laboratories of Schtreker in Tübingen, Würtz in Paris, and Kolbe in Marburg. On his return to St. Petersburg in 1865, he read his dissertation for the degree of Master of Chemistry on "The Hydrogen of Phosphorous Acid and its Incapacity to be replaced by Metals." In 1867 he began to lecture on chemistry at the St. Petersburg University. He also gave special lectures on organic chemistry, and was head of the analytical laboratory. In 1885 he left the analytical department and devoted himself entirely to teaching organic chemistry. His doctor's dissertation was on "The Synthesis and Properties of Hydrocarbons." In the seventies of last century he was secretary, and in the eighties rector, of the Physico-mathematical Faculty. In recent years he left the University and lectured at the Polytechnic Institute of St. Petersburg.

Menschutkin devoted his spare time to the Physico-chemical Society, the Journal of which he edited. He was vice-president of the Students' Aid Society, and, being a fine musician, he organised the students' choir and orchestra.

His first researches were on the inorganic acids, but he subsequently devoted himself almost exclusively to organic chemistry. In the 'seventies he did some good work in the province of physical chemistry and in the mechanics of chemistry. His researches on the influence of isomerism of alcohols and acids on the formation of composite ethers were published in the Records of the St. Petersburg Imperial Academy in 1877, and he was awarded the Sokoloff medal for this work. This was his first fundamental work, and it marked an epoch in the history of Russian chemistry. Prof. Menschutkin supplemented these researches by further work on the same subject in 1881. His researches on etherification from 1877 to 1882 brought many important additions to that branch of organic chemistry. In 1898, 1900, and 1902 he was occupied in investigating the influence of carbon chains on the velocity of reaction and decomposition of carbon compounds. His last important research was on the velocity of chemical change in the polymethylene series, which was translated into English and published in the Journal of the Chemical Society. A paper on the "Influence of Catalysts on the Formation of Anilides" almost closes his scientific career.

His "Lectures on Organic Chemistry" passed through many editions. His "Analytical Chemistry" became the text-book for all the Russian universities and technical schools. In his preface to the sixth edition, which has been translated into English and German, Prof. Menschutkin claims that analytical chemistry should form the basis for the study of organic and physical chemistry. Prof. Menschutkin, unlike his contemporary Prof. Mendeléeff, was a wonderful manipulator in the laboratory, and this was partly the secret of the precision of his results. Prof. Mendeléeff had the wider vision of the science, Prof. Menschutkin excelled in details. His earliest work was much influenced by his first teacher, Prof. Sokoloff.

NOTES.

IT was announced in Sunday's *Observer* that the Government would shortly introduce a Bill dealing with the constitution of the proposed Imperial College of Applied Science at South Kensington, and the relation of the college to the University of London. We find, however, that this report is incorrect; though the scheme for the establishment of the college was outlined nearly four years ago, when Messrs. Wernher, Beit and Co. offered 100,000*l.* towards the cost and the London County Council agreed to contribute 20,000*l.* a year for maintenance, the matter is still in abeyance. This delay, as we have remarked before, is both unfortunate and dangerous. The chief point at issue is whether the college shall form part of the University of London and be controlled by the Senate of the University, or whether it shall be an independent institution having a governing body of its own. While the relationship between the two institutions is being decided, there is no visible sign that the scheme is taking definite shape, and many men of science and leaders of industry are becoming impatient at the delay. The departmental committee on the Royal College of Science

and Royal School of Mines, in referring to the composition and functions of the governing body of the new college, remarked (see NATURE, February 8, 1906, p. 345):—"Of the relation of the new institution to the University of London, it is necessary to premise that we are agreed that it is desirable that the new institution should be established immediately, and that its organisation should proceed without delay." With this recommendation we are in complete agreement. When the college has been in existence for several years it will be time enough to decide what its connection with the University must be. In the meantime, the special governing body proposed by the departmental committee ought to be appointed to start the institution. If something is not done soon, the enthusiasm with which the scheme for the establishment of the new college for advanced instruction and research in applied science was received will give place to public condemnation of the dilatory methods adopted in a matter of great national importance.

PROF. A. LIPPMANN and Prof. Simon Newcomb have been elected honorary fellows of the Physical Society.

DR. C. D. WALCOTT, director of the U.S. Geological Survey, has been elected secretary of the Smithsonian Institution in succession to the late Prof. S. P. Langley.

PROF. J. MILNE, F.R.S., will deliver the opening lecture of the session at the West India Committee Rooms this evening, February 21, the subject being "The Construction of Buildings in Earthquake Countries."

A STORM area of more than usual magnitude was influencing the weather over the whole of the British Islands, and, indeed, over the greater part of western Europe, during Tuesday night and Wednesday. The central area of the disturbance was situated near Skudesnaes at 8 a.m. on February 20, the barometer registering 27·65 inches, which is probably a record low reading in that position. The barometer was below 29 inches over nearly the whole of the United Kingdom, and the fall was unusually rapid. Strong westerly gales occurred throughout Tuesday night, and they were continuing yesterday in all parts of our islands, as well as in France.

THE executive of the British Fire Prevention Committee has appointed a special commission on concrete aggregations. The scope of the commission is described in the following resolution:—"That having regard to the confusion existing as to concrete aggregates, and the absence of their exact specification, the British Fire Prevention Committee do hereby constitute from among its members and subscribers a special commission to report upon and define the aggregates suitable for concrete floors intended to be fire resisting having due regard to questions of strength, expansion, and the chemical constituents and changes of the aggregates." In forming the commission the various technical interests have as far as possible been represented. Sir William Preece, K.C.B., F.R.S., will act as chairman, and Mr. Matt Garbutt as honorary secretary. Correspondence should be addressed to the assistant secretary, 1 Waterloo Place, S.W.

THE February number of the *Century Magazine* contains a short article on Amundsen's expedition and the North-West Passage, by General A. W. Greely. A short outline (illustrated by a map) of the history of the search for the North-West Passage is given, and General Greely writes appreciatively of Amundsen's skill and daring in the handling of the *Gjoa*, as well as of the value of the magnetic work he carried out.

THE *Times* of February 5 publishes a telegram from Calcutta stating that a message had been received there on the previous day from Dr. Sven Hedin. Dr. Hedin reached Ngangon Tso on January 21, and hopes to arrive at Shigatse at the end of this month. The explorer says that the journey approaching completion is the most wonderful he has made in Asia in twenty-two years. Eight hundred and forty miles of unknown country, on a line running diagonally across Tibet, have been explored, and mapped in 184 sheets. Many new lakes, rivers, mountain ranges, and goldfields have been discovered, and the geographical results are said to be extraordinarily rich.

LIEUT. BOYD ALEXANDER, who, along with his brother Captain Claud Alexander, Captain G. B. Gosling, Mr. P. A. Talbot (surveyor), and a Portuguese collector, left this country in the spring of 1904 on an exploring expedition across Africa, has returned to London. Captain Claud Alexander died at Maifoni in November, 1904, and Captain Gosling in the Ubangi-Welle region in June, 1906. Much valuable work has been accomplished. A careful triangulation has been carried out from Ibi, in Nigeria, to Lake Chad, and the lake itself traversed in various directions. Part of the course of the Shari was explored; from thence the Ubangi was reached, and the expedition made its way northward to the little-known region where many of the Bahr-el-Ghazal tributaries rise, and down the Yei to the Nile. The expedition has been particularly successful in collecting specimens in natural history, including skulls, bones, and skins of the okapi.

DETAILED investigations of the Calabrian earthquake of September 8, 1905, are now appearing. We have received a memoir by Prof. Rizzo on the rate of propagation of this earthquake, and a note, published in the *Atti* of the Turin Academy of Sciences, in which he discusses the depth at which this earthquake originated, and adopts 50 kilometres as the most probable value. Another paper, by Dr. Mario Baratta, in the Journal of the Tuscan Academy of Natural Sciences, deals with the distribution of the damage, and shows that there were seven distinct centres of destructive violence, and that the earthquake was a true polycentral one. Indirectly, this paper shows that Prof. Rizzo's estimate of the depth of origin, founded on the assumption that the focus was simple and comparatively restricted in extent, must be in excess of the truth, so that 50 kilometres should be regarded as the maximum possible, not the actual, depth of origin.

PROF. P. CARMODY, who was an eye-witness of the earthquake at Kingston on January 18, has sent to the *Times* some details of the disturbance, from which we have obtained the following particulars of scientific interest:—The building material that has best withstood the shock is wood, and next to this cement. Brick has suffered most, and stone is almost as bad. An examination of the several streets in different parts of the town shows that generally the east and west walls of the buildings have collapsed, while those facing north and south have been but little injured. This indicates that the earth movement ran east and west. Another striking general feature is that the east and west walls have fallen away from the rest of the building, meeting together in narrow streets, of which there are many running north and south, and therefore making it impossible for anyone to escape uninjured from these narrow streets. The streets running east and west have not been completely blocked by fallen débris, partly because they are wider, but principally

because the walls running in this direction have suffered less. A peculiar alteration in the position of statues in the square is deserving of record, as it may subsequently throw some light on the direction of the earth movement. On the south side of the square is a statue of the Queen. The figure is turned slightly to the left on the pedestal. In a corresponding position on the north side of the square another statue is turned slightly to the right. The statue of Père Dupont, facing north-east, was thrown off the pedestal and lay broken on the ground; another statue, facing west, is snapped across the middle, and the bust has dropped on the lower part of the pedestal, but not overturned. These four statues are within a hundred yards or so of each other. In Kingston the earthquake was revealed to most persons by a strong swaying, side to side motion, which soon changed to a sharp up and down shake, and then terminated. The grating of the bricks and stones as they slid over each other was the first sound that distinguished it from the ordinary West Indian earthquake. Gusts of wind blew after sunset, and between 7 p.m. and 8 p.m. another shock was felt. During the night this was followed by six or seven others, and these were repeated during the subsequent day and night, but without causing further appreciable damage.

THE London County Council has decided to issue, under the superintendence of Dr. A. C. Haddon, a series of handbooks to the ethnological collection of the Horniman Museum, Forest Hill. The first of these, compiled by Dr. H. S. Harrison, has just made its appearance under the title of "From Stone to Steel," being a handbook of the cases illustrating the Stone, Bronze, and Iron ages. It is well illustrated, and describes clearly and concisely the various types of weapons and implements met with in the superficial deposits of Europe. The chief types of the human race met with in Europe are also noticed, while a general survey of the history of stone and metal implements in non-European countries is added.

HORSE-BREEDING in Wisconsin forms the subject of Bulletin No. 141 of the University of Wisconsin Agricultural Station, issued in November last, the report being drawn up by Mr. A. S. Alexander. New laws for the licensing of stallions for public service in Wisconsin came into force in January of last year, and the present report deals with the working of these laws, and at the same time suggests such further enactments as appear necessary to improve the breed of horses in the State. Special attention has been directed to the elimination of unsound horses, and with the present powers it has been found possible to enforce the retirement of a considerable number of stallions coming under this category. The ultimate aim of the authorities is, however, to get rid of all but pure-bred stallions for stud purposes; but, as elsewhere, farmers and breeders do not respond as heartily as might be desired to efforts which are essentially for their own benefit.

"THE Laws in Force against Injurious Insects and Foul Brood in the United States" is the title of the sixty-first bulletin issued by the Entomological Bureau of the U.S. Department of Agriculture, the text being drawn up by Dr. L. O. Howard, the entomologist and chief of the section, and Mr. A. F. Burgess, secretary of the American Association of Horticultural Inspectors. Bulletins covering much the same ground were issued respectively in 1895 and 1898, and the publication of the present issue has been rendered necessary by the enactment of new laws and the active interest in the subject recently manifested by several States in the Union. From the preface, it appears to have been found impossible to bring the work absolutely up to date, although practically all the more important laws are included. The issue also includes an account of the annual meetings of the American Association of Horticultural Inspectors from 1897 to 1905.

IN the course of an article on the biology of the sandy tracts of Illinois, by Messrs. C. A. Hart and H. A. Gleason, forming the seventh part of vol. vii. of the Bulletin of the Illinois State Laboratory of Natural History, the first-named author observes that sand-dwelling insects display a remarkable similarity in colour to their surroundings, this being essential owing to their exposed condition. The similarity is chiefly restricted to the dorsal surface, and is noticeable in insects of all orders. In the case of the Carolina grasshopper, individuals taken from the sandy tract appeared to be paler than those from the surrounding darker ground. The moulting of these insects takes place in daylight, when the colourless fresh exterior is exposed to the action of rays reflected from surrounding surfaces, and it has been suggested by Vosseler that these rays may by some kind of photographic action produce an approximation to the general colour of the environment. How the effect is produced remains to be explained, but the explanation seems a probable one.

ACCORDING to *Beilage zur allgemeinen Zeitung* for January 30, an expedition is in course of being organised, under the auspices of the Royal Academy of Sciences of Berlin and the Government of the Dutch East Indies, for the purpose of exploring Java in search of further remains of Pithecanthropus. The originator of the idea appears to be Frau Prof. Selenka, widow of the late Prof. Selenka, of Munich, who has already travelled extensively in Borneo for the purpose of collecting embryos of the orang-utan. Dr. Elbert is attached to the expedition as geologist, whilst Dr. Maskowski, of Berlin, goes out as zoologist. A Dutch engineer, Mr. Oppenoorth, will have charge of the surveying and excavating operations. The Pleistocene volcanic breccia from which the original remains of Pithecanthropus were obtained by Prof. Dubois at Trinil is believed to have a wide extent in the mountains of Java, reaching in some places to a height of 100 metres or more above sea-level, and it is proposed to examine this stratum thoroughly in a number of the more promising localities. We may cordially endorse the hope expressed by our German contemporary that the expedition will succeed in its object, and bring to Europe a collection which will throw some definite light on the ancestry of the human race.

THE *Times* of February 4 contained an article on the grouse-disease inquiry, summarising the results of the work of the departmental committee up to the present time. The committee, it will be remembered, was appointed by the Board of Agriculture, with the proviso that it was to find its own funds. It is for the most part composed of owners of grouse-moors, with Lord Lovat as chairman. From the point of view of progress in the inquiry, it is unfortunate that the work of investigation has coincided with a period of complete health among British grouse. The article criticises, not altogether favourably, a pamphlet issued by the committee under the title of "Notes on the Grouse," purporting to give a *résumé* of all that is known about the disease. Among its omissions is the absence of any reference to the theory that the midge may be the carrier of the infection. Whether

Klein's bacillus is really the cause of the disease must for the present be left open. Much time has been spent in searching for this organism, but hitherto without success. If the bacillus "should, after all, prove to have nothing to do with the disease, all this time will have been lost. It is not suggested that this will prove to be the case; but merely that it would have been better to start with an open mind on that point as well as upon others." It is pointed out that as no progress can be made while the disease is in abeyance, and that the original subscriptions to the committee were to last for three years only, further financial means will be required with the recrudescence of the malady in the future if any definite results are to be obtained.

THE Proceedings of the Cotteswold Naturalists' Field Club and the Transactions of the Hull Geological Society are excellent examples of the way in which the work of local societies may be produced. The former is printed by the historic house of John Bellows, in Gloucester. In the part for September, 1906, Mr. S. S. Buckman has a handsomely illustrated paper on Schlotheimia and species of other genera of Liassic ammonites. The reports of various excursions are accompanied by useful landscape-views. The Hull Geological Society, in its issue styled "vol. vi., part i., for the years 1901–5," published in 1906, gives us Mr. Danford's detailed investigation of the belemnites of the Speeton Clay, with four remarkably fine plates of photographs, taken, like Mr. Buckman's, from the actual specimens. One is tempted to ask, however, whether the money spent so liberally on such papers would not have been better devoted to their production in the *Geological Magazine*. The excellent records of local surface-changes in Yorkshire, by Messrs. Butterfield and McTurk, and Mr. Richardson's note on Ceratodus from Westbury-on-Severn, stand, of course, in another category. The judgment of scientific readers must often be suspended between regret at the scattering of valuable work and admiration at the zeal with which it is put forward in its place of origin. It must be admitted that local publications of so high a standard are in themselves a stimulus to research.

THE Journal of the Royal Sanitary Institute for February (xxviii., No. 1) contains an important paper by Prof. S. Delépine on testing the germicidal power of various substances by the thread method, in which it is concluded that nearly all the problems of disinfection can be studied by means of it. Dr. Newsholme contributes a paper on the voluntary notification of phthisis in Brighton, and Dr. Heron one on coordination of measures against tuberculosis.

THE report from the Select Committee on the Housing of the Working Classes Acts Amendment Bill, which was recently issued, contains some important recommendations, particularly as regards sanitary administration. It is found that at present sanitary control is imperfect, and that the administration of the Acts by the rural district councils is neglected. Among the recommendations are transference of the administration of the public health and housing laws to the county councils; the provision of medical officers of health, properly qualified and adequately remunerated, so that they can devote their whole time and energies to the duties of their office; the provision of an expert staff of inspectors under the medical officer, whose title shall be altered from that of "Inspector of Nuisances" to "Sanitary Inspector"; and the registration of every house and tenement in rural districts. It is considered that small local authorities cannot satisfactorily frame and administer building and public-health bye-laws, and it is suggested that the Local Government Board should establish a staff of officers for the special purpose of supervising the construction, sanitary condition, and repair of houses under the Public Health Acts, and the provision of houses under the Housing Acts.

No. 25 of the "Scientific Memoirs of the Government of India," by Captain S. R. Christophers, is devoted to a consideration of the importance of larval characters in the classification of mosquitoes. It is suggested therefrom that Stegomyia should be removed from the Culicina and placed in a group, Stegomyina, of its own, that Megarhinus and Toxorhynchites, together with Mucidus and Psorophora (removed from the Culicina), should form a separate group, &c. Memoir No. 26, also by Captain Christophers, deals with the *Leucocytozoon canis*, a protozoan parasite of the white blood corpuscles of the dog, first described by Bentley and later by James. According to Christophers, *L. canis* comes within the division Hæmogregarina of Laveran, and very possibly represents the mammalian form of Karyolysus (Labbe). Reproduction occurs by the formation of true cysts, containing about thirty sporozoits. Encystment takes place in cells of the bone marrow. After escaping from the cysts, the sporozoits invade mononuclear transitional cells in the marrow, where they are seen as naked, oval forms. These undergo changes and become encapsuled, whilst the host cell is altered in a characteristic way. The complete sexual development of this parasite takes place in the dog-tick (*R. sangineus*).

THE *Kew Bulletin* was initiated in 1887, and although for a period the annual volumes were in abeyance, the series is now complete for a period of twenty years. The director of the gardens has recently issued an index as appendix v. to last year's volume, detailing the contents from the commencement of the journal to the end of last year.

THE numbers of the *Agricultural News* (December 29, 1906, and January 12, 1907) lately received contain references to the agricultural conference at Jamaica that was so disastrously cut short. With regard to rubber in British Guiana, an expression of opinion by Dr. Bovallius is quoted wherein species of Sapium are recommended for cultivation on the lowlands in preference to Hevea and Castilloa, that require to be planted at a higher elevation.

SEVERAL references have appeared recently in the morning journals to an alleged cure for the opium habit emanating from the Straits Settlements. Mr. E. M. Holmes, writing to the *Times*, January 22, states that the plant has been identified as *Combretum Sundaicum*, a woody climber growing abundantly on the plains around Kuala Lumpur, in Selangor. Further information is supplied in the *Pharmaceutical Journal*, January 26, where Mr. Holmes says that it would be premature to express a definite opinion until a larger quantity of the material is available for chemical analysis and physiological investigation.

IT is probably unknown to many pteridologists that crested and other "sporting" ferns may not infrequently be collected in the British Isles. Mr. C. T. Druery, who has found several wild "sports," writing in the Journal of the Royal Horticultural Society (December, 1906), quotes as two instances the discovery of a markedly crested form of *Athyrium filix-foemina* at Kilrush, Ireland, and the

growth of a crested variety of bracken at Faygate, Sussex. Other papers in the same journal include an article on horticulture in relation to medicine, and notes on tufted pansies, hollies, and the ideal potato. In the first named Mr. E. M. Holmes furnishes a list of plants now cultivated as herbs, among which one unexpectedly finds the nettle and mallow; an account of medicinal plants suitable for cultivation in this country is also given.

ACCORDING to the report of the Department of Agriculture in the Madras Presidency for 1905–6, a large experimental area has been acquired at the village of Taliparamba, in the Malabar district, for growing pepper vines with the object of studying their morphology, varieties, and other problems connected with their cultivation. Under the control of Mr. C. A. Barber, the results are likely to add materially to our knowledge of this historically and economically interesting product, and will, it is hoped, resuscitate the industry in South India. Other important products receiving attention are sugar-canes, ground-nuts, cotton, and tobacco, but experiments are not sufficiently advanced to furnish conclusions. The manufacture of door-mats, napkins, and muslins from the fibre of *Agave vivipara* is an extension of the usual applications of this fibre.

THE Cycads are so few in number, and they occupy such an important position in plant taxonomy, that a paper embodying new researches cannot fail to be interesting. As the outcome of an expedition to Chavarillo, in the Mexican tropics, Prof. C. J. Chamberlain was able to secure material of the little-known ovule of the genus Dioon, and his results are published in the *Botanical Gazette* (November, 1906). The author obtained a series of stages from the appearance of the archegonium initial cell to the germination of the seed. The archegonia are formed in October to the number of four or five in each ovule; a neck cell is cut off, and subsequently a ventral canal nucleus separates mitotically from the egg nucleus. Haustoria are developed in connection with the transference of nourishment to the egg cell. The nucleus of the ovum is the largest known in plants, and contains twelve chromosomes. Incidentally, the author concurs with the opinion that plants of Dioon may continue to live for a thousand years.

A NEW journal bearing the title *Gazeto Matematika Internacia* is to be published in Esperanto. It will contain original articles on theoretical and applied mathematics, mechanics and theoretical physics, reprints of articles published in other languages, reviews, correspondence, biographies, and papers on the history and teaching of mathematics. It is not intended to compete with, but rather to supplement and strengthen, existing journals. The publisher is F. J. Vaes, Mathenesserlaan 290, Rotterdam.

MR. B. M. DUGGAR details some experiments to ascertain the value of the osmotic pressures in the cells of certain marine algæ in a paper published as vol. xvi., No. 8, of the Transactions of the Academy of Sciences in St. Louis. Common salt, nitre, and sugar were used to make plasmolysing solutions, both in distilled and sea-water. It was found that the amount of nitre in sea-water required to plasmolyse together with the equivalent value of the salts in the sea-water was less than the amount in the fresh-water plasmolysing solution, while the reverse held good for sugar. An attempt to examine the toxic effects of adding to sea-water additional amounts of the different constituent salts occurring in sea-water elicited the facts that magnesium salts, ordinarily toxic to phanerogams and fresh-water algæ, were almost inert, and ammonium compounds were the most active.

FROM Messrs. Burroughs, Wellcome and Co. we have received a copy of the 1907 edition of their "Photographic Exposure Record," which is familiar to most of our photographic readers. It is bound in art-green canvas, and is issued at a shilling. This neat pocket-book has been brought well up to date, and, as we have pointed out on previous occasions, should be the *vade mecum* of every photographer. Even in this small compass a great amount of useful information is compressed, in spite of increased space being provided this year for the record of negative exposures, there being room now for 336 entries. Each copy is accompanied by a folding card for hanging up, which gives useful information regarding the timing of development by the factorial method for various degrees of contrast, and particulars of equivalent plate-speed numbers according to the different systems in use. An entirely new series of examples illustrates the article on exposure.

MR. JOHN C. PACKARD, of the High School, Brookline, Mass., sends us a description of an apparatus he has devised to determine the resultant of two motions at right angles to one another, one uniform, the other uniformly accelerated. A steel ball, 1 inch in diameter, is placed at the top of an inclined plane of plate glass, and is made to acquire a uniform motion in a horizontal direction by being rolled down an auxiliary incline behind a ledge; the ball is then allowed to roll down the glass plane. A tracing of the curve generated by the ball is secured by fixing a sheet of squared paper to the plane and a piece of soft carbon paper over it. The ball in rolling over the carbon paper leaves its trace on the squared paper beneath. A study of the curve thus generated enables the pupil to arrive at the laws of uniformly accelerated motion.

A FOURTH edition of an "Introduction to Physical Chemistry," by Prof. James Walker, F.R.S., has been published by Messrs. Macmillan and Co., Ltd. The work has been enlarged by the inclusion of sections dealing with the behaviour of radio-active elements, atomic and molecular dimensions, and neutrality and salt-hydrolysis. Newer data afforded by recent researches have been substituted for the numerical values of previous editions.

WE regret that in a short notice of Prof. G. S. Boulger's work on "Familiar Trees," in NATURE of January 31, the reviewer was under a misapprehension when he remarked that certain trees had been omitted. The book reviewed is only the first volume of a new edition of Prof. Boulger's work, which is still being issued in fortnightly parts, and the missing species will be dealt with in another volume. The volume should, we consider, have been described as vol. i. on the title-page instead of using the words "First Series."

THE authorities of the British Museum (Natural History) have recently adapted the telephoto lens for securing accurate photographs of specimens. The installation consists of a 12×10 camera with an extension of 4 feet, fitted with an 18×16 rectilinear lens and telephoto attachment, the whole apparatus being made by Messrs. J. H. Dallmeyer, Ltd. It has proved very successful, the improvement in perspective and depth of definition in the photographs being very noticeable when compared with those taken on the same scale with an ordinary lens.

OUR ASTRONOMICAL COLUMN.

THE RECENT SOLAR ECLIPSE IN INDIA.—From a brief paragraph which appears in the *Pioneer Mail* for January 25 we learn that some interesting photographs of the partial eclipse of the sun were obtained at Dehra Dun (N.W. Prov. India) on January 14. A drop in the temperature of 4° corresponded with the passage of the shadow, and there was a very marked decrease in the illumination of the surrounding landscape. Venus became clearly visible to the naked eye.

THE LATE DR. ROBERTS'S CELESTIAL PHOTOGRAPHS.—A preliminary catalogue of Dr. Roberts's collection of photographs of various celestial objects and regions, comprising some 2485 original negatives, is published by Madame Dorothea Isaac-Roberts in No. 4154 of the *Astronomische Nachrichten* (February 9). An introductory statement which accompanies it gives a brief account of the various classes of negatives, the period during which they were obtained, and the instruments employed by the observer. A complete list of Dr. Roberts's tribute to astronomy is to be published as soon as circumstances permit, and, as the number of copies of the paper will be limited, those interested in photographic astronomy, and desirous of receiving a copy, are requested to send in their names at once to Madame Dorothea Isaac-Roberts, Château Rosa Bonheur, By-Thomery, S.-et-M., France. Positives on glass reproduced from the Isaac-Roberts negatives will be lent for the purpose of micrometric measurements if application be made, and provided that the documents be returned after the completion of the measurements.

A LOST COMET (1905*f*).—Whilst examining three photographs taken at Mount Wilson on July 22, 1905, Prof. Barnard found the trail of a comet which appears to have evaded all other observations, and, as the object might prove to be a periodic comet, he now publishes some measures of position which he has made in order to determine, if possible, an approximate orbit, in No. 4153 of the *Astronomische Nachrichten* (February 6).

The positions (1905·0) of the comet at the beginning and end of the trail were :—

$$R.A. = 18h.\ 23m.\ 16{\cdot}4s.,\quad \delta = -20^\circ\ 30'{\cdot}0,$$

at 16h. 20m. G.M.T., and

$$R.A. = 18h.\ 23m.\ 41{\cdot}2s.,\quad \delta = -20^\circ\ 31'{\cdot}9,$$

at 18h. 55m. G.M.T., respectively; the position angle and length of the trail were found to be 288° 24′ and 368″, thus giving a daily motion amounting to 3m. 49·5s., −17′ 55″. On examining the Harvard plates for this date, Miss Leavitt was unable to find any trace of the object, which must have been much smaller than Giacobini's 1905 III. comet, and at least six or eight times less bright.

THE SPECTRUM OF MIRA.—Four photographs of the spectrum of Mira were obtained at the Lowell Observatory during the recent maximum of the star's brightness, and a brief discussion of them is published by Mr. V. M. Slipher in No. 1, vol. xxv. (February), of the *Astrophysical Journal*. The first spectrogram, obtained on December 13, 1906, included the region λ 4300 to λ 5000, and shows both Hβ and Hγ as strong, bright lines. The second photograph was taken on December 18, and shows the four hydrogen lines Hα, Hβ, Hγ and Hδ as bright lines increasing in intensity in the order given, Hα being notably weaker than the others. Numerous absorption bands, sharp and intense on their more refrangible edges, and gradually fading out towards the red, are shown, in addition to the hydrogen lines, on the plate taken on December 21. On the last plate taken, December 24, all the hydrogen lines were bright, Hα being bordered on the violet side by a strong and rather broad absorption line. Of the metallic absorption lines, those due to vanadium are recorded as being especially strong.

SUN AND PLANET CHART.—We have received, from the firm of Carl Zeiss, 29 Margaret Street, W., a copy of a very useful chart which enables a ready determination to be made of the position of the sun, or of any of the planets, in regard to the fixed stars during 1907. It consists of a chart of the equatorial constellations, together with right ascension and declination curves, on the same scale as the chart, of the objects to be found. By simply drawing ordinates for the required date, as found on the chart, and projecting the points where they intersect the R.A. and declination curves on to the star chart, the relative position of the sun or planet may be determined in less than one minute.

THIRTY-SIX NEW VARIABLE STARS.—By superposing positive and negative copies of six photographs taken with a 1-inch Cooke lens, Miss Leavitt discovered thirty-six new variable stars in a region 30° square, having its centre at R.A. = 12h., dec. = −60°. These variables are mostly situated in the constellations Carina and Centaurus, and six of them are probably of the Algol type. Nova Velorum was discovered, and sixteen known variables were rediscovered on the same plates (Harvard College Observatory Circular, No. 122).

SEISMOLOGICAL NOTES.

Valparaiso Seismograms.

ON August 17, 1906, Valparaiso was visited by an earthquake of unusual severity. Seismograms of this disturbance were obtained at all observatories throughout the world which were properly equipped with apparatus to record teleseismic motion. The seismograms obtained in this country, as was pointed out to me by Mr. R. D. Oldham, and noted by other observers, exhibit a dual character. This duality is clearly seen in the annexed seismogram from Kew, reproduced by the kind permission of Dr. R. T. Glazebrook. After preliminary tremors, there is a "shock" or maximum, marked A, at 1.5 G.M.T., and a second "shock" or maximum, marked B, forty-five minutes later, or at 1.50. If the latter shock originated in or near to Valparaiso, and took 1h. 5m. to travel from that part of the world to Britain, it originated there at 7.59 in Valparaiso time. The most accurate time received from Santiago is 7.58.40, or practically 7.59. We may therefore conclude that B represents the disturbance which led to devastation in Valparaiso and places in that vicinity. The question now arises as to what is shock A at 1.5 G.M.T. From the duration of its preliminary tremors, it evidently came from some place about 105° distant, which happens to be the situation of Valparaiso, and the time of its origin, wherever that may have been—Central Asia or South America—was in G.M.T. oh. om. (7.14 Valparaiso time), but up to date I am not aware that the inhabitants in Valparaiso know anything about a shock at 7.14. Shock A and shock B may have a direct relationship, or they may be independent disturbances which occurred about the same time. Together they make a jumble which might be compared with the meeting of waves at the mouths of two opposing estuaries. The International Seismological Association, which met last year in Rome, issued from its headquarters in Strassburg a circular to seismological stations generally asking for seismograms of "the Valparaiso earthquake." These and a variety of detail about instruments and the stations where seismograms were obtained are to be placed before the delegates of that association when they meet at the Hague for their study.

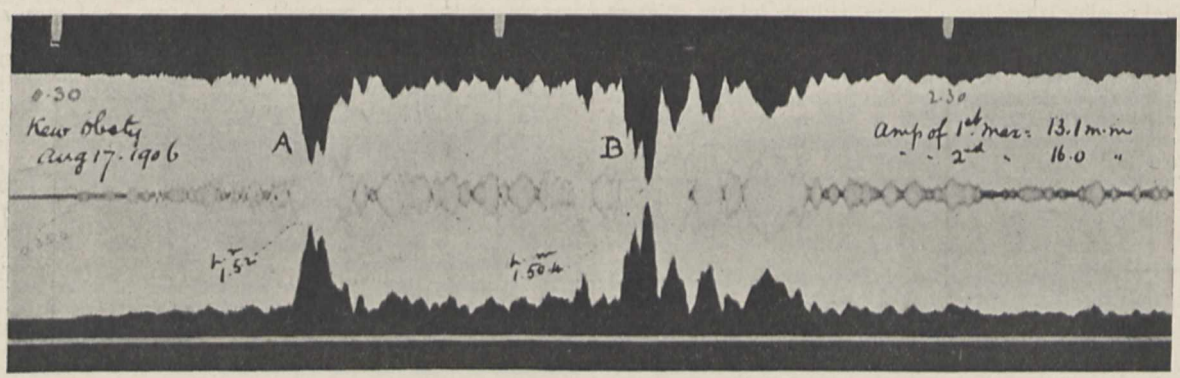
A New Seismometer.

The International Seismological Association offers prizes of 50*l*., 35*l*., 25*l*., and 15*l*. for the construction of a seismometer. It is to record earthquakes which have their origin near to the place of observation, which we assume means earthquakes that can be felt. It must register both horizontal and vertical movements. No doubt the authors of this condition are well aware that vertical displacements are accompanied by angular displacements. Any recording seismometer under the influence of vertical movement at its best becomes an indifferent variety of clinometer. Usually its records have no more value than those from a seismoscope. One remarkable condition is that the new instrument must have a magnification of not less than forty to fifty times. Seismographs used in Japan, and by all who have had experience in recording earthquakes of local origin, find a magnification of from six to ten quite sufficient. If a shock has a range of a quarter of an inch, which in soft ground may well be the case, this

would appear on the record-receiving surface of the new seismograph more than a foot or 30 cm. in length. It is, of course, possible to construct a large record receiver, but is it necessary? About a record of time, which is probably the most important element required by the working seismologist, nothing whatever is said.

Seismographic and other Record-receiving Surfaces.

The record receivers to which I refer are the types used in connection with horizontal pendulums adopted by the British Association, and now in use at many stations widely distributed round the world. Nearly all of these record on a surface of photographic paper moving at the rate of 60 mm. per hour. There are, however, one or two instruments where the paper moves at a rate of about 250 mm. per hour. With very large earthquakes, the times of commencement or the commencement of the preliminary tremors, as recorded on either the slow or comparatively rapidly moving paper, are identical, the seismographs being similar and placed side by side. With earthquakes of moderate intensity this is not always the case. On the slowly moving paper the commencement of the preliminary tremors may be lost. The explanation apparently rests in the fact that slowly moving paper passing beneath two illuminated cross slits or an illuminated "pin-hole" has a longer exposure than that which is moving quickly. The longer the exposure the broader the line. In one case the film takes about twelve seconds to pass beneath the "pin-hole," and in the other between two and three seconds.



Seismogram of the Valparaiso Earthquake, August 17, 1906.

In either case, when the boom of the pendulum, which at its outer extremity carries the equivalent of a "pin-hole," is steady, we get a straight line on the film moving beneath the same. Very slight movements of the boom, however, are to be seen on the film which has passed quickly beneath its spot of light which cannot be seen on the film which has moved slowly. On the latter minute ripples have been eclipsed in the broadened line. The meaning of this, not only to practical seismologists, but to all who have to deal with photographic recording apparatus, is that the best result which can be obtained from a given instrument largely depends upon the speed of the photographic record-receiving surface.

JOHN MILNE.

SCIENCE IN INDIA.[1]

THE "narratives" from which extracts have been taken for publication in the report before us are those of officers of the Indian Survey Department who are employed on work of scientific investigation. There is little of topographical, and nothing of geographical, interest in them if we except certain results derived from Captain Wood's mission to Nepal. They afford, however, most convincing proof of the strenuous nature of the work of the scientific branch of the department, and should serve amply to justify the maintenance of a well-matured system of scientific investigation in the eyes of those critics who are disposed to assert that India cannot afford to be scientific.

No less than 128 pages out of the 187 which comprise the report are devoted to the reproduction of tables giving the results of magnetic observations, which are further illustrated by a map showing the stations of observation of the magnetic survey. Since the year 1901, these have been carried practically over the whole peninsular area with the exception of the Central Provinces. A description of some of the stations and of the instruments used completes the narrative, but no general deductions are made, nor is any indication afforded as to the practical result of these undoubtedly valuable observations.

Major Conyngham's report on the pendulum observations for determining the force of gravity is directly interesting. The latest instrumental equipment for this class of observation includes "half-second" pendulums, which are only one-quarter the length of those previously used in the department. A new method (an Austrian invention) has also been introduced for registration of the coincidence of beat between the free pendulum and the clock pendulum, the pendulums being no longer swung *in vacuo*. A considerable increase in accuracy of observation has thus been assured, further refinements being introduced in the corrections applied for the minute vibrations (or "wagging") of the stand on which the instrument is fixed, due to the swing of the pendulum. Some of the results are curious. For instance, it was found at Calcutta that the perpetual tremor, or vibration, set up by traffic, due to the nature of those alluvial deposits on which the city may be said to be floating, absolutely negatived the value of the observations, whilst, on the other hand, observations taken at Colaba, in Bombay, were not affected appreciably by the firing of the big guns of the fort in their vicinity.

The value of "g" (force of gravity) being used to determine the figure of the spheroid and the density of the earth's crust, it was found at Colaba that the excess of attraction indicated by the observations equalled that which would be accounted for by a disc of earth matter below the instrument 2530 feet thick with an excess of density equal to 2·8 above the average of surface density. At Dehra Dun, on the other hand, the defect in "g" indicated a deficiency in density of 2·8 extending to 2930 feet in depth. Assuming that the surface density is 2·8, this means that we must imagine a cavity 2930 feet deep under Dehra Dun; in other words, "the matter underlying Dehra Dun is so deficient in density—we do not know to what depth this deficiency may extend—that it would have to be pressed downwards until the surface of the land was 2930 feet below its present position before it would attain the average density of the crust of the earth. Likewise at Colaba an expansion of the underlying strata until a hill 2500 feet high had been formed would be requisite to reduce the excessively dense rock that is found here to the average density of 2·8."

Certain levelling operations referred to in another part of the report have been undertaken in the interests of these

[1] "Extracts from Narrative Reports of Officers of the Survey of India for the Season 1903-04." Pp. 187. (Calcutta.)

pendulum observations to determine the difference of level between Dehra Dun and Mussoorie.

Valuable results still continue to be obtained from the tidal observations, which extend over forty-two ports from Aden to Port Blair. Tide tables for forty ports are now published in England based on the observations of the Indian Survey. Several instructive tables will be found in the report, especially those showing the errors in the predicted times and heights of high and low water at the various stations. These tables apparently indicate a superiority in the automatic system of recording.

Amongst the most interesting records of the season are the results obtained by a careful re-computation of Captain Wood's observations for determining the position of Everest and other high peaks in Nepal. The more rigorous methods employed give a very slight difference (never amounting to half a second of arc) between the new and old determinations of the coordinate values of the stations of observation, which differences are reflected in a greater degree in the values of the peaks observed, but the corrections in altitude of the peaks observed, due to the employment of a revised coefficient for refraction, are more marked. The height of Mount Everest, for instance, is reduced by about 300 feet (28,700 feet instead of 29,000 feet), and a general reduction in altitude of most of the peaks is apparent. This, however, must not be accepted as a final determination. There are other factors in the computation of altitudes observed under extraordinary conditions still to be determined with more rigorous exactness, and it is quite possible that the ultimate altitude of the highest mountain in the world may be fixed at a higher figure than 29,000 feet rather than a lower one.

A short statement of the progress of topographical surveys in Sind (with no narrative of any interest) and of riverain surveys in the Punjab, with a few notes on town and municipal surveys generally, completes the report.

THE NEEDS OF THE UNIVERSITY OF CAMBRIDGE.

TEN years ago the Duke of Devonshire, as Chancellor of the University of Cambridge, directed attention to the resources and the needs of the University, and at the beginning of 1899 the Cambridge University Association was formed. The progress towards the re-endowment of the University, which it is the object of the association to promote, is described by the Chancellor in a letter of which a copy has been sent to us, and is here summarised.

The sums which the Cambridge University Association has been able to transfer to the University amount in all to about 115,000*l*. Of this total a considerable portion was allotted by the donors to the building of the new medical school, the school of engineering, the proposed new buildings of the Cavendish Laboratory, the school of agriculture, the museum of archæology and ethnology, and to the University library, but a large proportion has been available for general purposes.

Although the progress already made in the equipment of the several departments must be regarded with satisfaction, few of the other wants keenly felt in 1899 have yet been met, and in certain cases new wants have inevitably arisen during the last seven years. In the scientific departments every year must of necessity bring new demands for specialisation in teaching and for the provision of facilities for research. In some departments, notably those of agriculture, engineering, and chemistry, the number of students has greatly increased, and additional accommodation is required.

The greater of the immediate needs of the University may thus be stated. The sum of 18,000*l*. promised for the University library represents only the first instalment of a capital sum of 148,000*l*. required. Chemistry requires 10,000*l*. capital and 2000*l*. income; physics, 12,000*l*. capital and at least 1000*l*. income; engineering, 10,000*l*. capital, and income and equipment for research; botany, 1000*l*. capital and 250*l*. income; physiology, 10,000*l*. capital and 1800*l*. income; agriculture, 20,000*l*. capital (of which 12,000*l*. has been promised) and 600*l*. income; the medical school will cost at least 20,000*l*. to complete, and in addition a considerable sum is needed for the provision of instruments, &c., and a large income for additions to the teaching staff. Geology asks for 2800*l*. capital and 1300*l*. income. A new, or at least a greatly enlarged, museum of zoology will shortly become necessary, and an income of 1500*l*. is also required for this subject. Entomology, a subject of great importance in its relations to forestry and tropical medicine, is in need of 10,000*l*. capital. Oriental studies require 2000*l*. income. A new museum of archæology and ethnology, urgently needed for the preservation, and for the display for the use of researchers, of the valuable collections possessed by the University, will cost 25,000*l*., and a considerable income will be required for staff and maintenance. History is in need of 800*l*. income, and a sum for the provision of lecture rooms. Economics require 2000*l*. income, the moral sciences (including experimental psychology) 1400*l*. capital and 1250*l*. income. Classics require about 900*l*. income, and mathematics capital for new lecture-rooms and 3500*l*. income. Law asks for 600*l*. income. Modern languages urgently require a sum sufficient to create professorships in at least English, French, and German (at present represented by two readers and a lecturer), and to ensure the proper representation of other modern languages. There are other needs, some of them not intrinsically less important than those mentioned, but demanding more modest sums for their satisfaction.

The disabilities arising from the low scale of existing salaries are common to almost every department. The average stipend of a professor is but 550*l*., and that of a university teacher, other than a professor, 250*l*. per annum, and these figures include the emoluments received from fellowships and from fees. The disability is increased by the fact that the University *can set aside only* 200*l*. *per annum to form a pension fund for its forty-four professors*, and nothing at all for other teachers. There is, in addition, need for the creation of many new posts.

If the University is to retain the services of its most distinguished men it is imperative that the income assured to them, both during and after the period of active work, should bear comparison with what they may obtain in similar positions elsewhere.

It is stated that in all a capital sum of nearly one million and a half, apart from any question of a pension fund for professors, might without extravagance be immediately expended on the equipment of, and on the provision of staff for, the University.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The professorship of agriculture in the University was established in the year 1899, in consequence of a generous offer by the Drapers' Company to contribute 800*l*. a year for ten years to the agricultural education fund, for the stipend of the professor. The Drapers' Company has now signified its intention to continue its contribution of 800*l*. a year for a further period of ten years, dating from the year 1909, on the understanding that the Department of Agriculture, and the stipend of the professor, shall be maintained as at present. The company has further expressed approval of a suggestion, made by the board of agricultural studies, that the source of the endowment should be indicated, as in the case of some other foundations, by attaching to the chair the title of the "Drapers' Professorship of Agriculture."

The following have been appointed members of the board of electors to certain professorships:—Dr. Keynes and Mr. W. E. Johnson, of King's College, to that of the Knightsbridge professorship of moral philosophy; Mr. F. H. Neville, of Sidney Sussex College, to that of the professorship of chemistry and to that of the Jacksonian professorship of natural philosophy; Prof. Forsyth, to that of the Plumian professorship of astronomy; Prof. Howard Marsh, to that of the professorship of anatomy; Prof. S. H. Vines, to that of the professorship of botany; Dr. Bonney, to that of the Woodwardian professorship of geology and to that of the professorship of mineralogy; Sir Thomas Barlow, Bart., to that of the Downing pro-

fessorship of medicine; Dr. Gaskell, to that of the professorship of zoology and comparative anatomy; Dr. Keynes, to that of the professorship of political economy; Dr. W. N. Shaw, to that of the Cavendish professorship of physics; Prof. J. J. Thomson, to that of the professorship of mechanism and applied mechanics; Prof. C. S. Sherrington, to that of the professorship of physiology; Prof. Nuttall, to that of the professorship of pathology; the Hon. B. A. W. Russell, to that of the professorship of mental philosophy and logic; and Mr. A. E. Shipley, of Christ's College, to that of the professorship of agriculture.

The teachers' training syndicate has appointed Dr. Rouse, of Christ's College, O. Browning, of King's College, and J. Wallis, of Christ's College, as delegates to attend the International Congress on School Hygiene to be held in London next May.

PROF. H. MCLEOD, F.R.S., is to receive the honorary degree of LL.D. from the University of St. Andrews at the graduation ceremonial on April 2.

PROF. THOMAS LOVEDAY, professor of philosophy at the South African College, Cape Town, has been appointed librarian to the University of Sheffield.

ARRANGEMENTS have been made for establishing a distinct department of the Board of Education to deal with all grades of education in Wales and Monmouthshire. Mr. A. T. Davies has been appointed permanent secretary of this Welsh Education Department, and Mr. O. M. Edwards chief inspector for Welsh education, and both will be directly responsible to the president.

A REUTER message from Pittsburg announces that the Western University of Pennsylvania will confer the honorary degree of LL.D. upon the following gentlemen, among others, who will be present at the Founders' Day celebrations of the Carnegie Institute on April 13 next:—Sir Robert Ball, Sir William Turner, K.C.B., Sir William Preece, K.C.B., Signor Marconi, Mr. Chalmers Mitchell, Dr. John Rhys, and the Rev. E. S. Roberts, master of Caius College, Cambridge.

A RECENT issue of *Science* contains further striking instances of the importance attached to higher education by wealthy American citizens. Rensselaer Polytechnic Institute has received a gift of 200,000*l.* from Mrs. Russell Sage. The money will be used for the school of mechanical and electrical engineering. Mrs. Sage has also given 200,000*l.* to the Emma Willard School of Troy. The establishment and permanent endowment of Peabody College for Teachers, at Nashville, Tennessee, has also been assured. The Tennessee legislature has just passed a Bill providing the college with 50,000*l.* The city of Nashville has given 40,000*l.*, and the county of Davidson 20,000*l.* These gifts have been made in response to a proposition from the Peabody Education Board to endow the college with 200,000*l.* All the conditions imposed by the Peabody Board have now been complied with, and it only remains for that board to organise the institution. The college will have 310,000*l.* in money. In addition to this, the University of Nashville has given the grounds and buildings now occupied by the college, valued at 50,000*l.* It is understood also that gifts will be received at once from other sources amounting to about 200,000*l.* We also notice that by the will of Arthur Mills, of Brookline, Harvard University will ultimately receive 30,000*l.*

IT is satisfactory to learn from the annual report that the Geographical Association, which is doing very useful work in promoting the study of geography in schools by scientific methods, is making substantial progress. In many schools geography is still regarded as a collection of names and phrases which convey no real meaning to the pupils, but, thanks largely to the efforts of the association, both teachers and examiners are beginning to realise that geography must be approached in the spirit of practical inquiry if it is to be of any value as a school subject. Ordnance Survey maps can now be obtained by schools at greatly reduced prices upon application to the Director-General of the Ordnance Survey, Southampton, and suitable maps to supplement these will no doubt be suggested by the committee appointed by the association to consider the substance and scope of atlases for elementary schools. A special committee on lantern-slides has also been appointed. This committee hopes to prepare series of slides illustrative of certain aspects of geography, as well as of various countries. It is specially anxious to obtain sets of views of different districts in the United Kingdom illustrative of their scenery and social conditions, as well as from British and other lands beyond the seas. Such illustrations, combined with exercises on the construction and use of maps, practical measurements with tape and plane-table, meteorological observations recorded day by day, and the spirit of "Seek and ye shall find" permeating the whole of the work, will transform geography from a dismal study into a living science by which both the imaginative and the critical faculties may be cultivated. We have no sympathy with the old order of things, but the change which the Geographical Association is bringing about gives decided satisfaction.

THE provisional programme of the Federal Conference on Education, organised by the League of the Empire, and to be held in London from May 24 to June 1, includes the following educational subjects:—Teachers: (1) comparison of (*a*) the provisions for the supply and the training of elementary teachers, and of (*b*) the conditions of their work in the United Kingdom and other countries of the Empire and Crown colonies; (2) similar comparison in the case of secondary teachers; (3) practicability of temporary interchange of teachers and of inspectors between the United Kingdom and other countries of the Empire and Crown colonies. The relations between secondary and primary schools in the various countries of the Empire. Means of establishing a system of mutual recognition of equivalent standards of attainment in the several countries of the Empire in connection with primary, secondary, and university education. Cooperation in educational publications: (1) scheme of the League of the Empire for Imperial text-books in history; (2) means for ensuring correctness in text-books dealing with geography, or in which local knowledge is required. Cooperation in school work: (1) the formation of a central exhibition of industrial or other school work; (2) the organisation of the exchange of school work and specimens between departments, museums, and between individual schools on a permanent basis. School subjects: (1) the English language: (*a*) reading (literature), (*b*) composition, (*c*) pronunciation; (2) geography in its relations to: (*a*) history, (*b*) discovery and commerce; (*c*) the growth of the Empire, illustrated by lantern slides and other means; (3) encouragement of nature-study. Education of non-British races: comparison of ideals, methods, and standards in various parts of the Empire. Other subjects which may be discussed if time allows: (*a*) cadet corps and military training; (*b*) educational facilities in sparsely populated districts; (*c*) educational treatment of poor law and reformatory children; (*d*) civic and moral education; (*e*) metric system of weights and measures; (*f*) school gardens.

SOCIETIES AND ACADEMIES.

LONDON.

Mineralogical Society, January 29.—Prof. H. A. Miers, F.R.S., president, in the chair.—Experiments bearing on the order of crystallisation of rock-constituents: Prof. H. A. **Miers.** The general results of experiments made by Miss F. Isaac and Prof. Miers with mixtures of salol and betol in all proportions were described; the experiments have established the supersolubility curves even beyond the points where they cross below the eutectic temperature. Owing to the fact that the main separation of crystals in the cooling mixtures takes place only when the liquids have been supercooled to temperatures given by the supersolubility curves, it has been found (1) that in general the mixtures do not solidify as a eutectic mixture; (2) that, according to the conditions of supercooling, either substance could be made to crystallise before the other in mixtures approaching the eutectic in composition. It was suggested that these results are applicable to the solidification of many rocks and alloys.—Serpentine rock

from the Tarnthaler Köpfe, Tyrol: Dr. A. P. **Young.** The minerals found in the serpentine are diopside, tremolite, clinochlore, picotite, magnetite, iron pyrites, and a fibrous mineral referred to antigorite. The latter mineral is regarded as holding a place between the micas and chlorites. On the surface of the serpentine are projecting bastite pseudomorphs coated with films of silvery lustre. The serpentine is a non-foliated intrusive core which on the borders is highly foliated and passes into talc-bearing phyllites.—A simple tabular arrangement of the thirty-two crystallographic classes: Dr. J. W. **Evans.** The table is based on the character of the symmetry of the principal zone axis or zone axes. Each column contains classes with the same rotational symmetry round the axis, and each row those which agree in the other symmetrical characters of the axis.—A new model of crystal refractometer: Dr. G. F. Herbert **Smith.** This instrument is identical in principle with that previously described, and is intended for use with large mineral specimens and mounted gem-stones. No part extends above the level of the plate holding the dense glass hemisphere. Further, the optical combination has double the focal length of the earlier form, and provides, consequently, greater refinement.—Isomorphism as illustrated by certain varieties of magnetite: Prof. B. J. **Harrington.** Analyses are given of specimens of magnetite from St. Joseph du Lac, Canada, and from Magnet Cove, Arkansas, both showing the unusual combination of octahedron and trapezohedron {311}. The Canadian specimen contained about 5 per cent. of TiO_2, 8 per cent. of MnO, and 3 per cent. of MgO, and the specimen from Arkansas about 10 per cent. of Al_2O_3, 2 per cent. of TiO_2, 2 per cent. of MnO, and 9 per cent. of MgO.—Mr. **Fleischmann** exhibited a collection of zeolites from Japan, Dr. **Evans** an objective giving a flat field with convergent light, and Prof. **Miers** a goniometer to be used for the measurement of the refractive indices of cooling solutions, for which purpose it is provided with means for maintaining a constant temperature for any desired period.

Zoological Society. February 5.—H.G. the Duke of Bedford, K.G., president, in the chair.—Mammals collected in Mindanao, Philippines, by Mr. M. P. Anderson for the Duke of Bedford's exploration of eastern Asia: O. **Thomas.** Seven species were mentioned, one of which was new, and is designated *Crunomys melanius*, sp.n.—The origin of the lateral horns of the giraffe in fœtal life on the area of the parietal bones: Prof. E. Ray **Lankester.** The author described and showed the exact relation of the lateral horns in the fœtus taken from the giraffe which died last spring in the society's gardens. It was demonstrated that the lateral horn of the giraffe was exclusively in origin a part of the fibrous osteogenetic tissue of the parietal bone of which it was a part, and had no connection whatever with the frontal. Thus the statement made by Sir Richard Owen in his account of a new-born giraffe, in a paper read before the society in 1839, was finally shown to be based on an unfortunate accident. Owen had cut out the horn-bearing area of the skull, and after an interval of time had reversed the relations of the excised piece of bone, taking frontal for parietal and parietal for frontal. The author expressed the opinion that the *parietal* lateral horn of the giraffe could not be considered to be the same morphological unit as the frontal lateral horn of the okapi.—Parallel hair-fringes and colour-striping on the face of fœtal and adult giraffes: Prof. E. Ray **Lankester.** The author described a remarkable colour-banding or striping of the hairy covering of the face in the fœtal giraffe, and showed that similar dark and light striping occurred in a very marked form in adult giraffes, though not in all individuals.—The existence of rudimentary antlers in the okapi; Prof. E. Ray **Lankester.** A description was given of the polished tip or apex of the okapi's horn which breaks through the integument. The author showed that transverse fissures or incisions were produced one behind the other in the naked apex, tending to cut off in succession a series of small bony caps, which he regarded as rudimentary antlers. He expressly refrained from concluding that this formation of minute antler-caps was to be regarded as genetically connected with the antler-formation of the Cervidæ, though such a connection was possible.—A new Amazonian tree-frog, *Hyla resinifictrix*, closely related to *H. venulosa*, but distinguished by fully half-webbed fingers: G. A. Boulenger, on behalf of Dr. E. A. **Goeldi.** This frog was remarkable for its habit of making good-sized basins of resinous substances in hollow branches of high trees, in which water collects, which served as a nursery for the eggs and larvæ. The frog collected the resin from the bark of certain trees, such as the aromatic "brewbranco" (*Protium heptaphyllum*).—The collection of Cumacea in the Copenhagen Museum: Dr. W. T. **Calman.** Altogether thirty species were dealt with, of which twenty-five were described as new. The majority of the specimens were derived from collections made in New Zealand and the Gulf of Siam by Mr. H. Suter and Dr. Th. Mortensen respectively.

Chemical Society, February 7.—Prof. R. Meldola, F.R.S., president, in the chair.—The rapid electro-analytical deposition and separation of metals, part i., the metals of the silver and copper groups and zinc: H. J. S. **Sand.** The metals studied are silver, mercury, copper, bismuth, lead, cadmium, and zinc. With the exception of the separation silver-mercury, each metal has been successfully separated from all the others by the method of graded potential. In order to separate silver from mercury, the metals were deposited together, converted into their cyanides, and these separated in the usual way by means of their different behaviour to acids. The time required for the depositions in these experiments varied between five and fifteen minutes.—The alkaloids of ergot: G. **Barger** and F. H. **Carr.** It is shown that ergotoxine, $C_{35}H_{41}O_6N_5$, is the active principle of ergot, and Kraft's assertion that the crystalline alkaloid, ergotinine, is a dehydrated ergotoxine is confirmed. Ergotinine is physiologically inactive when pure.—Influence of substitution on the formation of diazoamines and amino-azo-compounds, part vi., the partially methylated 4 : 6-diamino-*m*-xylenes: G. T. **Morgan** and Miss F. M. G. **Micklethwait.** The authors have methylated progressively 4 : 6-diamino-*m*-xylene, and have studied the action of diazonium salts on the products.—The constitution of umbellulone, part ii., the reduction of umbellulonic acid: F. **Tutin.** By further study of the oxidation products of this ketone further confirmation of the constitutional formula originally assigned to it has been obtained.—The reduction of hydroxylaminodihydroumbelluloneoxime: F. **Tutin.** Derivatives of aminotetrahydroumbellulylamine, obtained by the reduction of this oxime, are described.—Studies on optically active carbimides, part v., the aryl esters and the amides of *l*-menthylcarbamic acid: R. H. **Pickard** and W. O. **Littlebury.** Eleven aryl esters and eighteen amides of *l*-menthylcarbamic acid were described, and rotations of these when dissolved in chloroform and pyridine compared. Attention was directed to the approximately constant molecular rotation given by certain derivatives of menthylamine and menthol.—Some constituents of natural indigo, part i.: A. G. **Perkin** and W. P. **Bloxam.** Three brown amorphous substances, $C_{16}H_{12}O_3N_2$, $C_{24}H_{22}O_5N_2$, and $C_{16}H_{14}O_4N_2$ are described, which on treatment with potassium hydroxide yield anthranilic acid. It is considered possible that these brown compounds are derivatives or condensation products of indoxyl, which are formed from indican during the process of manufacture.—The occurrence of isatin in some samples of Java indigo: A. G. **Perkin.** The quantity of isatin present was exceedingly small, and in many samples it appeared to be absent; but its occurrence occasionally is interesting, as it indicates that the formation of indirubin during the manufacture of natural indigo follows the well-known synthesis of von Baeyer.—The absorption spectra of benzoic acid, the benzoates, and benzamide: W. N. **Hartley** and E. P. **Hedley.** The absorption curves of benzoic acid, potassium and silver benzoates, and benzamide have been drawn from the photographs of the spectra of these substances. The absorption bands of the different substances are all obviously related to the bands in benzoic acid, and the absorption is due to the benzene ring (compare Baly and Collie, Trans. Chem. Soc., 1905, lxxxvii., 1332).—The absorption spectra of phthalic, *iso*phthalic, and terephthalic acids, phthalic anhydride, and phthalimide:

W. N. **Hartley** and E. P. **Hedley.** *o*-Phthalic acid gives an absorption curve of the character that might be expected from a comparison with that of benzoic acid. *iso*Phthalic acid has a shallow band in the same position as that of phthalic acid, but less persistent. Terephthalic acid has no band, but merely an extension at or near where a band might be expected.—$\alpha\alpha\gamma$-Trimethyl- and $\alpha\alpha\gamma\gamma$-tetramethyl-tricarballylic acids and $\alpha\delta$-dimethylbutane-$\alpha\beta\delta$-tricarboxylic acid: H. **Henstock** and C. H. G. **Sprankling.**—A reaction of certain colouring matters of the oxazine series: J. F. **Thorpe.**—The alkylation of *d*-fructose: T. **Purdie** and D. McLaren **Paul.** The series of derivatives of fructose obtained by methylating this ketose is described.—A simple apparatus, with stirrer, for treating a liquid at its boiling point with two or more gases: N. L. **Gebhard.**—Note on the arsenates of lead and calcium: S. **Pickering.**—Camphor-β-sulphinic acid and camphorylsulphonium bases: S. **Smiles** and T. P. **Hilditch.** The sulphinic acid and the sulphonium bases prepared exhibit a strong lævorotatory power in distinction from the dextrorotatory sulphonic acid from which they were obtained. The authors conclude that this change is caused by the conversion of the sulphur from the sexavalent to the quadrivalent state.—The condensation of salicylamide with aryl aldehydes: C. A. **Keane** and W. W. S. **Nicholls.** Benzaldehyde, when heated with salicylamide in presence of hydrochloric acid or of sodium acetate, condenses to form a cyclic compound of the oxazine group, namely, 2-phenyl-1 : 3-benzoxazone. Homologues of this were prepared by condensing salicylamide with anisaldehyde and *o*-methoxybenzamide with benzaldehyde.—The condensation of diethylmalonamide with aldehydes: H. **Burrows** and C. A. **Keane.** Diethylmalonamide, when heated with benzaldehyde in presence of hydrochloric acid, condenses similarly to salicylamide (see note on preceding paper) to form a cyclic compound of the pyrimidine group, 4 : 6-diketo-2-phenyl-5 : 5-diethylhexahydropyrimidine.

Mathematical Society, February 14.—Sir W. D. Niven, vice-president, in the chair.—Prof. A. R. **Forsyth** gave an account of the life and scientific work of the late Colonel A. Mannheim, an honorary foreign member of the society.—Repeated integrals: Dr. E. W. **Hobson.** When Riemann's definition of integration is adopted, it may happen that the double integral of a function does not exist, although the repeated integral does exist if the integrations are performed in a certain order. The more extended definition of integration introduced by Lebesgue throws light on this and other anomalies in the theory of the relations of double integrals to repeated integrals.—The projective geometry of a binary quartic and its Hessian: Prof. E. B. **Elliott.** The quartic is regarded as the equation of four straight lines drawn through the origin, and is represented by the four points in which these lines meet a chosen conic drawn through the origin. The original quartic and its Hessian are members of a pencil of quartics, each represented by four points on the conic, and all the quadrangles which are thus obtained have the same harmonic triangle. Any quadrangle of the set is determined by the harmonic triangle and one vertex of the quadrangle. With this vertex a certain point on a chosen side of the harmonic triangle can be associated by a linear construction, and the quadrangle is determined by this point and the harmonic triangle. The determining point for the Hessian can be associated with that for the original quartic by a linear construction which is given in the paper.—A formula for the sum of a finite number of terms of the hypergeometric series when the fourth element is equal to unity: Prof. M. J. M. **Hill.** The formula includes the well-known expression for the sum of the series, and gives an exact value for the remainder after s terms.—Groups defined by the order of two generators and the order of their commutator: Prof. G. A. **Miller.**—An informal communication on hyper-exponential numbers was made by Lieut.-Colonel A. **Cunningham.**

DUBLIN.

Royal Irish Academy, January 14.—Dr. F. A. Tarleton, president, in the chair.—Infection of bovines by the avian tubercle bacillus: Prof. **Mettam.** The paper gave an account of experiments with cultures of avian tubercle bacillus. Injected into the auricular vein of a heifer, the virus produced a fatal infection. In the other experiment a portion of a culture was given by the stomach-pump to a young bull. The animal became infected as shown by the tuberculin test. It recovered from the infection, however, because just prior to slaughter the animal was retested, but did not respond, and the lesions found at *post-mortem* were sterile, and failed to produce a lesion in the rabbit in which they were inoculated. Both animals were shown to be free from tuberculosis prior to experiment by the use of tuberculin. The same author also read a note upon the development of tubercles in the lacteals of the villi of the small intestine in rabbits infected by feeding with tuberculous material from a bovine source. The tubercle has the same anatomical structure as that developing in the pulmonary capillaries or liver sinusoids—epithelioid cells of mononuclear leucocyte origin, lymphocytes, and giant cells. The epithelium of the villus may be intact.—The general solution in integers of the indeterminate equation $aX^3+bY^3+cZ^3+dXYZ=0$: Dr. T. **Stuart.** The solution of this equation (or of special cases of it) has been considered by Sylvester, Lucas, Desboves, and other writers. The only known method (save that of trial) for finding a solution is by means of artificially constructed identities. In this paper the various identities and theorems obtained by previous writers are coordinated and shown to be deducible from elementary geometrical considerations, and some statements of Sylvester and Desboves are also shown to require considerable modification. The geometrical method of attacking the problem leads to important results in high factorisation.

January 28.—The river Shannon—its present regimen and geological history: J. R. **Kilroe.** The river admits of easy navigation, falling only about 150 feet in 140 miles. It commenced to flow upon a plain of post-Eocene date 2500 feet to 3000 feet above present datum, and a very trifling inclination to the north, west, or south would have permanently deflected the drainage. Retention of its course alone could have kept the gorge at Killaloe open, but at some time shortly prior to the Glacial epoch the river seems to have abandoned the gorge, until the ancient bed by Killaloe was lowered, at certain points below the sea-level, by glacier erosion. Upon the disappearance of the ice the river resumed its original course.

PARIS.

Academy of Sciences, February 11.—M. A. Chauveau in the chair.—The preparation of acylcampholic esters, and on a new method of formation of phenyloxyhomicampholic acid: A. **Haller** and Charles **Weimann.** The cyanocampholic esters treated with alkyl magnesium iodides yield imido-compounds, the latter, with sulphuric acid, giving ketones. The cyanogen group of the cyanocampholic ester is here replaced by the group —CO.R, R being the alkyl group of the magnesium compound. Numerous examples of the application of this reaction are given.—The mechanism of the transformations in normal media of the Crustaceæ: E. L. **Bouvier.** At the commencement of the Quaternary epoch the formation of the Isthmus of Panama caused a separation of the crustaceans in this region, and each group has developed in a normal medium since that time. Typical species are compared to show the amount of the differences which have arisen during this period.—Has the African elephant a pleural cavity? Alfred **Giard.** The *post-mortem* examination of an African elephant, recently described by Mme. M. Phisalix, would appear to show that the African elephant has a pleural cavity. In the case of the Asiatic elephant there is clear evidence that the visceral and parietal layers of the pleura are closely connected together by matted elastic tissue, and it is highly probable that this is also the case in the African elephant. The diagnosis of pleurisy on account of thickness of the pleura and its adherences would, therefore, appear to be a mistaken one.—Various syntheses of dimethyl*iso*propyl-carbinol: Louis **Henry.** The α-chloro-*iso*butyric aldehyde reacting with magnesium methyl bromide gives the expected pinacolic alcohol, but its tertiary isomer, dimethyl*iso*propyl carbinol. A theory of this reaction, supported by experimental facts, is proposed.—Observations of the sun made at the Observatory of Lyons during the fourth quarter of 1906: J.

Guillaume. The results are summarised in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—The problem of Dirichlet: H. **Lebesgue.**—The non-applicability of two continuous regions of n and $n+p$ dimensions: René **Baire.**—The channelled spectra of parallel gratings: Georges **Meslin.** A mathematical discussion of the various hypotheses which have been proposed in this connection, and in particular that due to M. Garbe, whose theory is shown to give a complete explanation of the phenomena.—A singular state of matter observed in a dissolved chromic salt: Albert **Colson.**—The alkylation of metallic cyanides: H. **Guillemard.**—The catalytic reduction of unsaturated ethyl esters: G. **Darzens.** An application of the Sabatier and Senderens reaction to the preparation of ethyl propionate, isovalerate, and pelargonate from the corresponding unsaturated esters. The addition of two atoms of hydrogen to a whole series of acids of the type $R.(CH_3).C:CH.CO_2H$, a general method for the preparation of which is described, can also be effected in this way. Examples of the application of the method in the aromatic and hydroaromatic series are also given.—The transformation of primary saturated alcohols into the corresponding monobasic acids: H. **Fournier.** Alkaline permanganate has been shown to give oxalic acid with some primary alcohols. The author shows that if the conditions prescribed by him are followed, a yield of acid amounting to 75 per cent. of the theoretical can be obtained.—The presence of aldehydes in cheese and the part played by them in the formation of bitterness: A. **Trillat** and M. **Sauton.** Experiments are given establishing the presence of aldehydes in cheese, and also the existence of a relation between the quantity of aldehydes and the bitterness of the cheese.—Alternating currents of varying periods corresponding to musical sounds; the physiological effects of rhythmic alternating currents: Maurice **Dupont.**—Remarks on the preceding paper by M. **d'Arsonval.**—Some phenomena of biological adaptation by rhythmical anticipation: H. **Piéron.**—Ether anæsthesia; parallel with chloroform anæsthesia: Maurice **Nicloux.** A quantitative study of the distribution of ether in various organs of the body during anæsthesia. These quantities are greater with ether than with chloroform, and the ether is eliminated more rapidly.—Lymphosarcoma in the dog: A. **Borrel.**—The discovery of the marine Aquitanian in the middle part of the Rhone valley: L. **Joleaud.**—Some geothermal measurements effected in the Pas-de-Calais basin: Félix **Leprince-Ringuet.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 21.

ROYAL SOCIETY, at 4.30.—The Estimation of Chloroform in the Blood of Anæsthetised Animals: G. A. Buckmaster and J. A. Gardner.—On Electrical Seed-Testing: Prof. T. Johnson.—On Longitudinal Symmetry in Phanerogamia: Prof. Percy Groom.—On the Inheritance of Flower-Colour in *Antirrhinum majus*: Miss M. Wheldale.

ROYAL INSTITUTION, at 3.—The Minute Structure of Igneous Rocks and their Significance: Alfred Harker, F.R.S.

CHEMICAL SOCIETY, at 8.30.—The Constitution of Oxyazo-compounds: W. B. Tuck.—The Influence of Solvents on the Rotation of Optically Active Compounds, Part ix., A New General Method for Studying Intramolecular Change: T. S. Patterson and A. McMillan.—The Reduction Products of ortho- and para-Dimethoxybenzoin: J. C. Irvine and A. M. Moodie.—Replacement of Halogens by Hydroxyl, i., The Hydrolytic Decomposition of Hydrogen and Sodium Monochloroacetates by Water and by Alkali, and the Influence of Neutral Salts on the Reaction Velocities: G. Senter.—The Reaction of Ammonium Salts with the Constituents of the Soil: A. D. Hall and C. T. Gimingham.

LINNEAN SOCIETY, at 8.—The Percy Sladen Trust Expedition to the Indian Ocean, Introduction, Part i., Ceylon to Mauritius: J. Stanley Gardiner.—Land Nemerteans, with a Note on the Distribution of the Group: R. C. Punnett.—Land Crustaceans: L. A. Borradaile.—Hymenoptera: P. Cameron.—Dragon Flies: F. F. Laidlaw.—Fourmis des Seychelles, Admirantes, Farquhar et Chagos: Prof. A. Forel.—Pycnogonidæ: G. H. Carpenter.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Lecture on "Modern Theory of Conduction of Electricity in Metals": Prof. J. J. Thomson, F.R.S.

FRIDAY, FEBRUARY 22.

ROYAL INSTITUTION, at 9.—Flame in Gas and Petrol Motors: Dugald Clerk.

PHYSICAL SOCIETY, at 5.—Transformer Indicator Diagrams: Prof. Lyle.—Ionisation of Gases by α Particles of Radium: Prof. Bragg.—A Micro-manometer: B. Roberts.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Impurities in Boiler Feed-water; their Nature, Effect and Elimination: F. E. Walker.

SATURDAY, FEBRUARY 23.

ROYAL INSTITUTION, at 3.—Röntgen, Kathode, and Positive Rays: Prof. J. J. Thomson, F.R.S.

THE ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.30.—Notes on Dr. Fletcher's Report on the Sanitary Circumstances of the Village of Coggleshall: T. V. Holmes.—Botanical Surveying in Brittany; an Account of Ecological Work on the Bouche d'Erguy: T. G. Hill.

MONDAY, FEBRUARY 25.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Inland Waterways: G. G. Chisholm.

INSTITUTE OF ACTUARIES, at 5.—Comparative Bonuses under Whole Life and Endowment Assurances: H. J. Rietschel.

TUESDAY, FEBRUARY 26.

ROYAL INSTITUTION, at 3.—The Visual Apparatus of Man and Animals: Prof. William Stirling.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On the Limits of Thermal Efficiency in Internal-Combustion Motors: Dugald Clerk.

WEDNESDAY, FEBRUARY 27.

GEOLOGICAL SOCIETY, at 8.—On the Lower Ordovician Succession in Scandinavia: W. G. Fearnsides.—The Occurrence of Pseudomorphous Pebbles of Pyrites at the Crown Reef Mine, Witwatersrand: C. Baring Horwood.

SOCIETY OF ARTS, at 8.—Modern Type-writers and Accessories: Arthur E. Morton.

THURSDAY, FEBRUARY 28.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Dispersion in Artificial Double Refraction: L. N. G. Filon.—The Occlusion of the Residual Gas by the Glass Walls of Vacuum Tubes: A. A. Campbell Swinton.—The Theory of Correlation for any Number of Variables, treated by a New System of Notation: G. Udny Yule.

SATURDAY, MARCH 2.

ROYAL INSTITUTION, at 3.—Röntgen, Kathode, and Positiv Rays: Prof. J. J. Thomson, F.R.S.

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