THURSDAY, NOVEMBER 16, 1899.

THE CAMBRIDGE NATURAL HISTORY.

The Cambridge Natural History. "Insects Part II." By David Sharp. Pp. xii + 626. (London: Macmillan and Co., Ltd., 1899.)

THE appearance of the concluding part of Dr. Sharp's treatise on Insects, after an interval of nearly four years since that of its predecessor, is most welcome to all readers who were led by the first part of this work to recognise what a step in advance had been taken in the treatment of the subject.

The present volume has confirmed the opinions we then expressed in these columns on Part i., and again we must record our admiration for the knowledge and industry of the author, and for the attractive manner in which he has set forth his results; for wherever the subject-matter allows, the whole work is most fascinating reading.

As was pointed out in 1896, the chief feature of this work is the extensive use made of modern researches, of a kind not hitherto found in text-books. So far as insect morphology is concerned, one or two other recent works may challenge comparison with the present one, but we know of none that attempts to bring forward so large a bulk of unfamiliar particulars, which in a "natural history" are appropriately of the first importance, about the habits and life-histories of insects. But such topics take space, and a complete history of insects on this large scale can only be condensed, even into the 1100 or more pages of this treatise, either by general compression or by the selection of topics for detailed treatment, to the exclusion, so far as practicable, of others. Dr. Sharp has preferred the latter plan, and has been remarkably concise in dealing with such parts of his subject as are familiar from other accessible text-books, which this work may be said rather to supplement than to supersede.

The treatment of certain portions, particularly of Coleoptera and Lepidoptera, will perhaps come as a disappointment to those students who do not bear in mind the limitations of space that have hampered the author. Preconceived notions of the relative importance of insect-families are not easily got rid of, and it is something of a shock to find, *e.g.*, the Cerambycidæ dismissed with less than four, or the Tineidæ with three pages. It would have been an advantage if the editors could have seen their way to devote still more space to the subject, perhaps by restricting Vol. v. to the insects alone. The association with the Prototracheata and Myriapods, if zoologically orthodox, is not of much practical value.

We think, too, that the omission of certain obscure families, except for a bare mention of their existence, would have been a gain. However much symmetry may require a notice of each of the many families of insects (Dr. Sharp enumerates eighty-five in the Coleoptera alone), such notice is not worth giving unless it can be adequately done, and the accounts, for example, of the Rutelinæ, Ægialitidæ, or Apioceridæ, to select at random, serve no clearly useful purpose.

The present volume deals with the Tubuliferous and Aculeate Hymenoptera, the Coleoptera, Lepidoptera, Diptera, Thysanoptera and Hemiptera. The Aphaniptera are treated as a sub-order of Diptera, and the Strepsiptera and Anoplura are included provisionally with Coleoptera and Hemiptera respectively.

Of these orders, the Hymenoptera, which lend themselves admirably to treatment from a bionomical standpoint, are dealt with in great fulness, the observations of M. Fabre on habits being in particular constantly referred to at length. No less than fifty-three pages are devoted to the ants alone, and, among much that is interesting, attention may be called to the accounts of the Dorylides, of the associations of ants with other insects (chiefly based on Father Wasmann's work, and again dealt with under Coleoptera), and to Mr. Green's drawing, on p. 147, of a worker of *Oecophylla smaragdina* using a larva of the species as a kind of animated gum-bottle for joining together the edges of leaves.

In proportion to their numbers, Coleoptera are the least interesting of insects. Their life-histories are very little known, and with the exception of the singular parasitism and hypermetamorphosis found in the Cantharidæ and their allies, are singularly devoid of noticeable peculiarities. It is not surprising, therefore, that even Dr. Sharp's intimate knowledge of the Order has not prevented him from being "gravelled for lack of matter,' and that this chapter, overweighted as it is with many families, is among the least readable in the work. With the removal of Gyrinidæ from the Hydradephaga, few entomologists will be disposed to disagree; but the grouping of the Clavicorn and Serricorn series of Coleoptera into a single aggregate, to be called Polymorpha, is of questionable value. The new series is admittedly incapable of definition, except by the fact that its components do not belong elsewhere; and to associate into a single congeries of forms such widely different families as, for example, the Staphylinidæ and Buprestidæ, is to abandon classification, so far as a fourth of the Order is concerned.

Dr. Sharp pays a good deal of attention to stridulating organs throughout his work, and describes and figures (we imagine, for the first time) a remarkable modification of the hind legs of Passalid larvæ into paws which scratch a stridulating plate on the middle coxæ. It is hard to imagine why a larva that lives in rotten wood should desire to stridulate, but the practice appears to be common among the Lamellicorns. He does not refer to, and perhaps is not acquainted with, the remarkable asymmetrical structure, probably a sound-producing organ, which Ribaga has described in the abdomen of the bed-bug.

Great advances have been made in recent years in the study of Lepidoptera, chiefly with a view to obtaining sound classificatory points; and the chapter on these insects is noteworthy for the completeness with which it deals with lepidopterous structure and development, especially of the mouth parts (in connection with which attention may be called to the figure illustrating the pupal mandibles of *Micropteryx*, first described by Dr. Chapman in 1883) and of the wings, wing-scales, and coloration. An interesting sense organ of unknown function in the abdomen of *Chrysiridia* is here described for the first time. More might have been said with advantage on Dr. Chapman's researches on lepidopterous

pupæ, for, though several times alluded to in the text, no description of them is given. Although incomplete, they have given a great impetus to the study of lepidopterous relationships, and it is not every reader that has time or opportunity for turning them up in the *Transactions* where they appeared.

The system followed in the Heterocera is that given in Sir George Hampson's "Fauna of British India—Moths," but it has the manifest disadvantage that it does not include two or three of the families referred to. On p. 432 the Prodoxidæ are called a family, though they are clearly intended to be included in the family Tineidæ. The use of the same term and ending for an aggregate and its subdivision tends to confusion.

Mention of the Lepidoptera leads naturally to the subject of mimicry. So far as facts are concerned, Dr. Sharp brings forward many interesting examples, among them an unrecorded case of the larva of a British bug, *Nabis lativentris*, which mimics an ant, the resemblance being absent in the imago. On the other hand, no reference is made to some of the astounding and comparatively little known resemblances found among Membracidæ. In a species allied to one, *Heteronotus trinodosus*, which is figured, the prothoracic prolongation takes on the form of the entire body of a Hymenopterous insect, so that the Membracid walks about under a mask, or rather, a false body, of the most deceptive kind.

Dr. Sharp is, however, averse from countenancing any theory of the subject, and his brief account of existing hypotheses is scarcely impartial. In a singular criticism he writes:

"In endeavouring to realise the steps of the process of the development of the resemblance we meet with the difficulty that the amount of resemblance to the model that is assumed to be efficient at one step of the development, and to bring safety, is at the next step supposed to be inefficient and to involve destruction."

This appears either to involve a non-comprehension or to imply a complete negation of the principles of natural selection; we do not know whether the latter is intended.

Of the remaining chapters, that on Diptera is of especial value, on account, not so much of their intrinsic interest, great as that is when once the repugnance to their study has been overcome, as of the help it gives towards obtaining a fair general knowledge of an Order which does not form as a whole the subject of popular monographs, and of which the study is particularly difficult.

In view of the economic importance of Diptera, it is greatly to be regretted that they do not absorb more of the entomological energy that is wasted in investigating trifles that lead to nothing. With Dr. Sharp's account, it is possible at least to make a start.

Economic questions, which would have led the author outside the scope of this work, are seldom referred to. With this necessary exception, it is difficult to find a subject of any importance in entomology that is not, in some place or other, touched on more or less fully, and often in the light of independent observation and research. Very few forms of real interest are omitted; but among them is that of *Dyscritina*, on the life-history of which Mr. E. E. Green has lately thrown light. Though his paper was published since the appearance of Vol. v. of this series, reference might have been made in the short appendix to the present volume to his account of this Forficulid larva, which so singularly modifies our knowledge of the earwigs.

We do not recollect to have before met with the word "exstulpate," which Dr. Sharp is rather fond of using to denote the extruding of an eversible papilla. If it is a latinised form of the German "ausstülpen," it can hardly be considered as an ornament to the English language!

It remains to allude to the illustrations; these are as good as, though relatively fewer than, those in the preceding volume. The figures of *Ornithoptera paradisea*, one of the few butterflies selected for figuring, are not successful. Exquisite as this insect, at least the male, is, it does not look well in a woodcut, and these large blocks look coarse and inappropriate on so small a page.

W. F. H. BLANDFORD.

A COMPREHENSIVE GEOGRAPHY.

The International Geography. By Seventy Authors. Edited by Hugh Robert Mill, D.Sc. Pp. xx + 1098. With 488 illustrations. (London: George Newnes, Ltd., 1899.)

SOME forty years ago geography was the most dreary of subjects in school lessons. Its text-books were as arid as the Sahara, lists of names and compilations of statistics; mere cram, without a single statement or principle which could help the learner to understand the history either of the earth or its inhabitants; useful as exercise for the memory, but baneful in every other respect. All that has been changed. Geography is now taught as illustrative of principles. Like geology, it is an application of a group of the natural sciences to explain a particular problem, the history of the earth; differing however, from that in dwelling more on the superficial aspect—the physiography—of our globe, and less on underlying causes or on the remote past. The volume before us is an example of the new method. Though too large for direct use as a text-book in schools, for it consists in all of over 1100 pages of rather closely-printed type (which ageing eyes will wish thicker), it will filter down to the classes through the teachers. The first part of the work deals with the principles of geography, the more distinctly scientific aspect of the subject, in a series of excellent essays, which treat of the principles and progress of geography, its relation to mathematics, the making of maps, the plan of the earth and the features of its surface, the ocean, atmosphere and climate, the distribution of life, including the races of man, and the political aspect of geography; all these subjects being discussed by very high authorities. Each of the following parts is devoted to one of the great divisions of the earth, treating it first as a whole, and then under its minor natural or political divisions, in a series of separate articles, each of which is contributed by "a specialist or recognised authority of high standing."

To review critically such a book as this demands something like geographical omniscience, to which I have no pretensions; probably the editor himself is about the only really competent person, and he might be not unnaturally suspected of a certain prejudice. So I have

tried to look at a few sections from the point of view of personal knowledge, and others from that of ignorance; for in the one case I might test the information, in the other regard the book as a learner. For the former purpose I have read in a carping spirit. Not that I hold it right to do this with a really good book. Horace lays down the true rule, "Ubi plura nitent in carmine non ego paucis offendar maculis"; but I did it, and now give the results to show that the book will stand a test which is almost unjust. A short glossary of rock names and some other geological terms would be a useful addition for the sake of the unlearned. In the course of my reading I have found one misprint, "Apls" for Alps, which is very likely due to that familiar of the printer who should be out of place in a chapel. Editors are not always responsible for press errors. However, here they must be few indeed. In mentioning Suess' idea that sometimes it is rather the ocean which has sunk than the land which has risen, a writer says that the 100-foot beach-line in Western Scotland

"maintains its level, lying on rocks of different ages and hardness, and crosses undisturbed great faults and dislocations."

But if the antiquity of the faults, as is the case here, is much greater than that of the beaches, the last reason is not conclusive, for the mass might be so far welded together as to move as a whole But is the fact itself certain? If it be so, it does away with an objection commonly urged against the marine origin of the parallel roads of Glenroy. At any rate it should have been added that in Norway, not to mention other parts of the northern hemisphere, a beach level often varies in height. Perhaps, also, a little too much prominence is given to the theory of the earth's tetrahedral figure, for it is still on its trial, and apparently fails, as the author admits, to explain every fact. On p. 57 boulder clay is said to be an accumulation left by ice-sheets or in extra-glacial lakes. As not a few persons who have carefully studied the subject maintain that some boulder clay has been deposited in the sea, and have added proofs which have been met only by hypotheses, that view also should have been mentioned as a third possibility. In another aspect of ice-work, one author (p. 258) boldly abandons glacial excavation to account for the origin of the Alpine lakes, and attributes them, rightly as I believe, to crust movements; yet we are told on p. 272 that the lakes of the Alpine foreland are clearly related to the great ice-sheet which once overspread it. We presume this signifies glacial excavation; but, if so, what about the "hinter land"? Again, has it yet been *proved* (see p. 269) that the Scandinavian ice-sheet extended over northern Germany? It is, no doubt, an article of faith with a large school; but as difficulties suggest themselves to a sceptical mind after examining the ground, a less positive statement would have been better. As regards the Alps, it is not a happy phrase to speak of the Finster Aarhorn, Jungfrau, Möneh, Wetterhorn, &c., as

"grouped in one compact mass of snows and rugged peaks *round* the valleys of Lautebrunnen and Grindelwald";

for nothing can be more striking than the apparent ending, of those valleys at the foot of that great mountain wall. We find no mention of the Viso among the Italian Alps, yet no peak is more conspicuous than it from the Piedmontese plain; and the fact that the south-eastern Alps near the Austro-Italian frontier—so remarkable in their scenery—are magnesian limestone is not clearly stated.

The Pelvoux (p. 237) is not over 13,000 feet high, for only two peaks in the Dauphine group, the Ecrins and the Meije, exceed that elevation. To say that "since historic times not the slightest eruption has taken place in Auvergne" assumes a controverted point. In Italy the remarkable group of the Carrara mountains is not distinguished so clearly as it should be from the rest of the Appennines, and to say that Pozzuoli "stands in the midst of vast ruins of the Roman period" is not quite the most accurate of phrases.

Enough however of such criticisms, for they are so trivial as to be hardly worth mention. We only write them down to show how difficult, even if one tries to carp, it is to find any fault. When we come to excellencies their name is legion. With seventy contributors, all of whom have done their work well, it is almost invidious to select, but we may mention Prof. De Lapparent's article on the physical geography of France as no less lucid in statement than powerful in grasp, and those on Natal, the Transvaal and the Orange Free State, by the Right Hon. J. Bryce (which we naturally selected to look at from the standpoint of general ignorance), as singularly clear and informing. The book must have cost Dr. Mill no little toil as editor. Organisation and correspondence in a work like this must have been heavy tasks; and besides these he has himself contributed some excellent articles, and translated wholly or partially those of seventeen contributors. We heartily congratulate him on the final result. He deserves our gratitude for giving us a geography which is at once good in literary form and invaluable for reference, far in advance of any similar work which has been produced in this country. No teacher, indeed no advanced student, can afford to be without it; more than this, it must be on the shelves of every important library, and will be of the greatest use to literary as well as to scientific men, indeed to all who read for the love of culture. T. G. BONNEY.

CHEMISTRY FOR THE PEOPLE.

Einführung in die Chimie in leichtfasslicher Form. Von Prof. Dr. Lassar-Cohn. Pp. xi + 299. (Hamburg and Liepzig: Leopold Voss, 1899.)

THIS book begins with an interesting *apologia*. When the author first took up the work of teaching in Volkshochschulen he lectured to the pupils very much in the same way that he himself had been lectured to in the University during his first semester. He soon came to think, however, that this was a mistake, and that a class of people, meeting in the evening hours for the improvement of their general knowledge, should not be treated like students taking up a professional study. He therefore altered the form of his lectures, and endeavoured to present a more general and expansive view of chemistry, and to impart, as it were, the

spirit and stimulus of the science. In like manner he came to the conclusion that ordinary chemical text-books are unsuitable for the pupils of Volkshochschulen, and the present work has been written to fill the void. The case which Prof. Lassar-Cohn endeavours to meet is a somewhat special one. Given an evening class of young men desirous of improving their general education, which is the best way of giving them some notion of chemistry? Prof. Lassar-Cohn answers this question by saying that as a laboratory is a luxury which a Volkshochschule cannot afford, you must content yourself with experimental lectures and present the subject in its broadest and most interesting aspect.

Here again, it would seem, the prejudice of University training makes itself felt, in the notion that a laboratory suitable for teaching the elements of chemistry is necessarily the large and expensively furnished apartment set apart in universities for the professional study of chemistry. This is indeed a common enough belief, one that has led in this country to great extravagance and much futile teaching. It is impossible to believe that Germany would make difficulties about providing the Volkshochschulen with all that is really requisite for teaching, by practical work, the amount of elementary physics and chemistry which should be there attempted. Until this is done, until a properly coordinated course of work in the laboratory and class-room can be arranged, really profitable *teaching* will, in the opinion of the present writer, be impossible.

Whether or not we accept the author's standpoint that lectures are inevitable, we must admit they may be made to open out new vistas of knowledge and supply a stimulus to study, and we cannot hesitate to praise the book before us. Dr. Lassar-Cohn possesses in a high degree the faculty of exposition; he writes in a style which, for force, clearness, and above all, freedom from prolixity, is uncommon enough in German text-books. The matter of the book, too, fully corresponds with the author's intention. It is comprehensive without being encyclopædic, and is supplied with a good deal of human interest. The historical element is not introduced to any great extent, not as much, in fact, as it might well be in such a book. Hardly a great name in the roll of chemists is mentioned, except that of Kekulé. The book begins much in the orthodox way, with an attempt to delimit the frontier between chemistry and physics, and quickly and discreetly passes on to water and hydrogen. After this come the halogens and the hydracids, followed by lucid explanation of the laws of chemical combination and the atomic and molecular theories. The other chief non-metals and their compounds are passed in review, and then half a dozen of the metals are dealt with. Here and there chapters appear dealing with special topics, such as the building up of plants from inorganic substances, the preparation of metals by electrolysis, the classification of the elements. The treatment of these topics is excellent. The author has a lightness of touch which is very agreeable, and very different from the heavy hand of the compiler. This is particularly evident in the treatment of organic chemistry, which is admirably reviewed in some forty pages, and throughout the work there is indeed a pleasant sense of freshness. To those who wish to gain a general idea of the scope of modern chemistry, and who cannot obtain class instruction, this book may be strongly recommended. It has not the popular interest of the author's "Chemistry in Daily Life"; but it has a different object, the aim being to show the philosophy rather than the practical usefulness of the science. It is probable that there is a considerable public to whom the book will be a really valuable acquisition, and with whom it will fulfil its aim of being an introduction to chemistry "in leichtfasslicher Form."

The illustrations, which are fairly numerous, call for a word of criticism. They are exceedingly crude, overshaded, and often purposeless. The first figure in the book, for example, is an ill-drawn dinner-bell, which is to illustrate the statement that a bell when sounded remains unchanged in substance, and that therefore the science of sound belongs to physics!

In a brief postscript Dr. Lassar-Cohn enters a vigorous protest against the recent decision of the German Chemical Society to tabulate the atomic weights on the basis of O = 16. He maintains that, to the beginner, it will be quite unintelligible why the lightest atom should have a weight of 1·01—chemical teaching, in fact, will sink back to a half-alchemistic stage if the system of atomic weights, which lies at the foundation of the whole science, is to be a matter for belief rather than for logical reasoning. There seems to be some exaggeration here. Whatever may be said in favour of oxygen being taken as 16 or 15·88, it is surely not a very difficult matter to explain, even to beginners, the practical reasons why *for the time being* 16 has been selected. It may indeed be an advantage if pupils are thereby forced to realise a little more fully than has been usual how atomic weights actually are determined. It must be admitted, however, that the question of O = 16 *versus* H = 1 is well worth consideration from the point of view of the chemical teacher.

A. S.

OUR BOOK SHELF.

Laboratory Manual. Experiments to illustrate the Principles of Chemistry. By H. W. Hillyer, Ph.D. Pp. 200. (New York: The Macmillan Company. London: Macmillan and Co., Ltd.)

THIS book is intended as an introduction to chemistry for college students, and is written on the newer (or, as we have heard it termed, the new-fangled) plan. In other words, the student is asked to record what he finds in his experiments, and not told what he should find. The success of this newer method, as of the older one, must depend on much besides the text-book; but if it be assumed that the student is anxious to learn and willing to take trouble, there can be little doubt where the advantage lies.

In addressing the student, the author remarks that "the mere bringing of chemical substances into conditions under which they will react has less utility as a means of culture than most of the manual occupations"—a just if a somewhat "superior" observation—and he proceeds to give general directions which, if only observed, will leave nothing to be desired in the student's attitude of mind. Experience shows, alas! how very difficult it is to get these injunctions observed.

To illustrate the author's method, the following may be

cited. "Heat a few pieces of zinc with a strong solution of sodium hydroxide. What gas escapes? What is there in the solution? From your previous experience, what acids will dissolve zinc?" Or again, "To 1 c.c. of silver nitrate solution add a little ammonium chloride solution, and then a solution of some of the salt made above [sodium thiosulphate]. Describe the phenomena, and explain, using equations."

It is obvious that each of these experiments opens up a large subject, and will necessitate reference to a descriptive text-book, and probably to a demonstrator as well. This is, of course, eminently desirable, and there can be little doubt that Dr. Hillyer's book, if properly used, will prove a helpful laboratory manual. It ranges over inorganic chemistry, and the selection of experiments has been carefully directed to bring out the most important facts and principles.

L'Industrie des Matières Colorantes Azoïques. Par George F. Jaubert. Pp. 167. (Paris: Gauthier-Villars.)

IT is over forty years since the late Dr. Peter Griess placed at the disposal of chemists a reaction which has since proved of such importance, both scientifically and technically, that a large literature is now in existence dealing with the class of compounds known as azo- and diazo-compounds. From the industrial side, the most important development has been the manufacture of a group of colouring-matters which are now turned out on a colossal scale, and which are so numerous in individual members, that in the last edition of the "Tabellarische Übersicht" of Schultz and Julius (1897) no less than two hundred and seventy-three distinct technical products of this class were catalogued. The present little work is one of the useful "Aide-Mémoire" series from the "Encyclopédie Scientifique," published under the direction of M. Léauté of the Institute. It is fairly brought down to date, and contains in a handy and portable form a tabular list of the colouring-matters in question, including also the nitro- and azoxy-compounds which find place in technology. The little volume will be found valuable by all engaged in this department of chemical industry. R. M.

Elementary Practical Mathematics. By Frank Castle, M.I.M.E. Pp. x + 401. (London: Macmillan and Co., Ltd., 1899.)

IN this book the student is carried rapidly through a course of arithmetic, algebra, geometry and trigonometry to some of the simpler problems of mensuration and dynamics. The idea is to bring the desk and paper work of the pupil into closer touch than heretofore with the work of the shop or factory—in other words, to indicate from the very beginning the practical value of mathematical methods.

The purely academic theorem or problem is to be "taboo," or, in the words of the preface, "abstract reasoning is to be relegated to the background, and concrete facts are to form the basis of the student's work." The principle is probably a sound one, but it may be carried too far; and experience alone will decide as to the efficiency of the system embodied in Mr. Castle's book. The student, if not otherwise instructed, will find certain parts very hard to follow. Thus on p. 341, in the discussion on maxima and minima, a differential coefficient is suddenly introduced without a word of explanation or apology. The great brevity, which the limits of the book impose on many of the sections, will also be a serious barrier to their ready intelligibility. As a general rule, the explanations and descriptions are clear and accurate; but we have noticed two statements which, if not absolutely incorrect, are, at any rate, misleading. On p. 23 we read that "the invariable interval of time between two consecutive southings of a star is divided into 24 equal parts, each called an hour." True, but this is not the hour as usually understood and *practically* used; yet there is nothing in the context to indicate the distinction between the sidereal and mean solar hour. The other doubtful statement is on p. 290, where we read: "Any change in the direction or speed of a moving body is produced by force. When a force acts in either of these ways it is said to do work." The "direction of a moving body" is a curious truncated phrase; but the implication that a force always does work when it alters the direction of motion of a moving body is still more curious. Here truly are sinks of waste of solar energy that were never dreamed of in the philosophy of Helmholtz and Kelvin! These blemishes apart, however, there is much to commend in the book. Contracted arithmetical operations are strongly insisted upon. The chapters on logarithms, the slide-rule, orthographic projection and graphical methods, are particularly deserving of praise. The book is beautifully printed, the illustrations are clear and well conceived, and the examples—both in the text and in the exercises—are all of a distinctly practical character.

The New Education. Manual Training: Woodwork. By Richard Wake. Pp. viii + 360. (London: Chapman and Hall, Ltd., 1899.)

MANUAL training, or instruction in the use of tools, may be made of great educational value if care is taken to develop the rational and constructive faculties rather than to produce dexterity in tool manipulation. The author of this volume deals with the subject upon the right lines, and the course described by him will encourage pupils to measure accurately, observe minutely, and work with close attention to details—all of which are desirable attributes to cultivate. A special feature of the course is the effort made to develop the creative faculty in children by inducing them to design for themselves the simple models to be constructed in wood. No attempt is made to describe woodwork of the ornamental character which is often seen in school workshops; each exercise has a purpose, and that purpose is to educate.

The book covers the requirements in manual training for Standards V., VI. and VII. of public elementary schools. It is well illustrated with working drawings and reproductions from photographs showing pupils performing the various operations of woodwork. Teachers of the subject will find the volume helpful and suggestive.

The Naval Pioneers of Australia. By Louis Becke and Walter Jeffery. With illustrations. Pp. xii + 314. (London: John Murray, 1899.)

THIS is a pleasant and accurate compilation for popular reading, based largely on the authoritative documents now being published by the Government of New South Wales. It is, in fact, a short history of the connection of the British navy with Australia. The standpoint is that of political rather than natural history; but many references are made to the large interest taken by Sir Joseph Banks in the beginnings of Australian colonisation. The problems of the first discovery of Australia are scarcely touched on, and the book is in no sense concerned with controversial questions.

Arithmetical Exercises in Chemistry. By Leonard Dobbin, Ph.D. Third Edition. Pp. vi + 52. (Edinburgh: James Thin, 1899.)

PROF. CRUM BROWN, who contributes a preface to this book, points out that it contains clear descriptions of "the principles involved in the calculations required in dealing with chemical changes, and such physical changes as are of special importance to junior students of chemistry." The exercises should be of value in fixing ideas in the minds of students and illustrating the operations of arithmetical chemistry. The ability to make such simple calculations as are here given is essential to a clear understanding of the laws of chemistry.

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.*]

Coccospheres and Rhabdospheres.

I RECENTLY learned with much surprise from Sir John Murray that the German *Valdivia* expedition failed to discover anywhere in the ocean either Coccospheres or Rhabdospheres. Since the earlier Plankton expedition under Prof. Hensen had also failed to find any of these organisms, a certain amount of doubt has been privately expressed in Germany and elsewhere as to the validity of the results obtained by Mr. V. H. Blackman and myself.

In addition to our Atlantic work (published in *Phil. Trans.*, 1898) on this subject, I may state that, through the agency of Captains Cowie, Leigh and Wright, of the P. and O. Company, we have obtained these organisms from the Indian Ocean.

I have, however, received most welcome confirmation from Mrs. Weber van Bosse, who is with her distinguished husband on board H.M. *Siboga* engaged in the Dutch expedition in Malayan waters. She writes :—"Will you kindly insert a little note in a paper to state that the *Siboga* expedition found *Coccosphaera pelagica* and *C. leptopora* both in the Ceram and Banda Seas? We get them floating in the water with the horizontal cylinder of Hensen. . . . I found also Rhabdoliths, but as yet no Rhabdospheres. I am looking out for them," &c.

November 10. GEORGE MURRAY.

The Stockholm Fisheries Conference.

As the British Government was represented by official delegates at the recent International Fisheries Conference at Stockholm, and took part in its proceedings presumably with th e view of undertaking fishery investigations upon a more extended scale in the future than it has previously done, the resolutions of the Conference (see p. 34) are of more than usual interest and importance to marine biologists in this country. For this reason I would ask you to allow me space for some remarks upon them.

The general plan of the investigations proposed by the Conference, both as regards hydrographical and biological work, will, I believe, meet with the approval of all competent judges, though doubtless minor differences of opinion as to details will be found. The researches suggested are a continuation, upon a more extended scale, of those which the various bodies undertaking fishery investigations in this country have been endeavouring to carry out in so far as the limited means at their disposal have permitted, and there can be no doubt that only by the prosecution of such investigations can that accurate knowledge be acquired upon which a rational treatment of fishery questions may be based.

Two points only relating to the schemes of investigation proposed by the Conference call for comment. In the first place, with regard to the value of international co-operation in such investigations it may be pointed out that, in case the scheme should not be carried out in its entirety, such co-operation is of greater importance in the hydrographical than in the biological work, since in the former simultaneous observations made by identical methods over great areas are of primary importance, a condition which does not apply to an equal extent to the latter. This, however, does not affect what is, perhaps, the chief argument in favour of international co-operation, and one which is given a prominent place in the preamble to the resolutions of the Conference, namely, that any attempt to regulate the fisheries of the high seas can only be carried out by international agreement. Whether or not any such international agreement can be regarded as reasonably probable, or whether, if attained, the regulation could be made effective, are certainly questions open to doubt.

In the second place, from the point of view of British fisheries as a whole, the area proposed by the Conference to be covered by the hydrographical investigations should be extended to include the English Channel, the Irish Sea and the western coasts of the British Isles. Even in considering the North Sea fisheries alone such an extension is of importance, since it has been clearly demonstrated that water from the Channel enters the southern part of the North Sea from time to time, and the fauna of this region is known to contain a considerable number of southern forms, which show it to be in reality an extension of the Channel fauna.

In attempting to give effect to the recommendations of the Stockholm Conference, what appears to be the most satisfactory course for the British Government to pursue is to develop and as far as possible coordinate the work of the various organisations already in existence, namely, the Marine Biological Association (either as at present constituted, or with a more intimate connection with the Fisheries Department of the Board of Trade), the Scientific Department of the Scottish Fishery Board, and the Fishery Department of the Royal Dublin Society, at the same time encouraging the formation of local laboratories established by County Councils and other bodies at various points around the coast, such as those of Liverpool (at Port Erin), Piel, Cullercoats and Millport.

For the actual carrying out of the proposed investigations the two essential requirements are (1) a sufficient number of capable naturalists devoting their whole energies to the work, and (2) sea-going steamships efficiently equipped. The various laboratories around the coast would form valuable ports of call or depôts for the vessels engaged in the investigations. The elaborate and expensive organisation of a central bureau and of a central laboratory proposed by the Stockholm Conference appears to me to be a matter of only secondary importance, against which some objections may be made. To coordinate the investigations of the different countries, and to insure such uniformity of method as will make the results of the different observers comparable, an international Council, composed chiefly of the experts actually responsible for carrying out the investigations, and meeting once a year, seems an adequate arrangement.

With an elaborate organisation such as that suggested by the Conference there is a danger that the work of the biological stations would degenerate into the mere taking and recording of routine observations, whilst original work and the development of new methods of research, which are in reality of far greater importance, would receive a check. Good men would certainly not be attracted to work which consisted merely in recording observations taken according to a stereotyped plan dictated by a central bureau. A large amount of individual freedom to the workers is absolutely essential in order to secure the best results from scientific research. For these reasons a more elastic organisation than that of the international central bureau proposed by the Stockholm Conference would seem to be preferable.

The Laboratory, Plymouth. E. J. ALLEN.

Sextant-Telescopes.

I RECENTLY made the attempt to attach one of the prism forms of binocular to a sextant in place of the ordinary telescope, and it seemed that such an adaptation would materially increase the usefulness of the instrument and add to the accuracy of its records. In the sextant which I used there was no provision for rigorous attachment, and only a device of a temporary character could be adopted; but a very slight modification in the construction of the instrument or of the so-called "up and down piece" would overcome this drawback.

I am inclined to believe that very frequently only a plain sight is used in observations at sea, and that in many cases, where some optical power is employed, an ordinary Galilean opera-glass, with a power of about three, is preferred. The telescope usually supplied, which will give a power of from ten to fourteen, has so many drawbacks that its use is not popular, at least in the Mercantile Marine. The field is small, the telescope inverts, and the sextant is obliged to be held at a considerable distance from the body, so that if the framework be not made of aluminium it becomes heavy and burdensome.

The prism opera-glass which I used was made by Messrs. Goerz, of Holborn Circus, and among other advantages over the ordinary form, it gave more light in the field of view, of obvious importance in judging of the position of a dimly illuminated horizon. Also there was a direct view, so that the ordinary methods of observing needed no modification, and the field was sufficiently large to enable the object to be followed with ease. The power was about nine, quite as high probably as could be used on the deck of a ship with advantage; but I imagine it would be preferable in surveying work to use the highest power constructed, which gives a magnification of twelve. Possibly fifteen might be reached with advantage.

Liverpool Observatory. W. E. PLUMMER.

Solution of the Quartic.

PERHAPS the following semi-graphic solution of a quartic equation may be of some interest to your readers.

Suppose the parabola $x^2-y=0$ is drawn, once for all, on a sheet of squared paper. Take an equal parabola, and place it with its vertex at the point (a, b) and axis parallel to OX so that its equation, in this position, is

$$(y-a)^2=x-b.$$

Then the abscissæ of the intersections of the parabolas are the real roots of

$$x^4-2ax^2-x+(a^2+b)=0 \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Now the general quartic is at once reducible to the form

$$x^4+px^2+qx+r=0,$$

and if we put

$$x=-z\sqrt[3]{q},$$

this becomes

$$z^4+\frac{p}{q^{\frac{2}{3}}}z^2-z+\frac{r}{q^{\frac{4}{3}}}=0.$$

This is identical with (1) if

$$a=-\frac{p}{2q^{\frac{2}{3}}},\quad b=\frac{4r-p^2}{4q^{\frac{4}{3}}};$$

so we can calculate a, b, then place the movable parabola in position, read off the real values of z, and finally take

$$x=-z\sqrt[3]{q}.$$

G. B. MATHEWS.

10 Menai View, Upper Bangor, N. Wales.

Rural Education.

I AM very glad to learn from my friend, Prof. Meldola, that the school of which I previously wrote is so well known. The frequent reference to Bigods as an experiment, and as the first attempt to give a systematic training in science in a purely rural district, led me to imagine that people were not generally aware of Sexey's Trade School. It seemed therefore that some mention of its success might act as an encouragement to others, but obviously the fact that this work has been successfully carried on for some years in Somersetshire in no way detracts from the value of what is now being done in Essex. I may observe too that, while the latter has had to depend mainly upon the generosity of Lady Warwick and the enthusiasm of Prof. Meldola, the former enjoyed certain advantages in the way of endowment.

At Bruton the outlay in capital has amounted to 5140*l.* (cost of site 640*l.*, buildings and equipment 4500*l.*). This sum is made up of grants from the County Council amounting altogether to 1100*l.*, and of 4040*l.* derived from endowment, income account and donations. The County Council Building grants were thus distributed: in 1891 250*l.* for building and equipment, in 1892 450*l.* for a similar purpose, in 1894 250*l.* for new class-rooms and metal work, in 1897 150*l.* for a new physical laboratory, &c.; in all 1100*l.* Nothing under this head has been contributed by the Science and Art Department. Since 1893 a capitation grant of 2*l.* for day scholars and 3*l.* for boarders has been paid by the County Council to all approved schools in Somersetshire. At Sexey's Trade School this amounts to about 225*l.* a year. These grants go towards the salaries of science and technical teachers, and the school is open to inspection by the County Director of Technical Education. The total annual income of the school is about 1200*l.* Since 1894, pupils from the school have obtained 21 out of 36 County Intermediate Scholarships, and 5 out of 11 Senior Scholarships.

The school was opened with fifty pupils in temporary premises in April 1891. At Easter 1892 the new buildings were opened with sixty pupils. The cost of the buildings so far was nearly 3000*l.*, towards which, as stated above, the County Council contributed 700*l.* and the Governors subscribed 120*l.* Some of the classes were registered in connection with the Science and Art Department in the autumn of 1892, and the first examinations were held in May 1893. The school buildings were enlarged in 1897, when two new class-rooms, a metal workshop and gymnasium were erected. In 1895 the new regulations of the Science and Art Department for organised science schools were issued. The school appears to have been working for three years on similar lines to those laid down by the Department, and I am told that the conversion of the school into an "organised science school" was accomplished with practically no change of curriculum or method. The first grant of 260*l.* under the new regulations was received in 1896. Since then the grant has been very high, almost maximum grants for chemistry and physics having been awarded. The grant this year was 385*l.* and the number of pupils presented was fifty-seven. The grants from the Department have been as follows:—1893, 57*l.*; 1894, 104*l.*,; 1895, 96*l.*; 1896, 260*l.*; 1897, 384*l.*; 1898, 355*l.*; 1899, 385*l.* To comply with the requirements of the Department, a new physical laboratory and other buildings were provided in 1897, and this year a new museum and additions to the master's residence are being undertaken at a cost of nearly 400*l.*

I regret that I can furnish no information as to the constitution of the Technical Instruction Committee of the Somersetshire County Council, but doubtless these particulars can be ascertained from its annual report. JOHN C. MEDD.

Stratton, near Cirencester, October 29.

I SHOULD like to add to the above interesting statement by Mr. Medd that a rural school of science, which is even more akin to Bigods' than Sexey's Trade School, has been at work for some years at Bakewell in Derbyshire. I referred to this in my address at Bigods in 1898. The resemblance in constitution and function is due to the co-education of boys and girls, and it would add to the value of the present discussion if some information could be given as to the working of the Bakewell school.

R. MELDOLA.

IN addition to Sexey's Trade School, Bruton, the visitors of Sexey's Hospital recently (and in this case also at the instance of Mr. Hobhouse) have established a dual school of the same general type as the Bruton school in the village of Blackford, five or six miles from the nearest railway station, and in the midst of a purely agricultural district. New buildings have been erected at a cost of about 4000*l.*, towards which the County Education Committee has contributed 1000*l.*, in addition to 250*l.* in aid of the equipment of the laboratory and workshop. The Blackford school has been carried on for about one year in unsuitable temporary premises, but nevertheless attracted more than fifty pupils. The new buildings were opened at the end of September by Sir Henry Roscoe. The school has now between seventy and eighty pupils, a considerable proportion being boarders. The school will receive from the County Education Committee an annual grant of at least 120*l.*

C. H. BOTHAMLEY.

County Education Office, Weston-super-Mare, November 2.

Birds Capturing Butterflies.

WITH reference to Mr. O. H. Latter's note in NATURE (September 28, p. 520) on the capture of butterflies by the sedge warbler, it may be of interest to note that Sweet, whose work on keeping warblers in captivity is incorporated with Bechstein's "Cage-birds" in Bohn's edition of that work, recommends a living butterfly as a bait for this very species, and for several other warblers, when it is desired to trap adult birds.

I may mention that not long ago I saw here in Calcutta a common Mynah (*Acridotheres tristis*) with a white butterfly in its bill, which it had no doubt obtained in repose, as the day was dull, and the Mynah is not very expert at catching insects on the wing. I remember also once seeing at Dehra Dun a Dhyal or Magpie-robin (*Copsychus saularis*) take a disabled *Catopsilia* I threw out for it, though I have seen the same bird disregard a specimen flying at no great distance. Evidently the birds wait their opportunity, and, though too wise to waste their energies in the pursuit of these evasive insects on the wing, are always ready to snap them up when they can take them at a disadvantage. In this way it can hardly be expected that attacks by birds on butterflies will be often noticed, unless a naturalist will undertake to watch individual insectivorous birds for whole days at a time.

Similarly, one does not in India see kites and crows pursuing sparrows, though a dead one flung out will be greedily snapped up

by either species, and no doubt fledglings perish in numbers by these ever-watchful enemies. F. FINN.

Indian Museum, Calcutta, October 19.

MR. FINN'S letter is interesting as giving support to the opinion that it is when at rest that butterflies are chiefly attacked by birds. The injuries to be noticed on the wings of the insects very frequently are symmetrical on the right and left sides, and can only have been inflicted when the wings were folded in repose. I can only recall one occasion on which I have witnessed a bird attack a butterfly in flight, and then the attempt was unsuccessful. OSWALD H. LATTER.

Charterhouse, Godalming, November 7.

THE EFFECT OF WEATHER ON EVERY-DAY LIFE.[1]

SOME time since, a distinguished member of the Cotton Exchange asked my assistance to solve a problem connected with the variation of prices in "futures." He remarked that these prices varied almost from hour to hour without any apparent cause, such as a knowledge of the state of the crop or of the condition of the American market, which would explain these fluctuations. He was tempted to look for a subjective cause, and thought it might be found in the state of the weather exercising a powerful but unrecognised influence on the dispositions of purchasers and speculators, inducing them to buy or sell as they were alternately swayed by hopefulness or despondency. I was therefore invited to compare the movement of the cotton market with the variations in the weather, with the view of detecting the hidden relation, and was further stimulated to exertion by the assurance that if the origin of the fluctuation could be discovered "wealth beyond the dreams of avarice" would be at my command. Unhappily I failed to trace in the fickle weather the hidden springs that underlie the motives of speculators; and that fortune is still to be made by some one, possessed it may be of greater ingenuity or greater application, and to such an one I present the idea without hope of reward or acknowledgment.

Mr. Dexter's book reminded me of this experience, for he, too, has apparently embarked on an inquiry as difficult, but with a motive more noble, and let us hope with a reward more certain. Mr. Dexter wishes to trace the influence of weather on human conduct in general, and to see how far man's emotional state is affected by meteorological conditions. His reward is the attainment of a degree of Doctor of Philosophy, and the inquiry which he has instituted has apparently been undertaken with a view to meet the requirements of the authorities of Columbia University. One may sincerely hope that Mr. Dexter will have his ambition gratified, for to say that he has not spared himself in the labour of the inquiry is to say little. What is much more to the purpose he has not spared others. Teachers and superintendents of schools, wardens of prisons, superintendents of asylums for the insane, officials of the Weather Bureau and many others have been laid under contribution, by having submitted to them a "questionnaire" to completely satisfy whose interrogations involved not a little labour. Apart from the inconvenience which such a process might cause individuals, we doubt whether the plan adopted is the most trustworthy that could be found. Personal influence rather than climatic conditions is likely to introduce a systematic error into the final result. It is open to question whether the authorities consulted have satisfactorily eliminated the effect of weather from their own systems and mental states. The power of punishment rests with the authorities who have been consulted, and it may happen that those under their care are the victims of an irritability, engendered in the supervisors from causes with which the weather has absolutely no concern. To judge therefore mainly by the infliction of punishments seems of rather doubtful wisdom. This obvious objection has, of course, not escaped the author, and in one place he certainly recognises that the emotional state of the teacher is a not unimportant factor in the result. Indeed, he says, it may be the teacher we are studying more largely even than the pupil. The frankness with which this admission is made is more to be approved than is the reasoning by which it is set aside.

And now we are tempted to record a fact of which Mr. Dexter is entitled to make the fullest use. The temperature is 78°, the sky is cloudy, the wind is east, the velocity about three miles an hour, and under these conditions we find it much easier to present the facts at which Mr. Dexter has arrived than to criticise his results or carp at his methods. We notice that the author has studied, grouped, and commented on no less than fourteen classes of empirical data, embracing more than a quarter of a million separate facts. These fortunately can be grouped under fewer heads than the elaborate method pursued by the author admitted, and we hope we shall do him no injustice by the curtailment. First we have the registration and the behaviour of children in public schools (which we should probably call Board Schools in England) in New York City and at Denver, Colorado, two very widely different climates it will be remarked. Then we have a large amount of information drawn from police reports, which include assault and battery, discipline in penitentiaries, arrests for insanity and reported suicides. To these are added a few more or less fancy matters, in which the numbers involved are necessarily small, such as the clerical errors discovered in the records of certain of the national banks in New York City, maximum strength tests in gymnasia, and lastly "a study in discrimination carried on in the Psychological Laboratory of Columbia University." The discussion, it will be seen, is very wide, and one fact that will strike the reader prominently when he considers the variety of occupations into which the author has thought it judicious to push his investigations is the length to which this kind of inquiry can be carried when once we are bound hand and foot by the demon of statistics. Possibly the weather has no more to do with a clerk's mistakes than has the quantity or the quality of his supper the night before, but given a nicely ruled sheet of paper, and a system of rectangular coordinates, it is impossible to forgo the delight of plotting results to a scale. This is a harmless amusement; but when we begin to draw conclusions and to build theories, we may go as hopelessly astray as did the famous witness who connected the high tides with the building of a steeple. The author endeavours to meet any criticism of this nature in a passage which we may quote at length, to serve both as an example of his style of writing and his method of argument.

"The meteorological conditions are the essential causes of certain general physiological or mental states, some of which seem to be fertile fields for the action of immediate causes which are, from the standpoint of this problem, accidental. To be concrete, on a certain morning Johnny could not have what he wanted for breakfast, and went to school with the sulks, with a consequent disastrous effect upon his deportment. Most certainly the disappointment at home had a causal relation to his demerit, and no excuse from the weather is sought. But if we take the record of 200 Johnnies for 600 different days, and find that on certain days more of them are out of sorts than on other days, we look for a constant con-

[1] "Conduct and the Weather: an inductive study of the mental effects of definite meteorological conditions." By Edwin Grant Dexter, A.M. (New York and London: The Macmillan Co. *Psychological Review* Memoir.)

dition which might be considered in some way the cause. We cannot suppose that bad breakfasts or whippings or the disappointments common to child life would bear this constant relation, so look for it elsewhere. Wherever found it must be considered valid. But it must be some factor which would be a part of the environment of all the children similarly affected. We have sought it in the varying conditions of weather, with what success is shown by the curves which form the basis of our discussion."

These curves or diagrams are not so conclusive as the author seems to think. We have no proof that a legitimate application of the calculus of probabilities has been attempted. We cannot estimate the amount of variation exhibited by particular instances from the general interpolatory curve. In a word we cannot understand how the numerous observations have been combined, so that the unavoidable irregular errors have the least possible effect on the result. Further, these diagrams, or at least some of them, present another difficulty. To take the first figure which exhibits the effect of weather on the deportment, the class and mechanical work of boys and of girls in schools of various towns, and of boys and girls combined, in Colorado. The abscissa line is divided into eight sections of equal length defined by the weather conditions—hot, cold, wind, calm, storm, muggy, cloud and clear. Evidently there is no connection between the several parts—no regular progression in such an abscissa line. We cannot see, therefore, any reason for joining the several points, of which five out of eight are practically zero. But taking the author's interpretation as it stands, which for reasons already given we are quite prepared to do, this is what we learn.

In climates similar to those of New York, deportment and work are considered to be at their best on cold, calm, clear days, irrespective of sex, and at their worst on "muggy" days. In Colorado, calmness of the atmosphere produces a desirable effect on the condition of the pupils, wind exercises the most deplorable influence. Deportment, which apparently plays a great part in these schools, a fact which should rejoice the shade of the late Mr. Turveydrop, is affected by weather conditions, more in the case of boys than girls. This fact is explained by one teacher on the ground that boys are under less disciplinary control than girls. Another adds that girls "are greater adepts, not only at restraining impulses to do mischief, but also in concealing all evidences of it when it is in progress. This may be due to a greater horror on their part of an open reprimand." The cogency of this argument is not manifest, because the consequences of detection are likely to be visited on the boys with greater asperity than is covered by the term "open reprimand." The knowledge that acute punishment can and will follow conviction, should act as a deterrent and suggest methods of concealment that defy the penetration of the teacher.

When we come to discuss the behaviour of children of older growth, we still find the weather capable of exercising a baneful influence on their conduct and self-control, as illustrated by the number of suicides, assaults, and the perpetration of grave crimes. With regard to the morbid tendency disclosed in the mental state that produces the first of these misdemeanours, the author confirms the remark of Morselli and of others, who have considered the statistics of suicide, that an undue proportion take place in May and the spring and summer months of the year. This fact, which is contrary to the commonly received opinion, Mr. Dexter explains as arising not merely from a depleted vitality, produced by the exhausting influence of the cold of winter, but also by the "conscious or unconscious contrast of the recognised low condition of vitality with the exuberance of energy and life in the rejuvenated nature about, making one that is weak feel that the struggle against the resistance to life and progress, in competition with a world so virile, is hopeless." This remark is perhaps more ingenious than convincing, but if any considerable space of time is supposed to elapse between the contemplation and the completion of the act, it seems useless to tabulate the number of suicides with the height of the barometer and the humidity of the atmosphere, quantities that are continually varying.

It is of interest to notice that the number of assaults increases pretty uniformly with the temperature, or it would be more correct to say with an excess of temperature. Given a hot day in the spring or autumn, and our pugnacity rises in an alarming manner, though in the hot days of summer this quarrelsome mood is not so aggressive. The author concludes from the arrangement of his facts that the effects of heat up to a certain limit are vitalising in their tendency, while at the same time irritating; but above that limit, heat is so devitalising in its effects as to leave hardly energy enough to carry on a fight. Sad to relate, the effect of heat upon ladies is greater than on men; and this is shown not only by an increased desire to fight, but also by evident mental unbalancing. Whether one is the consequence of the other, or whether both are to be traced to the greater sensitiveness of women to weather conditions, is too thorny a subject for masculine debate. But the tales that come from penitentiaries and from those who have charge of the insane, alike testify to the irritating effects of increased temperature. In this connection the author thinks that a study of the record of profanity might yield interesting results, but unfortunately he adds "inclination alone will at least get no one into the police court," so that numerical data are wanting to discuss this phase of the weakness of human nature. It would probably be found that the curve would not greatly differ from that of assault, and it would certainly be comforting if we could shift the responsibility of our deviations from rectitude to such an impersonal agent as the weather. In our own ignorance we were rather tempted to attribute these lapses from good conduct to too free an indulgence in alcoholic beverages in the warm weather, but the author with far greater familiarity with the subject traces them to a much deeper source to be found possibly "in the depletion of the cell structure," or "in acceleration of the oxidising processes of life," expressions which we can only hope are as accurate as they are sonorous.

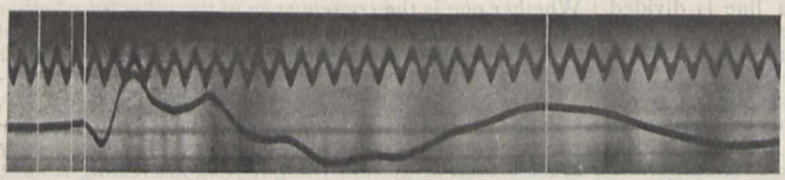
It is no new question to seek the effect of weather upon the moods and impulses of the population, but Mr. Dexter has tapped a new source of inquiry when he asks what are the meteorological conditions which induce clerks in banks, and we presume computers in general, to make mistakes in their work, and to offer up incorrect answers. When the barometer is low, let us forswear computations, but if the humidity be at the same time small, it would be positively immoral to attempt to add up a column of figures. The author explains this by the fact "that the intellectual balance is more disturbed by the increased electrical potential than is the emotional." We are afraid to discuss this proposition, more especially as we have overstepped the limits of space, but we must find room to say that we respect the evident trouble and care which the author has taken in compiling his results, and to ask his pardon if our remarks have appeared too flippant, when applied to a work which he has taken very seriously. Some of his inquiries are not yet complete, but we hope that he will continue them to the end, and leave his results in such a form that a more rigorous discussion may be possible. By "rigorous" is merely meant on recognised mathematical principles, in which one can see easily the relative "weight" which is to be attached to the separate deductions, and the "probable error" that accompanies each. W. E. P.

VIBRATIONS OF GUN BARRELS.[1]

THE authors of this research on the vibrations of gun barrels were induced to make an experimental investigation of the behaviour of rifle barrels, in order to clear up certain difficulties connected with that which is known in ballistics as the *error of departure*. It had been noticed that in shooting with a rifle (whether held loosely, or firmly fixed), that the initial tangent to the trajectory —"die Anfangstangente der Flugbahn"—does not coincide, as would be expected, with the axis of the bore of the barrel, when produced, but is more or less inclined to it at a small angle; this is called *the angle of error of departure*. The authors, working with photo-chronographic methods, determined the movements of the muzzle end of a rifle in a vertical plane, and a vibrational movement of the barrel was detected, and recorded on a moving photographic plate, on the same plate; a trace from a tuning-fork of known period was also formed, so that the position of the muzzle was known at any instant. The rifle used was of the Mauser type M 71.

The collection of photo-chronographic records, twenty-eight in number, show the manner in which a rifle barrel vibrates when subjected to the concussion due to an explosive. Figures 6, Plate I., and 7, Plate II., indicate a rapid initial vibration, apparently due to the beginning of the explosion. The records, as a whole, show how an error of departure may be produced. The photographs in some cases are not so clear and defined as those usually produced in physiological research; this is probably due to the beam of light having been cut off by an object of circular section, such as the wire used by the experimentalists. A thin metallic lamina, such as blackened aluminium foil, would have given sharper details. The authors show that the experimental results agree well with figures calculated on the assumption that the rifle barrel is a cylindrical tube.

There is much in the work of Messrs. Cranz and Koch which will be of value to the student of ballistics and to those who design military and other rifles. F. J. J-S.



γ

FIG. 1.

γ

FIG. 2.

Curves showing the vibrations of different parts of a gun barrel after firing. The spot on the bright line marked γ indicates the moment at which the shot left the barrel. Fig. 1 is the vibration curve of a point 1·5 cm. from the mouth, and Fig. 2 of a point 18·5 cm. from the mouth.

NOTES.

THE Council of the Royal Society has adjudicated the medals for the current year as follows:—The Copley Medal to Lord Rayleigh, F.R.S., for his contributions to physical science; a Royal Medal to Prof. George Francis Fitzgerald, F.R.S., for his contributions to the advancement of physical science, especially in the domains of optics and electricity; a Royal Medal to Prof. William Carmichael McIntosh, F.R.S., for his important monograph on British marine zoology and on the fisheries industries, and on account of his work in establishing a Marine Biological Laboratory at St. Andrews; the Davy Medal to Mr. Edward Schunck, F.R.S., for his investigations on madder, indigo and chlorophyll. Her Majesty the Queen has graciously signified her approval of the award of the Royal Medals.

THE first congress of Russian electricians, organised by the Société Impériale Technique de Russie with the authority of the Ministers of the Interior and Finance, will be held at St. Petersburg on December 27, 1899 (January 8, 1900). The objects of the congress are the promotion of friendly intercourse between electricians, the exhibition of the most recent inventions in electricity and its applications to industry, the discussion of instruction in technical electricity, and other subjects which are concerned with the advancement of electrical science in Russia. The apparatus and machinery, plant, models and inventions, sent by electricians of any nationality, will be exhibited in the rooms of the Imperial Technical Society, Panteleimonskaja 2, St. Petersburg, to which address all communications should be forwarded. Objects intended for the exhibition will be admitted into Russia free of duty, under the condition that they are removed within a month of the close of the exhibition.

PROF. TYLOR writes to call attention to the remarkable activity of anthropological research of late years throughout Austria-Hungary. Students interested in such work may profit much by visiting several districts now of easy access, whether in quest of remains of the Hungarian Copper Age, the caves and burial-places of the Trieste district, the dug-out canoes of the Bosnian fishermen, or the dwindling survivals of ancient patriarchal-communal life in the zadrugas of Croatia. As an example of the activity of the anthropological museums may be mentioned the descriptive catalogue, by Dr. Jankó, of the Biró Ethnographic Collection from New Guinea in the Hungarian National Museum at Buda-Pesth. The first part has been lately published, and is of so excellent quality that it is to be hoped that funds will be forthcoming to complete the work on the same scale.

MR. R. F. MUIRHEAD has been elected president of the Edinburgh Mathematical Society for the ensuing year.

THE American Geographical Society receives 1000*l.* under the will of the late Mr. C. P. Daly, for the foundation of a medal to be awarded for distinguished services to geography.

THE *Chemist and Druggist* announces that Prof. Moissan has been appointed director of the Laboratory of Practical Chemistry at the Paris Faculty of Sciences.

THOUGH the distance is not less than thirty miles, the sound of the firing at Ladysmith is said to be so plainly heard at Estcourt that the reports of heavy guns (supposed to be the two naval 4·7-inch guns, followed by the bursting of Lyddite shells) can be easily distinguished above those of the Boer 40-pounders and the smaller guns on both sides.

WE learn from *Science* that Mr. R. E. Snodgrass and Mr. A. H. Heller have just returned from a ten months' collecting

[1] "Untersuchungen über die Vibration des Gewehrlaufs." Von C. Cranz und K. R. Koch. Pp. 31. Six plates; 13 figures in letterpress. (München: 1899.)

trip to the Galapagos Islands. The collections are large; birds, fish, and insects and spiders being represented by especially large numbers of specimens. The collections belong to Stanford University, under whose auspices the expedition was made.

As the gravels in the neighbourhood of Chelsea are very rich in rude flint-flakes and the like, many students of archæology and geology may be glad to know that a large vacant space at the corner of Cheyne Walk and Beaufort Street, Chelsea, is shortly to be built upon, and the excavations will probably go down into hitherto undisturbed soil. Mr. W. F. Sinclair calls our attention to the opportunity which the excavations will afford for collecting flint specimens.

By the death of Mr. William Pamplin, in the ninety-third year of his age, on August 9, English botanists have lost their *doyen*. Mr. Pamplin was an authority on British plants, and especially on their geographical distribution, in the first half of the present century. The "London Catalogue of British Plants" owed much to him. In the year 1827 he published a list of the rarer plants of Battersea and Clapham; and he was elected an Associate of the Linnean Society in 1830. Mr. Pamplin at one time carried on the business of a second-hand bookseller in London, but had lived for many years in great retirement near Bala in North Wales.

The annual course of Christmas lectures, specially adapted for young people, at the Royal Institution, will this year be delivered by Mr. C. V. Boys, F.R.S. The subject will be "Fluids in Motion and at Rest." The lectures (which will be six in number) will commence on Thursday, December 28, at three o'clock. The remaining lectures will be delivered on December 30, and on January 2, 4, 6, and 9, 1900.

Science announces that Mr. O. F. Cook, of the Division of Botany, U.S. Department of Agriculture, left New York a few days ago for Puerto Rico to make a preliminary examination of the plant products of that island with reference to the introduction of new and useful tropical plants. Mr. Cook is accompanied by Mr. G. N. Collins, of the Department of Agriculture, as photographer, and by Mr. George P. Gall, who is sent by the Smithsonian Institution to collect material for the National Herbarium.

We learn from the *Cape Times* that Mr. P. L. Sclater, F.R.S., who has lately returned from a visit to South Africa, attended a meeting of the South African Philosophical Society on September 17, and gave an address on the desirability of establishing a Zoological Garden in Capetown. Mr. Sclater showed that the important centres all over the world were taking measures to establish such institutions for instruction and recreation, and urged that Capetown, being the port and capital of what would shortly be an enormous empire, should not be behindhand in the matter. Mr. Sclater's proposals were discussed and well received, and a committee of the Society was appointed to consider the subject and report to a future meeting.

Referring to the death of Dr. Edward Orton, professor of geology in the Ohio State University, in the seventieth year of his age, the *American Journal of Science* remarks that while his labours have extended to all branches of geological science, his close watch of the exploitation of petroleum and natural gas, in Ohio and the neighbouring States of Pennsylvania and Indiana, has given him a place of pre-eminence as interpreter of these important geological products. In 1897 Dr. Orton was elected president of the Geological Society of America, and, as president of the American Association for the Advancement of Science, presided at the recent meeting of the Association, in Columbus, in August last. Prof. Orton was a man of broad culture and of influence outside his chosen science. He was for a time president of Antioch College, Yellow Springs, Ohio, and then became president of the Ohio Agricultural and Mechanical College, which has now become the State University. He resigned the presidency and became State geologist in 1882, which position he held up to the present year. Dr. Orton received the degree of Ph.D. from Hamilton College in 1848, and LL.D. from Ohio State University in 1881.

At the opening meeting of the new session of the Royal Geographical Society on Monday, the president announced that, including the Government grant, the funds at the disposal of the joint committee on Antarctic exploration amounted to 90,000*l.*, but he recalled the fact that the grant which had been promised was made dependent upon another 5000*l.* being raised from other sources. A valuable paper, illustrated by many striking photographs, was read by Mr. W. Rickmer Rickmers, on a journey in the Eastern provinces of Bokhara, with his wife and Dr. von Krafft, now of the Geological Survey of India. Mr. Rickmers established a permanent camp on a tributary of the Yakh-su river, with the object of studying the wonderful mountain system of the "conglomerates" of East Bokhara. The "conglomerates" cover an area of 800 square miles, disposed in a long strip between the rivers Vaksh and Panj, with a strike from north-east to south-west. They show distinct stratification, and Dr. von Krafft ascribes them to the Tertiary period. The stones composing them are chiefly crystalline. The greatest thickness of the formation may be said to be at least 4000 feet. The population of the region is mainly dependent for its livelihood on the gold-washing industry. The yearly gold output of East Bokhara is variously estimated from 20,000*l.* to 30,000*l.*, but this is a mere trifle considering the potentialities of the alluvial deposits. The quantities extracted by the natives in the course of centuries have hardly encroached upon the store, and are as nothing compared with what Europeans could produce in a few years.

As appears from the Report of the Select Committee on the Destruction of Vermin, lately presented to the House of Assembly of the Cape, no less a sum than 27,084*l.* was spent in the various districts of the Colony in the year ending June 30, 1899, in rewards paid for the "destruction of vermin." This large expenditure not unnaturally excited the attention of the Legislative Assembly, who appointed a Select Committee to consider it. The Committee, after taking the evidence of many farmers, land-owners and other persons interested in the subject, have come to the conclusion that it is expedient for the agricultural interest (a predominant factor, it may be remarked, in Cape politics) that the system of giving rewards for the "destruction of vermin" should be continued, but that more care should be exercised in ascertaining that those who claim the rewards are properly entitled to them. The "vermin" in question appear from the evidence to be the Black-backed Jackal (*Canis mesomelas*), the Aard Wolf (*Proteles cristatus*), the Cape Baboon (*Papio porcarius*), and the so called "Lynx" or Roode Cat (*Felis caracal*), all of which are accused of ravaging the farmers' flocks, especially during the lambing season. The Aard Wolf, it is admitted, is not usually carnivorous, but is said to have developed of late years a noxious habit of tearing open the breeding ewes in order to get at the milk in their breasts.

A possible substitute for india-rubber and gutta-percha was exhibited and described by Mr. W. F. Reid at the last meeting of the Society of Chemical Industry, under the name of "Velvril." The material appears to be suitable for machine-belting—made by coating cotton canvas with it—waterproofing cloth or canvas, and as a varnish for paint, wood or metal; and so far as its mechanical and protective properties are

concerned, it compares favourably with gutta-percha. *The Electrician* is of the opinion that the material at present lacks the flexibility necessary to the core of a submarine cable, and also the strength and elasticity required for a golf ball. Perhaps with improved methods of manufacture these qualities can be given to "Velvril," but until then gutta-percha will hold its own as the most suitable substance for these two purposes.

A FEW years ago the phenomena of "Barisâl Guns," and other similar noises, were discussed at some length in the columns of NATURE. A valuable contribution has recently been made to this interesting subject by Prof. A. Issel, in a paper published in the *Bollettino* of the Italian Seismological Society. The author's chief object is to describe the detonations which were heard at about the time of the Umbria-Marches earthquake of December 18, 1897. These detonations are quite distinct from the sound which generally accompanies an earthquake-shock. They are rather crashes, more or less prolonged, and resemble the boom of thunder or the report of heavy guns at a distance. Sometimes they are isolated ; at other times they occur in series, following one another at brief intervals. Generally they begin with a strong blow, which has very often a slightly metallic sound, and then gradually diminish in number and intensity until they cease, but there may be one or more renewals of activity. To many persons the crashes seemed to come from Monte Nerone, where the epicentre of the earthquake was situated. They are frequently heard at other times by the inhabitants of the middle Appennine region, and are known to them by the name of Bombìo. Very often they occur in close connection with earthquakes, and they may be followed immediately by a slight shock or tremor ; they are also stronger and more numerous during epochs of maximum seismic activity. Prof. Issel correlates these crashes with those known in other places as Marinas, Mist-Poeffers, &c. ; and, as these phenomena are especially characteristic of seismic districts, he regards them for the most part as due to endogenous causes.

ELECTRICITY is rapidly gaining ground as a motive power for harbour and dock works and for traction on canals. In France haulage by electricity has been in use on some of the canals for several years, and, besides being found economical, has been of special value for working the boats through tunnels. The system is now to have a trial in this country, a portion of the Leeds and Liverpool Canal near Wigan being fitted for electric traction ; and it is anticipated that, besides other advantages, a saving in the cost of traction of 50 per cent. as compared with horse haulage will be effected. On the Dortmund and Ems Canal in Germany, recently opened for traffic, the cranes and other machinery at the terminal stations, and all the work at the locks connected with the opening and closing of the gates and sluices are to be operated from a central station, where electricity is to be provided by steam power. The haulage along the canal is to be effected by a small electric locomotive running along the tow-path, and obtaining its supply from trolly wires. On the Erie Canal one or more systems have already been tried with partial success. It is now reported that the storage battery system is to be introduced ; an electric traction engine will run along the tow-path and haul a canal boat filled with storage batteries of sufficient capacity to furnish current for the traction engine and the boats towed by it. The locks of the North Sea and Baltic Canal, and also the new lock of the Amsterdam Canal at Ymuiden, are both worked by electricity, which is found to have great advantages over hydraulic power in winter when sharp frosts prevail. In this country, at Southampton Docks and other places, cranes are in use worked by electricity.

A THESIS on "The Memory Image and its Qualitative Fidelity," reprinted from the *American Journal of Psychology*, has been received from Dr. I. Madison Bentley. The results of experiments carried on for the special investigation of the visual memory image and its fidelity to an original presentation have led to several conclusions of psychological interest. It appears that discs—grey and coloured—shown and remembered in daylight, tend to grow light in the visual memory, while grey discs shown in a dark chamber display a tendency in the visual image to grow dark during an unilluminated interval. These results indicate that the condition of the retina in respect to stimulation during the memory interval is important for the memory image. Illuminated and unilluminated intervals, where all other conditions are constant, are followed by different judgments with the same memory stimuli. It is therefore concluded that in all experiments with brightness and colour, where a time interval is involved, care should be taken to control the state of the visual organ. It is not improbable that a similar caution would apply to other sense memories. The results also show that memory is not to be regarded as a storehouse of perfectly conserved images, but that the most simple memories are continually exposed to change, and that it is, at times, only by the combination of various memorial resources that retention is made definite and exact.

THE intermittent treatment of sewage in bacteria coke-beds forms the subject of a second report presented to the London County Council by their chemist. Various investigations were carried out and are here recorded with the object of ascertaining the most effective method of constructing and working the coke-beds, and the data obtained form an interesting contribution to the literature, now considerable, daily accumulating on this method of sewage treatment.

THE reports of the malaria expedition in Italy under the direction of Prof. Koch receive adverse criticism at the hands of Dr. Grassi, writing in the *Atti dei Lincei*, viii. (2), 8. Among the points at issue it would appear that Koch, in the reports referred to, still admitted the possibility of malaria being propagated by *Culex pipiens*, a view long since abandoned by Grassi on circumstantial evidence, which he now summarises in detail. Much of the evidence which led Grassi to attribute the propagation of malaria to Anopheles and not to Culex has been given in previous papers in the same journal.

THE well-known experiment of the early popular text-books on "freezing and boiling water simultaneously" under the exhausted receiver of an air-pump being difficult to perform in practice, Mr. R. W. Quick describes in the *Physical Review* another mode of achieving a similar result. This is a continuation of the experiment commonly described under the heading "water boiled by cold," in which the tightly-corked flask containing the water and steam is cooled, first with iced water, and then with a mixture of solid carbon dioxide and ether, until ice forms as the water boils—or the flask bursts. As Mr. Quick remarks, there must not be sufficient residuum of air in the flask to keep the pressure above 0·46 cm. (the vapour pressure of ice at 0° C.), otherwise no amount of cooling would be effectual in causing boiling and freezing simultaneously.

A PAPER by Prof. Archibald Barr, on "Similar structures and machines," read before the Institution of Engineers and Shipbuilders in Scotland, is appearing in the form of a series of illustrated articles in *Engineering*. The disproportionality between large and small structures required to ensure corresponding strength in supporting weight is illustrated by figures showing the difference in structure between the skeletons of large and small animals, and also by diagrams showing the Britannia and Forth Bridges reduced to the same span.

THE *Proceedings* of the annual meeting of the Indiana Academy of Science, held at Indianapolis at the end of December last, contains quite a number of mathematical papers, foremost

among which are Mr. D. A. Rothrock's papers on point invariants for the Lie groups of the plane, and on differential invariants derived from point invariants. To those interested in the geometry of the triangle, Mr. Robert Judson Aley's list of concurrent sets of three lines connected with the triangle will prove a most useful synopsis for purposes of reference; it enumerates eighty-four different concurrences. The same writer communicates a note on a new triangle and some of its properties; while Mr. C. E. Smith, of Indiana University, discusses the geometry of Simson's line. A linear relation between certain of Klein's X-functions and sigma functions of lower division value is given in a note by Mr. John A. Miller.

A FEW years ago Lussana discovered that the electric resistance of aqueous solutions presented certain anomalies in the neighbourhood of the temperature of maximum density, these anomalies being represented by a point of inflection in the curve expressing the relation between the resistance and the temperature. In view of the objections raised against Lussana's work and the intimate relation known to exist between the electric resistance of a fluid and its viscosity, it occurred to Dr. G. Pacher to examine whether any variations analogous to those found by Lussana existed in the coefficient of viscosity of water near the temperature of 4° C. The results of Dr. Pacher's experiments are described in a paper in the *Atti del R. Istituto Veneto*, lviii. (2), pp. 785–814. The coefficient of viscosity was found by observing the efflux of the liquid through a capillary tube, Poiseuille's law being assumed, and the temperature was maintained constant by immersing the tube in a water bath. From the viscosity its temperature-coefficient was calculated and represented graphically by a curve. The conclusions arrived at are as follows: (1) In the neighbourhood of 4° the viscosity of distilled water presents an anomaly indicated by a point of inflection in the curve connecting he viscosity with the temperature; (2) the temperature-coefficient of the viscosity presents a maximum followed by a minimum between the temperatures of 3° and 6°; (3) given the relation between the temperature-coefficient of viscosity and that of electrical resistance, a similar anomaly may be expected to exist in the electrical resistance of distilled water; (4) Lussana's results thus receive indirect confirmation from the present investigation.

A POPULAR account of the possibilities and difficulties of aërial navigation, based upon the scientific experiments made by Langley, Lilienthal, Pilcher, Maxim and others, appears in the current number of the *Fortnightly Review*.

SIR JOHN EVANS'S presidential address, on "The Antiquity of Man, with especial reference to the Stone Age in Egypt," delivered at the Birmingham and Midland Institute, has recently been published. It is a brightly written sketch of a vast subject; the more important approximate dates are given, which is a useful feature.

THOSE who are interested in Indian folk-lore must always keep an eye upon the *Journal* of the Asiatic Society of Bengal. The first part of the new volume of the Anthropological Section for this year contains a variety of interesting papers, amongst which may be noted one, by Mr. C. C. Mitra, on folk-lore about birds, and one, by Mr. C. A. Silberrad, on a rain-compelling ceremony which is performed by women.

A COPY of the Report and Transactions of the South-Eastern Union of Scientific Societies, containing an account of the proceedings at the fourth annual Congress held at Rochester in May last, has been received. The Union systematises scientific work among the different societies composing it, and in various ways promotes the interests of science. Next year's Congress will be held at Brighton early in June.

FROM Messrs. Williams and Norgate's very useful "Book Circular" (Scientific Series, No. 72), containing descriptive notes on the contents of recent foreign publications, we obtain the following announcements as to forthcoming scientific works:—"Die Elemente der Entwicklungslehre des Menschen und der Wirbeltiere" is the title of a work by Prof. O. Hertwig, of Berlin, which will shortly be published.—M. Le Dantec, lecturer on embryology at the University of Paris, has written a work entitled "Lamarckiens et Darwiniens," which will be issued very shortly.—"Ueber Reduktionstheilung, Spindelbildung Centrosomen und Cilienbildung im Pflanzenreiche" will be the subject of the sixth part of Prof. E. Strasburger's "Histologische Untersuchungen."—The first part of "Nouveaux éléments de botanique," by Prof. Louis Crié, of Rennes, will soon appear, and the second part will be published in the course of next year.—The fourth edition of Prof. Lapparent's "Traité de Géologie" will be issued in three parts. Of these, the first two will appear almost immediately, and the third will appear in January.

THE difficulty of preparing metallic cæsium is well known. The metal has hitherto been obtained chiefly by the electrolysis of the cyanide mixed with barium cyanide, but the unsatisfactory character of this process is sufficiently shown by the price of the product, which is about twenty-eight shillings a gramme. It has been shown quite recently by Herren Graeffe and Eckhardt that cæsium can be prepared easily and with an almost theoretical yield by the reduction of cæsium carbonate by means of magnesium powder. The mixture is heated in an iron tube through which a slow current of hydrogen passes. The metal distils over, and is collected under melted paraffin. It has a silvery lustre with a slight yellow tint, and remains bright under paraffin. On exposure to air it oxidises rapidly, melts, and finally inflames. In its action on water it resembles potassium. A previous attempt by Winkler to prepare cæsium by reducing the carbonate with magnesium failed, and led that chemist to doubt the statement of Beketoff that the reducibility of the alkaline carbonates increased with increasing atomic weight of the metal. Herren Graeffe and Eckhardt, however, confirm Beketoff's conclusion, and show that cæsium is more easily reducible than rubidium, and rubidium than potassium.

THE additions to the Zoological Society's Gardens during the past week include a Sykes's Monkey (*Cercopithecus albigularis*) from East Africa, presented by Lord Alexander Thynne; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. W. J. Beard; a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, a Viverrine Phalanger (*Pseudochirus cooki*) from Tasmania, an Agile Wallaby (*Macropus agilis*) from Australia, a Brown Capuchin (*Cebus fatuellus*) from Guiana, a Rufous-necked Wallaby (*Macropus ruficollis*) from New South Wales, three Cardinal Eclectus (*Eclectus cardinalis*) from Amboyna, four Serrated Terrapins (*Chrysemys scripta*), three Prickly Trionyx (*Trionyx spinifer*), four Menobranchs (*Necturus maculatus*), an Amphiuma (*Amphiuma means*) from North America, three Mute Swans (*Cygnus olor*), European, deposited; a Black-backed Jackal (*Canis mesomelas*) from South Africa, two Brazilian Caracaras (*Polyborus brasiliensis*), an Anaconda (*Eunectes murinus*) from South America, purchased; a Spring-Bok (*Gazella euchore*) from South Africa, received in exchange; a Hog Deer (*Cervus porcinus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE ANDROMEDES.—In respect to the reported observation of Biela's comet, no confirmation of which, however, is yet to hand, it will be well to keep careful watch on the character of the second November display. The maximum is timed to occur from the 23rd to the 27th, the approximate coordinates of the radiant being

R.A. = 1h. 40m.
Decl. = +44°;

that is, a little north-west of γ Andromedæ. The usual characteristic of these meteors is their slow flight, in contrast to the swift Leonids, and this should facilitate photographic impressions of them being obtained.

HOLMES' COMET (1899 *d*).

Ephemeris for 12h. Greenwich Mean Time.

1899.	R.A.	Decl.
	h. m. s.	° ′ ″
Nov. 16 ...	2 20 25·87 ...	+48 25 43·7
17 ...	19 24·98 ...	19 55·4
18 ...	18 25·68 ...	13 51·5
19 ...	17 28·03 ...	7 32·5
20 ...	16 32·09 ...	48 0 59·3
21 ...	15 37·93 ...	47 54 12·3
22 ...	14 45·60 ...	47 12·4
23 ...	2 13 55·17 ...	+47 40 0·2

OCCULTATION OF NEPTUNE.—On Sunday evening next, November 19, there will be an occultation of Neptune, visible throughout the whole of northern Europe, for the observation of which the following particulars will be useful :—

	Sidereal time.	Mean time.	Angle from North point.	Angle from Vertex.
	h. m.	h. m.	°	°
Disappearance...	22 4 ...	6 10 ...	95 ...	129
Reappearance ...	22 56 ...	7 1 ...	261 ...	299

The angles given will facilitate the adjustment of the moon's image so as to bring the points of "immersion" and "emersion" into the positions of best definition. The "angle from the north point" is the angle subtended at the centre of the moon's disc by the arc extending from the star when in contact to the point of intersection of the moon's limb by a great circle passing through the North Pole; the "angle from the vertex" is the angle subtended by the arc extending from the star to the point of intersection of the limb by a vertical great circle passing through the zenith.

For the convenience of observers south of London it may be mentioned that the limits of latitude for this occultation are 90° N. to 25° N.

"THE HEAVENS AT A GLANCE" (1900).—Mr. Arthur Mee, of Cardiff, has published his annual astronomical calendar, upon which is given a concise tabulation of the more important astronomical constants and events for the coming year. One half of the card constitutes a celestial diary, indicating the favourable dispositions of the various constellations for each month, the sun's declination, phases of the moon, and configuration of the planets, with detailed enumeration of occultations and variable star phenomena. Following this, descriptive notes are given of the prominent features visible on the moon at various stages throughout the lunation; times of elongation, opposition, &c., of the planets throughout the year; a list of the more prominent meteor showers, the eclipses of the year, and several facts concerning variable stars. The whole is printed on a single card, facilitating its being kept within reach for instant reference by the observer's side, and thus specially recommends itself to the amateur who may be unable to spare the time necessary for obtaining the information from the more complete reference works of the observatory. Astronomical time is used throughout, and all the data are for Greenwich, but are applicable with slight corrections to the whole of the British Isles. Not the least important feature is the clear style of arrangement and printing, which will render its use more pleasant under actual working conditions.

THE CONFERENCE OF GERMAN MEN OF SCIENCE AT MUNICH.

THE seventy-first meeting of the Society of German Naturalists and Physicians opened at Munich on September 17, and continued until the 23rd.

A great disaster had just visited the city; the floods which had wrought such havoc throughout the Salzkammergut and South Bavaria culminated their work of destruction in Munich, where the Isar, rising many metres in a few hours, destroyed two of the finest bridges in the capital, inundated the low-lying parts of the town, and threw out of gear the Electric Works and many factories along the banks; many lives were lost.

The Prince Regent bridge, which was entirely destroyed, was the gift of the ruler whose name it bears; the original cost was 1,500,000 marks, and the munificent Prince has undertaken to bear the cost of rebuilding the same.

In spite of the dislocation of all routes of communications, the congress was attended by about 3500 members. The proceedings opened with a gala meeting in the Royal Theatre on Monday, September 18, when the congress was inaugurated by Councillor von Winckel, and the members were welcomed, on behalf of the Prince Regent, by Prince Ludwig Ferdinand, who evinced his interest by attending all subsequent general meetings.

After several other speeches had been delivered, Dr. Fridtjof Nansen ascended the tribune and summarised the scientific results of his Polar Expedition.

Parenthetically, it is interesting to note that three of the most remarkable addresses were delivered by foreigners—Nansen, van t' Hoff and Ramsay—in fluent German.

Nansen showed the typical glacial appearance of the Siberian coast, then described Franz Josef's Land, which is far less extensive than appears on the maps; the land is almost entirely covered with ice, relieved here and there with masses of black basalt rocks, which rest on a seam of clay some 500 feet in thickness.

The Arctic Ocean may be considered as a kind of lagoon separated from the Atlantic by a submarine range of mountains, stretching from Spitsbergen to Greenland; this range is responsible for a curious condition of things. The Arctic Ocean is covered with a layer of brackish water containing a low percentage of salt, and collected from the Siberian rivers and the Bering Strait; below this is Gulf Stream water, containing a normal quantity of salt.

If these two layers of water were mixed, the average temperature would fall, but this average would not be so cold as that of the surface layer of Arctic water; this condition accounts for the enormous formation of ice in the polar region.

The points were all illustrated by photographs, tables and diagrams, and drawings of the diatoms found in the fresh-water lakes, formed by the sun melting the surface of the ice, were shown.

The lecturer was followed by Prof. von Bergmann, who demonstrated the value of radiography in the diagnosis of surgical diseases; and by Prof. Förster, who described the alteration in the face of the heavens from the remotest periods down to the present time.

After these addresses many members adjourned to the Technical College, the whole of which magnificent building had been placed at the disposal of the congress, and where reading and writing rooms, reception and inquiry offices, a restaurant, &c., were to be found.

Here the daily programme was to be obtained, and each member of the congress was presented by the city with an admirable album of views and a "Festschrift."

The Festschrift was a magnificent quarto volume describing the development of Munich under the influence of the natural sciences during the last decades. The first part of the work was devoted to vital statistics and general municipal organisation. A few facts are, however, of general interest and formed the subject of addresses during the congress.

The Electrical Works on the Isar are a most remarkable example of a municipal undertaking; besides the current used for the electric cars, lighting, telegraph and telephone purposes, they supply current to work 172 motors (1329 H.P.), 13,500 incandescent and 329 arc-lights in 91 factories. Besides the Corporation works, there are 317 private installations, of which 69 use gas, 39 water, and 179 steam to supply the motive power.

The population of Munich is 450,000. The cost of lighting the streets (incandescent gas and arc-lights) represented last year, per head of the population, a yearly cost of 1·925 marks; in 1881 the cost was less than half this sum, 0·81 mark per head.

Of the two most prominent industries in Munich, the second, the industrial production of cold, originated in the demands and necessities of the first, the brewing industry.

In 1898 there were 24 breweries, producing 1,540,000 hectolitres of beer. Munich has always been celebrated for its beer, and in the year 1500 possessed 38, in 1618 no less than 69 breweries.

The industry of the production of low temperatures is due to the energy of, and was initiated by, Dr. Carl Linde, who in 1881, with the help of the Polytechnic Society, started the famous works, where successful experiments were carried out with the "high pressure and low temperature system," and with the happy combination of Siemens' alternating principle with the Joule-Thompson "cooling effect," produced by the streaming of gases from high to low pressures. The following are the chief industrial and scientific uses of low temperatures: manufacture of ice in the brewing industry; preservation of meat and alimentary products generally; preservation of anatomical specimens; in the morgues; the arrestation of the development of the silk cocoon; arrestation of the growth of bulbs (making the same independent of their accustomary flowering season); in the testing of meteorological instruments; and in scientific research generally; the preparation of explosives, the fractionation of liquid air, and consequent preparation of mixtures rich in oxygen; the manufacture of ozone.

The Cold Air Storage Installation at Munich is the most complete building of the kind at present erected; the cells are kept constant at 3° C., and the air contains 60–70 per cent. of moisture.

The second general meeting was also held in the Royal Theatre, and the addresses on this occasion were delivered by Prof. Boltzmann (Vienna) on the course of the development of modern physical methods; by Prof. Birch-Hirschfeld on science and therapeutics; and by Prof. Klemperer (Berlin) on Justus von Liebig and medical science.

The last-named speaker showed that Liebig initiated the use of chemical preparations of known composition in the place of those plant infusions of doubtful consistency, which formed the staple drugs of the older physicians. Prof. Klemperer declared that the days were drawing near when such extracts would disappear from pharmacology, and chemistry would be entirely substituted for botany.

In another, less direct, way Liebig was the means of enriching our pharmacopœia, for it is by the method of organic analysis he perfected that the composition of the numerous synthetic remedies of to-day is determined. Chloroform and chloral were discovered by him, and, working in a somewhat different region of thought, Liebig exploded the theory that the warmth of the animal organism was in part due to electricity and the action of the nerves, showing that all animal warmth was produced by the chemical processes continually taking place within the organism.

THE CHEMICAL SECTION.

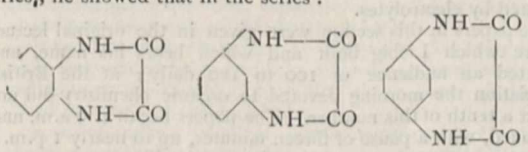
This Section was presided over by Prof. Adolf von Baeyer, Professor of Chemistry at the University of Munich, who welcomed the members of the section, and spoke a few words in memory of Bunsen; the following passage deserves to be quoted:—

"Bunsen's value as a teacher and master lay not so much in the lectures he delivered as in the example he set. He was always working himself, and worked in the presence of his pupils."[1]

Prof. Wislicenus, sen., was elected president for the first day, and won general approval by keeping the speakers strictly to the twenty-minute time limit.

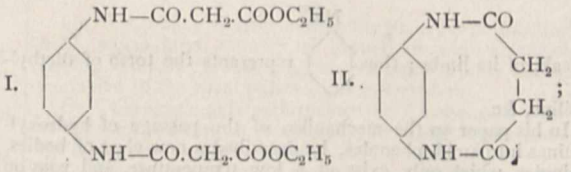
The proceedings were opened by Prof. van t' Hoff (Berlin), who showed that the formation of the Stassfurt salt beds by the evaporation, at 25° C., of a solution of common salt, borates, and calcium and magnesium sulphate and chloride, could be graphically represented on a diagram.

Richard Meyer gave an account of his experiments on the condensation of aromatic diamines with dibasic acids of the oxalic series; he showed that in the series:



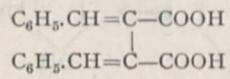
the ortho-derivative alone was stable; further, that with malonic ether an amino acid ether (I.) was obtained, but with succinic ether a ring (II.)

[1] This seems an important pronouncement in view of the disputed question of the efficacy of private-research rooms as compared with large laboratories.



the difference being possibly due to the greater length of the succinic acid chain lessening the tension.

Dr. H. Stobbe (Leipsig) described the condensation products of benzaldehyde with succinic ether, and showed that such a body as dibenzal succinic acid



which yields a colourless anhydride is converted by means of iodine into a stereoisomeric acid giving a bright yellow anhydride.

Dr. Krämer (Berlin) advanced certain views as to the formation of petroleum by the decomposition of diatoms; he found that the wax contained in diatomaceous mud consisted largely of decane.

In the subsequent discussion a geologist pertinently remarked that though it was possible that petroleum was formed to a certain extent in this way, yet much larger quantities must be formed by the decomposition of fish and marine animals generally; in confirmation of the animal origin of petroleum he mentioned the fact that many fossil bivalves contained, on opening, drops of oil; he also suggested that the oil in the Caucasus was formed to some extent by the large number of fish that were killed yearly by passing from the fresh water into the strong brine of the lagoons.

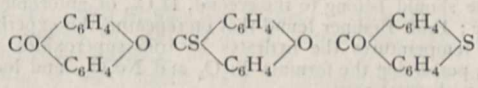
The animal origin of petroleum was acknowledged by all speakers.

J. Tafel followed with a paper on the course of electrolytic reduction. The experiments were carried out with a solution of caffeine, and the rapidity of the reaction measured by the evolution of hydrogen at the kathode as compared with the evolution of hydrogen in a similar cell containing dilute sulphuric acid.

In order to effect reduction Tafel showed that the kathode must be of lead, and, moreover, must be coated by spongy lead, the use of a polished lead pole giving a bad result, immediately rectified by the introduction of a little lead acetate solution. The introduction of copper and the noble metals stopped the reaction, which, in the case of these metals, recovered its normal course; if platinum had been introduced, there was no recovery.

In the discussion Drs. Bodländer, Nernst and Arendt took part, the latter remarking that the anode also should be of lead.

Richard Meyer read a second paper on the thio-derivatives of the di- and tri-phenylmethane series, and the influence on the fluorescence of the substitution of sulphur for oxygen in such bodies as

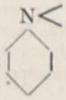


the results were, however, conflicting.

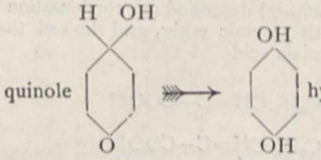
R. Schenck read a paper on the two kinds of dimorphism and their mutual relationship, describing the course of the change (in the case of para-azoanisole) from enantiomorphism to monotropism.

Dr. Bachhold (Frankfort) gave a short account of the work done by bacteria in the disposal of sewage—in one experiment he took mud from the filter-beds in July and found it to contain 14·60 per cent. of fats; on preserving this, moist, in a corked flask till November, he found it contained only 5·82 per cent. of fats; if the mud was previously dried, the percentage, naturally, did not alter.

Prof. Bamberger's (Zürich) address was of especial interest to organic chemists, and was also remarkable in introducing a new expression, which should be welcomed by chemical philologists. He used the expression "torso" to describe the molecular aggregate or residue which had been bereft, so to

speak, of its limbs; thus  represents the torso of diethyl-aniline, &c.

In his paper on the mechanism of the passage of hydroxyl-amines into amidophenoles, he described a new class of bodies, quinoles, which only exist at a low temperature, and pass on warming into more stable isomers; thus he obtained a quinole isomeric with hydroquinone:



Prof. Lieben (Vienna) gave a general review of the properties and formation of the aldoles, introducing a new classification of these bodies, according to the ease with which they lose water—the three classes being thus graphically represented:

I. II. III.
$CH_3—CH(OH)—$ $R.CH_2.CH(OH)—$ $R_2.CH—CH(OH)—$.

Aldoles belonging to the first class split off water with difficulty, those belonging to the third class with ease.

Prof. Ramsay's address on "The Newly-discovered Gases" was delivered at a combined meeting of the Chemical and Physical Sections, and, despite the early hour at which it was given, attracted a large audience.

As full accounts of these researches have appeared from time to time in NATURE, it will suffice to state that the lecture was illustrated by Crookes' tubes, containing the gases, and to recall the analogy in the periodic system between the group formed by the new gases and the group formed by the halogens

H=1 F=19 Cl=35·5 Br=80 I=127
Helium=4 Neon=20 Argon=40 Krypton=82 Xenon=128

The periodic system, indeed, furnished the subject-matter for several papers in the Chemical Section, and, passing over a paper on this subject, which caused much amusement, it is interesting to note the conclusions arrived at by Prof. Brauner in his investigation of the position of the elements of the rarer earths in this system.

He considers that the position indicated by the fourth group and the eighth series must be assigned to a group of three elements.

Cerium 140, Praseodidymium 140·8, Neodidymium 143·6.[1]

This conclusion is based in great measure on the study of the higher oxides. Prof. Brauner considers that the oxides Pr_2O_4 and Nd_2O_4 belong to the oxides of the PbO_2 or ozonic type—that is to say that the metals in these oxides are tetravalent, and the oxides correspond to Ce_2O_4.

At first sight the oxides obtained by precipitation with hydrogen peroxide should belong to the second, H_2O_2, or antozonic type of oxide; Prof. Brauner found that on repeating this experiment at low temperatures the hydrates of true superoxides were formed, possessing the formula Pr_2O_5 and Nd_2O_5, and loosing oxygen with great ease.

Dr. Otto Bleier followed with a paper on "The Vapour Density of Sulphur."

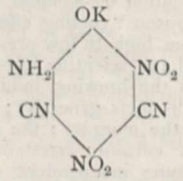
The present methods for the determination of vapour densities cannot be applied with exactitude in experiments performed in order to determine the density of sulphur vapour before the molecules have begun to dissociate.

By a new method, which combines low pressures and low temperatures, Dr. Bleier showed that, though it was impossible to reach a combination of pressure and temperature at which no dissociation of the sulphur molecule had taken place, yet at 214° and at a pressure of 4 m.m. the density of the vapour was 7·88, which corresponds to a molecule containing $7\frac{1}{2}$ atoms; it may therefore be reasonably concluded that the molecule of undissociated sulphur vapour may be represented by S_8, and not by S_6, as given in the text-books.

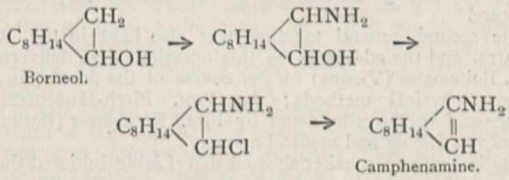
[1] The German expressions Praseodym and Neodym are less cumbersome!

Papers were also read by Dr. Staudenmeier on graphitic acid, and by Prof. S. Ruhemann on the acetylene carboxylic acids.

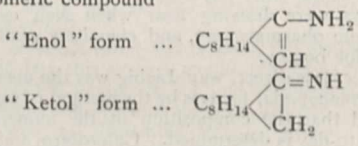
Dr. Nietzki gave the results of investigations undertaken with his pupils on isopurpuric acid, and detailed the grounds on which he assigned to the potassium salt of this acid the formula:



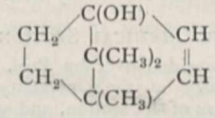
Dr. Dulden gave an account of certain researches in the camphor series. Starting with borneol, he obtained amido-borneol, and converted this body by means of phosphorus pentachloride into a substance which, with potash, split off hydrochloric acid to yield camphenamine:



This body shows a considerable analogy with vinylamine, and is a tautomeric compound



The investigator hopes to convert this base into an isomer of camphor by replacing the NH_2 group by hydroxyl; experiments in this direction have led to the isolation of a substance which appears to possess the formula:



Dr. Brauns (Giessen), in a paper on the different modifications of sulphur, described no less than seven distinct varieties. A paper of considerable interest to English chemists described the researches on colloid metals, conducted by Prof. E. von Meyer and Dr. Lattermann, the first example of a metal in this condition having been discovered by Carey Lea.

Mercury, bismuth, copper and silver were obtained in a colloidal condition by reduction of dilute solutions of their salts by means of sub-salts of tin, and subsequent precipitation of the colloid metals by ammonium citrate. Such solutions contained invariably stannic acid in a colloidal condition, and it seems probable that mercury, copper and bismuth can only exist in this state when combined with stannic acid. Colloidal silver when treated with a halogen yields a colloidal solution of the silver halide; true colloids, such as gelatine, increase greatly the stability of the above solutions, which, on the other hand, are immediately precipitated by electrolytes.

The papers in this section were given in the original lecture theatre which Liebig built and which bears his name, and attracted an audience of 100 to 120 daily; at the British Association the morning devoted to organic chemistry did not attract a tenth of this number. The papers began at 9 a.m. and continued, with a pause of fifteen minutes, up to nearly 1 p.m.; the section resumed at 3 p.m. and sat again till 5.30 p.m.; two and a half days were occupied by the sessions of this section.

Among the chemists attending the meeting were von Baeyer, van 't Hoff, E. Fischer, Curtius, Kahlbaum, Bernsthen, Ramsay, W. H. Perkin, jun., R. Meyer, H. Stobbe, Bamberger, Brauner (Prague), Hantzsch, Lieben, Einhorn, Ostwald, Werner, J. and W. Wislicenus, Soxhlet, Staudenmeier.

OTHER SECTIONS.

In the Physiological Section Prof. Rudolf Cohn (Königsberg) described a new series of his investigations of the nature of the base obtained by the action of hydrochloric acid on albumen.

He obtained a body possessing the formula $(C_6H_{13}N)_2$, and isomeric with and similar to leucinimide, and probably possessing the constitution of dioxydibutyldiethylendiamine. The ease of the formation of such bodies may explain the occurrence of certain bases, such as spermine in the animal organism.

In the Section for Hygiene and Bacteriology an important discussion was inaugurated by Dr. Czaplewski on the method of using formaldehyde (formal, formaline) as a disinfectant.

A remarkable paper was contributed to this section by Dr. Weyl (Berlin) on the sterilisation of water by means of ozone. Water to be sterilised is pumped to the top of a tower and allowed to flow slowly over stones, meeting as it falls a current of air charged with ozone.

In one experiment with Spree water containing 80,000–90,000 micro organisms per cc., 3000 litres of water were obtained in an hour, containing less than 100 organisms per cc.

This process appears to be also effectual in purifying peat and bog water, the solution of the iron salts of humic acid being decomposed and oxidised, and the brown colour disappearing in consequence.

The method can be advantageously used in connection with filter-beds, by which the floating organic matter is removed from the water before it is treated with ozonised air.

The cost of sterilising an average river water works out at ¼*d.* to ½*d.* per 1000 litres; no ozone remains in solution.

In the Physical Section an interesting paper was read by Dr. Carl Linde, on the industrial uses of liquid air.

Prof. Adami's discourse, in the same section, was remarkable for demonstrating the possibility of constructing dynamos and galvanometers at the cost of a few pence, and the power of performing electrical experiments with the simplest materials. It is impossible in an abstract to give any idea of the charm of Prof. Adami's manipulations.

Prof. C. Kahlbaum's (Basle) experiments on the distillation of metals showed that most metals can be distilled in vacuo, vessels of glass or porcelain being used. Very remarkable is the fact that alloys can be fractionated by this method; in one experiment the copper was quantitatively separated from the nickel in a German coin, the nickel remaining in the flask as a silvery regulus, and the copper crystallising in the receiver; such newly-distilled metals resist to a greater degree the action of atmospheric oxygen.

Prof. Ostwald's paper on periodic changes in the rate of reaction was received with some scepticism, and produced a lively discussion. It appeared that pieces of a certain block of metallic chromium, 5 kilograms in weight, and prepared by Dr. Goldschmidt, showed a remarkable property.

When such pieces were placed in dilute hydrochloric acid, the numbers of the bubbles of hydrogen evolved in equal times, and measured in a capillary tube, exhibited a constant variation; thus in equal periods of time two, four, six and eight bubbles appeared respectively, and then the series recommenced with two bubbles. This truly remarkable phenomenon was confirmed by observations reaching over many months.

Unfortunately, this was the only specimen of metallic chromium which could be obtained possessing this curious property.

All the scientific sections were invited to a meeting in the Kailnsaal, where Prof. Chun explained the exhibition of the results of the German Deep Sea Expedition.

These results confirmed in many cases the results obtained on the *Challenger* expedition, especially as to the existence of life at the greatest depth of the Antarctic Ocean.

When the explorers landed at Kerguelen they were immediately surrounded by great flocks of birds, showing no fear, and perching on the shoulder or pecking at the boots of the astonished members of the expedition.

Some of the fish found at depths of 3000 metres, to which depth naturally but little light penetrates, resembled those found in the Lias, representing a period when the atmosphere of the earth was dense, and charged with carbon; these fish were in some cases provided with special means of collecting light, being in possession of enormous eyes occupying nearly the whole side of the head, or supplied with telescopic organs; in other cases they carried their light with them on their heads, in a somewhat similar fashion to the glow-worm.

On Wednesday afternoon and on Saturday no meetings were held, and a large number of excursions were arranged, comprising visits to the lakes and watering-places near Munich, and excursion to the royal palaces and to Ratisbon.

On Thursday a gala-performance of "Lohengrin" was given at the Opera by royal command, for which every member of the Congress received a ticket.

During the whole week the picture galleries and exhibitions were open to the members at a reduced charge, and opportunities of visiting the breweries, ice-works, &c., were afforded.

The accommodation of the guests was in the hands of a special committee, who performed their difficult task to the satisfaction of every one, the prices of the rooms being especially moderate.

The next meeting of the Society will be held in September 1900, at Aachen (Aix-la-Chapelle), and, being easy of access, should attract English men of science. W. T. L.

BOTANY AT THE BRITISH ASSOCIATION.

THE President of the Section (Sir George King) delivered an address in which he gave a comprehensive sketch of the history of Indian botany. Reports were presented by the committees on assimilation in plants and on fertilisation in the Phæophyceæ. In the former investigations—conducted by Dr. F. F. Blackman (Cambridge)—the experimental work dealt with the sources of the carbon dioxide of leaf assimilation, with the respiration of the stem as distinguished from the leaf, with the magnitude of the absorption of carbon dioxide from the soil, and with kindred problems, of which a preliminary account was given by Dr. Blackman at the Bristol meeting. Mr. Lloyd Williams (Bangor) had been engaged during the past year in researches into the cytology and life-history of various members of the Phæophyceæ, including *Dictyota dichotoma*, *Halidrys siliquosa*, *Himanthalia lorea*, *Laminaria saccharina*, *Alaria esculenta* and several species of Fucaceæ.

Mr. Williams contributed a preliminary note on the life-history and cytology of *Halidrys siliquosa*, in which he dealt with the formation and liberation of the sexual cells, the striking phenomena accompanying the act of fertilisation, the segmentation of the spore, together with the cytology of the various processes. In the process of fertilisation the most important points observed were (1) the gyrating, clockwise movement of the antherozoids; (2) the long time taken to effect fertilisation—30-50 minutes as against 3-10 minutes in *Fucus*; (3) the peculiar behaviour of the egg at the moment of fertilisation, its distension and sharp rugged conical projections with beady threads emitted from their apices; (4) the subsequent restoration of the egg to its normal shape and size.

In accordance with the usual custom, Friday afternoon was devoted to a semi-popular lecture, which was this year delivered by Mr. Harold Wager, on the sexuality of the fungi. The lecturer gave an interesting and clear account, illustrated by lantern slides, of the phenomena of sexuality in the various groups of fungi.

An additional value was given to the lecture by the number of new facts dealt with by Mr. Wager; these included some new observations on fertilisation in *Peronospora parasitica* and *Polyphagus Euglenae*.

Miss Ethel Sargant gave a demonstration of vermiform nuclei in the fertilised embryo-sac of *Lilium Martagon* (*vide Proc. Roy. Soc.*, vol. lxv. p. 163, 1899).

Mr. J. C. Willis, Director of the Royal Botanic Garden, Peradeniya, Ceylon, gave an account of the research laboratory and of the facilities afforded to botanists conducting investigations in the Ceylon Gardens.

On Saturday, September 16, Mr. G. Dowker, the local secretary of Section K, whose intimate knowledge of the Kent flora made him an admirable leader, conducted a botanical excursion to Sandwich. Those who were present at the meetings of Section K will learn with sincere regret that Mr. Dowker died suddenly on Friday, September 22. The botanists present at Dover had learned in their short acquaintance with Mr. Dowker to appreciate his kindly nature and the keen interest he took in botanical work.

THALLOPHYTA.

Prof. Marshall Ward gave an account of his recent work on *Onygena equina*, a horn-destroying fungus (*Proc. Roy. Soc.*

vol. lxv., 1899, p. 158). The genus *Onygena* comprises six species, all very imperfectly known, remarkable for their growth on feathers, hair, horn, hoofs, &c., on which their sporocarps appear as drumstick-shaped bodies 5–10 mm. high. A cow's horn thoroughly infested with the mycelium of *O. equina* yielded material for the investigation; the author not only verified what little was known, but was able to cultivate the fungus, to trace its life-history, and to supply some details as to its action on horn. The development of the sporocarps, the structure, germination and biology of the chlamydospores were dealt with; also the details and development of the asci and the germination of the ascospores. Prof. Ward expressed the view that no trace of any morphological structure comparable to sexual organs could be discovered, though many points suggest the alliance of this fungus with Erysipheæ and the Truffles.

Mr. R. H. Biffen (Cambridge) presented an account of *Bulgaria polymorpha* (Wettstein) as a wood-destroying fungus. *Bulgaria polymorpha* is stated by Ludwig to be parasitic on oak. The author has examined its anatomy, and studied it in pure cultures on wood and in food-material. The white early growth soon becomes bright orange; small rounded elevations are afterwards formed, which are incipient reproductive bodies. The action on wood was examined in some detail. The fungus grows better on oak than on pine. The lignified wood-elements are de-lignified. Details as to the reactions in various stages of its destructive action are dealt with in the paper. The author does not regard the fungus as of great importance as a wood-destroying organism in this country.

Mr. A. Howard (Cambridge) described some recent work on a disease of *Tradescantia*.

During the summer it was found that two species of *Tradescantia*, growing in greenhouses, were being attacked by a fungus. Diseased leaves and stems were in many cases found to be covered with long white conidiophores. Pure cultures were made of the parasite, which proved to be a species of *Botryosporium*. Some difficulty was experienced in obtaining this form free from another fungus, a species of *Cladosporium*. It was found in the case of the naturally growing host plants that infection started either on the upper side of the leaf or from the margin. Tangential sections of the upper epidermis of the leaf, when grown in hanging drops, showed in all cases hyphæ on the epidermis, which gave rise to the same species of *Cladosporium* as that mentioned above, occurring as a weed in the *Botryosporium* cultures. The development of this *Cladosporium* was then followed out from a single spore by the hanging-drop method, and infection experiments were made which proved successful.

Prof. Potter (Newcastle) read a paper on a bacterial disease—white rot—of the turnip.

The author found in the early autumn numerous turnips, whose roots, when fully grown, became completely rotten. The rotten portion presents a white glazy appearance, and the tissues are reduced to a soft pulpy condition; the cell-walls are much swollen, faintly stratified, and separate from each other along the middle lamella. The decaying mass is infested with bacteria, but the most careful microscopic search has failed to detect any fungoid hyphæ. The rottenness can be readily introduced into a sound root by inoculation at a wounded surface; from this point the decay spreads rapidly through the root, the leaves gradually turn yellow, and in about fourteen days the entire plant has succumbed. Among the bacteria found in the rotten mass one has been isolated, which, when sown from a pure culture on turnips, under sterile conditions, induces all the characteristic effects of the "white-rot."

The bacterium, which has a single polar flagellum, was described by the author under the name *Pseudomonas destructans*. It occurs in the form of short rods about 3μ long by ·8μ broad, with one polar flagellum; it rapidly liquefies gelatine, forming circular whitish colonies. The organism is parasitic on turnips, potatoes, carrots, but not on beetroot, forming a cytase.

Mr. Harold Wager gave an account of the phosphorus-containing elements in yeast. By using the method of Macallum for the determination of phosphorus in cells, which consists in the formation of a precipitate by means of a nitric acid solution of ammonium molybdate and subsequent coloration by means of the reducing agent phenylhydrazine hydrochloride, the author has been able to demonstrate that the phosphorus resides in a definite organ of the cell, which has been described as a nucleus by various observers. This affords, therefore, additional evidence in favour of the nuclear nature of the body.

Prof. Ward contributed some notes on methods for use in the culture of algæ. The notes were of the nature of suggestions, the experiments being still in progress; but the author gave an account of the work in hand with a view to interest those engaged in investigations involving the cultivation of algæ.

If agar is swollen in dilute acetic acid, and then washed very thoroughly, it can be used, mixed with the necessary culture fluids, as a convenient medium for the growth of some algæ, as Beyerinck had already observed.

The author has succeeded in separating algæ by the following methods:—

The algæ are shaken up in a sterilised nutritive mineral solution, mixed rapidly with silica jelly, also sterilised, and poured into glass dishes. With species of *Oscillaria* and of *Palmella* the author has observed growth in hanging drops of this silica-jelly medium under high powers.

Another device is as follows:—Shake the algæ up in the nutritive solution and rapidly mix with sterilised plaster of paris and pour into dishes. The fixed algæ grow *in situ* in some cases, but others appear to be too sensitive for such treatment.

Experiments have also been made as follows, with some promise of success:—The algæ are shaken up in the culture medium, and a large quantity of lime-water quickly added. Carbon dioxide gas is then passed rapidly through, and the algæ are thrown down with the precipitate of calcium carbonate; this is poured into dishes as if it were plaster of paris. Perhaps this method could be utilised in the study of calcareous algæ, but with some forms it appears too drastic. One drawback is the difficulty of obviating the use of unsterilised materials.

In illustration of the application of the methods, Prof. Ward described some observations of the growth of *Oscillaria tenerrima* in hanging drops of silica-jelly. The growth of a single filament was followed for more than a week, and the curve showed that growth ceased during the hours of darkness, and was coincident with assimilation during the day. The author also obtained "light-figures" by exposing plates of green algæ, covered with stencil letters, to various intensities of daylight reflected from mirrors. When the light was not too strong, a green letter on a colourless ground was formed, but with intense illumination the exposed algæ were killed, while those in the covered area, illuminated only by diffuse light, were able to grow; the result was a colourless letter on a green ground.

Mr. W. G. Freeman (Royal College of Science) contributed a note on the *Anabaena*-containing roots of some Cycads. The author drew attention to the manner in which the roots occur on various species of Cycads growing in very poor soil in the Royal Botanic Garden, Peradeniya. In most cases a dense coralloid mass of specialised fleshy roots was found encircling the stem; in others—*e.g. Macrozamia Peroffskiana*—normal-looking lateral roots ran horizontally beneath the ground, giving off the special algæ-containing roots at intervals. These primary lateral roots may be apogeotropic for a time, but after bearing the *Anabaena*-containing masses they resume a normal habit and grow downwards.

Mr. E. J. Butler (Queen's College, Cork) communicated a note on a mixed infection in *Abutilon* roots. The roots of seedlings of *Abutilon* hybrids in the plant-houses of Queen's College, Cork, presented tuberoid enlargements due to, at least, two parasites—a Nematode and an Ascomycete. (1) The Nematode is a *Heterodera*, apparently not identical with *H. Schachtii*. All stages of the life-history were worked out by the author. (2) The Ascomycete is a new *Thielavia*, which the author named *T. Hartogii*, differing from *T. basicola* in its more abundant sporidia in each pseudo-sporangium and dark green chlamydospores. (3) A fungus, coexisting with (1) and (2), whose unseptate hyphæ, "cellulose" wall and reproductive bodies recall Peronosporeæ, has been partially studied.

PTERIDOPHYTA.

Prof. Bower read a paper on fern sporangia and spores, in which he gave an account of the results of his recent investigations described at a meeting of the Royal Society on April 20 (*Proc. Roy. Soc.*, vol. lxv. p. 96, 1899). Prof. Bower suggested the following classification of the ferns based on (1) the relative time of appearance of sporangia of the same sorus, (2) certain details of structure of the sporangium and its stalk, (3) the orientation of the sporangia relating to the whole sorus, (4) the potential productiveness of the sporangium as estimated by its spore-mother cells, and the actual spore-output.

Simplices	Marattiaceæ	Eusporangiatæ.
	Osmundaceæ	
	Schizæaceæ	
	Gleicheniaceæ	
	Matonineæ	
Gradatæ	Loxsomaceæ	Leptosporangiatæ.
	Hymenophyllaceæ	
	Cyatheaceæ	
	Dicksonieæ	
	Dennstædtineæ	
Mixtæ ...	The bulk of the Polypodiaceæ	

Mr. L. A. Boodle (Jodrell Laboratory, Royal Gardens, Kew) gave an account, illustrated by numerous microphotographs, of his researches into the stem-structure in *Schizaeaceae*, *Gleicheniaceae*, and *Hymenophyllaceae*.

There is a wide difference between the types of stem-structure shown by the different members of the *Schizaeaceae*. *Lygodium* has a stele in which the xylem forms a central solid mass and is surrounded by a continuous ring of phloem, pericycle and endodermis. *Aneimia Phyllitidis* has a ring of separate bundles (or steles); *Mohria* resembles *Aneimia Phyllitidis* in type. Certain species of *Aneimia*, *e.g. A. mexicana*, have in the internodes a complete ring of xylem bounded on the inner and outer side by a ring of phloem, pericycle and endodermis, with a central pith. *Schizaea* has a ring of xylem surrounding a central pith, but no internal phloem or endodermis.

The above four genera, which make up the *Schizaeaceae*, agree in having a stem protoxylem, which is not well marked. *Lygodium*, *Aneimia*, and *Mohria* are exarch; in *Schizaea*, however, the relative position of the protoxylem has not been made out with certainty.

The *Aneimia* type (which corresponds with that of a mature *Polypodium*) may be regarded as the more specialised type among the *Schizaeaceae*, and *Lygodium* (which corresponds in structure with the base of the stem of *Polypodium*) as the more primitive type.

The *Gleicheniaceae* and *Hymenophyllaceae* also include forms with a solid central mass of xylem, but differing in some details from *Lygodium*. *Gleichenia* is mesarch and closely resembles the fossil genus *Heterangium*. In the *Gleicheniaceae* the only advance on the *Lygodium* type is found in *Platyzoma*, in which there is a ring of xylem surrounding a central pith, as in *Schizaea*, but differing from the latter plant in having an inner endodermis.

In the larger species of *Trichomanes* there is a solid xylem-mass, but with a group of parenchyma in connection with the one or two more or less centrally placed protoxylems. In *Hymenophyllum* the corresponding parenchymatous mass is large in proportion to the amount of xylem. In the smallest species of *Trichomanes* the stele of the rhizome takes the form of a collateral bundle. The protoxylem of *Trichomanes spicatum*, unlike the other species examined, resembles that of the *Schizaeaceae*.

The solid stele may be regarded as primitive, the *Aneimia* type being derived from it by the following steps:—

(1) Solid central xylem-mass surrounded by phloem, &c.

(2) Ring of xylem surrounding a central pith.

(3) Ring of xylem with internal phloem, endodermis, and pith.

(4) Ring of separate bundles formed by the breaking up of the above vascular ring, owing to large leaf-gaps.

PHYSIOLOGY.

Sir William Thiselton-Dyer described some experiments of far-reaching importance, made by Prof. Dewar, on the influence of the temperature of liquid hydrogen on the germinative power of seeds. The most important was one in which five kinds of seeds, varying in size and composition, were immersed for six hours in liquid hydrogen. The temperature to which they were cooled was −453° F. below melting ice. They were subsequently sown at Kew, and germinated readily without exception (*vide Proc. Roy. Soc.*, vol. lxv. p. 361, 1899).

The bearing of the experiment on the accepted conception of protoplasm gave rise to some discussion. Protoplasm is conceived to consist of physiological molecules, the properties of which cannot be explained with our present knowledge of either physics or chemistry. They are in a state of constant kinetic energy based upon equally continual metabolic change. But if it is admitted that the latter is impossible at very low temperatures, the former must cease and the evidence of life disappears. The physiological molecule becomes purely static; its energy is wholly potential, and in fact it becomes, as Prof. Casimir De Candolle has pointed out, analogous to an explosive.

Mr. Francis Darwin described some exceedingly interesting investigations on the localisation of the irritability in geotropic organs. The seedlings of *Setaria*, *Sorghum* and some other grasses are remarkable for possessing a hypotcotyl or stalk-like part intercalated between the grain and the cotyledon. Rothert has shown that while the hypocotyl is the motor apparatus, the sensitiveness to light resides in the cotyledon, which transmits a stimulus to the hypocotyl, and this results in curvature. The author showed that the cotyledon is also a sense-organ for gravitation, the stimulus which leads to geotropic curvature being in like manner transmitted to the hypocotyl. If a seedling of *Sorghum* or *Setaria* is fixed by its grain to a support so that the hypocotyl is horizontal, it bends upwards apogeotropically till the cotyledon is vertical; it then ceases to be geotropically stimulated, and no longer transmits an influence to the region of curvature. But if the conditions are reversed, if the seedling is supported by its cotyledon (which is fixed in a horizontal position) while the hypocotyl projects freely, the result is otherwise. The hypocotyl begins to curve upwards just as in the first experiment, but it does not cease to curve when the free end points vertically upwards; the curvature continues indefinitely, so that the hypocotyl curls into a spiral of three or four rings. This can only be explained by the assumption that the geotropic sensitiveness resides in the cotyledon, and that since the cotyledon remains horizontal it continues to be stimulated and transmits a continuous influence to the motor part of the seedling.

On Saturday morning some of the members of the Botanical Section took part in a joint discussion with the Chemical Section on symbiosis. Prof. Marshall Ward introduced the subject by an able account of the meaning and significance of symbiosis, as illustrated by numerous instances of symbiosis and symbiotic fermentations afforded by various vegetable organisms. After describing particular cases of symbiosis, more particularly of symbiotic fermentations, Prof. Ward dealt with the physiology of symbiosis.

Mr. J. Parkin (Cambridge) communicated some isolated observations bearing on the function of latex.

The author has lately returned from a year's sojourn in Ceylon, where he has been acting as scientific assistant to Mr. Willis, the Director of the Royal Botanic Gardens. During his time there he has been principally engaged in investigations on caoutchouc-yielding trees, chiefly *Hevea brasiliensis* (Para Rubber) and *Castilloa elastica*, var. (a Central American rubber-tree). The results of this research are contained in a recently-published circular of the Royal Botanic Gardens, Ceylon, entitled "Caoutchouc or India-rubber," intended primarily for those interested in rubber cultivation.

The author drew attention to some of the observations and experiments recorded in the circular, which, besides their practical value, have a general botanical interest; he also recorded other observations which may throw light on the functions of laticiferous tissue.

The points treated of in the paper were grouped under six sections:—

Section I. dealt with the coagulation of the latex of *Hevea*.

Section II. contained observations and remarks relating to the carbohydrates of latex.

In Section III. reasons were given for thinking that in some caoutchouc trees the latex of the young stems and leaves differs in composition from that of the trunk and main branches. While the latter yield rubber free of stickiness, the former give a somewhat viscous substance with feeble elasticity. Such is the case with *Hevea*, *Castilloa*, *Landolphia Kirkii*, &c.

Section IV. treats of an important fact connected with the tapping of *Hevea* trees—namely, that wounding the bark causes a greater flow of latex from subsequent injuries.

In Section V. a peculiarity in the exudation of latex from the severed base of the petiole of *Hevea brasiliensis* and *Plumiera acutifolia* was described and discussed.

And in Section VI. a special laticiferous system in the immature seed of *Hevea brasiliensis* was described.

The paper concluded with general remarks and suggestions on the origin and functions of laticiferous tissue.

Mr. R. H. Biffen (Cambridge) contributed some notes on india-rubber. Caoutchouc is a constituent of the latex of many plants belonging chiefly to the Euphorbiaceæ, Apocynaceæ and Urticaceæ, that is, of plants characterised by the possession of laticiferous cells as distinct from vessels. Caoutchouc occurs as small particles in latex; if a reagent is added which will cause coagulation, the particles run together in strings and form a moss-like mass of rubber with the watery portions of the latex entangled within it. Two physical processes are now being used. (1) The latex, mixed with water, is strained and churned; the thick cream which rises to the surface is pressed through rollers and converted into rubber. (2) The author's process consists in separating the rubber with a centrifugal apparatus. Details are given in the paper regarding the chemical properties of the different kinds of rubber obtained from *Hevea*, *Castilloa*, *Manihot*, *Ficus*, *Hancornia*, *Kickxia*, *Artocarpus* and *Clusia*. The author also raises some questions of theoretical interest with regard to possible relations between caoutchouc, starch and resin-bodies, and indicates lines for further inquiry.

Flowering Plants, &c.

Mr. J. C. Willis, of Peradeniya, Ceylon, read a paper of exceptional merit, illustrated by numerous lantern slides, on the morphology and life-history of the Indo-Ceylonese Podostemaceæ.

The paper read was an abstract of a forthcoming monograph of the Indian and Ceylon species of this very remarkable order of water plants, in which the various species will be described in detail both morphologically and ecologically. A few typical species were described and their life-history explained, showing the extraordinary modifications which the vegetative system has undergone to suit the needs of life in rising and falling water and in rapid currents. The vegetative organs consist largely of modified roots forming thallus-like bodies, and bearing leafy or floral endogenous shoots, and branching themselves in an exo- or endo-genous manner. The conclusion was drawn that the endo- or exo-genous origin of an organ or a branch is a phenomenon of an adaptive nature in these plants, and to a large extent in others also. The adaptive modifications of the structure, such as the gradual reduction, through a series of forms, of the shoots and leaves, the increased multiplication of the shoots by vegetative budding, the reduction of the number of flowers per shoot, and the change to anemophily, the increased dorsiventrality and other characters, were shown to be rather correlated with the rise and fall of the water than with the velocity of the stream. In conclusion, some of the more general questions of morphology were discussed in the light of the observations made on these plants.

Prof. Douglas Campbell (California) gave a short account of work in progress on the development of the flowers and embryos of various species of Araceæ.

The materials for the author's investigations were collected mostly in Jamaica, and include species of *Dieffenbachia*, *Aglaonema*, *Philodendron* and *Anthurium*. A study was also made of *Lysichiton* of Pacific North America.

A study of the development of the ovule indicates that the primitive form is axial, as in other low monocotyledons; the early development of the embryo-sac follows the ordinary type. Later there is a multiplication of the antipodal cells, and the sac becomes filled with endosperm at an early stage. The ovule is often massive, and there is a marked development of mucilage-secreting hairs upon the funiculus and the base of the nucellus. In all forms so far examined the embryo is destitute of a suspensor, and the cotyledon is very large, sometimes suggesting the scutellum of the grass-embryo.

The forms with a single carpel are probably most primitive and most nearly related to the other low monocotyledons.

Mr. G. Dowker gave a description of the sand dunes between Deal and Sandwich, with remarks on the flora of the district.

The author in this paper gave an account of the formation of the dunes and mud-banks, claiming for them the reclamation of the large tract of sand from the sea, mostly since the Roman occupation of Britain. He referred to the Acts of Parliament passed prohibiting the destruction of the mat grass, which contributed so largely to the preservation of the hills, and lamented that nothing was done to prevent the wholesale gathering of Sea holly by men who ruthlessly destroyed it by taking it away to sell. He recounted his long experience and knowledge of the district, dating back to his schoolboy days with the Rev. J. Layton, a distinguished botanist of Sandwich. He particularised the following rare or characteristic plants as denizens of the hills: *Allium vineale*, *A. compactum*, *Poa bulbosa*, *Hippophae rhamnoides*, *Silene conica*, *Orobanche caryophyllacea*, *Lepidium latifolium*, and on the salt marshes, *Atriplex pedunculata*, *Frankenia levis*, *Aster Tripolium*, and *Polypogon monspeliensis*. The author added a list of over 300 species of flowering plants to be met with in the district.

Miss Dale (Cambridge) presented a paper on intumescences of *Hibiscus vitifolius*.

The plants on which the observations were made were grown, directly or indirectly, from seed from Somaliland. The intumescences, which vary in size and shape, occur on the leaves, stems, green parts of the flower, and on the young fruit. Some are entirely colourless; others are green at the base. On the leaf the intumescences are either purely epidermal or partly sub-epidermal; and on the stem the outgrowths are more complex and usually larger.

A number of seedlings were planted in separate pots, and allowed to grow under identical conditions. They all developed intumescences, and were all very much alike. When each had about nine or ten leaves, and was beginning to flower, the plants were placed under different conditions, and examined at the end of six weeks.

The experimental evidence points to the conclusion that the intumescences are pathological, and are due neither to insects nor to fungi, but to the direct effects of environment. The formation of outgrowths appears to be caused by excessive moisture combined with a high temperature. If the temperature is low the plants do not appear to have strength to form them. The production of outgrowths seems to be a response on the part of the plant to insufficient transpiration.

Fossil Plants, &c.

Prof. Bertrand (Lille) described the structure of a stem of a ribbed *Sigillaria*. The specimens of *Sigillaria* hitherto described anatomically are species with a smooth bark, but no account has so far been published of the structure of an undoubted *Sigillaria* belonging to the *Rhytidolepis* section. The species described by Prof. Bertrand exhibits external characters recalling those of *Sigillaria elongata*. The primary wood, which forms a continuous ring, agrees with that of the stems previously described as *Diploxylon*; it is enclosed externally by a zone of secondary wood. The primary xylem is characterised by the prominent ridges or points on its external face, the projecting points corresponding with the grooves on the surface of the stem. In the immediate neighbourhood of the origin of a leaf-trace, the small tracheal elements form a median band in the middle of a sinus on the face of the corona. Each leaf-trace passes outwards through a medullary ray of the secondary wood; it consists solely of primary elements. The author compared his specimen with *Sigillaria spinulosa* and with *Diploxylon* stems from Halifax, Oldham and Burntisland. The central cylinder of the ribbed *Sigillaria* differs from that of a Phanerogam in the manner of origin of the leaf-traces, and in the structure and centripetal development of the primary wood.

Prof. F. E. Weiss (Manchester) communicated a paper on a biserial *Halonia* belonging to the genus *Lepidophloios*.

At the Bristol meeting of the British Association, Dr. D. H. Scott exhibited photographs of this *Halonia* from the Hough Hill Colliery, Stalybridge, and pointed out the agreement of its structure with that of *Lepidodendron fuliginosum* of Williamson. Dr. Scott had generously allowed the author to undertake the further examination of the specimen, and this confirmed the identity of the internal structure of the *Halonia* with that of Williamson's *Lepidodendron fuliginosum*.

The same structure is shown also by stems of the ordinary multiseriate Halonias, which, as Kidston and Potonié have shown, belong undoubtedly to the genus *Lepidophloios*. Stems, therefore, showing the structure of *Lepidodendron fuliginosum*, Williamson, should be referred to the genus *Lepidophloios*.

The fruiting branches of this genus, however, termed *Halonia*, or halonial branches, have usually a number of rows of spirally arranged tubercles. The Hough Hill *Halonia* has only two rows of tubercles; hence it would by some palæobotanists be classed as Ulodendroid, but it seems better to call it a "biserial *Halonia*," since the name of Halonia has been reserved by Kidston and others for the fruiting branches of *Lepidophloios*, and also because its elevated tubercles distinguish it from the usually depressed Ulodendroid scars.

The author described two specimens of biserial Halonias showing on the surface *Lepidophloios* leaf-scars, in support of the view that the Hough Hill specimen may be regarded as a fruiting branch of *Lepidophloios*.

Mr. A. C. Seward showed some microphotographs, and gave a brief account of a new genus of Palæozoic plants.

The description of this genus, which represents a new type of Cycadofilices, was founded on a single specimen in the Binney Collection of Coal-measure Plants. The specimen consists of a small piece of stem, unfortunately without the cortical tissues, with the structure of the primary and secondary wood very clearly preserved. A strand of primary xylem, 1·9 cm. in diameter, occupies the axial region; this consists of large isodiametric or slightly elongated tracheids with multiseriate bordered pits, associated with parenchymatous tissue; the narrow protoxylem elements occur at the margin of the primary stele, which is, therefore, of exarch structure. Surrounding the primary stele there is a broad cylinder of secondary wood exhibiting anatomical features characteristic of Cycadean stems. Leaf-traces, consisting of long tracheids intermixed with parenchyma, are given off from the periphery of the primary strand.

The features of most interest in the anatomy of this stem are (1) the manner of origin and behaviour of the leaf-traces; (2) the exarch structure of the primary xylem; and (3) the structure of the large primary tracheids. The author placed the genus among the Cycadofilices, and compared it with *Heterangium* and other Palæozoic genera, also with *Lygodium* and other recent plants.

Mr. A. C. Seward also gave a *résumé* of his recent work on the Jurassic flora of Britain. The Lower Oolite rocks exposed in the cliff-section between Whitby and a few miles south of Scarborough have long been famous as affording rich collections of fossil plants, which enable us to form a fairly accurate idea of the chief characteristics of the Jurassic flora. Plants from the Yorkshire coast are abundantly represented in most of the English museums as well as in continental collections. The Ferns and Cycadean genera constituted a large proportion of the vegetation, with an abundance of one or two species of *Equisetites* and a few conifers; no trace of undoubted Angiosperms has so far been discovered. The account of the flora includes a description of the more important types, a general comparison of the English species with recent plants, and remarks on the characteristics and distribution of the Lower Oolite floras.

The same author, in conjunction with Miss J. Gowan, gave an account of the morphology and geological history of the maidenhair tree (*Ginkgo biloba*). The chief points dealt with in the paper may be summarised as follows:—

(1) *Ginkgo bilboa.*—The history of our knowledge of *Ginkgo*; its external features and peculiarities; the variability in form and structure of the leaves; the structure and morphology of the male and female flowers; pollination and fertilisation of the ovule; the development and structure of the embryo; the anatomy of the seedling and adult plant; comparison of *Ginkgo* with other genera, and its place in the plant-kingdom.

(2) *Fossil Ginkgoaceae.*—A general consideration of the evidence available towards an account of the past history of *Ginkgo* and closely allied plants; a comparison of *Ginkgo* with various fossil types from Palæozoic, Mesozoic and Tertiary horizons; the geographical distribution of *Ginkgo* during the Mesozoic and Tertiary epochs.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following is the speech delivered on November 9 by the Public Orator, Dr. Sandys, in presenting Prof. Somerville for the complete degree of Master of Arts *honoris causa*.

Agri culturae professorem nostrum primum, auspiciis optimis nuper electum, Universitatis totius nomine libenter salutamus. Salutamus virum, primum per sex annos rei rusticae experientia probatum, deinde per quinquennium scientiae studiis et domi et peregre excultum; virum non modo nomismate non uno honorifice donatum, sed etiam doctoris titulo inter Monacenses summa cum laude ornatum; virum denique et Societati Regiae Edinensi et Societati Linnaeanae Londinensi in perpetuum adscriptum. Olim inter Edinenses primus rei silvestris praeceptor, deinde in Universitate Dunelmensi agri culturae professor primus constitutus, nuper eodem cum titulo e Boreali Britanniae regione ad nos feliciter devectus est. Viri talis auxilio rei rusticae scientia, olim ab ipso Tullio senectutis inter voluptates numerata nunc demum etiam iuventutis nostrae inter studia locum diu sibi debitum sine dubio vindicabit.

Duco ad vos WILLELMUM SOMERVILLE.

Mr. Shelford Bidwell, F.R.S., has been approved for the degree of Doctor of Science.

An Isaac Newton Student in Astronomy and Physical Optics will be elected next term. The studentship is worth 200*l.* a year for three years. Candidates must be Bachelors of Arts who are under the age of twenty-five. Applications are to be sent to the Vice-Chancellor between January 16 and 26, 1900.

Prof. Somerville will give an inaugural lecture on "Some aspects of the bearings of Science and Education on Practical Agriculture" on Friday, November 24, at noon, in the Chemical Theatre.

A report proposing a new scheme for the Mathematical Tripos has been issued to the Senate. Among other changes, it suggests the abolition of the time-honoured "order of merit" in the Tripos list.

BY the will of the late Mr. Cornelius Vanderbilt, of New York, Yale University receives 100,000 dollars, and Vanderbilt University 50,000 dollars.

SIR MICHAEL HICKS BEACH, Chancellor of the Exchequer, spoke on the subject of commercial education at the Mansion House on Friday last. In the course of his remarks he referred to the University of London, and said that the reorganisation offered an opportunity to a "pious founder" to graft upon the University a faculty of commerce in which the study of all subjects belonging to commercial education shall be encouraged. He pointed out that there is no part of the world in which there are greater chances at the present time of pushing our trade and commerce than in the empire of China, and yet there is no civilised part of the world the language and history and customs of which are so absolutely unknown to the vast majority of our people. If it were possible to expend a comparatively small sum in extending a knowledge of these things in connection with a faculty of commerce in the University, more might be done to promote British trade and commerce in China than will ever be done by extracting concessions from the Government of China, many of which, the speaker added, will confer benefit upon nobody except the promoters who try to float them into companies.

THE ninth annual report of the Technical Instruction Committee of the City of Manchester shows that steady progress was made during the year ending last month. The large scale of the operations of the committee may be judged by the fact that the payments made in connection with the Municipal Technical School amounted to 16,796*l.* The expenditure on capital account to meet various charges in respect of the new building was 26,531*l.*, making a total sum of 97,061*l.* expended for this purpose up to last March. The receipts from the Exchequer Contribution Account (Customs and Excise) were 15,567*l.* and the amount raised from the rates was 7585*l.* The new estimates provide a sum of 33,000*l.* for building purposes during the current year in connection with the technical school in course of construction. The total sum now borrowed upon capital account for providing technical schools in Manchester is 140,000*l.* When the new municipal technical school is completed, Manchester will possess one of the finest buildings in the country for carrying on the work of technical education. For the equipment of the building alone a loan of 59,025*l.* has been sanctioned by the Local Government Board. Referring to the subject of secondary education, the committee remark:—"The enactment during the past session of Parliament of a measure establishing a Board of Education cannot but be satisfactory, however much it may fall short of finality, to all those who are sincerely interested in the advance on sound lines of secondary and technical education, since it creates for the first time a real and responsible Minister of Education, and unifies the various branches of education—elementary, secondary and technical—under one controlling authority. It will unquestionably promote the efficient working of the technical schools by the measures which it will take to place the secondary education of the country, now so lamentably deficient, upon a sound and satisfactory basis, without which no technical education worthy of the name can be carried on."

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 10.—Ordinary meeting held in the Physical Laboratory of the Central Technical College (by invitation of Prof. Ayrton).—Prof. Lodge, F.R.S., President, in the chair.—Mr. F. S. Spiers read a paper on contact electricity. The object of the paper was to determine, in a more satisfactory manner than has hitherto been attempted, the part played by the medium in the potential difference which arises when two dissimilar metals are put in contact. The first experiments were made with a piece of apparatus used by Profs. Ayrton and Perry about twenty years ago. This apparatus, in which the metals in contact are capable of a rotation of 180° about a vertical axis, and are placed between two vertical inductors connected to a quadrant electrometer, was afterwards considerably improved, and the compensation arrangement of Lord Kelvin was introduced so as to measure the potential differences by a null method. The metals first used were platinum and zinc, but on account of the low melting point of the latter metal it was replaced by aluminium. In order to try and remove the air sheets which cling to the surfaces of the metals, the tube was repeatedly heated and exhausted. The potential difference between the plates was found to gradually fall as this was done. It was proved that this was due to the oxidation of the aluminium, for on cleaning its surface the original effect was again obtained. Attempts were then made to remove the oxygen by displacing it with hydrogen; but after four washings with pure dry gas and at low pressures there was still enough oxygen left to completely oxidise the aluminium. The oxide of aluminium is not decomposed by hydrogen at a bright red heat. It was therefore decided to substitute iron and burn out the oxygen with hydrogen by encasing the lower part of the apparatus in a copper tube, and heating to bright redness with a blowpipe flame. By this means the value of the Volta effect between iron and platinum in an atmosphere of hydrogen was found to be 0·6 of a volt, the platinum being positive to the iron. This result is different both in magnitude and sign to that obtained when air is the medium. The Chairman said he had given the subject of contact electricity some attention during the last fifteen years, and the author had performed a valuable series of experiments which he should have liked to have seen done several years ago. He had always felt that a vacuum would never get rid of the condensed air films. The burning-out process used had provided the most trustworthy results upon the subject. Dr. Lehfeldt pointed out that the action of hydrogen upon ferric oxide was a limited one, and that it was impossible to bring about complete deoxidisation in that manner. At a dull red heat the ratio between the water vapour and oxygen present is about 20 to 1. Prof. Perry expressed his interest in the experiments, but said that they had not affected his opinion upon the nature of the Volta effect. Prof. Armstrong said he was not wholly satisfied with the results, although a substantial approach to a solution had been made. The author had fully realised the difficulties of the experiments, but he had treated the matter as a surface gas effect, and had not guarded against moisture. Gases must be both dirty and moist before chemical action can take place, and we cannot expect to arrive at a solution of the problem until we have removed not only oxygen but dirt and moisture. It is impossible to completely exhaust the apparatus, and a number of molecules must always be left which is more than necessary to produce the Volta effect. Moisture can never be got rid of by exhaustion. The method of Dewar of using liquid oxygen or liquid hydrogen would get rid of gases and water vapour, and in this manner it would be possible to perform experiments which could be regarded as final. If the effect disappeared at low temperatures it might be urged that the temperature was too low for it to be produced. The author must have been dealing with combination effects, for it had been proved that hydrogen alloyed both with platinum and iron at a dull red heat. Mr. Cooper said he would like to see the experiments repeated after precautions had been taken to remove nitrogen from the apparatus. Prof. S. P. Thompson said he had recently taken part in a discussion upon the subject with some earnest followers of the old contact theory. They uphold that the property of metals which determines the potential difference when two are put in contact is as fixed and definite as other physical properties, such as density, and that the potential difference observed in air is approximately the same as the true potential difference. It has been agreed to call the former the apparent potential difference. Prof. Thompson said that according to Pellat the real Volta effect was near to the effect observed in air. In circuits formed of metals there are other electromotive forces of the order of a millionth of a volt. The chemical electromotive forces in a circuit are of the order of a volt. The value of the Volta effect derived from thermodynamical considerations concerning the Peltier effect is much smaller than observed chemical potential differences. If, however, we take into account not only the Peltier effect but also the Thomson effect, we will have other terms entering into the equations which may tend to give a value more nearly equal to a volt. Prof. Thompson said that in observing chemical E.M.F.s the Peltier effects did not come into the question because of their smallness compared with the value of the chemical effect. Prof. Perry pointed out that the Peltier effect was not distinct from the Volta effect, but was simply the differential coefficient of it. The Chairman said that if a circuit containing Peltier effects were treated thermodynamically as if it were a reversible heat engine, we could arrive at an equation connecting the value of the Peltier effects with the rate of change of the whole electromotive force in the circuit with temperature. The electromotive force which changed was not necessarily the Volta effect. Prof. Perry said he thought it was. Prof. Ayrton suggested that an advance might be made in the theoretical side of the question if the Chairman were to put in writing his objections to the statement that the E.M.F. concerned was the true Volta effect. The extent of the Peltier effect proves the variation of the Volta effect with temperature; but because it is small it does not necessarily follow that the Volta effect is small. Where the Volta effect is a maximum or a minimum the Peltier effect vanishes. The experimental work of the paper did not go far enough to convince him of the nature of contact electricity. Before we can hope to prove anything with respect to the two theories, we must be able to get a cyclic change of events; that is to say, we must be able to change our surfaces and media in a perfectly definite manner so as to be able at any time to return to the particular state from which we started. Prof. Everett said that as the variation in the potential difference between two metals in a medium was probably due to slow chemical action which caused the metals to become less and less susceptible, he should expect that changing backwards and forwards from one medium to another would give to the potential difference an oscillatory variation gradually becoming smaller and smaller. The Chairman said he would like to see experiments showing a cyclic effect similar to that mentioned by Prof. Ayrton. The difficulty in these experiments is to avoid chemical action. Chemical action is not necessary to get the Volta effect. The effect would be greatest in dry gas. Moisture tends to reduce the effect, and that is why its presence is unimportant. Prof. Callendar expressed his interest in the surface character of the effect and its independence of the manner in which the plates were touched. Dr. Stansfield suggested gold as a suitable metal to be experimented on because of its non-oxidisability. Mr. Spiers, in replying, referred to Dr. Lehfeldt's assertion that the whole of the oxygen cannot be removed by hydrogen. In his experiments, however, there was very little ferric oxide and a large quantity of hydrogen, and although it was possible that all the oxide was not reduced, still a large portion of it was. The experiments were to be carried on, and attempts would be made to get a cyclic effect.—A paper on the heat of formation of alloys was postponed until the next meeting.

MANCHESTER.

Literary and Philosophical Society, October 31.—Prof. Horace Lamb, F.R.S., President, in the chair.—Dr. Broadbent introduced the subject of the well at Giggleswick, known for the ebb and flow of its water, and asked whether an explanation of what is known locally as the "silver thread" could be offered by any member. The well consists of a stone cistern, at the top and back of which the water enters from the Giggleswick Scars, there being two small outlets about half-way down each side of the tank and opposite each other. Under certain conditions there appears extending through the water, from one outlet to the other, a thread apparently formed of air. Prof. O. Reynolds suggested that the phenomenon might be explained by the inflow producing a circulation of the water having its vortex parallel between the two outlets, the reduction of pressure thus permitting a passage of air from one orifice to the other.—Mr. J. Cosmo Melvill communicated a paper by Mr. Peter

Cameron, entitled "Hymenoptera Orientalia; or, contributions to a knowledge of the Hymenoptera of the Oriental zoological region. Part ix. The Hymenoptera of the Khasia Hills. Second paper."—A paper "On the question of Irish influence on early Icelandic literature, as illustrated by the Irish MSS. in the Bodleian Library," was read by Miss Winifred Faraday (communicated by Mr. F. J. Faraday).

PARIS.

Academy of Sciences, November 6.—M. van Tieghem in the chair.—Researches on the diamines: piperazine, by M. Berthelot. The heats of solution of anhydrous diethylenediamine and its hydrate are given; and also the heats of combustion and formation, and of neutralisation with hydrochloric acid.—On some characters of the diamines deduced from their neutralisation, by M. Berthelot.—Preparation and estimation of glycogen, by M. Armand Gautier. The author had observed that when a slight excess of mercuric acetate is added to an animal or vegetable extract, dilute potassium carbonate solution being added at the same time to keep the liquid neutral, the nitrogenous bodies are nearly wholly precipitated. Liver or muscle is treated with boiling water, and the liquid pressed out on cloth. The neutralised liquid is concentrated by rapid boiling to half its bulk. The exact quantity of mercury solution is then added, the precipitate separated by a centrifugal machine. The clear liquid is acidified with acetic acid and poured into alcohol, when crude glycogen is precipitated. The method is a quantitative one, 1000 grams of fresh human liver giving 20·5 grams of glycogen, and of rabbit's liver 14·0 grams. Glycogen is apparently dissolved by water, but filtration through porcelain shows that the glycogen is not really dissolved, as the whole of the sugar is found on the outside of the filter, pure water only passing through. Its copper reducing power is slightly less than that of anhydrous glucose (97·8 : 100).—On the theory of the hydraulic brake in guns, by M. Vallier.—On the mass of the cubic decimetre of water, by MM. Ch. Fabry, J. Macé de Lepinay and A. Pérot. The authors have shown in previous papers how to measure the dimensions of a quartz cube in terms of a wave-length of light as a unit of length, and now give a method for obtaining, by a photograph of the fringes, the exact deviations of opposite faces from parallelism. These curves, together with the absolute thickness at one point, give the mean thickness corresponding to the pair of faces considered. The results of measurement of the mass of water at 4° C. displaced by this cube show that the mass of 1000 c.c. at 4° is 21·4 mgr. less than 1 kilogram, showing a remarkable agreement with an unpublished result of M. Chappuis (1 kgr. − 24 mgr.) obtained by a different method.—Microphonic registration of the beat of chronometers, by M. Alphonse Berget. The apparatus described, consisting of a small Hughes microphone working a relay, gave clear curves very easily read. The method has the advantage of suppressing the personal error in reading the chronometer, and also renders it possible to apply the method of coincidences with great accuracy to the comparison of a chronometer and a pendulum. It is also possible in this way to make one chronometer govern several pendulum clocks.—On the radio-activity induced by the Becquerel rays, by M. P. Curie and Mme. M. P. Curie. A disc of an inactive substance, placed immediately over a radio-active substance (polonium or radium), acquires the property of emitting Becquerel rays, and rendering air capable of conducting. The activity so induced increases with the time of exposure to the radium, but tends to a limit. Discs of various substances were tried—zinc, aluminium, brass, lead, platinum, bismuth, nickel, paper, barium carbonate, bismuth sulphide—but the effects produced were all of the same magnitude. Experiments were made showing that these results cannot be explained by the assumption of an actual transference of the radio-active material, either as powder or vapour, but that there really exists an induced radio-activity.—Remarks by M. Becquerel on the preceding paper.—On the spectrum of radium, by M. Eug. Demarçay. As the barium chloride gained in radio-activity new rays appeared in the spectrum, which it would appear reasonable to attribute to the radiating element. In the latest specimens prepared by M. and Mme. Curie, besides the spectra of barium, platinum, lead and calcium, were fifteen new lines, the most marked being one $\lambda = 3814{\cdot}7$, 4683·0, and a nebulous band having $\lambda = 4627{\cdot}4$ as a centre.—Electrical reproduction of Savart's figures, obtained by the aid of liquid layers, by M. P. de Heen.—Transformation of styrolene into metastyrolene under the influence of light, by M. Georges Lemoine. A quantitative study of this isomeric change, including the effect of the thickness of liquid layer, nature of the radiations, temperature.—On molybdenum dioxide, by M. Marcel Guichard. Pure MoO_2 can be prepared in several ways, by the action of molybdic anhydride upon ammonium molybdate, by heating ammonium molybdate alone, or by the electrolysis of fused molybdic anhydride, in all cases the final purification from unchanged molybdic anhydride being effected by washing with 10 per cent. soda solution, which gives much better results than the ammonia solution used by previous workers.—On rhamninose, by MM. Charles and Georges Tanret. Xanthorhamninose, which on hydrolysis gives ultimately rhametine, rhamnose and galactose, by careful treatment with very dilute sulphuric acid gives an intermediate sugar, rhamninose, besides galactose and rhamnose. The ferment rhamnose gives better yields of the new sugar, whose composition is $C_{18}H_{32}O_{14}$, its hydrolysis being represented by the equation

$$C_{18}H_{32}O_{114} + 2H_2O = 2C_6H_{12}O_5(\text{rhamnose}) + C_6H_{12}O_6(\text{galactose}).$$

Rhamninose is lævorotatory, $[\alpha]_D = -41°$, and melts with some decomposition at 140°. Its reducing power is one third that of glucose, and it is not fermentable by yeast. With sodium amalgam it gives rhamninite, $C_{18}H_{34}.O_{14}$, from which dulcite and rhamnose are obtained by hydrolysis. Galactonic and mucic acids are produced on oxidation by nitric acid.—Researches on the progressive development of essence of bergamot, by M. Eugène Charabot.—On a new disease of carnations, by M. Louis Mangin.—On the actual state of the volcanoes of Southern Europe, by M. Matteucci.—On the innervation of the pancreas, by MM. E. Wertheimer and L. Lepage.

AMSTERDAM.

Royal Academy of Sciences, September 30.—Prof. Van de Sande Bakhuyzen in the chair.—Prof. Beyerinck, on the production of indigo from woad (*Tsatis tinctoria*). The generally accepted opinion that woad contains the glucoside indican is erroneous. The chromogene, present in all growing parts of this plant, is indoxyl C_8H_7NO in the free state. *Polygonum tinctorium* and *Indigofera leptostachya* on the other hand contain indican, which can be split up into indoxyl and sugar by a peculiar enzyme, present in the species, but absent in the woad, by certain bacteria and yeasts and by boiling with acids. The woad, as an "indoxyl plant," when exposed to the vapour of ammonia in a confined atmosphere, at once produces indigo blue, whereas *Indigofera leptost.* and *Polyg. tinct.* as "indican plants" do not become blue by the action of ammonia, the indigo enzyme being destroyed by it. "Indican plants" can, however, be converted into dead "indoxyl plants" when slowly killed by the exclusion of air, which is best performed by complete submersion in mercury. If then exposed to alkaline vapour and extracted with alcohol, which dissolves the chlorophyll pigment, they become dark blue. Indigo plants do not contain a peculiar oxydase, but produce some alkali when slowly dying in the air.—Prof. Bakhuis Roozeboom communicated the results of an inquiry, made by Dr. W. Reinders, concerning the mixture crystals of HgI_2 with $HgBr_2$. The melted mixtures of these substances solidfy into a continuous series of rhombic mixture crystals. No chemical combination takes place. The temperatures of solidification show a minimum at 59 per cent. Mol. $Hg.Br_2$. Below 127° the mixture crystals change from rhombic, yellow ones into tetragonal red ones. Moreover, the transition temperature varies within a transition interval, which has been studied down to 0° partly in the optical way, partly through crystallisation of the mixture crystals out of solutions. With due allowance for the composition of the two kinds of coexisting mixture crystals, the fall of the conversion temperature is in accordance with the laws of diluted solutions. Prof. Bakhuis Roozeboom also presented, on behalf of Dr. Ernst Cohen and Dr. C. van Eyk, a paper entitled "The enantiotropy of tin (II.)."—Prof. Lobry de Bruyn presented, on behalf of Mr. H. Bijl and himself, a paper on isodialdane, a substance analogous with cane sugar. (These communications will be inserted in the *Proceedings.*)—The following were further presented for publication in the *Proceedings*: (*a*) by Prof. Bakhuis Roozeboom, on behalf of Dr. Ernst Cohen, a paper entitled, "On a new kind of transition elements (sixth kind)"; (*b*) by Prof. Kamerlingh Onnes, on methods and apparatus employed in the cryogen laboratory," and (1) on behalf of Mr. Fritz Hasenoehrl, "Die Dielektricitäts constante von verflüssigtem

Stickoxydul und Sauerstoff"; (2) on behalf of Dr. W. van Bemmelen, a paper on spasms in the earth's magnetic force. Dr. Van der Stok, correspondent of the Section, showed some seismograms and magnetograms illustrating Mr. Van Bemmelen's paper. Magnetical curves, obtained by means of a self-registering instrument, exhibit oscillations of the same kind as those observed on photographic lines produced by seismographs of various patterns, which oscillations are known as earthquake motions, pulsations and tremors. Seismographs have been in actual use for a few years only, while magnetical curves have been known for a period of about twenty years; the latter may, therefore, be considered more sufficient data for an investigation into these oscillations by statistical methods than the former. Dr. Van Bemmelen has investigated those movements of short duration, which he calls "spasms," and also the oscillations of a well-defined zigzaggy description and longer duration, viz. pulsations. In both phenomena the author has found well-marked diurnal and annual variations, but no connection between their frequency and cosmical causes can be traced. Dr. Van Bemmelen has also tried to investigate these movements by means of a very sensitive bifilar, which inquiry takes a great deal of time and trouble, because it is not possible to make this instrument self-registering, owing to the enlarged time scale and the lack of sensitiveness of the photographic paper. This inquiry by ocular observation has hitherto not yielded any definite results.—(*c*) By Prof Hubrecht, on behalf of Dr. J. F. van Bemmelen, a paper entitled "Results of a comparative inquiry into the palatine orbital and the temporal region of the skull of the monotremata."—(*d*) By Prof. V. A. Julius, on behalf of Dr. A. Smits, a paper entitled "On decreases in the tension of solution vapours at 0°." The previous experiments with the micromanometer on solutions of NaCl, KOH and sugar were repeated, and it was again found that the molecular decrease of vapour tension increased with the concentration. The inquiry was then extended to H_2SO_4, $CuSO_4$ and KNO_3. In the case of H_2SO_4 and $CuSO_4$ the molecular decrease of vapour tension increased with the concentration; while, on the contrary, in the case of KNO_3 the decrease of vapour tension became smaller on the concentration becoming greater.—(*e*) By Prof. Cardinaal, on behalf of Mr. K. Bes, a communication concerning the formation of the ultimate equation.—(*f*) By Prof. Zaayer, on behalf of Prof. W. Einthoven, a paper on the theory of the capillary electrometer. The mechanical friction in the capillary tube and the resistance of the circuit influence both time relations of the capillary electrometer. The amount of either of these influences has been measured. The experiments show that in many capillary electrometers the influence of the resistance of the circuit is far surpassed by that of the mechanical friction. Hermann's theory of the capillary electrometer is rejected.—(*g*) By Prof. Van der Waals, on behalf of Mr. E. H. J. Cunaeus, a paper entitled "Refractivity determination as a method of inquiry into the composition of the coexisting phases in the case of mixtures of acetone and ether." The inquiry comprises, besides the determination, by Lord Rayleigh's method, of the refractivity of some mixtures of H_2 and CO_2, also the determination of the refractivity of the vapour above various mixtures of acetone and ether, in order to derive therefrom the composition of the coexisting liquid and vapour phases with the appertaining pressure.—Prof. Haga showed a negative, obtained by means of Uran-rays, yielded by the "A" preparation from de Haën's manufactory (*Wied. Ann.*, August 1899).

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 16.

ROYAL SOCIETY, at 4.30.—Note on the E.M.F. of the Organ Shock, and on the Electrical Resistance of the Organ in *Malapterurus electricus*: Prof. F. Gotch, F.R.S., and G. J. Burch.—On the Formation of the Pelvic Plexus, with especial reference to the Nervus Collector in the Genus Mustelus: R. C. Punnett.—On the Least Potential Difference required to produce Discharge through various Gases: Hon. R. J. Strutt.—Mathematical Contributions to the Theory of Evolution. VII. On certain Formulæ in the Theory of Correlation, and their Application to the Inheritance of Characters not capable of Quantitative Measurement: Prof. Karl Pearson, F.R.S.—On the Propagation of Earthquake Motion to Great Distances: R. D. Oldham.—An Experimental Research on some Standards of Light: J. E. Petavel.

LINNEAN SOCIETY, at 8.—The Comparative Anatomy of certain Species of *Encephalartos*, a Genus of the *Cycadaceae*: W. C. Worsdell.—On a Collection of *Brachyura* from Torres Straits: W. T. Calman.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

CHEMICAL SOCIETY, at 8.—The Chlorine Derivatives of Pyridine. Part IV. Constitution of the Tetrachloropyridines: W. J. Sell and F. W. Dootson.—Contributions to our Knowledge of the Aconite Alkaloids. Part IV, On Japaconite and the Alkaloids of Japanese Aconite: Wyndham R. Dunstan, F.R.S., and H. M. Read.—On the Determination of Transition Temperatures: H. M. Dawson and P. Williams.

FRIDAY, NOVEMBER 17.

ANATOMICAL SOCIETY, at 4.—A Persistent Left Inferior Vena Cava: Stanley Boyd.—Specimen of Sacculated Œsophagus: Miss Stoney.—Child's Skull, showing Parietal Perforations: Prof. A. M. Paterson.—Note on the Morphology of the Biceps Flexor Cruris: Prof. B. C. Windle, F.R.S., and F. G. Parsons.—Lantern Demonstration of certain Points in the Lymphatic System of the Appendix: C. B. Lockwood.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Presidential Address on the Comparative Mortality of English Districts: Dr. Franklin Parsons.

MONDAY, NOVEMBER 20.

SOCIETY OF ARTS, at 8.—Enamelling upon Metals: H. H. Cunynghame.

TUESDAY, NOVEMBER 21.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Papers to be further discussed*: The Waterloo and City Railway: H. H. Dalrymple-Hay.—The Electrical Equipment of the Waterloo and City Railway: Bernard M. Jenkin.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—The Nature of the Arab Jinn illustrated by the Present Beliefs of the People of Marocco: Dr. E. Westermarck.

ROYAL STATISTICAL SOCIETY, at 5.—Notes on the Food Supply of the United Kingdom, Belgium, France and Germany: R. F. Crawford.

WEDNESDAY, NOVEMBER 22.

SOCIETY OF ARTS, at 8.—National Forestry: D. E. Hutchins.

GEOLOGICAL SOCIETY, at 8.—On some Remarkable Calcisponges from the Eocene Tertiary Strata of Victoria (Australia): Dr. G. J. Hinde, F.R.S.—The Silurian Sequence of Rhayader: H. Lapworth.

THURSDAY, NOVEMBER 23.

ROYAL SOCIETY, at 4.30.

SOCIETY OF ARTS, at 4.30.—Old and New Colombo: John Ferguson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Cost of Steam Raising: John Holliday.—Influence of Cheap Fuels on the Cost of Electrical Energy: R. E. Crompton.

FRIDAY, NOVEMBER 24.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Openings for Mechanical Engineers in China: The Right Hon. Rear-Admiral Lord Charles Beresford, C.B.

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