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ZOOLOGY AS A HIGHER STUDY.

A Text-book of Zoology. By Prof. T. Jeffery Parker, D.Sc., F.R.S., and Prof. William A. Haswell, M.A., D.Sc., F.R.S. 2 vols. Pp. xxxv + 779 and xx + 683. (London: Macmillan and Co., Ltd., 1897.)

Traité de Zoologie Concrète. By Prof. Yves Delages and E. Hérouard. Vols. i. and v. Pp. xxx + 584 and xi + 372. (Paris: Reinwald, Schleicher frères, 1896 and 1897.)

THOSE who write books to assist the University professor and the advanced student of zoology are entitled to great consideration on the part of those to whom their work is addressed, for their self-appointed task is a most difficult and in many ways an elusive one. The mass of detailed concrete fact with which such authors attempt to grapple is simply prodigious, and increases yearly at an enormously rapid rate. The generalisations and theories which hold these facts together are in proportion delicate and flimsy structures which, though they are absolutely essential, yet are easily strained, misrepresented, ignored or ludicrously accentuated by any but the most careful and judicious writer.

In judging an expository treatise dealing with a branch of science, it is necessary that a reviewer should not only recognise the claims upon his gratitude which the long labour of an author may possess, but should also distinctly appreciate the precise purpose of the treatise under notice—the point of view adopted by the author, and his reason for adopting it. The book by Profs. Parker and Haswell is addressed to University students, but yet is intended to be fitted for beginners. It consists essentially in an extended application of the method of teaching by detailed examination of a series of types or examples, now used almost universally for a preliminary or elementary course of zoological study. This method was started in this country not by Huxley, as our authors state, but by Rolleston. It is probably the best way of commencing the study of zoology. It should, however, be limited to a course involving some six or eight well-selected examples. To carry it on as the staple or main form of study after the preliminary course is, in my judgment, a serious error. An acquaintance with the large generalisations of zoology, a determined grasp of some of its unsolved problems, a concrete appreciation of the actual range and extent of genera and species, recent and fossil, in at any rate some large groups in a *complete* manner, and not by mere vague sampling, are what the University student needs to have offered him by way of education. He will, of course, examine and dissect carefully as many animals as he can; but they will not necessarily be those selected as examples by our authors. Nor should the student, I venture to think (after his preliminary course), mechanically demonstrate and identify a host of details in animal after animal, simply because those details are there capable of being identified, and are mentioned in the text-book. This would tend to make our delightful and romantic comparative anatomy as dreary and soul-destroying as is what Rolleston termed "Anthropotomy." A kind of training, it is true, may be given in this way, but it is a bad and injurious training, and does not lead to the progress of zoology or comparative anatomy.

It seems to me that, as a book to guide the student to a second course rather than one dealing with a further series of common-place examples treated with measured, not to say exasperating, detail, we should welcome one which treated only of exceptional, puzzling and debateable animals, such, for example, as Trichoplax, Limnocodium, Ctenoplana, a Cystid, Sternaspis, Acanthobdella, Lingula, Limulus, Peripatus, Neomenia, Balanoglossus, Hippocampus, Siphonops, Hatteria, Rhea and Ornithorhynchus. In such a book it would, at any rate, be necessary to consider the *significance* of the structures described, and to make them really the means of *discussing* the affinities of the several animals.

The publication of Profs. Parker's and Haswell's text-book was almost simultaneous with the sad and untimely death of one of its authors, Jeffery Parker. Many of the beautiful original drawings (more than one thousand in number!) with which the book is illustrated are from his pencil. There can be no doubt that his health suffered for a year or more before he succumbed, and hence we are justified in assigning responsibility for the very numerous and curious errors which the book contains to Prof. Haswell and to Prof. W. N. Parker, of Cardiff, who undertook a final revise of the sheets in this country, rather than to Jeffery Parker.

I have already indicated that I do not think that the unlimited extension of the method of teaching by detailed examination of representative types is satisfactory as *the* method to be pursued in a University course. Nevertheless the student will undoubtedly find Parker's and Haswell's book useful in assisting him in dissection and in examination of skeletons. The authors give a general account of the structure of the larger and smaller groups, illustrated by the selected examples, and a brief exposition of the classification and contents of each group of the animal kingdom; but there is no profession of making this exposition complete. Chapters on geographical distribution and the history of zoology are given at the end of the book, which are so well done that one could wish they were longer.

The authors have deliberately adopted a course of procedure with regard to the citation of authorities and references to monographs and other literature, which they defend in their preface at some length. Their procedure is simply this—that they give no references at all; they never cite the name of an authority, nor give the vaguest intimation as to whether the statement they are making is as old as Cuvier, or is a brand-new discovery, or a special opinion of their own. Even when they copy a woodcut from a previous work, they often omit to state the name of the author to whom it is due, and only quote the copyist who preceded them in taking it from the original author. I can not sufficiently strongly condemn this policy of omission. To me it appears simply disastrous. The authors of the present book have only imitated the example of some recent German writers in thus effacing the discoverer's claim to recognition, and, whilst reducing their own statements to a condition of puzzling confusion, have rendered their book useless

to the serious student who wishes to consult original authorities.

In addition to this objection to the omission of reference to authors, there is the fact that it suggests (perhaps rightly, perhaps wrongly) that the author is ignorant of the correct name with which to connect a particular view or discovery, or that he is too lazy to look the matter up, or that he wishes fraudulently to give the impression that he makes such and such a statement of his own knowledge and independently. Finally there is the objection, that by the omission of authors' and discoverers' names, and by thus failing to pursue the historical method of exposition, a very great means of lending interest to a vast mass of detail is sacrificed. Not only is the student deprived of what is often, when present, a very important aid to his memory, but what is in many cases the best and simplest scheme for the presentation of the subject to the student—viz. its actual historical development—is rendered impossible. I hope that others who feel as strongly as I do as to the injury done by those zoologists who deliberately ignore or refuse to cite the names and writings of their predecessors and contemporaries, will join in taking steps to condemn and, if possible, arrest, by the expression of authoritative public opinion, what seems to me a mischievous and mean kind of literary injustice.

The omission of reference to authorities is no doubt to some extent the cause of the existence in Parker's and Haswell's "Text-book of Zoology" of mistakes which either Prof. Haswell or Prof. W. N. Parker would have seized upon and corrected had they appeared as unverified by reference to a recent author in an ordinary treatise. But since no statement in the book is so supported, a reader revising the proof for the author would, on seeing an extraordinary assertion, say to himself, "Dear me! I suppose that is something new; something I've missed." It is probably owing to this that blunders have been left to mislead the student, and to undermine our confidence in all the statements made in the book which have any appearance of novelty. I have not searched the "Text-book" for errors, but I have come across the following in "sampling" its pages. Many of them are so serious that they should certainly be corrected in a new edition with the least possible delay, and steps should be taken to ascertain whether others of a like kind exist, and if so to remove them.

The most astonishing of these errors is the assertion by two sons of W. Kitchen Parker, that ossification occurs in the Selachii. They say (vol. ii. p. 158):

"The skeleton is composed of cartilage with, in many cases, deposition of bony matter in special places—notably in the jaws and the vertebral column. The entire spinal column may be nearly completely cartilaginous (Hexanchus and Heptanchus), but usually the centra are strengthened by radiating or concentric lamellæ of bone; or they may be completely ossified."

On the other hand (an inconsistency due probably to duplicate authorship and multiple responsibility) we find in the description of Chiloscyllium on p. 136, the statement that the skeleton is composed entirely of cartilage with, in certain places, depositions of calcareous salts. And, moreover, in the histological introduction in the first volume "calcified cartilage" is very properly mentioned and distinguished from bone. In attempting to follow up this extraordinary blunder, viz. the assertion that ossification takes place in the cartilage of Selachii, I have looked into the translation of Wiedersheim's "Comparative Anatomy of Vertebrates," and there I find the same assertion, the word which in the original German is "Verkalkung" being translated "ossification" (as though the German had been "Verknocherung"). Now the translator who made this mistake is Prof. W. N. Parker, of Cardiff. Hence we may conclude that it is he who is responsible for the similar statement in the "Text-book," and not either the late Jeffery Parker nor Prof. Haswell of Sydney. But whose soever the fault may be, the sooner so grossly misleading a statement is removed from a book addressed to young students, the better.

The following erroneous statements occur in vol. i. On p. 423 we read:

"Externally each nephridium [of the earthworm] opens by one of the small excretory pores which have already been mentioned as occurring on the ventral surface; internally it ends in a funnel-shaped ciliated extremity with an aperture, the *nephrostome*, opening into the cavity of the corresponding segment."

As a matter of fact, it is a curious and characteristic thing that the nephridia of Chætopoda do *not* open into the segment corresponding to the external pore, but into the segment next in front of it.

P. 372. In the description of Holothuria, our authors state:

"Opening into the cloaca is a pair of remarkable organs of doubtful function, the so-called *respiratory trees*. . . . Each of the terminal branches ends in a ciliated funnel opening into the cœlome."

As a matter of fact, the Holothurian respiratory tree does not possess such ciliated funnels, and in this differs notably from the so-called "posterior nephridia" of the Echiurids.

P. 561. In the description of Peripatus we read:

"A layer of cœlomic epithelium lines the wall of the cœlome and invests the contained organs. Incomplete muscular partitions divide the cavity into a median and two lateral compartments."

Nevertheless the authors elsewhere recognise the fact demonstrated by Sedgwick and myself, that the blood-holding body-cavity of Arthropods is *not* the cœlom but an enlarged system of blood-sinuses the hæmocœl; whilst the cœlom is reduced to perigonadial and perinephridial rudiments.

P. 732. We read that in Nautilus

"A large *vena cava* occupies a position corresponding closely with that of Sepia. It presents the remarkable peculiarity of being in free communication by numerous (valvular) apertures with the viscero-pericardial cavity of the cœlome."

A remarkable peculiarity, indeed, and one which has no existence in fact! The vena cava communicates with veinous blood-spaces by those apertures, and *not* with the cœlom.

In addition to such down-right errors as the above, it must be noted that the authors have too readily accepted the statements of some writers whose names, however, as usual, they do not give. Thus they describe and figure

the so-called "Salinella" of Frenzel as though some evidence worthy of attention had been produced in support of the existence of such a creature; and they declare that a species of Apus "has been shown to be" hermaphrodite. They allude to the assertions of Mr. H. M. Bernard. It is well that that gentleman's attention should be drawn to the fact, and that he should at once either withdraw or confirm by some evidence his published statement that a species of Apus is hermaphrodite.

As to faults of omission—there is no doubt always room for divergence of opinion as to what should and should not be comprised within the area of a book necessarily selective and limited. But nothing can, it seems to me, justify the omission of all reference to the important Leech, *Acanthobdella*, when the affinities and origin of the Hirudinea are discussed; nor such an inadequate account of the tubular continuations of the pericardial cœlom of Lamellibranchs as that which is given at p. 640, where Keber's organ is treated as an excretory organ, and nothing said of its morphological significance.

Opinions, no doubt, may differ as to the exact form and spelling of many zoological terms. At the same time, I fail to see the justification for writing "cœlome" in the place of "cœlom," "Cœlenterata" in place of "Cœlentera," and "Echinodermata" in the place of "Echinoderma."

It will thus be seen that although there is a great deal of excellent description in the new "Text-book," and many beautiful and useful figures, there is yet a very serious amount of inaccuracy, and in some matters of great importance a want of sound judgment which must seriously interfere with its utility.

It is not uninteresting to compare with the text-book of Parker and Haswell, one of the four text-books of zoology which are in course of publication at the present moment in France. We have that by Prof. Delages and M. Hérouard, also a text-book by Prof. Edmond Perrier of comprehensive scope and abundant detail; one edited by M. Raphael Blanchard, to which a whole series of authors contribute each his fascicle; and one by Prof. Roule, of Toulouse. The work projected by Prof. Delages is the most original of these, on account of the method pursued. Prof. Delages aims at a complete logical exposition of the characters of each phylum, class, order, family and genus of the animal kingdom. Not only that, but he gives a schematic figure which corresponds with his description of each group—so that the student realises in concrete form the characteristics of a class—an order or a family—characteristics which may be modified by greater or less development, but give the essential features of the group. Hence the term "Zoologie Concrète," which forms the title of the work. The plan is a carrying out into a complete system of the method which I (borrowing it from older writers) made use of when in my article Mollusca ("Encycl. Brit."), I drew an Archi-mollusc. Prof. Delages will, when he comes to that group, draw and describe not only an archi-mollusc, but an archi-gastropod, archi-cephalopod, &c., and also an archi-prosobranch, an archi-diotocardian, and an archi-patellid, and similar schematic forms—"types morphologiques," as he terms them—for every group—down to the actual genera. It is essential to the plan of Prof. Delages' work that every genus shall be not only named and cited, but described at sufficient length to enable the reader to identify the genus of a specimen concerning which he is interested, and thus to obtain a reference to more detailed monographic literature.

It is evident at once that the project is a very large one. Such a work fully carried out with complete anatomical detail such as is necessary to give a true conception of the relations of large and small groups, would be an ideal treatise for the advanced student. The only objections to it seem to be (1) that if thoroughly done it must be a work of enormous size, extending to at least twenty large octavo volumes. (2) That it is impossible for one or even two authors to possess a sufficiently detailed knowledge of the whole animal series to produce a really accurate and judicious account of every group with the minuteness proposed.

We have, however, two volumes already published—the first dealing with the structure of the Cell and with the group Protozoa, the second devoted to what MM. Delages and Hérouard call the "Vermidea," namely certain small groups of debated affinities; to wit, the Gephyræa, Polyzoa, Rotifera, Chætognatha, Kinorhyncha (Echinoderes), and Brachiopoda—names which Prof. Delages prefers to alter into Gephyria, Bryozoaria, Trochelmia, Kinorhynchia and Brachiopodia. Some of the changes in names and the classification adopted by MM. Delages and Hérouard (especially in regard to the Protozoa) are valuable and likely to secure general assent. But it is difficult to approve of the word Vermidea—a Greek adjective made from a Latin substantive—and one which, to me at any rate, seems not to be necessary for classificatory purposes.

In these two volumes we can see how the "concrete" system of exposition works. It certainly results in a very useful treatise on the Protozoa. Numerous process blocks (no less than eight hundred and seventy) are introduced into the text, and though they are by no means equal in beauty to the woodcuts of the text-book by Parker and Haswell, they are yet sufficient for their purpose. In the second volume published (that on the Vermidea), which is vol. v. of the series as planned by Prof. Delages, forty-five coloured plates are introduced as well as five hundred and twenty cuts. Many of the coloured plates are occupied with diagrammatic figures, showing by means of strong conventional colouring the anatomy of Gephyræans, Rotifers, Polyzoa and Brachiopods, but two are devoted to highly-finished coloured drawings of the living appearance of selected species of Sipunculids and Echiurids respectively. It is probably the first time that a treatise intended for students has been so fully illustrated. Naturally, in attempting to test the quality of such a book, one looks at the treatment of subjects specially familiar to one's self. In this volume I looked with curiosity at the account of Rhabdopleura. I find it excellent, occupying eight pages, with seven large process blocks—some coloured, which are diagrams, others copied from originals duly acknowledged. The only objection I have to offer is that here as elsewhere the authors yield to a very natural tendency, and instead of using the terms "tubarium," "pectocaulus," and "gymnocaulus," as applied to certain parts in the original description from which their information is

derived, invent new descriptive terms which seem neither necessary nor advantageous. As showing how difficult it is to quote accurately detailed accounts of an organism of which the writer who quotes has no special knowledge, the following is an instance. MM. Delages and Hérouard say "Ray Lankester a décrit à droit du rectum un testicule qui s'ouvrirait à la marge de l'anus ; mais Fowler a nié son existence." Whilst I thoroughly agree with Prof. Delages in the propriety and usefulness of citing the names of authors responsible for statements, and admire the thorough and conscientious way in which he has thus brought his work up to the latest date so as to make it a really valuable source of references, I note that it is difficult to be always exact in such citations. Fowler had no opportunity for denying the existence of the testis described by me in Rhabdopleura. Of its existence there is no possibility of doubt ; it was observed in several specimens, and figures of several of these were published by me. All that Fowler said was that he did not find it in certain specimens observed by him. This is entirely in accordance with what I had stated, since in by far the majority of living specimens studied by me it was absent, and only present in exceptional individuals which happened to be in a state of sexual maturity.

I will venture also to enter a protest against the citation by M. Delages of a genus of Protozoa based on the "ciliated pots" of Sipunculus. Every one knows that these are two-celled structures belonging to Sipunculus itself, and not parasites.

The plan of the "Zoologie Concrète" comprises nine volumes royal octavo of about 500 pages each ; but it seems to me impossible that the larger groups can be treated with the same thoroughness as are those dealt with in the two published volumes unless a much larger number of volumes is produced. We are promised a volume on the Prochordata in the present year, a volume on the Cœlentera in 1899, and separate volumes subsequently on each of the following groups :—Echinoderma, Vermes, Articulata, Mollusca, Vertebrata. Whether the work can be thus completed or not, there is no doubt that the volumes published are of considerable value, and their successors will be looked for with great interest by all zoological colleagues of MM. Delages and Hérouard.

The proper limitations of size and the true scope of zoological text-books form a subject which may be endlessly debated. After all, is it not the fact that Bronn's "Thierreich" is the only treatise which is sufficiently comprehensive and detailed? Do we not know that it will never be finished, but that it must be re-written volume by volume so long as zoology endures? And is not Gegenbaur's "Grundriss" the only really masterly condensation and convincing exposition of the great generalisations of comparative anatomy hitherto written?

Gegenbaur's book is nearly twenty-five years old. A brief survey of the genealogical significance of animal structure is needed now, which shall as firmly and clearly present the morphological doctrines of 1900 as did the "Grundriss" present those of 1875.

E. RAY LANKESTER.

WEATHER PREDICTION.

Die Wettervorhersage. Im auftrage der Direktion der deutschen Seewarte bearbeitet von Prof. Dr. W. J. van Bebber, Abtheilungsvorstand der deutschen Seewarte. Zweite verbesserte und vermehrte Auflage. (Stuttgart : Ferdinand Enke, 1898.)

SOME years ago Prof. van Bebber put before the world a popular account of the principles underlying weather prediction. His long experience at the Deutschen Seewarte enabled him to give the latest information concerning the processes employed in the most authoritative manner, and the result was necessarily a very interesting book. It is therefore not a matter of surprise that this treatise should have run out of print, and a second edition be peremptorily called for. Such a result must, however, be gratifying to the Professor, because he has recognised the fact, that the full value of the information supplied to the public through the weather bureau, supplemented as it is by weather charts and tables, cannot be fully appreciated so long as those for whose benefit such information is disseminated, remain ignorant of the general principles of meteorology. Guided by this motive, he has systematically endeavoured to popularise the science, while working in the forefront as a scientific meteorologist. His method of making the information useful, and of instructing those who are possibly far removed from a meteorological station, and therefore thrown to a considerable extent on their own resources, consisted in preparing a large number of weather charts, something like two hundred in all, arranged in a systematic order, in which might be found represented the conditions of the weather obtaining at any subsequent epoch. A judgment or forecast could then be formed from the similar data supplied in the book, and possibly the effect of local circumstances taken into account. The same method is pursued in the present edition ; indeed it has not been found necessary to alter the maps in any essential particular, judging by the dates to which they refer.

If there be any who doubt the efficacy of the modern system of forecasting the weather, or the utility of the practice, it will be to a certain extent reassuring to learn that, after twenty-two years' daily study of the weather maps of Europe, Prof. van Bebber still relies confidently on their accuracy and trustworthiness. And although individual judgment may be disposed to prefer its own conclusions in this matter of weather and the value of forecasts, the question is one on which authority should be at least heard with respect. For it is only those who systematically compare the forecasts with actual results, and who also are able to draw their information from reports covering large areas, who can judge of the success of a system which is more or less upon its trial. One failure to issue a storm warning from which suffering and disaster result, is remembered far more easily than the many more numerous cases in which the signal sends out its warning with due effect. It must be admitted that there is apparently not the same tendency to cover the Meteorological Bureau with ridicule, when the forecast proves glaringly incorrect, as was noticeable some years ago ; but this greater leniency

may simply indicate that the joke has been worn threadbare, and not imply any degree of greater respect to the meteorological authority. Increased confidence can only come with greater knowledge, and therefore we are inclined to welcome the demand for a new edition of Prof. van Bebber's book as an indication that more attention is being paid to a subject, at least abroad, which nearly concerns the comfort of the community and the prosperity of many trades and callings.

Moreover, it is distinctly reassuring to find that the methods of weather prediction are in a measure stereotyped. That no particular change or improvement has been made in these methods, in the space of time covering the issue of the two editions, is a clear indication that they are based on well-ascertained scientific lines, from which the elements of chance have been eliminated. The two sections of the work into which the greatest amount of alteration has been introduced is, first, that dealing with the probable character of the weather over longer periods than twenty-four hours in advance, and in a lesser degree the movements of areas of low barometric pressure. The discussion of the paths along which cyclonic movements preferably travel, has been an inquiry on which Prof. van Bebber has long worked, and though the information derived from the examination of a greater number of instances might be expected to modify the conclusions derived entirely from experience, no great alteration seems to be necessary, and no fresh results appear to be indicated. The percentages of successful forecast or repetition of the same character of weather before, during, and after the passage of a cyclone, shown in the tabular statement, are those derived from a fourteen years' study of the behaviour of these systems. Seven years' further study has apparently only confirmed the conclusions originally drawn.

Only in the section on the possibility of predicting the weather some days in advance, do we meet with weather charts of a tolerably recent date, an evidence of the author's work during the last few years. Taking it for granted, as we may, that the weather of any region is mainly determined by the barometric pressure and the interchange of areas of high and low barometer, Van Bebber defines five conditions of weather type, determined by the relative positions of atmospheric pressure over the continent of Europe, which conditions are repeated in their general features with great frequency, and can be easily recognised. The length of continuance of the same weather after the establishment of one or other of these typical systems will vary at different times of the year, and according to the relative positions of high and low pressure; but, on the average, one can reckon upon the weather remaining unchanged for about three and a half days, and in favourable conditions on even greater permanency. What is now wanted is the means to predict with certainty the transference of one determining type of weather to another. When this knowledge exists, and the author looks forward hopefully to a time when it will be within our reach, we shall be able to make those longer forecasts which are demanded by the necessities of practical life.

OUR BOOK SHELF.

Maryland Geological Survey. Vol. I. Pp. 539. (Baltimore: The Johns Hopkins Press, 1897.)

Iowa Geological Survey. Vol. VI. *Report on Lead, Zinc, Artesian Wells, &c.* (Des Moines: Iowa Geological Survey, 1897.)

THE first volume of the "Maryland Geological Survey" is one of which Prof. W. B. Clark, the State Geologist, and others who have been concerned in its production, should be proud. The volume consists primarily of a summary of past and present knowledge concerning the physical features of Maryland, and embraces an account of the geology, physiography and natural resources of the State, with a bibliography of all publications relating to these matters. Of exceptional interest is an admirable report by Dr. L. A. Bauer upon magnetic surveys in general and the magnetic conditions of Maryland in particular. This report is an inspiring statement of the development and purposes of magnetic surveys, and the valuable information which Dr. Bauer has obtained should induce other States to institute similar inquiries to those carried out by him. The results of such work are not only of great importance to the county surveyors and others who are engaged in determining the boundaries of lands, but are also of wider value on account of the relations which exist between geology and terrestrial magnetism, many magnetic features of a district being related to the geological structure of the underlying rocks. Several fine plates, and other figures, illustrate the report.

A number of separate papers of general economic interest are included in the sixth volume published by the Iowa Geological Survey, under the direction of Dr. S. Calvin, the State Geologist. Prof. A. G. Leonard describes the lead and zinc deposits of the State, and Dr. S. W. Beyer the Sioux quartzite and certain associated rocks. Prof. W. H. Norton gives a detailed account of the artesian wells of Iowa, which should be found of considerable value by the citizens of the State; and Mr. H. F. Bain describes the relations of the Wisconsin and Kansan drifts in Central Iowa. The volume thus constitutes a worthy contribution to the economic geology of Iowa.

Elementary Chemistry, Practical and Theoretical. First Year's Course. By T. A. Cheetham, F.C.S. Pp. 128. (London: Blackie and Son, Ltd., 1898.)

THIS is an addition to the class of school books containing experiments which aim at developing a pupil's thinking powers rather than at supplying "useful knowledge" of the kind contained in elementary books of science a few years ago. It is an exercise book constructed on sound principles by a teacher of experience; therefore the experiments have an educational value, and are also practicable. The pupil is instructed to "observe what happens when mercury is heated," "observe the effects of heating sulphur under different conditions," "heat a weighed quantity of chalk, and find whether there is a gain or loss of weight," and so on, instructions being given how to proceed in each case. The course of work and study follows closely that proposed in the British Association Report on the Teaching of Chemistry, and the scope of the treatment includes the laws of chemical combination. The first part of the book is devoted to practical work, while the second contains material for lecture experiments and theoretical information to be studied in connection with the practical work of the laboratory.

The plan and execution have much to commend them, and the volume is a distinct advance upon the text-books of the days before the new methods of teaching chemistry had been developed. No book of science should, however, be published without an index.

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.*]

Nomenclature and Notation in Calorimetry.

ALL who are engaged in thermal investigations themselves, as well as those who have occasion to study the published work in this department of science, must have been frequently annoyed by the use of the word *calorie* with its varying signification. It has been sought to remove the inconvenience by qualifying the calorie as small or great, and in other ways; but on opening a book at any place where the results of thermal determinations are given, it is in most cases difficult to discover at once what unit of heat the author is using.

As different classes of investigation are carried on on different scales, it is obvious that it is a convenience, if not a necessity, to have different heat units at disposal. The unit which is suitable to express the thermal changes in a beaker in the laboratory, would manifestly be inconvenient when dealing with the daily or seasonal changes in a lake or an ocean. It is therefore natural and necessary to have heat units of different magnitudes, but it is neither natural nor necessary to call them all by the same name, and it is extremely inconvenient not to have a short form of notation which will show on its face the actual heat unit used.

In the early literature of the equivalence of heat and work in this country, one unit of heat is universally used; it is the pound-degree-Fahrenheit, and in the writings of Joule, Thomson, Rankine and others of that time, it is simply called "heat unit," as there was no other competing with it. With the rise and development of thermal chemistry, it was necessary to fashion the compound unit out of the simple units in common use in chemical laboratories; these are the gramme and the Celsius degree.

The heat given out by one gramme of water cooling by 1° C. at ordinary temperatures, is the unit most used in such researches; and it received the name of calorie, sometimes now called small calorie.

For many purposes this unit proved itself inconveniently small, and several larger units have been used, such as the heat given out by one kilogramme of water cooling 1° C. at ordinary temperatures, or the heat given out by one gramme of water cooling from 100° C. to 0° C.; but the name of calorie was retained in connection with them all, and in the specification of a quantity of heat by a number, the nature of the unit was indicated by the syllable cal. or the letter K, neither of which, of itself gives any information.

In my own work, and in the study of the writings of others, I have adopted a form of notation which I have found so useful that I propose to lay it before the readers of NATURE. I do not doubt that others who interest themselves in calorimetric work have been driven to adopt some similar, perhaps the same, perhaps a better form of notation; and I think they will agree with me that some system of self-interpreting notation should be universally adopted without loss of time.

Just as, when dealing with work, we use currently the expressions foot-pound and kilogramme-metre, so in calorimetry it is quite common to talk of a gramme-degree, or a kilogramme-degree; and what I propose is to use no other expression than these compound and self-explaining ones, and, in writing, to express them shortly by $g°$ and $k°$ respectively, to which for clearness the symbol of the thermometric scale must be added, so that they become $g°$ C. and $k°$ C. when Celsius' scale is used, or $g°$ F. and $k°$ F. when Fahrenheit's scale is used.

On this system the expression $g°$ C. would replace the ordinary "cal." and Ostwald's K would be represented by 100 $g°$ C. or 0·1 $k°$ C., or by $h°$ C., to mean hectogramme-degree C. With perfect exactness K would be expressed by g 100° C., but the difference between 100 $g°$ C. and g 100° C. is much less than the probable experimental error in any calorimetric operation. In a table containing a column of quantities of heat expressed in numbers of gramme-degrees-Celsius, the nature of the unit would be indicated at the top of the column by $g°$ C.; exactly as, in a column of temperatures, the unit is indicated by the symbol °C. or °F. The original British heat unit is then clearly expressed by lb.° F.

A heat unit made up of any unit of weight and any unit of temperature can be perfectly expressed in this system. Thus, if there were any advantage in doing so, we might have $g°$ F., lb.° C., $k°$ R. and many others, and their meaning would be at once apparent on inspection.

In oceanographical work, where the heat exchanges between one layer of water and another, or between the water and the air are under discussion, I have found the most convenient heat unit to be the fathom-degree-Fahrenheit, or the metre-degree-Celsius, which are abbreviated for the purposes of notation into $f°$ F. and $m°$ C., respectively. The nature of this unit will be most easily understood by considering an example.

In a paper, "On the Distribution of Temperature in Loch Lomond in the Autumn of 1885," read before the Royal Society of Edinburgh, and published in its *Proceedings* for the session 1885–86, I have given, at page 420, a table of the changes in the distribution of heat in the direction of depth, between several pairs of dates, in the Luss basin of Loch Lomond. At a certain depth, indicated by the intersection of the temperature curves, the temperature of the water is the same on both dates. The season being autumn, the layer above this depth has been losing heat, partly to the air above and partly to the water beneath, while the layer below the depth of common temperature has been on the whole the gainer. Thus, taking the dates September 5 and October 15, the intersection of the temperature curves is found at a depth of 16 fathoms; and in the interval of forty days the mean temperature of the water above this depth has fallen by 5·8° F., from 55·0° F. to 49·2° F. The thickness of the layer is 16 fathoms; therefore the loss of heat has been $16 \times 5{\cdot}8 = 92{\cdot}8\ f°$ F., or 92·8 fathom-degrees-Fahrenheit. The total depth of the lake at the spot was 35 fathoms, therefore the layer of water below the depth of common temperature was 19 fathoms thick. The mean temperature of this layer was 47·1° F. on September 5, and 48·9° F. on October 15, showing a rise of 1·8° F. in the interval. This corresponds to a gain of heat represented by $19 \times 1{\cdot}8 = 34{\cdot}7\ f°$ F. Assuming that the heat gained by the lower layer has been entirely at the expense of the upper one, we see that the loss of heat of the upper layer, during the interval, has been to the extent of 37·4 per cent. to the deeper water, and 62·6 per cent. to the air. The upper layer of water has thus been passing heat at the average rate of $1{\cdot}485\ f°$ F. into the air, and into the deeper water at the rate of $0{\cdot}85\ f°$ F. per day.

It is worthy of remark that the fathom-degree-Fahrenheit and the metre-degree-Celsius are interchangeable in heat calculations, because the fathom is 1·8 metre and the Celsius degree is 1·8° F.

This is a great convenience, and its usefulness will be apparent by applying it to the above example.

We have seen that, during the interval of forty days, the average transmission of heat from the upper layer of water has been at the daily rate of $1{\cdot}485\ f°$ F. to the air and of $0{\cdot}85\ f°$ F. to the deeper water. Writing $m°$ C. for $f°$ F., and considering a horizontal area of one square centimetre, we find at once that the average daily supply of heat from the water to the air has been at the rate of 148·5 $g°$ C., and to the deeper water at the rate of 85 $g°$ C. (gramme-degrees-Celsius) per square centimetre of superficial area.

It is unnecessary to provide for special cases where specially suitable units will be chosen as a matter of course; but for ordinary work of constantly recurring type it is important to have a system of nomenclature and of notation, each of which will tell its own story.

J. Y. BUCHANAN.

May 4.

Future Rainfall.

MOST people probably suppose that we have no light whatever on the fluctuations of our rainfall in future years, and that he would be a bold meteorologist who offered to forecast them. Yet, if there be truth in the conclusions arrived at by Prof. Brückner, we are not wholly without light on the subject; for a part of this country, at least, in common with probably the greater part of the globe, is subject to a regular recurrence of cold and wet periods, at about 35 years intervals (measuring from the centre of one such period to that of the next); these periods alternating with others which are hot and dry. It seems useful to inquire how we at present stand, and, if possible, what are our present prospects in respect of this theory.

For this purpose I will here employ a simple meteorological method, which seems to have been little used among us hitherto, viz. algebraic addition, step by step, of a series of plus and minus values; the resulting figures being then plotted as a curve.

Suppose *e.g.* any set of such values, as follows:

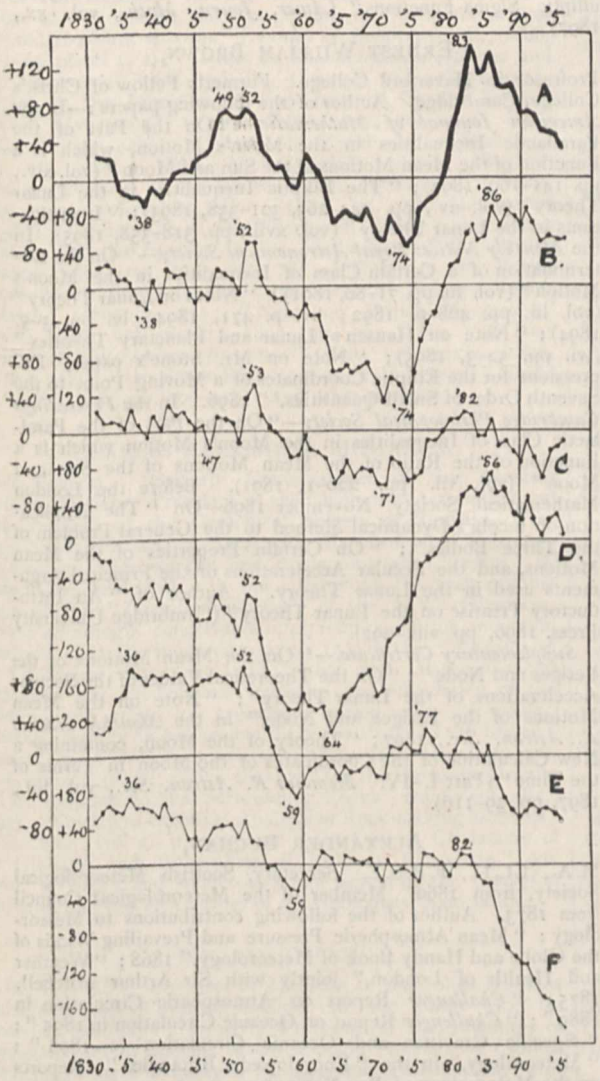
$$+3+6-2+8+12-3-9, \text{ \&c.}$$

By addition we get this series:

$$+9+7+15+27+24+15, \text{ \&c.}$$

This latter series is thrown into a curve.

In his *British Rainfall* for 1881, 1891, &c., Mr. Symons has given a series of rainfall values for a number of stations in



A, Boston; B, Oxford; C, Chilgrove; D, Exeter; E, Kendal; F, Bolton.

different parts of England (from 1830 onwards); also the percentage equivalents of these, the average for each station being taken as 100. These latter I have made use of, taking the excess over 100 as a plus value, and the deficiency under 100 as a minus. Thus *e.g.* 106 would be + 6; 94 would be − 6.

When this has been done with the values for Boston, in Lincolnshire, and the series treated by the addition-method described, we get the curve marked A in the diagram; and it is to this curve I would especially invite attention. For it is to the eastern parts of our country that Brückner's cycle applies; the west belongs to what he calls *Ausnahmegebiete*, or exceptional regions.

Bearing in mind that these curves rise for plus values and fall for minus, we note in this Boston curve a general rise from 1838 to 1849 (or 1852), also from 1874 to 1883; while we have general fall from 1852 to 1874, and from 1883 to 1896 (the last point dealt with). In other words, the two former were *wet* periods, the two latter *dry* periods.

The following figures show this:

	Years.	Dry.	Wet.
1838-52 ...	14 ...	4 ...	10
1874-83 ...	9 ...	none ...	all
1852-74 ...	22 ...	17 ...	5
1883-96 ...	13 ...	9 ...	4

Between the wave crests 1849 and 1883 are 34 years; and between the wave hollows 1838 and 1874 are 36 years. Or, if we like to take as approximate centres of the wet periods (say) 1843 and 1878, we have about the same interval, 35 years.

These fluctuations, standing alone, would clearly be too slender evidence of a cycle. But Brückner claims that his cycle of 35 years has been in evidence in various parts of the globe through these two centuries at least (since 1700).[1] If the eastern part of England, then, may be expected to conform to the law in future, we might reasonably, perhaps, look for the centre of another wet period somewhere in the second decade of next century. And for the near future (without attempting detail) a continuation for some years of the recent *régime* seems not unlikely, dry years preponderating over wet. That is, the curve should go down further, on the whole, for some years yet.

I have given a number of other curves for comparison, viz. B, Oxford; C, Chilgrove, in Sussex (near Chichester); D, Exeter, less reliable perhaps (see *Brit. Rf.*, 1881); E, Kendal; and F, Bolton, in Lancashire. As we go westwards, the curve seems to degrade somewhat (regarded from our standpoint), though the same type may be discerned. In the northern curves, Kendal and Bolton, we find little in common with the Boston curve, though something like a 35 years' interval may, in cases, be made out.

It may be well to state that other stations in the east of England yield very similar curves to that for Boston.

A. B. M.

Prehistoric Egypt.

I NOTICE a review in NATURE containing some statements about my own work which are inaccurate.

The term "New Race" is quite correct, as the race was entirely new to us, whatever their age; and as a tentative name which commits us to no theories, it can hardly be said that I "did not understand the facts of the case" in using it. In dating the race to at least 3000 B.C., I was doing all that the facts warranted at the time; and if we all agree now that they are older, it is by mere consensus of guessing, for no absolute proof of earlier age by juxtaposition with other things has even yet been found.

Further, Dr. Verneau's erroneous assumption that the condition of the bones could be produced by exposure to the air alone, is quoted, with the remark that my "sensational discovery therefore falls to the ground." How exposure to the air can possibly break off the ends of bones and scoop out the cellular structure, while the bone remains hard and firm, not even Dr. Verneau can explain. To deny cannibalism in such a case, reminds one of the indignant repudiation of the intention to smoke by a man who already has a pipe in his mouth and a match in his fingers.

No one values more than I do the discoveries of M. de Morgan; but had he dealt more with strict evidence and full details, and given weight to many facts which he has ignored, I venture to think that his work would have needed less revision in future.

W. M. FLINDERS PETRIE.

University College, W.C.

I HAVE read Mr. Petrie's letter, and I still think that M. de Morgan is right, and that Mr. Petrie is wrong. I also think that Dr. Verneau is right, and that his "assumption" is not "erroneous." Mr. Petrie's reference to the revision which he thinks M. de Morgan's work will need is remarkable; for his own will—in my opinion—need much more! however much M. de Morgan's may need!

THE REVIEWER.

[1] We may here recall that Bacon seems to have been aware of such a cycle.

Photographic Action of Printer's Ink.

IN your issue dated April 28, I notice an article reporting the Bakerian Lecture given by Dr. W. J. Russell.

One paragraph states that printing ink *at a distance* will act upon a photographic film. Is that the explanation of the following curious circumstance?

An Ilford ordinary plate, which I had kept in its box unopened for five years, was exposed recently upon a poorly-lighted subject; upon development I found, instead of my subject, the matter of the advertisement which was upon the outside wrapper. This came up strong and quickly, but nothing was seen of the subject upon which the plate had been exposed in the camera.

The image was a positive, and the large type word "Ilford" was very prominent.

So it would appear that the sensitised plate had been acted upon by the printer's ink, through the lid of the box and three wrappers of paper, two of which were brown.

W. TRUEMAN TUCKER.

Parkside, Loughborough, May 8.

A VERY interesting result. The picture no doubt arose from the printer's ink, and it shows what great length of time will do. The plate must have been face upwards. W. J. R.

May 9.

Electrical Impressions on Photographic Plates.

SOME simple variations of the inductoscript may be of general interest.

A photographic glass negative is placed on a plate, and a ¾-inch induction coil is sparked for one or two minutes on the outsides: a perfect positive with fine detail can be developed.

If printed paper is so treated, a clear image of the reading is made, white letters on a dark ground: a coin gives dark letters.

If the exposure to the spark is prolonged, an indistinct image of the print, which is on the other side of the paper, will also appear.

More or less perfect images can be made, if ink or pencil writing or a photographic print be put on the plate. When thin paper is placed between a coin and a plate, a fair, but less perfect, reproduction of the coin will be produced.

It makes very little difference whether fast or slow plates are employed. A. S. BATES.

Winchester College.

Bacteria on an Ancient Bronze Implement.

A FEW days ago an ancient bronze implement was brought to me showing small excrescences, the centres of rapid oxidisation, which the owner told me had only very recently developed.

On examining the material scraped off one of these excrescences under the microscope with fairly high powers (a ⅛ inch and ⅛ inch objective), it was found to be swarming with bacteria, which seemed to be the cause of the rapid oxidisation. I have not been able to trace any reference to bacteria inhabiting a similar nidus, and I should be much obliged to any correspondent who could direct me to the literature on the subject, and inform me of the best way of sterilising the implement without injury. WM. EDWARD NICHOLSON.

Lewes, May 3.

THE ROYAL SOCIETY SELECTED CANDIDATES.

THE following are the names and qualifications of the fifteen candidates selected by the Council of the Royal Society, to be recommended for election into the Society this year:—

HENRY FREDERICK BAKER,

M.A., Fellow and Lecturer of St. John's College, Cambridge; University Lecturer in Mathematics. Author of "A Treatise on Abel's Theorem and the Allied Theory" (1897); and of the following papers, among others:—"Weierstrassian Formulæ applied to the Binary Quartic and Ternary Cubic" (*Quart. Journ. Math.*, vol. xxiv., 1889); "Gordon's Series in the Theory of Forms" (*Messenger Math.*, vol. xix., 1889); "The Full System of Concomitants of Three Ternary Quadrics" (*Camb. Phil. Soc. Trans.*, vol. xv., 1889); "The Application of Newton's Polygon to the Singular Points of Algebraic Functions" (*ibid.*, vol. xv., 1893); "On Euler's ϕ-Function" (*Proc. Lond. Math. Soc.*, vol. xxi., 1890); "Fundamental Systems for Algebraic Functions" (*ibid.*, vol. xxvi., 1895); "On Noether's Fundamental Theorem" (*Math. Annalen.*, vol. xlii., 1893); "On a Geometrical Proof of Jacobi's I-Function Formulæ" (*ibid.*, vol. xliii., 1893); "On the Theory of Riemann's Integrals" (*ibid.*, vol. xlv., 1894); "The Practical Determination of the Deficiency and Adjoint ϕ-Curves for a Riemann Surface" (*ibid.*, vol. xlv., 1894); "On a Certain Automorphic Function" (*Camb. Phil. Soc. Proc.*, vol. viii., 1895); "On the Hyperelliptic Sigma-Functions" (*Amer. Journ. Math.*, vol. xx., 1897).

ERNEST WILLIAM BROWN,

Professor in Haverford College. Formerly Fellow of Christ's College, Cambridge. Author of the following papers:—In the *American Journal of Mathematics*—"On the Part of the Parallactic Inequalities in the Moon's Motion, which is a Function of the Mean Motions of the Sun and Moon" (vol. xiv., pp. 141–160, 1892); "The Elliptic Inequalities in the Lunar Theory" (vol. xv., pp. 244–263, 321–338, 1893); "Investigations in the Lunar Theory" (vol. xvii., pp. 318–358, 1895). In the *Monthly Notices Royal Astronomical Society*—"On the Determination of a Certain Class of Inequalities in the Moon's Motion" (vol. lii. pp. 71–80, 1891); "Notes on Lunar Theory" (vol. lii. pp. 408–9, 1892; liv. p. 471, 1894; lv. pp. 3–5, 1894); "Note on Hansen's Lunar and Planetary Theories" (lvi. pp. 52–3, 1895); "Note on Mr. Stone's paper, 'Expressions for the Elliptic Coordinates of a Moving Point to the Seventh Order of Small Quantities,'" 1896. In the *Proceedings Cambridge Philosophical Society*—"On the Part of the Parallactic Class of Inequalities in the Moon's Motion which is a Function of the Ratio of the Mean Motions of the Sun and Moon" (vol. vii. pp. 220–1, 1891). Before the London Mathematical Society, November 1896—On "The Application of Jacobi's Dynamical Method to the General Problem of the Three Bodies"; "On Certain Properties of the Mean Motions, and the Secular Accelerations of the Principal Arguments used in the Lunar Theory." Author of "An Introductory Treatise on the Lunar Theory" (Cambridge University Press, 1896, pp. viii.–292).

Supplementary Certificate.—"On the Mean Motions of the Perigee and Node"; "On the Theoretical Values of the Secular Accelerations of the Lunar Theory"; "Note on the Mean Motions of the Perigee and Node," in the *Monthly Notices R. Astron. Soc.*, 1897; "Theory of the Moon, containing a New Calculation of the Coordinates of the Moon in Terms of the Time" (Part I.–IV. *Memoirs R. Astron. Soc.*, vol. liii., 1897, pp. 39–116).

ALEXANDER BUCHAN,

M.A., LL.D., F.R.S.E. Secretary, Scottish Meteorological Society, from 1860. Member of the Meteorological Council from 1873. Author of the following contributions to Meteorology: "Mean Atmospheric Pressure and Prevailing Winds of the Globe and Handy Book of Meteorology," 1868; "Weather and Health of London," jointly with Sir Arthur Mitchell, 1875; "*Challenger* Report on Atmospheric Circulation in 1889"; "*Challenger* Report on Oceanic Circulation in 1895"; "Specific Gravities and Oceanic Circulation in 1896"; "Meteorology," in the "Encyclopædia Britannica"; Reports on the Meteorology of Ben Nevis, &c.

SIDNEY FREDERIC HARMER,

M.A., Superintendent of the University Museum of Zoology, and Fellow of King's College, Cambridge. Engaged for many years in researches in Embryology and Comparative Anatomy. Discoverer of important facts connected with the Anatomy of Cephalodiscus, which largely assisted in fixing its systematic position; and of the occurrence of a process of extensive Embryonic Fission in certain Polyzoa. Author of numerous papers on zoological subjects, including the following:—"On the Structure and Development of *Loxosoma*" (*Quart. Journ. Micros. Sci.*, vol. xxv., 1885); "On the Life-history of Pedicellina" (*ibid.*, xxvii., 1887); "On the British Species of *Crisia*" (*ibid.*, xxxii., 1891); "On the Nature of the Excretory

Processes in Marine Polyzoa" (*ibid.*, xxxiii., 1892); "On the Occurrence of Embryonic Fission in Cyclostomatous Polyzoa" (*ibid.*, xxxiv., 1893); "Preliminary Note on Embryonic Fission in *Lichenopora*" (*Roy. Soc. Proc.*, lvii.); "Appendix to the *Challenger* Report on *Cephalodiscus*" (*Challenger* Reports, vol. xx.); "Sur l'Embryogénie des Bryozoaires Ectoproctes" (*Arch. de Zool.*, 1887); "Notes on the Anatomy of *Sinophilus*" (*Journ. Marine Biol. Assoc.*, 1889). Joint Editor of the Cambridge Natural History. Member of Council of the Marine Biological Association. Is attached to science, and anxious to promote its progress.

ARTHUR LISTER,

F.L.S. Distinguished for his researches on the Mycetozoa. Author of "Notes on the Plasmodium of *Badhamia utricularis* and *Brefeldia maxima*" (*Annals of Botany*, vol. ii., 1888, pp. 1–24, plates 1, 2); "Notes on *Chondrioderma difforme* and other Mycetozoa" (*ibid.*, vol. iv., 1890, pp. 281–298, plate 1); "Notes on the Ingestion of Food-material by the Swarm-cells of Mycetozoa" (*Journ. Linn. Soc.*, vol. xxv., Bot., 1890, pp. 435–441); "Notes on Mycetozoa" (*Journ. of Bot.*, vol. xxix., 1891, pp. 257–268, plates 308–312); "On the Division of the Nuclei in the Mycetozoa" (*Journ. Linn. Soc.*, vol. xxix., Bot., 1893, pp. 529–542, plates 35, 36); "Monograph of the Mycetozoa," being a descriptive Catalogue of the Species in the Herbarium of the British Museum (1894, pp. 224, plate 78); "Guide to the British Mycetozoa exhibited in the Department of Botany, British Museum" (1895, p. 42); "Notes on British Mycetozoa" (*Journ. Bot.*, vol. xxxiii., 1895, pp. 323–325); "A New Variety of *Enteridium olivaceum*" (*ibid.*, vol. xxxiv., 1896, pp. 210–212); "On Some Rare Species of Mycetozoa" (*ibid.*, vol. xxxv., 1897, pp. 209–218); and other memoirs.

CHARLES ALEXANDER MCMAHON,

Lieut.-General. Formerly Commissioner of the Amritsar Division, Punjab. President of the Geologists' Association and Vice-President of the Geological Society of London. Distinguished for his acquaintance with the sciences of Petrology and Geology. He was the first to demonstrate (discover), by study in the field, and with the microscope, the truly granitic origin of the "Granitoid Gneiss" of the N.W. Himalaya, thereby affording a conceivable interpretation of the mountain structure. See his numerous papers (23) in the "Records of the Geological Survey of India" (1876-87). Later, General McMahon has contributed much to the elucidation of the structure and origin of crystalline rocks and rock-making minerals, notably in his papers "On the Rocks of the Lizard" (*Quart. Journ. Geol. Soc.*, vol. xlv., 1889, and, conjointly with Prof. Bonney, in vol. xlvii., 1891); "On the Dartmoor Granite and its Relation to the Surrounding Rocks" (*ibid.*, vol. xlix., 1893); "On Micro-chemical Analysis of Rock-making Minerals" (*Min. Mag.*, vol. x., p. 79); and "On Optical Characters of the Globules and Spherulites of Lithium Phosphate," &c. (*ibid.*, p. 229); and numerous minor papers in the *Geological Magazine* and the *Proceedings* of the Geologists' Association.

WILLIAM OSLER,

M.D., F.R.C.P. Professor of Medicine in the Johns Hopkins University and Physician-in-Chief to the Johns Hopkins Hospital, Baltimore; formerly Professor of the Institutes of Medicine, McGill College, Montreal; and Professor of Clinical Medicine in the University of Pennsylvania, Philadelphia. Has been during many years actively engaged in the advancement of scientific medicine, and has published a large number of communications, some of great interest and importance, chiefly dealing with clinical and pathological matters. Of these only a very few can be here enumerated, viz.: "On the Systolic Brain Murmur of Children" (*Bost. Med. and Surg. Journ.*, 1880); "Infectious Endocarditis" (*Arch. of Med.*, 1881, and Congr., London, 1881); "On Certain Parasites in the Blood of the Frog" (*Canada Naturalist*, 1882); "The Gulstonian Lectures on Malignant Endocarditis" (*Lancet*, 1885); "On the Morbid Anatomy of Typhoid Fever" (*Canada Med. and Surg. Journ.*, 1885); "On Certain Problems in the Physiology of the Blood Corpuscles" (*Phil. Med. News*, 1886); "The Relation of the Corpuscles to Coagulation Thrombosis" (*Brit. Med. Journ.*, 1886); "The Bicuspid Conditions of the Aortic Valves" (*Trans. Assoc. Amer. Physicians*, 1886); "The Cardiac Relations of Chorea" (*Amer. Journ. Med. Sci.*, 1887); "The Cerebral Palsies of Children" (*Med. News*, 1888); "On the Situation of the Anovesical Centre in Man" (*ibid.*); "On Phagocytes" (*ibid.*, 1889); "On Intrathoracic Growths from the Thyroid Gland" (*ibid.*); "Filaria Sanguinis Hominis" (*Johns Hopkins Bull.*, 1890); "On the Amœba Coli" (*ibid.*, 1890); "On Sensory Aphasia" (*Amer. Journ. Med. Sci.*, 1891); "On Typhoid Fever" (*Johns Hopkins Reports*, 1893 and 1894); "On Abdominal Tumours" (1894); "On Addison's Disease" (*Int. Med. Mag.*, 1896). Is also the author of several important articles in systems of medicine, and of a well-known text-book "On the Principles and Practice of Medicine." Has long occupied a leading position in Canada and the United States as a scientific physician, and has also a European reputation as one of the foremost representatives of Clinical Medicine and Pathology of the day.

HON. CHARLES ALGERNON PARSONS,

M.A. (Camb.). Engineer. M.Inst.C.E. Eminently distinguished as an inventor and engineer. By his invention of the compound steam turbine he has made it practicable to use steam economically in an engine without reciprocating parts. He has adapted the steam turbine successfully to dynamo driving and other uses, and his recent application of it to marine propulsion is a new departure of particular interest. In developing his inventions he has shown much scientific knowledge and experimental skill. Author of a number of papers on the steam turbine, its theory and its applications, in *Proc. Inst. Mech. Eng.*, 1888; *Trans. of the North-East Coast Inst. of Engineers and Shipbuilders*, 1887; Inst. of Civil Engineers, Conference, 1897; *Trans. Inst. Naval Architects*, 1887; Inst. of Marine Engineering, 1897. Has investigated experimentally the action of high-speed screw propellers (*Trans. Inst. Nav. Arch.*, April 1897); also the "Behaviour of Carbon at High Temperatures and under Great Pressures" (*Proc. Roy. Soc.*, *Phil. Mag.*, September 1893).

THOMAS PRESTON,

M.A. (Dubl.). Professor of Natural Philosophy, University College, Dublin. Fellow of the Royal University of Ireland. Inspector of Schools under the Science and Art Department. Has published works that have much advanced the study of Light and Heat. Author of treatise on "The Theory of Light" (Macmillan, 1890); and of one on "The Theory of Heat" (Macmillan, 1894); and of Memoirs "On the Motion of a Particle and the Equilibrium of a String on a Spherical Surface" (*Trans. Roy. Irish Acad.*, vol. xxix., 1889), and "On the Mass Inversion of Centrobaric Bodies" (*Proc. Roy. Dubl. Soc.*, 1887).

EDWARD WAYMOUTH REID,

M.B. (Cantab.), B.A. Professor of Physiology, University College, Dundee. Distinguished as a Physiologist, especially in inquiries relating to absorption and secretion, and to electromotive phenomena. Published the following papers on electromotive phenomena:—"On the Action of the Excised Mammalian Heart" (with Dr. Waller) (*Phil. Trans. Roy. Soc.*, 1887); "On the Process of Secretion in the Skin of the Common Eel" (*ibid.*, 1893, and *Journ. Physiol.*, 1894); "The Electromotive Properties of the Skin of the Common Eel" (*ibid.*, 1894); "Electromotive Phenomena of the Iris" (*Journ. Physiol.*, 1895). Also papers on osmose, absorption, and secretion in *Journ. Physiol.*, 1890, 1893, 1895–96.

ALEXANDER SCOTT,

M.A. (Cantab.), D.Sc. (Edin.), F.R.S.E., F.C.S. Late Assistant to the Jacksonian Professor of Experimental and Natural Philosophy. Distinguished by having paid great attention to the exact determination of atomic weights and of combining proportions by volume. Author, in conjunction with Prof. Dewar, of papers on the Vapour Densities of Potassium and Sodium; on the Atomic Weights of Manganese, Oxygen, and Silver; and on the Molecular Weights of substituted Ammonias, published in the *Proceedings of the Royal Society*. Author of papers on Vapour Densities at High Temperatures, and on the Composition of Water by Volume, the last published in the *Phil Trans.*, vol. clxxxiv. Author of a text-book entitled "Introduction to Chemical Theory" (A. and C. Black, 1891).

ALBERT CHARLES SEWARD,

M.A. (Cantab.), F.G.S. University Lecturer in Botany, Cambridge. Has made extended researches in Fossil Botany, the results of which have been published in a series of papers and works, of which the following may be specified :—That on the Wealden Flora gives, for the first time, a critical and comprehensive view of the vegetation of this important geological period, and in many respects enlarges and modifies our previous knowledge of the subject : "On *Calamites undulatus*" (*Geol. Mag.*, vol. v., 1888) ; "Notes on *Lomatophloios macrolepidotus*, Goldg." (*Proc. Camb. Phil. Soc.*, vol. vii., 1890) ; "Fossil Plants as Tests of Climate" (Sedgwick Prize Essay for 1892) ; "On the Genus *Myeloxylon*, Brong." (*Annals of Botany*, vol. vii., 1893) ; "On *Rachiopteris Williamsoni*, sp. nov., a new Fern from the Coal Measures" (*ibid.*, vol. viii., 1894) ; "Catalogue of the Mesozoic Plants in the Department of Geology, British Museum (Nat. Hist.)" ; "The Wealden Flora, Part I., *Thallophyta* to *Pteridophyta*. Part II., Gymnospermæ" (1894-95).

WILLIAM ASHWELL SHENSTONE,

F.I.C., Senior Science Master in Clifton College. Member of Council of the Chemical Society. Distinguished for his skill as an experimenter, for his ability as a teacher, and for his zeal in the introduction of improved methods of teaching physical science as a branch of general education. Author of the following and other papers :—"Ozone from Pure Oxygen" (*Journ. Chem. Soc.*, 1887) ; "The Volumetric Relation of Ozone and Oxygen," "The Influence of Temperature on the Composition and Solubility of Hydrated Calcium Sulphate and Calcium Hydroxide" (*Journ. Chem. Soc.*, 1888) ; "Some Improved Vacuum Joints and Taps" (*ibid.*, 1890) ; "Platinous Chloride as a Source of Chlorine," "The Adhesion of Mercury to Glass in the presence of Halogens" (*Journ. Chem. Soc.*, 1892) ; "On preparing Phosphoric Anhydride free from the Lower Oxides of Phosphorus," "Studies on the Formation of Ozone from Oxygen," Part II. (*Journ. Chem. Soc.*, 1893). Also author of the article on Ozone in the current edition of Watts' Dictionary ; "A Practical Introduction to Chemistry" (Rivington, 1886) ; "The Methods of Glass Blowing" (Rivington, 1886) ; Life and Work of Liebig" (Century Series, Cassell, 1895).

HENRY MARTYN TAYLOR,

Barrister-at-Law. Fellow of Trinity College, Cambridge. Formerly Tutor of Trinity College, Cambridge. Third Wrangler and Second Smith's Prizeman in 1865. Author of papers in the *Mathematical Messenger*, as follows :—Vol. iii. p. 189, "Geometrical Explanation of the Equations for the Longitude of the Node and the Inclination of the Orbit" ; vol. v. p. 1, 1876, "On the Generation of Developable Surface through Two given Curves" ; vol. vii. p. 22, 1877, "On Certain Series in Trigonometry" ; vol. vii. p. 145, 1877, "On the Porism of the Ring of Circles touching Two Circles" ; vol. xi. p. 177, "On a Six-point Circle connected with a Triangle" ; vol. xiii. p. 145, "On a Cubic Surface" ; vol. xvi. p. 39, "On a Geometrical Interpretation of the Algebraical Expression which, equated to Zero, represents a Curve or a Surface" ; vol. xvi. p. 143, "Extension of an Inversion Property." In the *Proceedings* London Mathematical Society : Vol. v. p. 105, 1874, "Inversion, with Special Reference to the Inversion of an Anchor Ring or Torus" ; vol. xiii. p. 102, "A Geometrical Theorem concerning the Division of a p-gon into n-gons (with R. C. Rowe) ; vol. xv. p. 122, "The Relations of the Intersections of a Circle with a Triangle" ; vol. xx. p. 422, a Geometrical note "On the Developable Surface through Two Conics Inscribed (or Escribed) in Two of the Faces of a Tetrahedron." In the *Quarterly Journal of Mathematics :* Vol. xxiv. p. 55, "On the Centre of an Algebraical Curve" ; vol. xxvi. p. 148, "Orthogonal Conics" ; vol. xxvi. p. 214, "Orthogonal Quadrics." In the *Philosophical Magazine :* Vol. l. p. 221, 1876, "On the Relative Values of the Pieces in Chess." *Philosophical Transactions*, vol. clxxxv. pp. 37-69, 1894, "On a Special Form of the General Equation of a Cubic Surface" ; and "On a Diagram representing the Twenty-seven Lines on the Surface." Writer of the article on Geometrical Conics in the last edition of "Encyclopædia Britannica," editor of "Elements of Euclid" for the Syndics of the Cambridge University Press ; author of two treatises—"On Great-Circle Sailing" ; "On a Method by which a Steamer's Lights might show her Course."

JAMES WIMSHURST.

Member of the Consultative Staff, Board of Trade. Qualifications : (1) Improvements in Electrical Influence Machines, which are now universally approved and adopted by Physicists ; (2) an Influence Machine which gives charges of electricity, alternating from positive to negative with each rotation of the disc (in this type the glass discs, without any metal upon them, are freely self-exciting) ; (3) has delivered a lecture upon Influence Machines at the Royal Institution, April 27, 1888, and read papers at the Physical Society, April 17, 1891, and June 22, 1893.

THE FLOW OF WATER.

MORE than one hundred years ago, the French philosopher Coulomb caused a disc suspended by a torsion wire to oscillate in a vessel of liquid, and he thus ascertained that the resistance to various bodies under such circumstances, when the movement is a slow one, varies directly as the velocity of the motion. This law of resistance, it should be noted, is quite contrary to that of the friction between solid bodies as investigated by General Morin. Colonel Beaufoy, Froude, and others, however, found that, at higher velocities, the resistance varied more nearly as the square of the velocity. The difference of the two conditions in which the variation was directly, or, as the higher power, undoubtedly represented on the one hand the condition of water in which the mere viscosity came into play, resisting the shearing stress of the layers in passing over each other, and on the other hand the condition when the breaking up of the water into eddying motion caused the resistance to become much greater.

Prof. Osborne Reynolds, about 1883, investigated the critical velocity at which this change of state occurs, and gave calculations concerning the critical velocity, accompanied by an account of some beautiful experiments. These experiments showed the sudden breaking up at the critical velocity of the stream in a glass tube, the water in which had been flowing quite steadily until that particular velocity was reached.

Now with water flowing in a tube or channel with wetted sides the velocity is greatest in the middle, and, according to the generally accepted theory, is zero at the sides. If this be the case, it would seem that in no event can the whole body of water in the tube break up into sinuous motion ; for it is evident that, although it is possible to have one of the conditions by itself, viz. the condition of lower velocity and parallel flow, it is not possible to have the other condition by itself, viz. the condition of sinuous flow. This leads irresistibly to the conclusion that at some point or other there must be a surface of separation between the two.

Such a surface of separation obviously requires special means in order to make it visible. When colouring material is introduced into water flowing under ordinary conditions, it mixes up at once throughout the whole mass. If, however, air is injected into the water, it has been recently found that, in the portion in which the sinuous state exists, the small particles of air, which appear when viewed by the eye as a sparkling mass, prevent the transmission of light and reveal on a screen, when a special lantern apparatus is employed, the actual behaviour of the flowing water. Figs. 1 and 2 show a rectangular body placed in the stream under such conditions. The lines of flow in Fig. 2 result from the use of slightly soapy water, which is used for the production of air bubbles ; whereas in Fig. 1 the air is injected into perfectly clear water, and larger bubbles are consequently formed.

Now, if the above figures are examined, it will be seen that round each there is a clear border line indicating a condition differing from that in the

general mass of the stream. This not only occurs with obstacles placed in a flowing stream, but in pipes as in Fig. 3. At the International Congress of Naval Architects held at the Imperial Institute last July, this mode of representing the flow of water was brought forward for the first time. It was then suggested that, in this clear border line the water was flowing in layers with parallel motion, while in the main body of the stream the flow was taking place with sinuous, or broken-up motion, and that the change of critical velocity occurred at the darker border between the two. This dark border is always more intense the higher the velocity of the flow, the width of the border becoming correspondingly reduced.

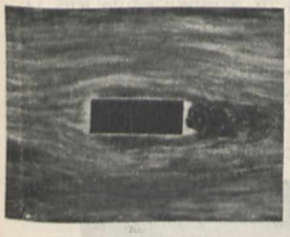


FIG. 1.—Clear water (thick sheet).

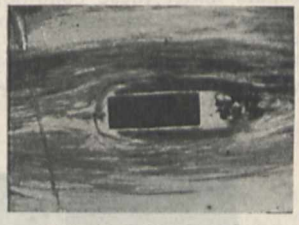


FIG. 2.—Soapy water (thick sheet).

As a good many important results turn upon this point, the subject has been pursued since that time by making a variety of experiments with bodies of varying degrees of roughness of surface, and with passages of various forms. One experiment, however, may be considered as a crucial test, which is to reduce the width of the channel itself, till it actually corresponds with the dimensions of the clear border. This has been done with the result indicated in Fig. 4, when what may be called the air method of making the flow visible entirely fails, the clear border line disappearing and the air passing through, not steadily as before, but spasmodically, while the clear border line of separation

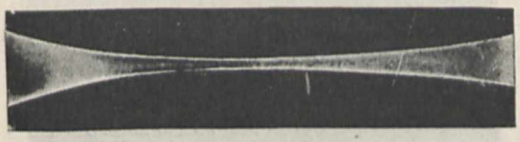


FIG. 3.—Narrow passage showing thin clear film.

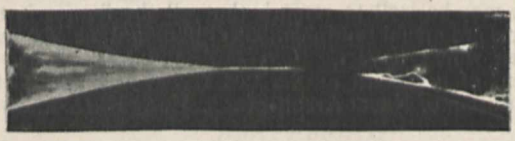


FIG. 4.—Passage still further reduced, showing failure of air method.

entirely disappears. One further step is now obvious, and that is to obtain, if possible, a sheet of water as thin as the border line itself, and examine its behaviour. The result of doing this has been brought forward in a paper read a few weeks ago at the meeting of the Naval Architects in London, when it was shown that in such a thin sheet of water stream line motion exists, thus indicating the absence of sinuous motion and the existence of the motion of parallel flow alone. Under these conditions, while it is impossible to make the motion of water visible, as before, by means of air, colour can be used, and colour bands, corresponding to the stream lines of the mathematician, can be obtained. Figs 5 and 6 indicate a comparison of these two methods to a semi-cylinder. Fig. 5, which is a case of a thick sheet, is an eddying mass of water all round, but is widest, of course, behind where the largest mass of slowly moving water exists. This case is particularly interesting, since it is a case for which the stream lines have been worked out on hydro-dynamical principles,

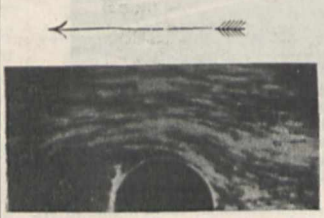


FIG. 5.—Semi-cylinder in thick sheet.

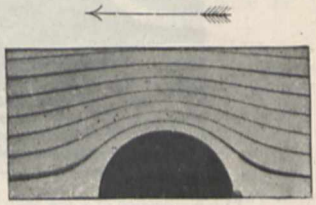


FIG. 6.—Semi-cylinder in thin sheet (test case).

and it is found, by carefully working out a test case, that for all practical purposes the results of the stream lines experimentally produced, agree with those theoretically obtained. As is well known the lines of flow for heat and electricity can be determined mathematically in the same way as those for a perfectly incompressible and frictionless fluid. Hence further verifications can be

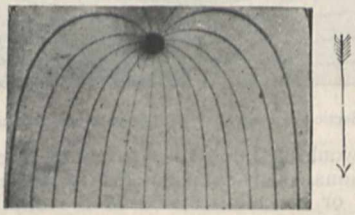


FIG. 7.—Uniform stream and "sink" in channel.

obtained by comparing the theoretical lines of force which have been worked out for electrical and magnetic problems. Fig. 7 is a case of the flow of water through a hole (called in hydro-mechanics a "sink"), and which corresponds to the flow of electricity from an electrified body into one of the wires of a wire grating (see Clerk-Maxwell's "Magnetism and Electricity," Fig. xiii., Art.

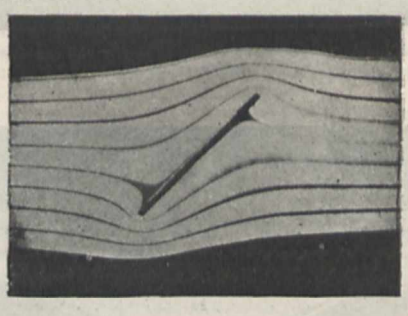


FIG. 8.—Inclined plate in thin sheet.

203, Vol. i.; third edition). A still more remarkable verification is that shown in Fig. 8, which is the case of water flowing past a plate inclined at 45 degrees. The central stream line has been predicted by Prof. Lamb to be a hyperbola, which dividing on the plate would flow round it and re-form on the other side, flowing away exactly as shown in Fig. 8, which figure can be compared with the illustration given in the treatise of Prof. Lamb.

Having thus found a way of representing stream lines by colour bands, various electrical problems, and problems connected with the flow of heat, can be solved in cases

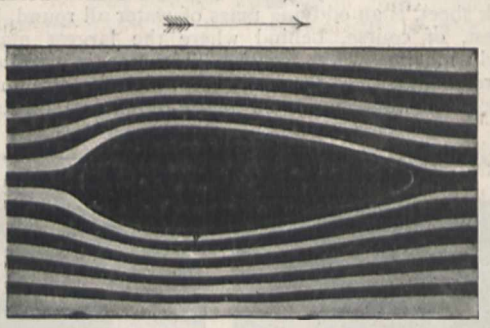


FIG. 9.—Section of screw shaft strut (broad colour bands in thin sheet).

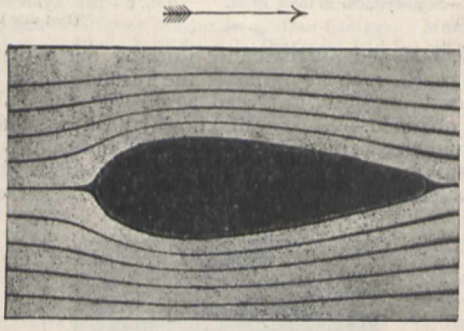


FIG. 10.—Section of screw shaft strut (narrow colour bands in thin sheet).

where it would be impossible to obtain direct mathematical solutions. It is sufficient for the present purpose to give one or two illustrations of the application of the method to problems of interest connected with the flow

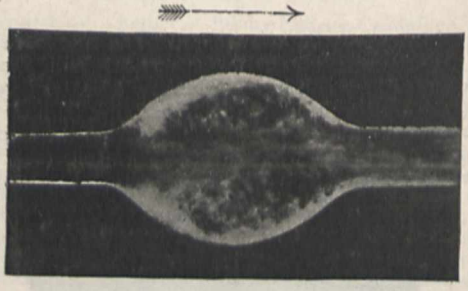


FIG. 11.—Sinuous motion in gradually enlarging and contracting channel (thick sheet).

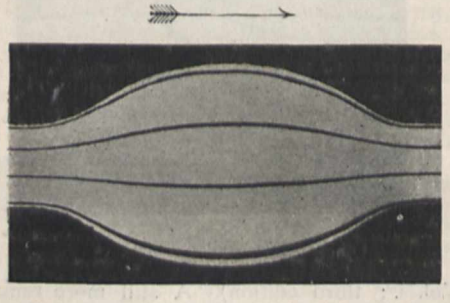


FIG. 12.—Colour bands in gradually enlarging and contracting channel (thin sheet).

of water. Thus, Figs. 9 and 10 illustrate the flow respectively in the case of broad and narrow stream bands round a section of the twin screw strut of one of Her Majesty's cruisers. This might of course be the section of a ship-shaped vessel moving through the water, and as is well known the width apart of the different stream lines would indicate the pressure and velocity in the fluid at every point. Thus stream lines can be obtained in such a case representing a process which for this form of section it would be practically impossible to do by any mathematical process. Figs. 11 and 12 illustrate the flow of water through a passage which gradually enlarges and then contracts. The former case represents the flow under ordinary conditions with the thick sheet of water; the latter case, Fig. 12, being the flow of the colour bands moving in a very thin sheet of water. One more case may be given even more remarkable than any of the foregoing, that is the case of a sudden enlargement of the section of a pipe. Fig. 13 represents the ordinary case of a thick sheet of water in which the eddies and whirls plainly indicate why it is that such a large loss of energy occurs under these conditions in a pipe; while Fig. 14 shows how a perfectly incompressible and frictionless fluid would flow under the same conditions. This is, however, actually what occurs with a thin sheet of water with suitably arranged colour bands.

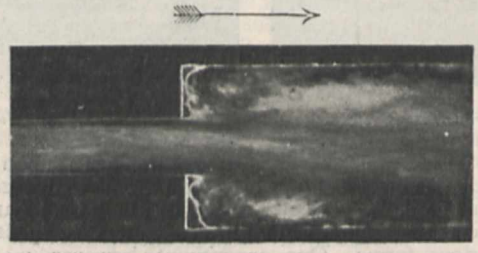


FIG. 13.—Sudden enlargement (thick sheet.)

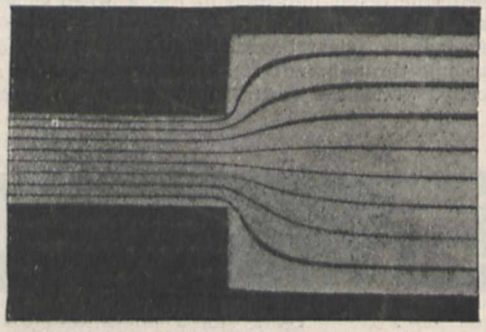


FIG. 14.—Sudden enlargement (thin sheet).

It may be well to remark that all the figures in this article are actual reproductions of photographs of flowing water, which have all been projected on a screen by means of a lantern at the two recent meetings of the Institution of Naval Architects. H. S. HELE-SHAW.

FORTHCOMING MEETING OF THE BRITISH ASSOCIATION.

THE preparations in Bristol for the meeting of the British Association on September 7 proceed apace, and local interest is now thoroughly aroused. The material for the handbook is nearly all in the hands of the editor (Dr. Bertram Rogers), and most of it in type. Among the contributors we note the names of E. J. Lowe, F.R.S. (Meteorology), C. Lloyd Morgan (Geology and Prehistoric Archæology), A. Bulleid (Glastonbury Lake Village), A. T. Martin (Roman Archæology), J. Latimer (History), J. R. Bramble (Architecture), Dr. D. S. Davies (Sanitation), J. W. White (Botany) J. M.

McCurrich (Docks and Tides), J. Holman and H. J. Spear (Economics).

It is hoped that the representation from Canada will be a feature of the meeting, and that many of those who contributed so largely to the success of the Toronto meeting will take this opportunity of paying a return visit. Committees with a view to furthering this object have been formed in Toronto under the presidency of Prof. Macallum, and in Montreal under the presidency of Prof. Bovey. It is hoped that the Mayor and the President of the Board of Trade in Toronto, the Minister of Education (Hon. G. W. Ross), the Secretary of the Royal Society of Canada (Dr. J. G. Bourinot, C.M.G.), the President of the Canadian Pacific Railway (Sir W. Van Horne, K.C.M.G.), and other distinguished guests will be present at the meeting. Among the names of those who are coming from the United States we note the names of Profs. Henry F. Osborn, J. W. Langley, H. P. Bowditch, R. A. Fessenden, R. H. Thurston, and J. Mark Baldwin. From the Continent among those of other eminent visitors are the names of Profs. A. von Kölliker, Ernest Häckel, Gustav Gilson, and Leo Errara, Dr. Paul Topinet, Prof. V. Dwelshauvers-Dery, Prof. Hugo Kronecker, and M. C. de Candolle.

Arrangements are in progress for a biological exhibit at the Clifton Zoological Gardens. Lord Llangattock has, we understand, consented to be the president of a representative honorary committee, and Dr. A. J. Harrison is chairman of the working committee of management. Tanks are being constructed, and arrangements made for an exhibit from the Marine Biological Association's station at Plymouth.

The provisional arrangements for excursions are as follows. Saturday, September 10: (1) Bath; (2) Aust Cliff, with especial reference to geology; (3) Severn Tunnel; (4) Stanton Drew, and Sutton Court, returning over Dundry Hill; (5) Cheddar, *viâ* Yatton, Wrington and Burrington Combe; (6) Avonmouth Docks, including a steamer excursion past Clevedon, Weston, the Holmes, Barry, and Cardiff; (7) Raglan Castle and Tintern Abbey; and (8) Bradford-on-Avon. Thursday, September 15: (1) the Bristol Waterworks; (2) Tortworth, by special invitation of Lord Ducie, for geologists; (3) Wells and Glastonbury, including the Lake Village; (4) Nailsea and Stroud, including Stonehouse, the Stanley Cloth Mills and Dye Works, Dudbridge, Minchinhampton, and Frocester Court; (5) Bowwood, including Avebury and Silbury; (6) Longleat and Sheerwater; (7) the Swindon Railway Works; and (8) Salisbury, Stonehenge and Amesbury. Offers of hospitality in connection with nearly all these excursions have been received and gladly accepted. It is proposed to conclude with a longer excursion, starting on Friday, September 16, to Exeter, Torquay, Dartmouth and Plymouth, returning over Dartmoor.

CITY BANQUET TO THE MEDICAL PROFESSION.

AT the Mansion House on Wednesday in last week, the Lord Mayor gave a banquet to the Presidents of the Royal College of Surgeons and Royal College of Physicians and leading members of the medical profession. This was the first occasion upon which the hospitality of the Mansion House has been extended to the medical profession as such, and a very large and distinguished company was present in response to the Lord Mayor's invitation. Lord Lansdowne, Secretary of State for War, was one of the guests, and in responding to a toast he announced that the Government proposed to make several concessions with regard to the rank of medical officers in the Army. It is proposed to form—out of the Army Medical Staff and the Medical Staff Corps—a Royal Army Medical Corps, the officers of which will bear the same military titles as other officers of the Army. These concessions have been received with great satisfaction by the medical profession, and they will doubtless lead to a marked increase in the number of candidates for the Army medical service. We give below a few extracts from some of the speeches made at the banquet.

In the course of his remarks, Lord Lansdowne spoke as follows:—

We are now about to deal with the large question in which I know the profession takes a deep interest—the question of the status and rank of the medical officers in the army. I have heard it said, Is not the title of "Doctor" or "Surgeon" a title by itself which any one might be proud to wear? But in the army rank means a great deal. It is the outward and visible sign of that authority and consideration with which the place of a man is clearly defined and designated, and it is necessary in the military profession that a man should have a proper military stamp. Let me say in half a dozen words how it is that we intend to deal with this question. We have made in former years various attempts to solve this question of titles by means of ingenious expedients, but the results have not been very satisfactory. In some cases we have, I think, invented titles which for cumbrousness and cacophony would be hard to beat. We now propose that the Army Medical Staff and the Army Medical Corps should be formed into one corps. The titles used shall be the simple, short, intelligible titles to which we are all accustomed. We propose to give the corps military titles up to and inclusive of the rank of Colonel. I have received some forcible hints that our scheme will be unsuccessful unless we proceed to the rank of General. But we in future intend to limit the rank of General to a very restricted number of officers, all of whom will be required to hold certain specific appointments carrying with them general command in the army, and they will be required to command troops, if necessary, in the field. I feel quite sure that it is not intended that any departmental officers shall be given the rank of General under this scheme. Her Majesty the Queen, whose good will towards the profession is well known, has signified her pleasure that the new corps shall be called the Royal Army Medical Corps.

The Lord Mayor, in proposing the toast of "The Medical Profession," remarked: I feel a peculiar pleasure in proposing that toast, because I think that this is the first occasion on which it has been proposed within these walls. I am delighted to welcome you here to-night in the name of the citizens of London. I welcome you for more reasons than one. In the first place I welcome you because for many generations past you have been intimately associated with the City of London. I believe that the Royal College of Physicians commenced in the City of London in 1518. The Royal College of Surgeons was intimately associated with one of our ancient City guilds—I refer to the Barber Surgeons Company. There is another company connected with your profession, also one of the livery companies, which has its residence in the City of London at the present time, and we members of the Corporation welcome you heartily as having some connection with us both in times past and at the present time.

In replying to the toast, Sir Samuel Wilks (President of the Royal College of Physicians of London) expressed the satisfaction of the profession at Lord Lansdowne's statement. Referring to the historical connection touched upon by the Lord Mayor, he said: There was a time when the two Colleges were City companies, and at that time they were under the jurisdiction of the City and of the Lord Mayor; the same, I believe, applied to the other cities of Dublin and Edinburgh. The Physicians and Surgeons existed nearly 500 years ago as distinct companies in the time of Henry VI., and at that time they were closely connected with the Corporation of London, and I believe they had to get their licence from the Lord Mayor. The Lord Mayor of that time had a supervision over the instruments of the Surgeons and also over another class of persons connected with the Surgeons whose names I will not mention, although the Lord Mayor has done so. One reads in books how often they had to fine these members of the College in sums of 6*s.* 8*d.* and 3*s.* 4*d.* for shaving polls and trimming beards on a Sunday. Subsequently came the charter of the College of Physicians which we obey at the present time, and twenty years after that came the charter given by Henry VIII. to the Surgeons. The

celebrated picture by Holbein hangs in a hall close by. In that picture the King is presenting the charter to the Surgeons. On his right hand are the physicians, Dr. Chambers and Sir William Butts. Previously to this time I believe the two Colleges held an examination similar to the conjoint scheme at the present day.

Sir William MacCormac (President of the Royal College of Surgeons of England), speaking for surgery, said the members of the profession outside the army and those within its ranks were grateful for what the noble Marquis, the Secretary of State for War, had done for those who thus served their country in the Medical Department of the army. He had agreed to grant the two great wishes which have been pressed upon him—army rank and the formation of an army medical corps. Passing to the historical connection mentioned, Sir William MacCormac said: In the history of the City of London one might recall the names of many distinguished men in our profession who have served their country in the wars. The Father of English Surgery, Richard Wiseman, surgeon to King Charles I. and Sergeant-Surgeon to King Charles II., had an eventful career during the Civil War. He was taken prisoner after the Battle of Worcester, and again while practising his profession as a surgeon in the Old Bailey at the sign of the "King's Head" he was taken to the Tower, and nearly lost his own head during the Commonwealth. About the same time John Woodhall, a surgeon at St. Bartholomew's Hospital, Surgeon-General to the East India Company, also a celebrated surgeon in this old City of London, who had served both in the army and in the navy, dedicates his curious work on surgery and the duties of the surgeon's mate to the "King's most excellent Majestie" Charles I., and also to the Right Hon. Sir Morris Abbot, Lord Mayior. Woodhall speaks of himself as an ancient master of the mysterie of Barber Surgeons, an old City company which became transformed in lapse of time, let us hope improved, into the Royal College of Surgeons, while the Apothecaries, who did so much in their time for the profession of this country, and still do so, continue as one of the City companies. So there are points of contact between our profession and the City of London.

Sir William Turner (President of the General Medical Council) proposed the toast of "The Houses of Lords and Commons," coupled with the names of Lord Lister and Sir Charles Cameron, both of whom replied.

Sir George Duffey proposed "The Health of the Right Hon. the Lord Mayor." In the course of his reply the Lord Mayor said: I have inaugurated this dinner to-night in the hope but not with the assurance that my successors will follow on with it. I see no reason, looking to the facts that almost every other profession has been recognised in this hall, why the medical profession should not be included with them.

NOTES.

THE first of the two annual conversaziones of the Royal Society was held yesterday evening, as we went to press.

THE following fifteen candidates were selected by the Council of the Royal Society on Thursday last to be recommended for election into the Society:—Mr. H. F. Baker, Prof. E. W. Brown, Dr. A. Buchan, Mr. S. F. Harmer, Mr. A. Lister, Lieut.-General C. A. McMahon, Dr. W. Osler, the Hon. C. A. Parsons, Prof. T. Preston, Prof. E. W. Reid, Mr. A. Scott, Mr. A. C. Seward, Mr. W. A. Shenstone, Mr. H. M. Taylor, and Mr. J. Wimshurst. The certificates of these candidates are given in another part of the present number.

THE annual visitation of the Board of Visitors of the Royal Observatory, Greenwich, will take place on Saturday, June 4. The Observatory will be open for inspection by invited guests at 3 o'clock.

The seventieth annual meeting of the German Association of Naturalists and Physicians will be held at Düsseldorf on September 19–24.

AT last week's meeting of the Paris Academy of Sciences it was announced that the French Minister of Public Instruction had asked the Academy for an expression of opinion upon the subject of the proposed law to change the national time. The communication was referred to a committee previously appointed to consider the proposed modifications.

THE following are the names of the Royal Commissioners appointed to inquire and report as to methods of treating and disposing of sewage:—The Earl of Iddesleigh (chairman), Sir Richard Thorne Thorne, K.C.B., Prof. Michael Foster, Prof. William Ramsay, Major-General Constantine Phipps Carey, Dr. James Burn Russell, Colonel Thomas Walter Harding, Mr. Thomas William Killick, and Mr. Charles Philip Cotton.

ON Monday next, May 16, a special evening meeting of the Royal Geographical Society will be held in commemoration of the 400th anniversary of the discovery of the Cape route to India by Vasco Da Gama. A paper on the subject will be read by the President. H.R.H. the Prince of Wales, H.R.H. the Duke of York, and His Excellency the Portuguese Minister, Count de Soveral, have promised to be present. The anniversary meeting of the Society will be held on May 23, and the annual conversazione will be held in the Natural History Museum, South Kensington, on the evening of Thursday, June 23.

THE Council of the Royal Geographical Society have awarded one of the two Royal medals to Dr. Sven Hedin for his work in Central Asia, and the other to Lieutenant E. A. Peary, United States Navy, for his explorations in Northern Greenland. The Council have also made the following awards:—The Murchison grant to Mr. H. Warington Smyth for his several journeys in Siam; the Back grant to Mr. George P. Tate for his survey work in Afghanistan, Baluchistan, especially Makran, Aden, and on the Indus; the Gill memorial to Mr. Edmund J. Garwood for his geographical work in Spitsbergen during two seasons, in company with Sir Martin Conway; the Cuthbert Peek grant to Mr. Poulett Weatherley for his exploration of the region between Lakes Mweru and Bangweolo. The following foreign geographers and travellers have been elected honorary corresponding members:—Don Marcos Jimenes de la Espada, Don Francisco Moreno, Buenos Ayres; Marquis of Rio Branco, Brazil; Dr. Thoroddsen, of Iceland; Prof. Ratzel, of Leipzig.

SEVERAL changes have have been made on the staff of the Geological Survey. The vacancy caused by the retirement of Mr. George Sharman, senior Palæontologist, has been filled by the appointment of Dr. F. L. Kitchin as Assistant Palæontologist, under Mr. E. T. Newton, F.R.S., Palæontologist. Dr. William Pollard has been appointed an Assistant Geologist in the Petrographical Department of the Survey at Jermyn Street, in the room of Prof. W. W. Watts; and Mr. C. B. Wedd has also been appointed an Assistant Geologist, to fill the vacancy caused by the resignation of Mr. C. E. De Rance. Mr. H. J. Seymour has joined the staff in Ireland as Assistant Geologist, to take charge of the petrographic work, in the room of Prof. W. J. Sollas, F.R.S.

AT a recent meeting of the Gesellschaft für Erdkünde held in Berlin, Dr. Gerhard Schott of the Deutsche Seewarte gave an account of the provisional plans for the forthcoming German deep-sea expedition. The expedition was originally suggested by Prof. Chun, of Breslau, and it was at first intended to confine its labours strictly to zoological research; but the sum granted by the Imperial Parliament (15,000*l.*) is considered sufficient to allow of a comprehensive series of physical and chemical observations being undertaken as well. Soundings will be made in little-explored regions in the eastern part of the South Atlantic, on the sub-Antarctic plateau to the east of the Cape, and in the immense stretch of the Indian Ocean between the equator and 30° S. lat. Special attention will be given by the chemists to analyses of the gas-contents of the waters at different depths. The

vessel, which will probably be chartered from the Hamburg-American line, is to be a steamer of at least 2000 tons, with a sea-speed of not less than 10 knots: the *personnel* of the expedition will include, besides Prof. Chun, a navigating officer, four zoologists, a botanist, an oceanographer, a chemist, a doctor, and a photographer. The expedition is to start in August, beginning work in the Faëroe-Shetland Channel, and going southward by the Canaries and Cape Verd Islands to the coast of German West Africa, where some special fishery problems are to be studied. From the Cape, the meeting-place of the hot and cold waters to the east is to be examined, and if possible an excursion made southward to Prince Edward Island. Next the waters east of Madagascar will be visited, and after touching at Zanzibar the expedition will work through the region of the Seychelle and Chagos Islands to Colombo, and thence back to Aden by the Eight-degree Channel, returning to Hamburg from Aden direct. The whole time occupied will probably be eight or nine months. We hope shortly to publish a detailed account of the final arrangements of the expedition.

THE death is announced of Prof. D. S. Kellicott, professor of zoology at Ohio State University.

THE Royal Agricultural Society has accepted the invitation to hold its country meeting in York in 1900.

PROF. JOHN MILNE has left England for a few weeks on a short tour, with the object of visiting seismological observatories in Italy, Sicily, and Germany.

THE Croonian Lectures of the Royal College of Physicians of London will be given by Dr. Sidney Martin on June 14, 16, 21 and 23. The subject is the chemical products of pathogenic bacteria considered with special reference to enteric fever.

THE Presidents of the Institute of Chemistry, Society of Chemical Industry, and Society of Public Analysts have sent out invitations for a reception to be held at the Royal Institute of Painters in Water Colours on Tuesday, May 24.

A MEETING of the Federated Institution of Mining Engineers will be held in the rooms of the Geological Society, Burlington House, on Thursday and Friday, May 19 and 20, under the presidency of Mr. A. M. Chambers.

IT is announced in the *Kew Bulletin* that Mr. J. A. Gammie, Deputy Superintendent of the Government Cinchona Plantation in Sikkim, has retired from that post, and Mr. Robert Pantling has been appointed his successor. Both Mr. Gammie and Mr. Pantling went out to Calcutta from Kew.

AT a meeting of the Essex Field Club to be held at Chingford on Saturday, May 21, Dr. H. C. Sorby, F.R.S., will lecture on "The Preparation of Marine Animals as Transparent Lantern-slides, illustrated by Characteristic Forms of the Essex Coast." The subject is one which has occupied Dr. Sorby's attention for some time, during his cruises off the coast in his yacht *Glimpse*. The preparation of marine animals as lantern-slides, so as to show not only their true general form, but also much of their internal structure, is as much a chemical as a biological problem, and different animals require very different treatment. A general account of the methods of preparing such slides was given by Dr. Sorby in a recent number of NATURE (March 31, p. 520). The company of naturalists and others interested in the subject is invited by the Essex Field Club. Cards for the meeting may be had of the Hon. Secretaries, Buckhurst Hill, Essex.

ON Saturday, May 14, the Yorkshire Naturalists' Union, of which Prof. Michael Foster is now the President, will hold a meeting at Clapham, Yorkshire, for the investigation of Ingleborough and Bowland Knotts. Special facilities have been obtained for the examination of the great Ingleborough Cave, which can be traversed for a distance of about half a mile. The cave is of little interest to the archæologist, no remains either of flint implements or bones having been found in it, but it is of surpassing interest to the physical geologist and to those who wish to study the formation of different forms of stalactites and stalagmites. An instructive leaflet containing notes on the geology and biology of the district has been prepared for the information of the members of the Union.

THE third International Congress of Applied Chemistry will be opened in Vienna on July 28, and will last until August 2, inclusive. From the *Chemical News* we learn that the subjects of the Congress are as follows: (*a*) Consultations concerning important questions in all departments of applied chemistry, and particularly of those the solution of which is a matter of public interest. (*b*) Agreement upon methods to be considered internationally valid for the analysis of such products as are valued upon the basis of their chemical composition. (*c*) Agreement upon methods to be considered internationally valid for the use of the different chemical industries. (*d*) Discussion on questions of instruction in applied chemistry, and consultations upon general affairs of chemists. And (*e*) commencement of a friendly understanding between the representatives of the different departments of applied chemistry at home and abroad. Papers to be read at the meeting should be in the hands of the General Secretary, M. F. Strohner, Vienna IV/2, Schönburgstrasse 6, not later than June 1. It is requested that no paper be longer than five pages octavo in print.

AN automatic telephone exchange system, which does away with the necessity for the staff of skilled operators at present required at exchanges, is being introduced into this country from the United States by the Direct Telephone Exchange Syndicate. Instead of ringing up the central station, requesting the attendant to put him in communication with the person to whom he wishes to speak, and waiting while the required alterations are made on the switch-board, the subscriber to an exchange worked on the automatic plan is himself able to connect his telephone with that of any other subscriber without the intervention of a third person. Each subscriber has upon the front of his instrument a circular disc pivoted at the centre, and having one-half of its circumference inscribed with figures from 0 to 9. If he wishes to communicate with another, he sets the disc so that the number of the other subscriber appears upon the dial, and he then finds his telephone in circuit with that of the person whose number he has indicated by his disc. When he has finished his conversation he simply hangs his receiver on its hook. Immediately, the switch which represents him at the exchange returns to its normal position, and communication is cut off. A third subscriber cannot get possession of the line until the first two have done with it; hence there is no possibility of interruption, and secrecy is assured. In the United States a considerable number of exchanges are in regular operation on this plan, and are stated to be proving perfectly satisfactory to their subscribers.

THE Melloni thermo-pile has of late years fallen somewhat into disuse. For the detection and measurement of small thermal changes, the bolometer of Langley, the micro-radiometer of Boys, and the extremely sensitive photo-electric cells of Minchin, have to some extent supplanted the older instrument. In a recent number of the *Zeit. Instrumentenkunde*, Prof. Heinrich Rubens shows that the capabilities of the original apparatus may be greatly increased if proper care is given to the construction, particularly by reducing the thermal capacity of the couples. Antimony and bismuth are mechanically ill-suited for the purpose; he therefore replaces them by iron and the nickel alloy "constantan," in the form of fine wires. The thermo electric "power" of an iron-constantan single couple

is only about half that of antimony-bismuth, but the gain in sensitiveness, due to lessened thermal capacity, quite outmeasures this defect. Prof. Rubens has succeeded in making such a thermo-pile with twenty couples in a line of 20 mm. ; the resistance is 3·5 ohms, and the E.M.F. 0·00106 of a volt per 1° C. This must be regarded as a very great advance in radiometry. It would be interesting to compare this instrument with photo-electric cells as regards their respective power of measuring stellar radiations. It should be noted that this is not the first time an iron-constantan couple has been applied to thermal investigations.

"THE collapse of a spherical shell under pressure" is a problem which has long puzzled the minds of mathematicians, and one which both engineers and geologists would be glad to see solved. An interesting series of experiments in which a hollow hemisphere of metal was made to collapse by the pressure applied on top of it by another hemisphere or plane, is described by Prof. H. Schoentjes, of Ghent, in the current *Bulletin de l'Académie royale de Belgique* (1898, No. 3). Prof. Schoentjes gives excellent photographs showing various cases of collapse in segments ; triangular, quadrangular, pentagonal and hexagonal forms being all represented. The present paper forms the sequel to one published in 1890, and among the author's conclusions the following are noteworthy :—When two similar hemispheres of 10 cm. diameter were crushed together by a hydraulic press with their summits in contact, only one of the hemispheres collapsed ; the cavity formed was spherical, and was moulded on the undeformed hemisphere just as if the latter hemisphere were solid. When a hemisphere of 15 cm. diameter was crushed against one of 10 cm , the smaller one penetrated nine times out of ten into the larger one ; the cavity was at first spherical, but afterwards its margin became polygonal. In one case only (and the author could not succeed in repeating the experiment), both hemispheres were deformed ; the larger one first penetrated the smaller, but under a force of 80 kilogrammes the edge of the cavity began to penetrate the large hemisphere. When a hemisphere was crushed by a plane the normal deformation was found to be hexagonal.

THE mathematical theory of the propagation of earthquake shocks is the subject of a somewhat interesting investigation at the hands of M. P. Rudski, an abstract of whose papers has just reached us (*Anzeiger der Akademie der Wissenschaften in Krakau*, November 1897). The author examines the consequences of the assumption made by Prof. A. Schmidt, of Stuttgart, that the wave-velocity in the interior of the earth is a function of the radius vector, which decreases as the latter increases. Under such circumstances, the rate of propagation of earthquakes along the earth's surface decreases from the epicentre outwards till a certain circle is reached, and then increases up to the antipodes of the epicentre. The position of the bounding circle in question depends on the depth of the disturbance, and M. Rudski considers it possible, from observations of earthquakes, to determine the relation between the wave-velocity and the radius vector.

A SERIES of observations of the temperature of the soil at the observatory of Catania from 1892 to 1896 has been published by Dr. Emmanuele Tringali in the *Atti dell'Accademia Gioenia di Scienze Naturali*. In addition to confirming the well-known laws according to which the diurnal and annual variations of temperature decrease and undergo retardation with increasing depth, Dr. Tringali finds that at Catania the velocity of transmission of the diurnal fluctuations is about 20 cm. for every 7½ hours, and that these fluctuations become practically unimportant at a depth of 60 cm., where they only amount to a few tenths of a degree when the atmospheric temperature changes as much as 17°.

THE summary of the Weekly Weather Report for the first quarter of this year, recently issued by the Meteorological Council, shows that in all the principal wheat-producing districts, except the north of Scotland, there is a considerable deficiency in the amount of the rainfall ; while in the grazing, &c., districts a deficiency is everywhere shown. Looking at the values for the winter half-year, the excess in the north of Scotland is 3·5 inches ; this is, of course, due to the tracks taken by the areas of low barometric pressure. The greatest deficiency occurs in the south of England and Channel Islands, where it amounts to 7 inches, and it exceeds 5 inches in the midland parts of England. As these values are for large districts, of course at some individual stations the deficiency is much more marked.

WE drew attention last week to the important meteorological station established by the Corporation of Southport, and we are glad to learn that the municipal authorities at many other stations are not behind that place in recognising the value of accurate meteorological observations, and of placing the stations in connection with the Meteorological Office or the Royal Meteorological Society. Among these we may specially mention the station established by the Corporation of Eastbourne, under the superintendence of Mr. R. Sheward, who has for many years published reports of the observations at that favourite sea-side resort, where every care has been taken to place the instruments in the best possible positions. Eastbourne enjoys a large amount of bright sunshine, the average annual duration being 1719 hours, while for London the average is only 1240 hours. Mr. Sheward bears witness to the value of the storm-warning telegrams issued by the Meteorological Office. He states that since the establishment of storm signals there, in 1893, no mishap has occurred to the fishing fleet, although his tables show that some serious gales have been experienced.

THE Bureau of Agriculture and Immigration of the State of Louisiana has recently issued the first volume of a treatise on the history, botany, and agriculture of the sugar-cane, and the chemistry and manufacture of its juices into sugar and other products, by Prof. W. C. Stubbs, Director of the Audubon Park Experimental Station at New Orleans. One chapter is devoted to the botanical relations of the plant, one to its anatomy and physiology, one to its modes of reproduction, and one to bacteriological notes on red cane.

THE plant yielding what is known in commerce as Ceara rubber or Maniçoba, and shipped from the Brazilian ports of Ceara, Bahia and Pernambuco, was identified at Kew eleven years ago as *Manihot Glaziovii*, Muell. Arg. Specimens of the plant were sent from Kew to our Colonies and possessions which seemed suitable for its cultivation, and the results of the attempts to introduce the Ceara rubber tree are described in the latest issues of the *Kew Bulletin* (Nos. 133–134, 1898). The following is a summary of the information thus obtained, and it furnishes another example of the valuable work done by Kew in the endeavour to increase the natural resources of British possessions : (1) The plant is readily propagated both from seeds and cuttings. Seeds are abundantly produced in almost every part of the world where the plant has been introduced. They may be gathered from plants when only three to five years old. There is therefore the great advantage that a large area could be planted within a comparatively short period. Sowing the seeds in the position where they are to grow permanently is universally adopted in Brazil. It is possible, if adopted elsewhere, this plan would greatly reduce the cost of establishing plantations. (2) The Ceara rubber plant is very hardy, a fast grower, free from insect and fungoid attacks, requires little or no attention when once established, and thrives in poor, dry and rocky soils unsuited to almost any other crop. It is evident, however,

that the yield of a few trees cannot be remunerative, and only large areas can hope to make the industry a paying one. (3) It produces a good class of rubber, second only when well prepared to the best Para rubber. For this there is a steady and continuous demand. The yield per tree is apparently small, but a return is obtained earlier than from any other rubber plant. With thick planting and judicious thinning as the trees grow up, it may be possible to increase the yield hitherto recorded; while with skilful treatment the permanent trees may be tapped twice yearly, and last in a productive state for fifteen to twenty years. (4) In spite, therefore, of the apparent want of success which so far has attended experiments with Ceara rubber plants in Ceylon and other countries, the increasing importance of rubber as an article in large demand in all civilised countries at good prices, suggests a reconsideration of the merits of this interesting plant. In many of our Colonies possessing a dry climate and a poor stony soil, it is possible that large areas could be profitably occupied with Ceara rubber trees so grown as to provide annual crops for tapping.

MR. D. A. GILCHRIST, Director of the Agricultural Department of the University Extension College, Reading, has issued his fourth annual report upon the field experiments carried on during last year. Since 1894 field experiments have been made at the College, and the results have been of distinct service to agriculturists. The County Councils of Berkshire, Dorset, Hampshire and Oxfordshire co-operate with the College in this work through their Technical Instruction Committees; subsidies being granted by these bodies to the College to meet the expenses. During the season 1897 the work included the testing of manures on most of the principal farm crops, and a further development was made in the direction of carrying out field experiments of a more continuous character, such as the effect of manures, applied at the beginning of a rotation of crops, throughout the whole rotation. The results of all field experiments are of much more value in the locality in which they are carried on than elsewhere; nevertheless, Mr. Gilchrist's report gives much useful information as to the effects of various manures on different crops, under very different conditions of soil; and from this, tolerably safe general conclusions may be drawn. The Agricultural Department of the University Extension College at Reading may indeed be compared with the agricultural experiment stations of Canada and the United States, for it is performing, so far as it is able, the functions of those institutions by conducting inquiries of value to agriculturists, and acting as a reference bureau.

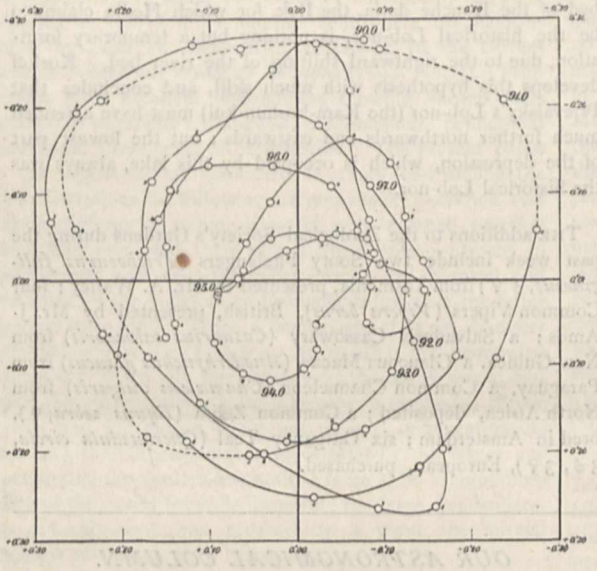
WE have received from P. K. Kozloff, member of the last Russian Tibet expedition, a very interesting contribution to the Lob-nor controversy. It is issued by the Russian Geographical Society as a pamphlet ("Lob-Nor"), and contains the Russian traveller's remarks concerning the lakes discovered by Sven Hedin, for which the Swedish explorer claims to be the true Lob-nor; while the lake Kara-koshun-kul, discovered by Prjevalsky, and described by him as the Lob-nor, would be, in Sven Hedin's opinion, but a secondary and temporary basin. P. K. Kozloff gives in his pamphlet all materials which may enable the reader to come to an independent opinion, namely, a map of the region, embodying the Russian surveys and Hedin's discovery; a copy of the Chinese map upon which Richthoffen and Hedin based their argumentation; and abstracts from Prjevalsky's, Pyevtsoff's, Bogdanovich's, Hedin's, and Kozloff's descriptions of the Lob-nor region. The map already shows to what extent Hedin's claims are admissible. The author then discusses Richthoffen's and Hedin's arguments. The Chinese map, which gives to the Lob-nor a more northern position than the position occupied by Prjevalsky's Lob-nor, Kozloff shows, is wrong, because it gives to the junction of the Tarim with the Konche daria (Airylgan) a much more northern position than was found already in 1765 by the Jesuits, and confirmed since by General Pyevtsoff. In fact, most of the positions on the Chinese map have more northern latitudes than the real ones. The lake Khas of the same map, with which Richthoffen and Hedin wanted to identify Prjevalsky's Lob-nor is, beyond any possible doubt, the lake Ghas of Prjevalsky, situated beyond the Nutsitu ridge marked on the Chinese map. As to the chain of four lakes discovered by Hedin, of which the southern only had been previously visited by Kozloff, they have been formed by the Konche daria, which, coming from the north-west, is continually shifting its bed in its lower part towards the right, *i.e.* westwards. The desert in the north of the Lob-nor has been formed through that shifting of the bed of the Konche daria, and the chain of lake-shaped enlargements of the old bed of the Konche daria, the Ilek, for which Hedin claims to be the historical Lob-nor, is nothing but a temporary formation, due to the rightward shifting of the river bed. Kozloff develops this hypothesis with much skill, and concludes that Prjevalsky's Lob-nor (the Kara-koshun-kul) must have extended much further northwards and eastwards; but the lowest part of the depression, which is occupied by this lake, always was the historical Lob-nor.

THE additions to the Zoological Society's Gardens during the past week include two Sooty Phalangers (*Trichosurus fuliginosus*, ♂ ♀) from Tasmania, presented by Mr. A. Walley; four Common Vipers (*Vipera berus*), British, presented by Mr. J. Amos; a Salvadoris Cassowary (*Casuarius salvadorii*) from New Guinea, a Glaucous Macaw (*Anodorhynchus glaucus*) from Paraguay, a Common Chamæleon (*Chamæleon vulgaris*) from North Africa, deposited; a Common Zebra (*Equus zebra*, ♀), bred in Amsterdam; six Garganey Teal (*Querquedula circia*, 3 ♂, 3 ♀), European, purchased.

OUR ASTRONOMICAL COLUMN.

THE SPECTRUM OF HYDROGEN IN NEBULÆ.—If hydrogen gas in a Geissler tube be examined spectroscopically, the brightest line observed is Hα. If, on the other hand, the lines of hydrogen in nebulæ be examined, Hβ may sometimes be well seen, while Hα, the C line, can scarcely be detected. To account for this apparent change of intensity several investigations have been made, and as long ago as 1868 Lockyer and Frankland showed that the hydrogen spectrum could be reduced to the single line Hβ under certain conditions of temperature and pressure. Prof. Scheiner has recently investigated the question of the luminosity of hydrogen in the nebulæ (*Astrophysical Journal*, No. 4, April 1898), and he has attempted to introduce "circumstances approximating to those under which the nebulæ emit light" to find out whether objective changes can be produced in the spectrum of hydrogen in an attenuated state, or whether the subjective weakening of the light is the determining factor, and if so to what extent. By exciting tubes filled with hydrogen in the field of a Tesla high tension transformer, the space surrounding them having a temperature of about − 200° C., Koch's investigations were confirmed that the spectrum of hydrogen did not change when the surrounding temperature was reduced as low as − 200° C. Prof. Scheiner next investigated the physiological disappearance of the Hα line, and without entering on the procedure adopted, which is described in the journal referred to above, we will limit ourselves to the result. The absence of the Hα line in the hydrogen spectrum is due to physiological reasons, and it is consequently not permissible to deduce from this peculiarity of the hydrogen spectrum in the nebulæ any conclusion whatever concerning the physical conditions under which the light emission of these celestial bodies takes place. Whether certain nebulæ may not prove exceptions to this rule, is to be left an open question; it is certainly not impossible that such may be the case.

THE MOVEMENT OF THE EARTH'S POLAR AXIS 1890·0–1897·5.—To the *Astr. Nachr.* (No. 3489) Prof. Albrecht contributes a short abstract of an investigation which he has just completed on the path of the earth's polar axis. In a previous number of the same journal (No. 3333) he gave the result of a similar piece of work for the period 1890·0–1895·2. The mass of material that has since accumulated has led Prof. Albrecht to reinvestigate the motion from the beginning, or, in other words, to trace the movement of the pole for the whole period 1890·0–1897·5. An examination of the resulting curve shows that from the year 1890 to 1895 a decrease in the amplitude took place, the curve towards the time of the latter year being not very far distant from the position of the mean pole. From 1895 the amplitude began to increase, but without reaching the value of that attained in the year 1890. The curve during the interval 1897·0–97·8 approached the mean pole by quite a tenth of a second more than it did during the period 1890·0–90·5. Prof. Albrecht consequently points out that since the curve does not



Movement of the north pole of the earth's axis.

repeat itself after a period of seven years, the orbit of the pole's movement cannot be represented by a term of twelve and of fourteen months period.

Comparing the observed and calculated values of $\phi-\phi_0$, he is led to infer that a part of the series of observations is more or less affected by systematic errors, the great portion being due to refraction disturbances. To remedy this in future it is pointed out that greater care must be taken to ensure equality of refraction towards the north and south by having large openings (shutters) in the observing room, and by placing the instrument central as regards the shutters. Further, mention is made of the locality of the observatory, and such positions should be chosen where the land and vegetation conditions towards the north and south do not offer great contrasts.

COMET PERRINE (MARCH 19).—The following ephemeris for this comet is continued from *Astr. Nach.*, 3488.

Berlin Midnight.

1898.	R.A.	Decl.	Br.
	h. m. s.	° ′	
May 12 ...	1 36 25 ...	+54 16·3 ...	0·38
13 ...	41 42 ...	54 29·1	
14 ...	46 56 ...	54 41·1	
15 ...	52 8 ...	54 52·2	
16 ...	1 57 18 ...	55 2·5 ...	0·33
17 ...	2 2 25 ...	55 12·1	
18 ...	7 30 ...	55 21·0	
19 ...	2 12 32 ...	+55 29·1	

During the present week the comet approaches the vicinity of the well-known great cluster in Perseus.

THE NORTHERN "DURCHMUSTERUNG."—A committee, consisting of Profs. E. C. Pickering, J. G. Hagen and M. B. Snyder, informs us (*Astrophysical Journal*, No. 4, April 1898) that a new edition of the *Durchmusterung* is being prepared by the Bonn Observatory, and will shortly be published, provided that subscriptions for a hundred copies at seventy marks each are promised. The fact that the original edition of this work is exhausted, and that the price asked was exceptionally low, should have induced many libraries and institutions to have taken this opportunity and become possessors of the work. It is stated that after May 1 of this year the price will be raised to one hundred and twenty marks, so that, if this date be adhered to, the opportunity for obtaining copies at the cheaper price has been missed.

THE ASTRONOMICAL SOCIETY OF WALES.—In this column we have several times referred to the excellent work the Astronomical Society of Wales is doing in promoting the study of astronomy and the allied sciences. The Society has just published in a new form and under somewhat new conditions the first issue of their quarterly journal, the *Cambrian Natural Observer*, which it is hoped will appear regularly. In the introduction we are told, "for some reason or other science does not seem to flourish in Wales; yet, the opportunities for the observation of natural phenomena—using these words in their broadest sense—are neither few nor unimportant." May the influence of the Society be so effective that such a statement as the above will in the next few years cease to be accurate.

SEA-BEACHES AND SANDBANKS.[1]

THIS paper is the sequel to one on "The Formation of Sand-dunes," in the *Geographical Journal*, March 1897. It embodies a research upon the processes which distribute the detritus which enters the sea at its margin, and upon the behaviour of the material distributed.

Fine mud settles through water with such extreme slowness, that wherever the bottom is disturbed by waves (say, to the edge of the continental shelf) it cannot anchor itself upon the bottom even during the slack water of the tides, so that the action of gravity is cheated. This leads to the conclusion that the transit of mud down the slope from the shore is not due to the action of gravity, but that the principal factor determining the well-known direction of mud-transport is the diminution of intensity of bottom agitation from the shallows to the depths.

The usual condition of sea-water is one of oscillation which is not quite symmetrical in amount (*i.e.* there is often a prevailing drift in one direction), and which is scarcely ever symmetrical in intensity, a short quick motion one way being balanced, as far as the movement of the water itself is concerned, by a long slow motion in the reverse direction.

The author shows how suitable oscillation on a seaward slope will set shingle travelling shoreward, and sand simultaneously travelling seaward. The condition of the transport of shingle (great intensity of motion) keeps most of it close against the shore, often in a bank or beach; while the inability of mud to settle except where the water is quiet causes it, as we have seen, to accumulate in mud flats beyond the limits of wave-action. The accumulations of sand are of greater variety, for, although the mean term in size, it possesses a greater independence of motion, or persistence, or effective inertia, than either of the extreme terms. Mud (by which is intended throughout such characteristic marine mud as the well-known "blue mud") obeys each slightest swirl of the water; it follows almost exactly the stream-lines; and it is only in the slow settlement of the mud in still water that muddy water behaves otherwise than as an emulsion. Shingle, again, is not raised to any great height from the bottom, and sinks so swiftly that it does not take a long free flight in water. Hence, when it is moving it follows almost precisely the direction of the momentary movement of the water. Sand, on the other hand, is frequently churned up to a considerable height from the bottom, and often has a long free path; but when the stream-lines of the water are suddenly deflected, whether vertically or horizontally, inertia carries the sand on, the stream-lines of the sand being deflected less than those of the water. Similarly, when the current slackens the sand flings itself forwards, as is so noticeable in the rippling of sand by

[1] By Vaughan Cornish, M.Sc. (Vict. Univ.). (Abstract of a paper read before the Royal Geographical Society on March 16, published in the *Geographical Journal*.)

waves. It is owing to its persistent motion that sea-sand accumulates in vast banks where it is flung by the sudden bending or checking of currents (*e.g.* at tidal nodes), or where it is dropped during tumultuous mixing of waters.

The wash of the waves, owing to percolation, piles up the pebbles thrown forward by the breaker, forming a bank, or ridge, or Full, and this is the action proper to the sea on a shore of shingle.

The piling up of the ridge goes on, its height and steepness increasing, until the wash can reach no higher, and the steepness of the ridge at each point is such that the assistance which gravity gives to the down-flowing surface stream counterbalances the loss of transporting power due to percolation at that level. This is the equilibrium profile or regimen of the Full. Now, the greater the volume of water flung forward by the breaker, the greater is the depth of the back-flowing surface stream, and thus for the same size of beach material the carrying power of the back-wash is more nearly equal to that of the on-wash. Consequently, in a given locality, the regimen slope of beach proper to a rough sea is not so steep as that for a quiet sea.

It is evident that the greatest amount of transport can occur when the sea acts upon the greatest quantity of shingle—that is to say, when the sea is at its highest level. The transporting power increases in a more rapid ratio than the rise of level, owing to the circumstance that most of the shingle is accumulated on the landward side of the beach, where its thickness is greatest. It follows that a wind blowing in the direction of the flood tide will have an advantage in shingle-transport over the wind which blows with the ebb; for the former, by opposing the turn of the tide, tends to increase the duration of tidal high water, and to diminish the duration of tidal low water. Thus, although the forces of currents may be equal and opposite in the two cases, the opportunities of action on shingle are greater when the wind blows with the flood tide. Again, the waves break most violently on the steep beach near high-tide mark, which further increases the effect of prolonged high water in promoting transport. The along-shore wind which is accompanied by a low barometer has a corresponding advantage of opportunity over the along-shore wind which is accompanied by a high barometer, and the wind along-shore which blows from the greater expanse of water over the wind which blows from the less.

[*From a photograph by the author.*

FIG. 1.—East end of Chesil Beach.

No stony particle of less than a certain critical size can remain permanently on a beach, but is ultimately swept out to sea. This critical size is greater on a coarse-grained than on a fine-grained beach, for the regimen slope of the former is steeper, and gravity therefore gives greater assistance to the back-wash. It is well known that every particle upon the surface of a beach suffers attrition, whence the conclusion has been too hastily drawn that the grain of an isolated beach naturally becomes finer as the distance increases from the extremity where the beach is fed with detritus. Now, it is to be noted that whereas the attrition of the particles tends to lower the average size of the shingle, and hence to make the grain of the beach finer, the removal of particles of less than the critical size raises the average dimension of the shingle. Hence we may deduce the following laws of grading of beach shingle applicable to a beach fed entirely at one extremity, whence the material travels along the beach:—

Law 1.—If the material be of uniform size, the grain of the beach becomes finer as we recede from the extremity.

Law 2.—If the material be mostly fine stuff, with a small admixture of coarse stuff, then (unless the coarse stuff be very friable, and the fine stuff very durable) the grain of the beach will become coarser as we recede from the extremity, for the average size is more affected by the removal of a large number of fine grains than by the attrition of a small number of coarse grains. This increase in coarseness will continue until the beach material is brought to a uniform size, when the grading proceeds as in 1.

Law 3.—If the material be mostly coarse stuff, with a small admixture of fine stuff, then, as we recede from the extremity, the grain of the beach will become finer, for the attrition of a great number of large particles has a greater effect upon the average size of the material than the removal of a small number of fine particles.

By combining 2 and 3 we can deduce corollaries applicable to the case of a beach fed from both extremities.

Law 4.—The grain of the beach is (*ceteris paribus*) coarser where the beach is exposed to the heaviest breakers. This law follows from what has been said on the action of the back-wash, and on a "critical size" of beach material.

Law 5.—The grain of the beach is (*ceteris paribus*) coarser near the "weather" end of a promontory. Thus, if west be the weather side, and the end of a long beach is protected from the east by a headland at the eastern extremity, then both large and small pebbles will travel eastward along the beach in a westerly wind, but only the small ones are carried back from the promontory during an east wind, so that the proportion of large pebbles to small is increased as we near the promontory from the west. This is, in fact, similar to the case of the sorting of sand from shingle by unsymmetrical oscillation.

The author considers that the chief factors which determine the observed grading of the Chesil Beach are as follows:—

(1) The beach is fed at both ends (Bridport and Chesilton).

(2) The material fed in at the west end is mostly fine, owing chiefly to the natural groynes at Golden Cap and Thorncombe.

(3) The material fed in at the east end is mostly coarse, owing to the nature of the local rock and the mode in which it is supplied to the foreshore.

(4) The main drift of water is easterly, but

(5) Of the fine shingle carried eastward from Bridport, much is brought back by waves from the east; whereas

(6) The strong outset at Chesilton removes such fine stuff as may be there supplied from Portland.

(7) The largest waves converge on Chesilton from both sides.

The formation of a beach-ridge, or Full of sand, is well seen when the sand is being brought in during off-shore winds. Sand being readily raised by upward-swirling water (which is equivalent to suction dredging), the building up of a Full of sand in front of the breaker is accompanied by the excavation of a trough, or Low, at the back of the breaker. This is roughly similar to the simultaneous excavation and elevation

which produces the ridge and furrow so well known as "ripple-mark." Fine dust or mud settles too slowly, coarse shingle too quickly, to lend themselves readily to this mode of distribution by waves. A Low is dredged out in sand when the breaker-line remains stationary for a time, as *e.g.* during tidal high water. During the ebb of spring tides, a lagoon is often left between the beach and a second stretch of sand. This lagoon marks the strip where the breakers act during the period of neap tides. At low water of spring tides, the belt of sand beyond the Low is a sort of beach, the seaward face of which is where the wash of the waves acts. Beyond it, during the continuance of the spring tides the breakers commence the formation of a second Low. When the tide is up and the sea is rough, there is an outer line of breakers on the bank, which is locally called the Ball.

The connection between tidal nodes and the accumulation of sandbanks is dealt with, and the analogies with sand-dunes are pointed out.

With regard to the sandbanks which accumulate on the more sheltered side of headlands, a good example of which is the Shambles shoal, eastward of Portland Bill, it is pointed out that the materials (broken shells, &c.) which form the Shambles sandbank are not deposited in still water. The sand deposits

[*From a photograph by the author.*

FIG. 2.—Blacknor Point, Portland.

from the mixing waters of meeting streams, an effect that is not surprising when we consider that the mixing of waters is achieved by vortices.

The checking and deflection of the streams is probably not nearly the whole of the mechanism by which the deposition of sand is brought about where a river meets the sea. A great part of this effect is probably due to the motions which attend the mixing of waters, a process which appears to be almost as potent a factor in the formation of sandbanks as is the mixing of airs in the production of clouds.

THE BACTERIAL CHARACTER OF CALF-LYMPH.

QUITE a flutter of excitement was produced in the ranks of the anti-vaccinators by the public announcement, made rather more than a couple of years ago, that lymph used for vaccination purposes frequently contained an immense number of bacteria, sometimes as many as two and one-half millions in a single cubic centimetre, and that amongst this vast microbial population forms were repeatedly present which, on inoculation, proved fatal to animals. A certain measure of authority was given to this communication, inasmuch as its author, Dr. Landmann, claimed to have carried out a very large number of experiments in support of his assertion; and his results were, moreover, brought before the well-known German Association of Naturalists and Physicians at one of its yearly meetings. Coupled, as Dr. Landmann's conclusions were, with the recommendation that only lymph should be used for inoculation purposes which had been officially declared germ-free—or, at any rate, devoid of pathogenic bacteria—his announcement gave such an impetus to the anti-vaccination crusade, and occasioned so much public discussion, that the Prussian Ministry felt it their duty to appoint a Commission to inquire into the character of calf-lymph. Meanwhile independent experimental inquiries were also started by various investigators, and amongst these Dr. Neidhart was able to show that Landmann's assertion that the red inflammatory margin of the pustules so frequently noticeable was directly due to the action of the bacteria present in the vaccine was not correct, inasmuch as such symptoms were produced when lymph quite free from bacteria was employed, whilst they were often absent in cases where the lymph was proved to be teeming with bacteria. The hysterical excitement caused by the circulation of Landmann's sensational statements was, however, considerably abated by the publication of the masterly report drawn up by Frosch upon the very large number of most valuable experiments undertaken in a purely scientific, uncontroversial spirit by the Prussian Committee of inquiry above referred to.

This document completely refuted Landmann's statements, and showed that the alarming conclusions arrived at by him had no real foundation in fact. Frosch further indicates, as the result of careful experiment, the best methods and most suitable precautions to be adopted in the inoculation of calves and the collection and application of the lymph, pointing out in the latter connection that local irritation from vaccination may be greatly moderated by diluting the lymph with glycerine.

These reassuring results were again independently confirmed by Kirchner, of Hanover, who, in extensive examinations of calf-lymph, found on no single occasion any pathogenic bacteria.

In the current number of the *Zeitschrift für Hygiene* the question has been again brought to the fore by the publication of elaborate experimental researches on the bacterial character of calf-lymph by Dr. Dreyer, of the Hygienic Institute of the University of Giessen.

Careful quantitative determinations of the bacterial contents of calf-lymph showed that the initial number of microbes present may vary considerably, and that in the majority of cases it is very large indeed—on one occasion reaching as many as 17½ millions in one cubic centimetre. Within twenty-four hours, however, a great diminution takes place; but this decrease does not continue at the same rapid rate. Thus, to cite one instance: a sample contained on the first day of its collection over 2½ millions of bacteria per c.c.; after five days, 112,750; after eighteen days there were still, however, 111,765 present. Some forms persist over very long periods of time; Dreyer observed bacteria after a lapse of five months, whilst Kirchner found 550 in a cubic centimetre sample over a year old.

To determine the pathogenic character of lymph-bacteria, Dreyer inoculated, subcutaneously and intraperitoneally, both mice and guinea-pigs. Out of thirty-five mice thus treated only two succumbed, one to subcutaneous and the other to intraperitoneal inoculation; in none of the other animals was any reaction perceptible. As regards the guinea-pigs, in no single instance did any result follow the intraperitoneal inoculations, whilst in nearly every subcutaneous inoculation a small and insignificant abscess was observed to form at the point of inoculation.

Not satisfied with these experiments, Dr. Dreyer experi-

mented upon himself and inoculated his arm each time with some of the same lymph he used for the mice and guinea-pigs respectively, but in no case did any reaction worthy of record follow.

In order to determine more particularly the qualitative bacterial character of these various samples of calf-lymph, plate-cultures were also made and pure cultures obtained of different bacteria, which were subsequently inoculated both into mice and into his own arm. In two cases coccus forms proved fatal to mice, whilst in the other inoculations no symptoms of importance followed. As regards the inoculations practised upon himself with these pure cultures, nothing more significant than a slight abscess resulted, except on one occasion when an affection of the adjoining lymphatic glands was experienced.

In commenting upon these results, Dr. Dreyer states that it should be borne in mind in connection with those instances where fatal results followed the introduction of the lymph into mice, that, in the first place, the mode of inoculation obliged to be adopted was not really comparable to the simple incision made in the case of human vaccination, and that, secondly, the quantity of lymph employed relative to the size of the animal was far greater than is the case in ordinary inoculations. Moreover, the two pathogenic results which followed the inoculation of a pure culture of a coccus form do not constitute any justifiable plea for the abolition of calf-lymph vaccination. It must be remembered that the conditions of such pathogenic infection are very different from those which may be present in ordinary inoculations, should pathogenic bacteria originally be present in the lymph, for, in employing a pure cultivation of a particular micro-organism, the latter is introduced into the system in immeasurably larger numbers than would be the case were it introduced direct with the lymph.

We would, in conclusion, recommend the closing paragraph of Dr. Dreyer's memoir to the consideration of that noisy section of unreasoning obstructionists who may, even in his experiments, endeavour to find some support for their crusade against the vaccination laws: "I consider, therefore, that I may conclude from my investigations that the latter afford no support which justifies the fear that animal lymph as at present prepared can produce any serious injury to those inoculated with it." G. C. FRANKLAND.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Junior Scientific Club held its 188th meeting at the Museum on May 4. After the Treasurer's balance-sheets had been read and carried, Mr. A. E. Tutton discoursed on the Glaciers of the Pennine Alps, illustrating his remarks by numerous lantern slides. Mr. H. E. Stapleton (St. John's) read a paper on turpentine extraction in the Southern States.—The Officers for this term are: President, Mr. W. E. Moss (Trinity). Chem. Sec., Mr. F. Soddy (Merton). Biolog. Sec., Mr. E. Gurney (New Coll.). Editor, Mr. H. E. Stapleton (St. John's). Treasurer, Mr. W. E. Blackall (Non. Coll.). Committee, Mr. W. B. Billinghurst (St. John's), Mr. C. E. A. Wilson (Ch. Ch.), Mr. F. P. Nunneley (B. N. C.), The conversazione will be held on May 24—Tuesday in Eights' Week—at 8 p.m.

CAMBRIDGE.—A University lectureship in applied mathematics will be vacant at the end of the academical year by the resignation of Mr. R. T. Glazebrook, F.R.S. Applications are to be sent to the Vice-Chancellor by May 17.

The Smith's prizes are awarded (1) to Mr. E. W. Barnes, Trinity, and (2) to Mr. W. A. Houston, St. John's.

Dr. Kanthack proposes to hold, during the Long Vacation, courses of instruction in general pathology, morbid anatomy and histology, bacteriology, and clinical pathology. The courses begin on July 8.

The University tables at Naples and Plymouth are about to be vacant. Applications for facilities for zoological research are to be sent to Prof. Newton by June 1.

Twenty-four candidates have passed the half-yearly examination in sanitary science just completed, and have received the University diploma in public health.

Twenty-eight additional freshmen, including one advanced student, were matriculated on May 5.

The University grant of 100*l.* a year for three years, made to the British School of Archæology at Athens in 1895, is to be renewed for another period of three years.

The Frank Smart studentship in botany, of the annual value of 100*l.* for two or three years, will be vacant on June 20. Candidates must be B.A.s who have taken honours in the Natural Sciences Tripos. Application is to be made to the Master of Caius College by June 11.

A combined examination for entrance scholarships and exhibitions in natural science will be held by Pembroke, Caius, King's, Jesus, Christ's, St. John's, and Emmanuel Colleges next term, beginning on November 1. A large number of major and minor scholarships and exhibitions, varying in annual value from 80*l.* to 30*l.*, will be offered. The subjects include chemistry, physics, elementary biology, physical geography, animal physiology, zoology, and botany; and candidates may offer from two to four of these. In all branches the candidates' practical work will be tested. Full particulars may be obtained from the Tutors of the respective colleges.

THE Duke of Devonshire stated in the House of Lords on Monday that, as soon as the Committee stage of the Irish Local Government Bill was disposed of, the London University Commission Bill would have a prominent place among those measures which the Government intended to pass during the remainder of the Session.

DURING the past fifteen months, says the Paris correspondent of the *Chemist and Druggist*, the sums subscribed by manufacturers and bankers in the district of Nancy for promoting the study of chemistry and physics, as applied to industry, in connection with the University of that town, have reached 400,000f. (16,000*l.*). The Lyons University has been authorised to contract a loan of 626,500f. (25,000*l.*), to be applied (1) to completing the Chemical Institute, (2) extending the laboratories of experimental and comparative medicine and physiology, (3) completing the laboratory of maritime physiology at Tamaris, Var.

THE following items concerning endowments of higher scientific education in the United States are recorded in *Science*:—The West Virginia University has established eleven fellowships yielding 300 dollars yearly and free tuition. The fellows are expected to teach one hour a week or give two hours' supervision in the laboratory. Among the eleven subjects for which the fellowships have been awarded are chemistry, physics, geology, zoology, botany, mathematics, mechanical engineering and civil engineering.—The estate of Mrs. Julia W. James, of Boston, divided by her will between the Museum of Fine Arts and the Massachusetts Institute of Technology, amounts to over 500,000 dollars.—The John Tyndall Fellowship of Columbia University for the encouragement of research in physics has been awarded to R. B. Owen, a graduate of the School of Engineering and professor of engineering in the University of Nebraska. Among the twenty-four fellowships annually awarded are the following: T. E. Hazen, botany; B. H. Owen, philosophy; J. D. Irving, geology; E. Kasner, mathematics; W. C. Kretz, astronomy; J. W. Miller, jun., mechanics; F. C. Paulmier, zoology; F. J. Pope, chemistry; C. E. Prevey, statistics; R. S. Woodworth, psychology.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, April 20.—W. Whitaker, F.R.S., President, in the chair.—Note on an ebbing and flowing well at Newton Nottage (Glamorganshire), by H. G. Madan. This well lies in a direct line drawn north and south from the church of Newton Nottage to the sea, about 80 yards south of the church and 500 yards from the sea. Sand-hills about 20 or 30 feet high lie between it and the sea. A range of carboniferous limestone cliffs runs east and west to the north of the church, while the same formation crops out in the sea at half-tide level. Between the two there is a band of Keuper conglomerate covered in one place at least by 7 feet of brown loamy clay with pebbles. At the shore-junction of conglomerate and limestone numerous springs occur, and it is in the conglomerate that the well is sunk, its bottom being 8 feet above Ordnance datum. A series of about forty observations made at intervals of an hour (and in many cases at the intermediate half-hours), during three consecutive days, enabled the author to construct a

curve showing the relationship existing between the rise and fall of the tide on the coast and that of the water in the well. The result is to establish the existence of a wave in the well of the same frequency as the tidal wave, but delayed, or with an establishment of, three hours (*plus* or *minus* a few minutes). The analyses of water taken from the well at its highest and lowest show no difference, so that no sea-water enters the well directly. On the other hand, the slight brackishness of the water appears to prove the diffusion of a small amount of salt water into the well.—*Petalocrinus*, by F. A. Bather. Certain curious fan-like objects, obviously echinodermal, have for a long time been preserved in the Riks-Museum at Stockholm, but their significance was first definitely ascertained when similar fossils were found in Iowa, and brought to England by Mrs. Davidson. The latter were described by Mr. Stuart Weller in a paper entitled "*Petalocrinus mirabilis* (n. sp.), and a New American Fauna"; and the former, with fresh material obtained by Mr. Weller from various American localities, are the subject of the present communication. The Silurian crinoid genus *Petalocrinus*, Weller, is discussed, on the evidence of all the original material from Iowa and of the further material above mentioned.—On the origin of the auriferous conglomerates of the Gold Coast Colony (West Africa), by Thomas B. F. Sam.—This paper gives an account of a recent journey from Adjah Bippo to the Ankobra Junction in the Gold Coast Colony. A range of clay-slate hills is succeeded for 6 miles by flat ground in which diorite was found, and that by a lofty hill in which clay-slate dipping east occurs. The Teberibie range with reefs of conglomerate, and a second range with similar reefs were crossed. Gold-bearing alluvia are briefly described, and the gold is supposed to have come from the hills. The Adjah Bippo, Takwa, and Teberibie formations are considered to be part of a syncline. Some conclusions are drawn as to the method of formation and probable auriferous character of the rocks.

Linnean Society, April 21.—Dr. A. Günther, F.R.S., President, in the chair.—On behalf of Lieut.-Colonel Birch-Reynardson there was exhibited a portion of the trunk of an apple-tree which had been so seriously attacked by water voles (*Arvicola amphibius*) as to cause the death of the tree; and several others, it was stated, had been similarly injured. Such extensive damage from such a cause was regarded as unusual.—Mr. G. E. Barrett Hamilton exhibited a head of the common brown rat (*Mus decumanus*), showing a curious deformity arising from injury to the incisor teeth.—Prof. Douglas Campbell communicated a paper, which was demonstrated by Mr. A. Gepp, on the structure of *Dendroceros*. The chief conclusions arrived at were as follows: (1) In its apical growth and the form of the thallus, *Dendroceros* differs decidedly from other genera of the order Hepaticæ. (2) The archegonium corresponds in its structure to that of the other Anthocerotaceæ, and is intermediate in character between *Notothylus* and *Anthoceros*. (3) The antheridium is solitary, and arises, as in the others of the order, endogenously. (4) The first wall in the embryo is longitudinal, as in *Anthoceros*, but the first transverse wall determines the limits of the foot, as in *Notothylas*. (5) The origin of the archesporium is from the amphithecium as in the other genera, but it is less massive than in either of these. (6) The division of the archesporial cells into sporogenous and sterile ones is less regular than in either of the other genera, and the primary archesporial cells may be transformed directly into sporogenous ones without any further divisions. (7) In *D. Breutelii* the spores remain undivided, but in *D. crispus* (?) they germinate within the capsule and are discharged as multicellular bodies. (8) Leitgeb's statement as to the absence of stomata from the capsule was confirmed.—Mr. W. P. Pycraft read a paper on the morphology of the owls (Part 1, Pterylography). In this, the first instalment of a series of papers in which it is proposed to deal with the affinities and phylogeny of the group, the pterylographic characters were alone considered, descriptions of adults, nestlings, and embryos being given. The author remarked that, so far as the distribution of the feather-tracts is concerned, the owls resemble the *Accipitres* more nearly than any other group. The form of the external aperture of the ear seems to have been originally subject to variations, the most successful of which have become fixed by selection. In some cases there is a marked asymmetry, which may either be confined to the membranes surrounding the aperture, or may extend to the skull itself. The author considered that the facts disclosed by a study of the pterylosis might justify a slight revision and rearrangement of some of the genera.—A paper was read by Mr. J. Johnstone upon the thymus and thyroid glands in the Marsupialia. The author had investigated the neck-glands in adults of nine and pouch-specimens of seven genera, representative of the leading Marsupial families. The thymus was observed to be absent only in the Koala (*Phascolarctus*), and to persist predominantly in the region of the carotid roots.

MANCHESTER.

Literary and Philosophical Society, April 19.—Mr. J. Cosmo Melvill, President, in the chair.—The following were elected officers and members of the Council for the ensuing year:—President, J. Cosmo Melvill; Vice-Presidents, Prof. O. Reynolds, F.R.S., Prof. A. Schuster, F.R.S., Charles Bailey, and W. H. Johnson; Secretaries, R. F. Gwyther and Francis Jones; Treasurer, J. J. Ashworth; Librarian, W. E. Hoyle; other members of the Council, Prof. H. B. Dixon, F.R.S., Prof. H. Lamb, F.R.S., F. Nicholson, J. E. King, R. L. Taylor, and F. J. Faraday.—Mr. Charles Bailey exhibited some living plants of Jacquin's oxlip (*Primula elatior*), which he had gathered ten days ago in a wood at Tindon End, near Thaxted, Essex. He pointed out its peculiar distribution in England—where it is confined to an area within the triangle formed between St. Neots in Huntingdonshire, Stowmarket in Suffolk, and Bishop Stortford in Hertfordshire—and explained the botanical characters which separate it from the primrose and the cowslip. With it Mr. Bailey exhibited a flower-scape from a root which he brought some years ago from Gloddaeth, near Llandudno, which was a natural hybrid between the cowslip and the primrose, and which flowered every spring in his garden. Such hybrids generally pass for the true oxlip, and they are not infrequent in districts where both parents occur; in the neighbourhood of Manchester he had found this spurious oxlip at Ashley, at Mobberley, and in several places in Derbyshire.

EDINBURGH.

Royal Society, April 4.—Prof. Copeland, in the chair.—At the request of the Council, an address on theories concerning the structure and origin of coral reefs and islands was given by Dr. John Murray. After a brief sketch of the history of the subject, and an exposition of the insufficiency of Darwin's famous theory as an explanation of the origin of many coral reefs and islands, Dr. Murray, with the help of lantern slides, gave an account of the theory he himself supported, which was to a large extent a return to the views of Chamisso (1820). The results of recent investigations, such as Mr. Andrews' labours at Christmas Island, the extensive observations by Alexander Agassiz in the Fiji group, the boring in the island of Funafuti, and the work of the Admiralty Surveyors in the Pacific Ocean, were then referred to; and, in spite of statements to the contrary which had been going the round of newspapers, Dr. Murray concluded that all these recent discoveries tended to verify his hypothesis rather than that of Darwin.

May 2.—Dr. Munro, in the chair.—In a paper on consonant sounds, Dr. Lloyd discussed in detail the simplest group of consonantal sounds, known as the spirate fricatives, namely, *f*, *v*, *th* (both forms), *s*, *z*, *sh*, *zh*, the Scottish gutturals *ich*, *och*, and the aspirate *h*. These are all produced by the friction of the air escaping through interstices more or less narrow. They could all be whispered through a range of pitch peculiar to each, the pitch depending upon the length and shape of the resonating cavity, which at the same time determined the vowel sound associated with the consonant.—Prof. D'Arcy Thompson communicated an examination of the so-called bipolar hypothesis. Of the list of ninety forms deduced by Dr. Murray from the *Challenger* Reports in support of this hypothesis, about half were insufficiently authenticated, and a great number more were very minute and described wholly from their hard parts; of the remainder some were not really arctic or antarctic forms, and the few that seemed to present "bipolar" characteristics were remarkable in other respects. Moreover, there were no examples cited from well-marked groups, such as fishes and Crustacea. In the discussion which followed, Dr. Murray argued that the fact of bipolarity had long been recognised, Prof. D'Arcy Thompson maintaining that the data supplied by Dr. Murray were insufficient to establish its existence.—Mr. A. J. Herbertson exhibited maps showing the mean monthly and annual rainfall over the land surface of the globe. This was the first attempt to construct mean monthly rainfall charts for the whole globe. All available data had been used, and many interesting results had been obtained.

DUBLIN.

Royal Dublin Society, April 20.—Prof. W. Noel Hartley, F.R.S., in the chair.—Prof. Emerson Reynolds, F.R.S., gave a demonstration of the properties of some new silicon derivatives discovered in the chemical laboratory of Trinity College, Dublin, and showed their use in photography.—Dr. E. J. McWeeney demonstrated a special method of performing the sero-diagnostic test for typhoid fever. It consisted in causing Eberth's bacillus to grow in a hanging drop of neutral bouillon containing 10 per cent. of the serum under investigation. After a few hours at 37° C. the individuals originally present (which should be very few—one only if possible), would be found to have multiplied in such a way as to form chains of short elements devoid of motility. In twelve hours these chains had become very long and beautifully curved and contorted, occupying the whole area of the drop. This chain formation only occurred with typhoid serum. With non-typhoid serum the drop soon became filled up with actively motile separate individuals. Filament-formation he did not look upon as significant. Similar appearances had been noted by Charrin and Roger for *Pyocyaneus*, by Pfaundler for *Coli*, and by Ledoux-Lebard for pseudo-tuberculosis. Photographs of desiccated and stained hanging-drop cultures were thrown on the screen.—Dr. J. H. Clark contributed a paper on protoplasmic movements: their relation to oxygen pressure. The paper gave a detailed statement of the author's investigations on the subject, of which an abstract appeared in the *Proceedings* of the Royal Society.—Dr. T. Johnson and Miss Hensman presented a paper consisting of a list of Irish Corallinaceæ, with the distribution of the Irish species, and many additions to the list of recorded species.

PARIS.

Academy of Sciences, May 2.—M. Wolf in the chair.—On the legitimacy of the trapezium rule in the study of the resistances of dams built of masonry, by M. Maurice Lévy. A critical examination of the "trapezium" law, according to which the normal pressures exerted upon each arch are connected by a linear relation.—Researches on the state in which silicon and chromium occur in steels, by MM. A. Carnot and Goutal. From a sample of ferrosilicon, by the prolonged action of dilute sulphuric acid, the silicide $SiFe_2$ was isolated, which differs from the substance of the same composition obtained by M. Moissan in being easily attacked by warm dilute acids. From alloys containing manganese, a double silicide of manganese and iron is obtained. Starting from chrome steels, similar methods gave $Fe_3Cr_9C_7$ or $CFe_3.3C_2Cr_3$ and $Fe_9Cr_3C_5$.—Remarks on some Crustacea obtained from the six scientific voyages of the Prince of Monaco, by MM. Milne-Edwards and E. L. Bouvier. Amongst the decapod Crustaceæ only one new form was found, *Sympagurus Grimaldii*.—On ortho-benzyl-benzoic and dimethylamido-diethylamido-ortho-benzoyl-benzoic acids and some of their derivatives, by MM. A. Haller and Guyot.—On the autoplastic grafts obtained by the transplantation of large dermic strips. Their stability and the slow modifications which they undergo, by M. Ollier. The transplanted skin undergoes a progressive atrophy, losing always its original dimensions.—The return of the first periodic Tempel Comet (1867 II.) in 1898, by M. R. Gautier. A revision of the elements of this comet, rendered necessary by the varying perturbations caused by the planet Jupiter.—Relations of commensurability between the mean movements of the satellites of Saturn, by M. Jean Mascart.—Reply to a reclamation of priority of M. Marqfoy, by M. Daniel Berthelot.—On the radiations emitted by thorium and its compounds, by M. G. C. Schmidt. Thorium salts emit rays similar to those discovered by M. Becquerel for uranium salts. Quantitative comparisons of the times required to discharge an electrified plate by the rays from thorium and uranium salts showed that the latter act more powerfully. The sign of the charge in either case is without effect upon the results.—On the cycles of magnetic torsion of a steel wire, by M. G. Moreau.—A receiver for Hertzian telegraphy without wires, by M. E. Ducretet. An improvement upon a similar instrument devised by M. Popoff. A Branly tube, which undergoes sudden changes of resistance under the influence of the Hertzian waves, forms part of a delicate relay system. The whole apparatus is automatic, the message being printed in Morse character upon a strip in the usual way, the strip ceasing to unroll when the waves stop.—On the electrical conductivity of potassium permanganate, by M. G. Bredig. Remarks on the paper of M. Legrand in a recent number of the *Comptes rendus*, pointing out the prior measurements of M. Bredig and MM. Franke and Lovén.—The Perpetual Secretary remarked that the conductivity of some solutions of potassium permanganate was measured by M. Bouty as early as 1884.—Effects of solar and lunar attractions upon the atmosphere. Example of the application of formulæ, by M. A. Poincare.—On the iodide of beryllium, by M. P. Lebeau. By the action of dry hydriodic acid gas upon beryllium carbide at 700°, the pure iodide BeI_2 is readily obtained as a crystalline sublimate. It forms colourless crystals, readily attacked by moist air, boiling between 585° and 595° C. It reacts violently with water, and with many organic substances, and from it new compounds of beryllium with sulphur, phosphorus, and cyanogen can be obtained.—On the presence of the chlorides of potassium and sodium in large proportions in the juice of grapes, and in the wines of the salt regions of Oranie, by M. Edmond Bonjean.—New reaction of tertiary alcohols and their ethers, by M. G. Denigès. The reaction employed is an acid solution of mercuric sulphate; characteristic yellow mercury compounds are formed.—Action of alkalis upon ouabaine, by M. Arnaud. An acid is formed, termed ouabaic acid, the sodium, strontium, and barium salts of which are described.—Action of bromine upon some phenols in presence of aluminium bromide, by M. F. Bodroux.—On the mono-alkyl-phosphoric ethers, by M. J. Cavalier.—Influence of diffused daylight upon the development of plants, by M. J. Wiesner.—On chocolate-coloured oats, by M. Balland. No differences in the results of analysis could be found between the brown grains and the ordinary white ones.—The bitterness of wines, by MM. F. Bordas, Joulin, and de Raczkowski. A description of the habit and mode of growth of the bacillus causing the bitterness in wine.—Pathogeny and histogenesis of cancer, a parasitic disease, by M. F. J. Bosc. The only specific element in malignant tumours is the parasitic sporozoa described in previous papers.—Softening of bone by phloroglucinol, by M. J. J. Andeer. A solution of phloroglucinol in hydrochloric acid forms a valuable histological reagent for softening bone without changing its relation to other structures.

AMSTERDAM.

Royal Academy of Sciences, March 26.—Prof. van de Sande Bakhuyzen in the chair.—Prof. Franchimont and Dr. H. Umbgrove on the action of sulphuric acid of 35 to 40 per cent. at the ordinary temperature upon acid aliphatic nitramines, upon neutral ones and upon their isomers. The first mentioned (methyl-, ethyl-, propyl- and butylnitramine) very slowly yielded nitrous oxide and an alcohol, and in addition—excepting methyl nitramine—a small quantity of non-saturated carburetted hydrogen. The same result was obtained with their potassium, barium and silver derivatives. The neutral nitramines were not attacked; their isomers, however, were attacked very rapidly. Experiments were made with the isomers of propylethylnitramine, of methylethylnitramine, of dimethylnitramine, and of ethylmethylnitramine. All of them, except the last, in which again CH_3 is united with nitrogen, yielded a little ethane, besides N_2O and one or two alcohols. The authors think that through the action of sulphuric acid the acid nitramines

$$C_nH_{2n+1}NH-N\lessdot^{O}_{O}$$

slowly change into

$$C_nH_{2n+1}N=N\lessdot^{O}_{OH},$$

and that the latter, being diazonitramines, are rapidly decomposed, as well as their alkyl derivatives, the isomers of the neutral nitramines.—Dr. G. C. J. Vosmaer and Prof. C. A. Pekelharing on the reception of food by sponges. When sponges (Spongillæ and Sycones) were fed with carmine, the colouring matter was always found first in the collar cells. Metschnikoff's objection against the view, according to which the food is received into the flagellated chambers, may perhaps have arisen from the circumstance that Metschnikoff allowed the moment favourable for the inquiry to slip by. In the case of Leucosolenia just taken out of the sea-water and cut open longitudinally, the movements of the flagellated chambers were found to be most irregular, and without a trace of coordination. The authors think that the regular passage of water through sponges, in consequence of an

irregular movement in the flagellated chambers, is to be explained by taking into account (1) the shape of the supplying and discharging apertures, from which it may be concluded that the collar cells counteract, like valves, the discharging of water through the supplying apertures, and (2) the shape of the discharging channels, which may serve as suction channels.—Prof. van Bemmelen made a communication on the absorptive power of colloidal silicic acid.—Prof. H. A. Lorentz on optical phenomena, depending on the electrical charge and the mass of the ions. Part I. Measurements on the Zeeman effect give the value of $\frac{l}{m}$, l being the charge and m the mass of the ions. The author remarks that some other phenomena depend on the quantity $\frac{l^2}{m}$; in particular he discusses the dispersion and the absorption coefficient of gaseous media.—Prof Korteweg presented a communication by Mr. W. A. Wijthoff, entitled "A system of operations in the space of four dimensions analogous with Hamilton's quaternions." The geometrical operations described in it are represented by biquaternions, which prove to be identical with those of Clifford for the elliptical space.

DIARY OF SOCIETIES.

THURSDAY, MAY 12.

ROYAL SOCIETY, at 4.30.—A Study of the Phyto-Plankton of the Atlantic: G. Murray, F.R.S., and V. H. Blackman.—The Electrical Response of Nerve to a Single Stimulus investigated with the Capillary Electrometer. Preliminary Communication: Prof. Gotch, F.R.S., and G. J. Burch.—Effects of Prolonged Heating on the Magnetic Properties of Iron: S. R. Roget.—On the Connection of Algebraic Functions with Automorphic Functions: E. T. Whittaker.

ROYAL INSTITUTION, at 3.—Heat: Lord Rayleigh.

MATHEMATICAL SOCIETY, at 8.—On the Numerical value of $\int_0^h e^{x^2} dx$: H. G. Dawson.—On the Reflection and Transmission of Electric Waves by a Metallic Grating: Prof. Lamb, F.R.S.—Notes on some Fundamental Properties of Manifolds: A. E. H. Love, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS (Society of Arts), at 8.—The Registration of Small Currents used for Electric Lighting and other Purposes: A. H. Gibbings.—A Magnetic Balance for Workshop Test of Permeability: Prof. J. A. Ewing, F.R.S.

FRIDAY, MAY 13.

ROYAL INSTITUTION, at 9.—Recent Experiments on certain of the Chemical Elements in Relation to Heat: Prof. W. A. Tilden, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 8.—Micrometrical Measures of the Double Stars β 883, Sirius, and Procyon: T. J. J. See.—The Relative Motion of the Components of γ Leonis: S. W. Burnham.—Vanadium in the Spectrum (C to D) of Sun-spots: Rev. A. L. Cortie.—Notes on the Zodiacal Light: Wm. Anderson.

PHYSICAL SOCIETY, at 5.—Galvanometers, Part II.: Prof. W. E. Ayrton and T. Mather.

MALACOLOGICAL SOCIETY, at 8.—Note on a very large Specimen of *Hippopus Hippopus*: Edgar A. Smith.—Description of New, or Imperfectly-known Species of *Nautilus* from the Inferior Oolite, contained in the British Museum (Natural History): G. C. Crick.—On the Anatomy of *Adeorbis subcarinatus* (Montagu): Martin F. Woodward.—Phylogeny of the Genera of Arionidæ: Henry A. Pilsbry.

SATURDAY, MAY 14.

GEOLOGISTS' ASSOCIATION (King's Cross, G.N.R.), at 1.20.—Excursion to Ayot and Hatfield. Directors: J. Hopkinson and A. E. Salter.

ESSEX FIELD CLUB, at 7.—Notes on the Trees and Shrubs of Epping Forest: F. W. Elliott.

MONDAY, MAY 16.

SOCIETY OF ARTS, at 8.—Electric Traction: Prof. Carus Wilson.

VICTORIA INSTITUTE, at 4.30.—The Philosophy of Education: Dr. A. T. Schofield.

TUESDAY, MAY 17.

ZOOLOGICAL SOCIETY, at 8.30.—On a Small Collection of Mammals obtained by Mr. Alfred Sharpe in Nyasaland: Oldfield Thomas.—On a Collection of Lepidoptera made in British East Africa by Mr. C. S Betton: Dr. A. G. Butler.—On some Earthworms from India: Miss Sophie M. Fedaib.

ROYAL STATISTICAL SOCIETY, at 5.—Local Taxation in London: G. Laurence Gomme.

ROYAL VICTORIA HALL, at 8.30.—Three Months on a Coral Island: Prof. Sollas, F.R.S.

WEDNESDAY, MAY 18.

SOCIETY OF ARTS, at 8.—The Evolution of the Cycle: J. K. Starley.

GEOLOGICAL SOCIETY, at 8.—The Garnet-actinolite Schists on the Southern Side of the St. Gothard Pass: Prof. T. G. Bonney, F.R.S.—On the Metamorphism of a Series of Grits and Shales in Northern Anglesey: Dr. C Callaway.—On a Volcanic Series in the Malvern Hills near the Herefordshire Beacon: H. D. Acland.

ROYAL METEOROLOGICAL SOCIETY (Burlington House), at 4.30.—The Frequency of Rainy Days in the British Islands: Robert H. Scott, F.R.S.—The Abnormal Weather of January, 1898: Frederick J. Brodie.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Exhibition of Aquatic Life.

THURSDAY, MAY 19.

ROYAL INSTITUTION, at 3.—Heat: Lord Rayleigh.

CHEMICAL SOCIETY, at 8.—The Action of Formaldehyde on Amines of the Naphthalene Series: G. T. Morgan.—On the Constitution of Oleic Acid and its Derivatives. Part I.: F. G. Edmed.

SATURDAY, MAY 21.

ROYAL INSTITUTION, at 3.—Biology of Spring: J. Arthur Thomson.

GEOLOGISTS' ASSOCIATION (Paddington Station, G.W.R.), at 1.40.—Excursion to Penn and Coleshill. Director: W. P. D. Stebbing.

ESSEX FIELD CLUB (at Chingford), at 7.—On the Preparation of Marine Animals as Transparent Lantern Slides: Dr. H. C. Sorby, F.R.S.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Flora of Perthshire: Dr. F. B. White (Blackwood).—Submarine Telegraphs: C. Bright (Lockwood).—The Origin and Growth of the Moral Instinct: A. Sutherland, 2 Vols. (Longmans).—Birds in London: W. H. Hudson (Longmans).—Experimental Mechanics: G. H. Wyatt (Rivingtons).—La Famille Névropathique: C. Féré, deux edition (Paris, Alcan).—Missouri Botanical Garden, 9th Annual Report (St. Louis, Missouri).—Garden-Making: L. H. Bailey (Macmillan).—William Stokes (Masters of Medicine Series): W. Stokes (Unwin).—The Fauna of British India, including Ceylon and Burma. Birds, Vol. iv.: W. T. Blanford (Taylor).

PAMPHLETS.—Science and Engineering: C. Bright (Constable).—Technical Education. Application of Funds by Local Authorities (Eyre).—Mines and Quarries. General Report and Statistics for 1897. Part I. District Statistics (Eyre).

SERIALS.—Strand Magazine, May (Newnes).—Science Progress, April (Scientific Press).—Chambers's Journal, May (Chambers).—Report of the Marlborough College Natural History Society, No. 46 (Marlborough).—Atlantic Monthly, May (Gay).—Quarterly Journal of the Geological Society, May (Longmans).—Observatory, May (Taylor).—Geographical Journal, May (Stanford)—Astrophysical Journal, April (Chicago).—Proceedings of the Royal Physical Society, Session 1896–97 (Edinburgh).—Monthly Weather Review, January (Washington).—Ditto, Annual Summary for 1897 (Washington).—Travaux de la Société Impériale des Naturalistes de St. Pétersbourg. Section de Géologie et de Minéralogie, vol. xxvi. livr. 5.—Ditto, Atlas de Vingt Planches in 4° du Vol. xxv. (St. Pétersbourg).

CONTENTS.