THURSDAY, MARCH 4, 1897.

THE NEED OF ORGANISING SCIENTIFIC OPINION.

I.

"Dear Sir,—You wish to know my notions
On sartin pints thet rile the land;
There's nothin' that my natur' so shuns
Ez bein' mean or underhand;
I'm a straight-spoken kind o' creetur
Thet blurts right out wut's in his head."

"There is a point where toleration sinks into sheer baseness and poltroonery. The toleration of the worst leads us to look on what is barely better as good enough, and to worship what is only moderately good. Woe to that man, or that nation, to whom mediocrity has become an ideal!"

LOWELL: "Biglow Papers."

"When a nation is unhappy, the old Prophet was right and not wrong in saying: Ye have forgotten God, ye have quitted the ways of God, or ye would not have been unhappy. It is not according to the laws of Fact that ye have lived and guided yourselves, but according to the laws of Delusion, Imposture and wilful and unwilful *Mistake* of Fact. We must have more Wisdom to govern us, we must be governed by the wisest, we must have an Aristocracy of Talent . . . but how to get it? . . . done nevertheless, sure enough, it must be; it shall and will be."

CARLYLE: "Past and Present."

MR. WILLIAMS'S little book, "Made in Germany," has considerably "riled the land," for, as most will know, it has attracted much notice. Shortly after its appearance, Lord Rosebery took it under his immediate protection, and discoursed upon it in public in a most interesting manner; and the fashion being thus set, many other politicians directly or indirectly referred to it. The Press throughout the country has contained articles innumerable discussing more or less superficially the issues which it raises. A rival volume has been published, under the title "The German Bogey," to refute, if not its conclusions, its recommendations. Last, but not least, it has pricked even the departmental conscience; and so great did the scare become, that the President of the Board of Trade felt justified, as he has lately told us, in ordering an inquiry into the matter. If report do not belie them, Sir Courtenay Boyle and Sir Robert Giffen entered on the inquiry with the desire and with the conviction that they would be able by the elastic agency of statistics to burst the big bubble blown in public by Mr. Williams; and if this be really the case, the very guarded tone of their Report is particularly noteworthy. Whatever desire they may have had to curse, if they do not bless, they at least show no cause why fault should be found with his implied main contention—which is, not merely that we are being beaten in this or that direction by commercial rivals, but that we are fast proving ourselves incapable of understanding the altered conditions under which the world now works, and of acting in accordance with such altered conditions.

Although the attention of the British public must have been in some degree attracted by all this cackling, yet there is no reason to suppose that the effect will be otherwise than ephemeral. It is clearly impossible to properly awaken John Bull from his stupid easy state of inordinate self-complacency, and whatever uneasiness he may feel for a time, he is soon reassured by comfortable optimism such as that displayed by political speakers like Lord Herschell and Mr. Ritchie in their recent addresses on foreign competition and trade, and when told that the fiscal returns show that business is improving, and that after all we are not doing so badly.

In fact, although ill at ease, the nation is incapable of appreciating the true depth and nature of its "unhappiness." Few of those who have criticised Mr. Williams, or even of those who have applied his arguments, are capable of fully understanding their force; the condition which he diagnoses as existing throughout the country must be judged by criteria other than those which mere statistics afford, or which are patent to politicians and the present race of statesmen.

Nothing could be further from the truth than a statement such as that recently made in the *Times* that it is too often forgotten that foreign countries are simply making up leeway. German industry is developing and prospering because it is conducted by methods almost exclusively forged in Germany, and which she alone of all nations knows how to use systematically, regularly and generally; because she has learnt how to organise and to discipline and to properly officer her forces; not because she has paid attention to "technical" education—but because she alone has known how to organise a true system of education, and has introduced a valid discipline into her schools; in short, because the nation has enjoyed a *scientific* education during practically the whole of the century, and is in consequence a cultured nation.

The story told by Sir Philip Magnus and his colleagues, in their interesting and most valuable letter to the Duke of Devonshire, contains absolutely no element of novelty: we merely see from it that we have to congratulate Germany on her continued attention to the advice and guidance of that "Aristocracy of Talent" which only she, of all nations of the world, has seen fit to create, to encourage and to properly utilise.

But we are not alone in our despondency. France, equally with ourselves, is alarmed at and envious of the success of Germany; her position is singularly similar to our own, as she also suffers from the want of a true national ideal of education. That two peoples such as the French and the English should lapse into such a state of flutter, however, is more than passing strange, and betokens great uneasiness of conscience, as we cannot either of us possibly imagine that we are to be left alone to manufacture for the world, or that those whom circumstances have so long unfortunately prevented from contributing their fair share are for ever to be kept under.

The ungenerous character of our complaints against articles made in Germany ought to be more obvious to us than it clearly is at the moment; to say the least, it is disgraceful that we should use the selfish arguments we do, in order to rouse a feeling of responsibility in our country, especially as we thereby withdraw attention from the true nature of the evil. Germany has but done her duty and lived according to the laws of Fact, and guided herself thereby; whilst we have followed the laws of Delusion, Imposture, and wilful and unwilful *Mistake* of Fact—for however unpleasant Carlyle's pessimism may be, it is impossible to deny the relevance of his conclusions to the present situation.

Let us, then, awaken to a sense of our duty, and to a sense of the real source of the danger which not only menaces us, but by which we are already, in part, overcome. In the future, we have to fear not German competition but that of our own colonists beyond the seas, and perhaps that of our American cousins most of all, besides that of the cheap labour of the vast populations of climes where Europeans cannot work with advantage. It is folly to suppose that Lancashire can continue much longer to spin cotton for the world; but America, Egypt, India, Japan and, sooner or later, China also will deprive us of the trade—not Germany, for she will suffer proportionally with ourselves.

It is all very well to congratulate ourselves on a temporary improvement in our iron trade, and to argue that an increase of a few per cent. in our output is more than equal to the whole output of a country which, may be, is advancing its production at a far greater rate than we are; but it cannot be forgotten that we largely import our iron ores, that fuel is got with increasing difficulty, and that wages are likely to rise considerably. In America, on the other hand, wages are likely to fall rather than rise, and ores and fuel are to hand in inexhaustible quantities, so that it cannot be long ere American iron will successfully compete with English and foreign.[1] In a Trade Review Circular before me, I find the words:—"Tin-plates: The majority of the orders primarily came from the United States, but every day brings us further proof that the time is not far distant when this will almost disappear." We must recognise that, at no very distant date, this will have to be said of articles of far greater importance than tin-plates. It is well known that shipbuilding, long a staple industry of this country, is fast being developed, not only in Germany, but also in the United States. America is bound, in fact, to develop, and not only on account of the restless energy of her people: her Government departments have attached to them many active men engaged in initiating or conducting scientific inquiries; and when the various departments are organised *inter se*, the country will have in its service a highly-trained body of scientific experts guiding all branches of public work, and cooperating to minimise the faults of democracy. And universities are arising all over the country, in which German models are being followed, not English. It is safe to predict that, ere many years are past, the United States will suddenly burst into prominence, and probably into predominance, as a nation promoting scientific inquiries of all kinds, so surely is a foundation being laid. Mistakes will frequently be made, perhaps, but they will soon be recognised and remedied in a country instinct with advance.

It is useless to consider mere statistics and to contrast the money values of our imports and exports; we must consider rather the extent to which our established industries have developed in response to modern requirements, and the extent to which new industries have been developed. When this is done, it is difficult—nay, impossible—to resist the conclusion that we are becoming less and less capable of helping ourselves, and more and more the victims of chance. In the engineering trades, which have always necessarily been conducted on fairly scientific lines, being based on exact measurements, we can still hold up our heads—as witness the marvellous development of the cycle industry. But in most, if not all those in which chemistry indirectly or directly plays a part—and in which does it not?—we are daily getting more and more behind the times: the research spirit practically does not enter into our industries; scientific method has no real place in most of them. The few brilliant exceptions which may be quoted but serve to prove this rule. But these are points which entirely escape Board of Trade officials and politicians and the general public; only those who have to do with our manufacturers are aware how entirely conservative and unprogressive are their views and actions.

In English works, as a rule, the sole effective management rests with the capitalist and man of business. This class of man places himself entirely in the hands of his works-manager or foreman, whose doings he too often cannot in the least criticise; and, consequently, a commanding position is taken in this country by the so-called practical man—one who knows how to do one thing, perhaps, very well, but being without scientific training and theoretical knowledge cannot advance, and if things do not go on as they should, is at a loss to know what exactly is wrong. And such men, unfortunately, are doing their very utmost, even at the present day, to prevent the entry into works of those who, having been scientifically trained, are capable of investigating the processes in charge of which they are placed, as well as of devising improvements and of preventing waste.

How different is the state of affairs elsewhere. To quote evidence given before the Sub-Committee of the London Technical Education Board by Dr. Messel, a well-known English manufacturer conversant with both the foreign and our system, not only is the importance of science far more acknowledged by manufacturers abroad than it is here, but it is accorded a consulting and deliberating voice in the management of their industries; furthermore, at the head of affairs you mostly find people who, however little they may now be able to devote themselves to scientific pursuits, possess a thorough scientific education, which befits them to select such scientific assistance (in chemistry, engineering, construction, &c.) as their work may require, who are capable of appreciating it, and who remain in touch with scientific teachers' teaching and progress.

As Matthew Arnold wrote in 1874, in the preface to the second edition of his "Higher Schools and Universities in Germany": "German practice is governed by the notion that what is to be done, should be done *scientifically*, as they say; that is, according to the reason of the thing, under the direction of experts, and without suffering ignorance and prejudice to intrude."

The same writer, in the first edition of his work published in 1868, remarked:

"Our rule of thumb has cost us dear already, and is probably destined to cost us dearer still. It is only by putting an unfair and extravagant strain on the wealth

[1] The following paragraph from *The Times* of March 1, is an interesting confirmation of my arguments:—

The American Steel Rail Trade.—With reference to the recent break up of the steel rail pool in the United States, it is said that the first cost to American makers of such rails is at present $15 per ton, but that probably the Carnegie Company's latest improvements in labour-saving machinery will enable it to produce them at something like $12 per ton. All steelworks are said to be making a great effort to conquer the European, and especially the South American markets, which latter had heretofore been almost monopolised by England. . . . With the help of these facilities Messrs. Carnegie and Rockefeller believe they will be able to control all markets, and to beat English railmakers on their own ground.

and energy of the country that we have managed to hide from ourselves the inconvenience we suffer, even in the lines where we think ourselves most successful, from our want of systematic instruction and science."

True at the time, these words are now doubly true. In the interval we have absolutely wasted the opportunity that was ours of securing the more important share of the coal-tar colour industry, which must be regarded as the most far-reaching of all the industries established in the Victorian era, as it carries in its train the production of synthetic products generally. Ours by right of first inception, ours as being by far the largest producers of the raw material—it has slipped away from us through sheer disregard of elementary first principles of defence, and insular narrowness of purview. Had we but appreciated and properly encouraged Hofmann and his school, how different the result might—nay, must—have been. Instead, however, of providing him with means adequate to his talents, we allowed him to languish for years in a poor one-storied building in Oxford-street, and only when too late began to think of treating him as he deserved. No foreign Government would have ever permitted such a man to be tempted away from its service. Although he returned to his native country only on a three years' visit, with the option of resuming his professorship here, on leaving our cold irresponsive atmosphere and finding himself in the warm glow of scientific enthusiasm of his fatherland, in presence of a Court at which science was deeply respected and at home, a nature such as his could not but feel the difference and elect to remain. Seeing and seizing his opportunity, he not only created a great school in Berlin, but also organised chemical science throughout Germany by the share he took in the establishment, in 1868, of the German Chemical Society, of which he remained the active leader until his death in 1892. Had he returned to us, *we* should have had a great chemical school, as the present Royal College of Science was built to plans drawn under his advice, and it was intended to devote the whole of the building to chemistry; but competition set in over the bones he had left, and they were divided without satisfying any one. We can never repair the evil wrought in those days. And all this was done under Government! Board of Trade statistics take no account of these little details, and the figures are in no way weighted thereby.

A grievous mistake was made also by the pioneers of the new industry—a mistake which was slavishly copied throughout the country, and continues to be down to the present time. It was not realised here, when laboratories were converted into manufactories, that manufactories must be conducted as laboratories if they were to remain virile institutions—that researches had to be carried on, both in order to improve the processes in use, and to discover new products to satisfy an ever-expanding public demand; no proper scientific staff was provided; and that English bugbear, the practical man without a vestige of theory in his composition, was allowed to become master of the field. Consequently, strangers stepped in who were more alive than ourselves to the necessity of working scientifically, and new prizes were instituted which they carried off: we being left in proud possession of a very honourable historical shield, but one which had become so battered that it retained little decorative value.

What does it matter—we can get our colours cheaply enough from abroad, say many; let the Germans cut each others throats, if they are so minded, in the competition to supply us at prices which, in very many cases, cannot be remunerative to them. And after all, it is worth but a few millions. But these good people forget that the loss of the colour industry implies inability to conduct any industry requiring the application of scientific skill, if it be one which must either develop or decay: and in these days there are few close boroughs in industry—secret processes are impossible. Moreover, where is the argument to stop? We may congratulate ourselves that although we eat mostly foreign bread and butter and cheese, we yet drink English milk; but we must not forget that in the future sterilised milk may perhaps be conveyed to us in tank vessels as petroleum is from America. In fact there will be no limit to the distance over which perishable articles of diet may be carried, unless our public analysts intervene more effectively in checking the introduction of preservatives such as boric acid and formic aldehyde into food materials—a modern fashion whereby, it can scarcely be doubted, the foundation is being laid in a most insidious manner for universal dyspepsia.

In short, the application of science to industry has brought the whole world into competition, and only those who fully understand and can apply all the rules and every detail of the game can hope to succeed in it. It remains to consider why we play the game so badly in many respects, and how we may learn to play it properly.

HENRY E. ARMSTRONG.

(*To be continued.*)

COMPRESSED AIR ILLNESS.

Compressed Air Illness; or, so-called Caisson Disease. By E. Hugh Snell, M.D., B.Sc. (Lond.). Pp. viii + 251. 6 Figs. (London: H. K. Lewis, 1896.)

DR. SNELL, the London County Council medical officer to the Blackwall Tunnel, has had ample clinical opportunity of observing the results of working for various periods of time in compressed air. The book before us must be regarded as a literary *résumé* of what is known upon this subject, to which is added Dr. Snell's own experience.

Chapter i. contains an historic account of ca sson disease. The interest of this chapter is not purely medical; it will have to the general reader a distinct value as an account of the progress made in the application of compressed air for the purpose of building the foundations of bridges, and in subaqueous tunnelling. In this connection the references to the reports of the engineers, &c., are of special value. Chapters ii. and iii. relate exclusively to the Blackwall Tunnel, a short description of the engineering works being followed by clinical abstracts of fifty out of the two hundred cases of compressed air disease which came under the author's own observation. In the chapter which treats of ætiology, Dr. Snell discusses the relative potency of the different factors at work in the causation of compressed air illness. He inclines to the view that too much importance has hitherto been attached to the length of the "locking-out" process. Other observers have laid great stress upon the necessity of the workers passing gradually from the compressed to the ordinary atmosphere, and have always advised employers to make arrangements accordingly. A factor of great importance, according to the author, is the ventilation of the compressed air space in which the men work. Tables are given, from which it appears that an increase from 4000 to 12,000 cubic feet in the supply of fresh air per man per hour was followed by a reduction, in the cases of illness per 100 days, of from 28 to *nil*. The length of stay in the compressed air, and the height of the pressure, especially the former, are factors the importance of which is confirmed by the author. At the conclusion of a criticism of the theories hitherto advanced to explain the symptoms occurring in compressed air illness, Dr. Snell, relying chiefly upon the experimental results of Bert, suggests that the symptoms are due to an escape from the blood, under ordinary atmospheric pressure, o the excess of gases which were dissolved in it, *viâ* the pulmonary capillaries, during the stay in the compressed air. The different constituents of the compressed air atmosphere have different coefficients of absorption, carbon dioxide, for instance, being eighty-eight times as soluble as nitrogen, and forty-five times as soluble as oxygen. The value of ventilation—*i.e.* frequent removal of carbon dioxide—as a preventive of compressed air illness is, according to Dr. Snell, due to its great solubility, a relatively large quantity of this gas entering into solution in the blood, in a given time, as compared with oxygen and nitrogen; hence a larger escape of gas takes place, upon reaching the normal atmosphere, when the atmosphere of the compressed air space has been rich in carbon dioxide. Thus it is owing not to its chemical, but to its physical properties, that carbon dioxide acts injuriously in this instance. Under the head of treatment the author discusses prevention and cure, the most important remedial agent being re-compression. The medical air lock, used at the Blackwall Tunnel, is described. A comprehensive bibliography and an accurate index conclude the work. F. W. T.

THE ZOOLOGICAL RECORD.

The Zoological Record. Vol. xxxii. Being records of zoölogical literature relating chiefly to the year 1895. By many authors. Edited (for the Zoological Society of London) by D. Sharp, M.A., F.R.S., F.Z.S., &c. 8vo. Pp. 1180. (London: Gurney and Jackson, 1896.)

THE thirty-second volume of the *Zoological Record*, containing an account of the oological literature of 1895, was issued shortly before the close of last year, with its customary and most praiseworthy regularity. It is edited for the Zoological Society of London, whose property the *Record* is, and at whose expense it is carried on, by Dr. David Sharp, F.R.S., the Curator in Zoology of the Cambridge University Museum, with the assistance of fourteen other naturalists in different departments of the subject. The volume is rather thicker than those which have preceded it. In the first place, as the editor apologetically explains, this is in consequence of the literature of two years, in the case of four out of the eighteen departments left in arrear last year, being included in the present volume. But the amount of zoological work performed every year also increases as science progresses. More volumes and more papers are published, and new scientific periodicals are continually being started. All these contribute to the annual increase in size of the *Zoological Record.* To form an idea of the number of periodicals which the much harassed recorder has now to consult, it is only necessary to cast one's eye over the alphabetical list of the abbreviations of their titles, which the general editor has prepared and printed in the present volume. Each of these abbreviations is accompanied by the full title of the periodical, the place of its publication, and the most accessible libraries in London and Cambridge in which a copy of it is to be found. This list occupies fifty-four closely printed pages in the present volume, and numerous additions are made to it every year.

As regards the eighteen different reports referring to the various departments of the animal kingdom, which are included in the present *Record*, it is difficult to compare one with another—at any rate, for one who does not profess to be intimately acquainted with all the eighteen subjects. There can be no doubt that *Record* xiii. on the Insecta, which is undertaken by Dr. Sharp himself, is the bulkiest. It contains no less than 387 closely-printed pages, and the task of preparing it must have involved much time and very serious labour. But if we had to give a prize for the best of the eighteen records (putting Insecta on one side), we should rather be inclined to bestow such a reward on Mr. Lydekker, because we think his introduction is the best. Mr. Lydekker's introduction gives a short summary of the principal events in the history of mammals during the year 1895. Other recorders also give introductions, but not, we think, in so complete a form. Dr. Sharp gives us no introduction to "Aves," and Mr. Boulenger omits this very essential feature in his two records. Other authors give a few lines only, which are hardly sufficient, but many of them, we regret to see, omit it altogether. We are strongly of opinion that a summary account of the most remarkable zoological publications and discoveries of the year should be prefaced to the list of publications in every subject and recommend the general editor to insist on this being done in the future. Many naturalists are sufficiently interested in a particular subject to read such a summary, but do not care to go into the mass of details. Dr. Sharp himself sets his recorders a good example in this respect.

At the close of the volume will be found a most useful alphabetical list of the names of new genera and sub-genera in zoology established in 1895, and mentioned in the present volume. The total number of such names in this volume is 1906. Last year the total number was 1438; but, allowing for the four records omitted in the last volume, and duplicated on the present occasion, the number of new generic terms would stand 1639 for 1894, and 1707 for 1895, showing, as is usual, a gradual but steady increase.

OUR BOOK SHELF.

The Story of the Weather. By George F. Chambers, F.R.A.S. Pp. 4 + 232. (London: George Newnes, Ltd., 1897.)

IN a few words of preface, the author pretty distinctly indicates the object with which this little book is written. The construction, which we put upon a short imaginary conversation there given, is, that the object is as much to sell a book as to teach meteorology. But in the author's own words, the object is "to present in a handy form, and in an unconventional style of language, a certain number of elementary facts, ideas, and suggestions, which ordinary people, laying no claim to scientific attainments generally, are usually glad to know." If the author has gauged the aim of ordinary people correctly, it would seem that they are "glad to know" a quantity of miscellaneous information that some people are glad to forget. This remark applies more particularly to a stock of old world weather signs, which are introduced, not as curiosities of weather lore, but are gravely given as a trustworthy means of foretelling the coming weather. Apparently with satisfaction, and as a justification for mentioning the habits of animals as affording true weather indications, the author quotes Mr. Inwards to the effect, that these creatures seem to have been fitted with what is to us an unknown sense, informing them of minute changes in the weather. We suppose it is this additional sense which instructs a mole, when a severe winter is approaching, to be more industrious in storing up worms and food than at other times. The moon is not allowed to have any effect on the weather, or to be useful as a weather indicator, perhaps with the exception of the Easter full moon, which, on the authority of Lord Grimthorpe, has some connection with cold weather. The stars, however, do fulfil a useful purpose in indicating the character of approaching weather, and the few rules given are, it is to be presumed, among those which ordinary mortals are "glad to know."

We believe that the book would be greatly improved by the omission of all these so-called weather facts and predictions. The earlier part of the book is unobjectionable. It gives, generally, a description of meteorological instruments, a brief history of the plan and method followed in making storm and weather predictions, and just such a sketch of elementary meteorology as one would expect to find within a moderate compass.

Applied Bacteriology: an Introductory Handbook for the use of Students, Medical Officers of Health, Analysts, and others. By T. H. Permain and C. G. Moore, M.A. (University Series.) Pp. xiii + 360, and plates. (London: Baillière, Tindall, and Cox, 1897.)

"THIS work," so the authors write in their preface, "is intended to be an introductory handbook for the use of students, medical men, and others who require a practical acquaintance with bacteriology without having at command the necessary time for a comprehensive study of the mass of work which it comprises." After a careful perusal we must confess that the teacher, who is both theoretically and practically acquainted with the bacteriology of disease and hygiene, would hesitate to recommend this work to students and medical men, however useful it may prove to those described as the "others." The introduction, which treats of bacteria in general, is fairly sound, so far as it goes; but it is somewhat superficial, and adapted rather to the requirements of the Extension Student or County Council Lecturer than to those of the serious inquirer. Chapters ii. and iii. deal with the apparatus and methods used in bacteriological work, and just as well might have been omitted, because, as we have pointed out on previous occasions, the *technique* can be learnt only in the laboratory, and "those who have little or no previous knowledge of the subject," that is those for whom, according to the authors, this work has been written, could not possibly acquire a knowledge of methods from the meagre and not always lucid instructions given. The ætiology of infective lesions and the problems of immunity are discussed in a manner which shows an almost total disregard of the principles underlying preventive medicine, undoubtedly the most important branch of applied bacteriology. Until we come to the chapter on fermentation it is always the same unsatisfactory reading: superficial and often careless reasoning, incorrect statements, dogmatic deductions which are irritating in the extreme to those acquainted with medicine. One of the worst chapters is that on the typhoid bacillus; it is misleading and full of errors of judgment and of fact; the chapter on cholera is not much better, and, in fact, little can be said in praise of any section dealing with disease. Names are also frequently misquoted: thus we read of Grüber instead of Gruber, Corbett instead of Cobbett, and Prof. Marshall Ward is accused of having swallowed pure cultures of Koch's comma bacillus. The chapters on fermentation and on the examination of water and filters are the least faulty, but they also treat their respective subjects in a superficial and more or less off-hand manner. The bacterial chemistry, if considered at all, should be discussed fully and critically, and such an error as "deriving the ptomaines from the base pyridine" is almost unpardonable. The source of the coloured plates at the end of the book, which are all taken from the Atlas recently published by Lehmann and Neumann, is not acknowledged. The work cannot be recommended to students and medical men, because the authors have not fully appreciated the serious importance of their subject, and although their own reading, judged by the references supplied, appears to be considerable, they are not sufficiently familiar with medicine, physiology, and pathology to advise those who possess some knowledge of these subjects.

A. A. KANTHACK.

Ostwald's Klassiker der exakten Wissenschaften, Nos. 80–85. (Leipzig: Wilhelm Engelmann, 1896.)

NO more serviceable or comprehensive series of reprints of scientific classics could be desired than the one to which the six volumes before us have just been added. No. 80 contains Helmholtz's paper, published in 1860, on the "Theorie der Luftswingungen in Röhren mit offenen Enden." The mathematical theory of the vibrations of the air in organ-pipes, or tubes with open ends, is well developed in this paper, and Prof. A. Wangerin, the editor of the volume, adds to it nearly fifty pages of notes on difficult points. No. 81—"Experimental-Untersuchungen über Electricität"—is a translation into German, of Faraday's paper on his electrical researches, from the *Philosophical Transactions* for 1832. It is edited by Dr. A. J. von Oettingen, who adds also a short biographical notice of Faraday. The same editor is responsible for the two succeeding volumes, Nos. 82 and 83, which contain Steiner's masterly contributions to geometry, under the title of "Systematische Entwicklung der Abhängigkeit geometrischer Gestalten von einander." In this work, Steiner reviewed the propositions of other geometers on porisms, projection-methods, transversals, duality and reciprocity, &c.

Nos. 84 and 85 of the series contain Caspar Friedrich Wolff's "Theoria Generationis," published in 1759. Both volumes have been translated into German, and edited, by Dr. Paul Samassa. In the first of the two volumes is the general explanation of the plan of Wolff's theory of organic development, and the section on the development of plants; the second part deals with the development of animals, and general conclusions.

Inorganic Chemical Preparations. By F. H. Thorp. Pp. 238. (Boston, Mass.: Ginn and Co., 1896.)

This work is divided into two parts, the first being an ntroductory chapter on general chemical operations such as solution, precipitation and filtration, and the second containing detailed directions for the preparation of 100 inorganic salts. The instructions in the first paper are very minute, and are apparently intended for elementary students. In the second part the arrangement followed is alphabetical, and it is stated in the preface that no attempt has been made to observe any particular grouping or sequence in the preparations. Thus the first preparation described is that of anhydrous aluminium chloride, and this is followed by aluminium hydrate and sulphate, preparations of quite another order of difficulty. This lack of arrangement and want of gradation seriously detract from the value of the book for teaching purposes. Little or no stress is laid upon the purity of the product, although the removal of one impurity is occasionally given, such as copper in the preparation of lead acetate. The preparation of pure iodine or silver, or even of pure water, according to the methods of Stas, would possibly be of higher educational value, and certainly be more interesting to the student than the formation, say, of barium and lead chromates by precipitation. A few of the equations given for the reactions require some revision. Thus for aluminium chloride we find

$$Al + Cl_3 = AlCl_3,$$

but for phosphorus trichloride

$$P + 3Cl = PCl_3.$$

As a collection of recipes, the work will be handy for reference in the laboratory. The inclusion of the methods of preparing some common reducing agents, such as cuprous chloride, chromous chloride, and sodium hyposulphite, would have added to the value of the book.

The Practical Photographer. Edited by Matthew Surface. Vol. vii. Pp. 332. (Bradford and London: Percy Lund, Humphries, and Co., Ltd., 1896.)

This very attractive volume should be seen by all who are interested in photography. The illustrations in it are striking examples of what can be done in the way of reproducing illustrations by photographic processes. Of especial interest is the series of short articles on photography and photographers in Japan. The aim of the editor seems to be to show the best that photography is capable of, whether in art or science or commercial application, and he may be congratulated upon the successful way in which he carries out this programme.

Life Assurance Explained. By William Schooling, F.R.A.S. Pp. xvi + 185. (London: Cassell and Co., Ltd., 1897.)

The principles upon which life assurance is based are stated very clearly in this book, and without reference to the merits or otherwise of individual companies. The book presents some instructive points for elementary students of vital statistics and actuarial methods. It is also a practical and a trustworthy guide, which should be consulted by every one who contemplates taking out an insurance policy of any kind.

Wasted Records of Disease. By Charles E. Paget. Pp. viii + 92. (London: Edward Arnold, 1897.)

In the three chapters of this book Mr. Paget reviews the attempts made to secure or establish permanent systems of disease registration; legislative recognition of the need for such registration, and its shortcomings; and steps advisable to secure a permanent and useful system of national disease registration. His plea for the establishment of a national system of notification and registration of disease, will have the support of most practitioners and officers of public health.

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.*]

Specific Characters.

Dr. A. R. Wallace, in his extremely interesting paper on "The Problem of Utility," lately published in *Linn. Soc. Journ.—Zool.*, vol. xxv., arrives at the conclusion (p. 486) that "every species (of the higher animals at all events) will usually possess at least three peculiarities: in the first place, it must exhibit some difference of structure or function adapting it to new conditions; secondly, some distinction of colour, form, or peculiar ornament serving as distinctive recognition-marks; and, thirdly, the physiological peculiarity of some amount of infertility when crossed with allied species. The first two constitute its 'specific characters.'"

Now it appears that the first of these differences is the fundamental one, and we ought not to find species living under exactly the same conditions and in precisely the same manner, separated only by infertility or "recognition-marks." Yet any one examining the current literature of entomology, would suppose that in numerous instances there were no differences whatever between allied species than those either of the class of "recognition-marks," or in the structure of the genital organs. That this would be an extremely erroneous supposition I am convinced both by experience and on theoretical grounds, and I would ask entomologists to produce even a single valid instance in support of it. The fact is, that the specific characters of the first class are overlooked by those who describe insects, until the describers come to imagine they have no existence. Nor is this surprising, since they are largely such as can only be elucidated by observations on the living insects, and no amount of cabinet-study will detect some of them.

It follows from the above considerations that species may occur which are perfectly distinct, but nevertheless offer no palpable differences in dead specimens. I know several instances of this sort, they are what I have termed *physiological species.* As Dr. Wallace states, recognition-marks are practically universal among the higher animals, but there occur groups in which they could not be of much, if any, use; and here it is that the separation of the species becomes so intricate. It is fortunate that many groups in which recognition-marks are reduced to a minimum, the organisms are minute and often transparent, so that their whole structure can be seen under the microscope.

In the case of insects, physiological species appear among the degraded forms, such as the Coccidæ and the bird-lice. Thus the coccid *Aspidiotus aurantii* is a great pest of orange-trees in California, the Eastern Mediterranean region, &c., but in Jamaica occurs a form of it, not distinguishable structurally from the type, which never attacks the orange. Lately Prof. Kellogg, in a paper on bird-lice, stated that a certain so-called species had a great number of hosts, and probably consisted of several species, confined to particular genera or species of birds; but, nevertheless, all attempts to separate them on structural grounds had proved unsatisfactory and inconclusive. Both the coccids and the bird-lice are creatures in which recognition-marks could not be of much service. The males of many Coccidæ, which are never seen by the females, are remarkably uniform in appearance, considering the structural diversities of many of their mates, the latter having contrivances for protection against parasites, against too rapid evaporation or too great heat, for the protection of the eggs, for concealment, and so forth. In *Orthezia*, which has a tolerably active female, the male has a beautiful caudal brush. Among plants the same sort of thing occurs. The higher plants exhibit diverse flowers for recognition by insects; but how subtle are the specific characters of many bacteria, fungi, and even ferns and grasses! Yet the species are distinct, as we see, for example, in the obviously different diseases produced sometimes by bacteria which are hardly or not distinguishable. Thus Dr. Kanthack tells us (Nature, vol. lv. p. 211): "No one nowadays ventures to define the cholera germ; there are two many varieties of it . . . We have come to the conclusion that when a bacillus is morphologically identical in appearance with the diphtheria bacillus, and in its biological characters closely resembles the conventional type of the diphtheria bacillus, he must be a bold man who ventures to say off-hand that this bacillus is or is not a diphtheria bacillus." Yet the same difficulty does not exist in diagnosing cholera or diphtheria.

I do not suppose that recognition-marks are wanting in many groups of higher animals, even higher invertebrates. The fresh-water bivalves can hardly be supposed to present them, and hence their separation into species becomes exceedingly difficult. But it appears that recognition-marks need not be in colour or markings, but may be, and often are, in odour or voice, which are not observable in dead specimens. Thus the nocturnal lepidoptera, the species of which are often perplexingly similar, undoubtedly many of them emit subtle odours—too subtle usually for us to appreciate. So also, some species of birds are known, which are almost exactly alike in the preserved skins, but are readily distinguished in life by the song or voice.

T. D. A. COCKERELL.

Mesilla, New Mexico, U.S.A., February 7.

The Force of a Ton.

Your readers will notice that Prof. Greenhill (p. 365) uses symbols as mere numbers, and that, so long as he does this, it can be of no possible interest or importance whether he writes *m* pounds or *w* pounds, or *n* or *a* or *b* or *z* pounds.

If he intends anything definite by his hint that "Dr. Lodge can testify to the treacherousness of *g*," will he kindly give a reference? Perhaps he is thinking of NATURE, 1891, vol. xliii. p. 513.

It is a little surprising that the label "5000 tons-weight" on a hydraulic press capable of exerting that thrust, should be considered liable to mislead a practical man into supposing that the piece of metal itself was so extremely heavy; but, though the addition of the syllable "weight" in that connection would have been both cumbersome and needless, and I should never have thought of suggesting it, I cannot see that it makes the slightest difference to his argument either way. Nor, I am almost glad to say, do I appreciate any of his other difficulties; especially not the difficulty said to be caused by "tossing standard weights in the air!" It reads like the popular method of studying geology "upon the Stanislaw." *Why* do they then weigh more? Is it because they come down with a bang?

Prof. Greenhill is very persistent about this question of a force-unit; but his justification lies in the fact that he is really tilting against the whole idea of *absolute measure*—that truly practical and most useful conception which this century owes to Gauss and Weber and to Thomson and Tait. All new ideas must pass through their era of attack, and should emerge the better for the process. The idea of absolute measure is still not finally and restfully settled down in the minds of all physicists; it is still too much mixed up with the comparatively trivial question of the particular kind of unit that shall be most commonly employed for numerical specification. Prof. Greenhill is doing indirect service to the better method by his resolute insistence on conservative traditions.

I rather regret Prof. Fitzgerald's letter (p. 389), because, although containing many statements which are manifestly true, it tends to confuse the issues.

Does he really maintain that the English words mass and massive should never be used in an accurate physical sense? Is he prepared to object to the expressions "quantity of heat" and "quantity of electricity" as well as to "quantity of matter"; or does he think that whereas those other quantities may be measured in various recognised ways, the quantity called "matter" cannot be legitimately measured by any of its inalienable properties? Does he hold that the conservation of matter, as ascertained by the constancy of its inertia and of its weight under various conditions, is a wholly metaphysical and confusing idea?

How would he wish us to express the gravitational attraction between two masses, $\gamma mm^1/r^2$; the *m*'s do not stand for inertia there? The physical factor *g*, which turns mass into weight without necessarily altering the numerical specification in any way, may be regarded as an abbreviation for $\gamma E/R^2$, with a correction for the shape of the earth and an allowance for centrifugal force, and is not a thing to be lightly ignored or introduced for the sake of some entirely imaginary convenience about units; not even for the sake of complicating mechanics, after all these years, by trying to express mass in something else than mere grammes or pounds or tons. Let the British student say so many pounds when he interprets *m*, and let him say so many *pounds-weight* when he interprets *mg*, and there is no difficulty whatever.

Lastly, does Prof. Fitzgerald seriously propose to introduce a new and impractical inertia unit, based upon the intensity of gravity near London, for general scientific purposes, or only for engineering-students' consumption: and, if the latter, does he hope thereby to heal the supposed breach between science and practice?

O. J. L.

Immunity from Snake-Bite.

THAT a relative immunity is acquired after a certain number of bee stings, as mentioned by Mr. R. C. T. Evans (NATURE, February 18, p. 367), is, I believe, admitted by most bee-masters. But from the few inquiries I have been able to make, the degree of immunity varies very much in different individuals, though when acquired it would seem to be permanent, or at least long-lasting.

A certain degree of immunity is acquired also by most persons against the stings of those varieties of insects which in Norway are commonly called *Myg*, and in East Anglia, to the great indignation of those who really suffer from them, Gnat. The reaction of different individuals to the stings of these mosquito-like insects is very different in degree, but on the whole the resident suffers less than a new comer. A curious fact is that in many susceptible persons there is a distinct periodicity in the phenomena which follow a sting. The immediate result is a small flattened wheal, 3 to 4 mm. in diameter, of a pale colour, but surrounded by a zone of pink injection. This is attended by itching, but both wheal and itching have gone in less than an hour. About twenty-four hours later the part begins to itch again, and in a few minutes a hard, rounded, deep-red papule, about 10 mm. in diameter, appears, and is quickly surrounded by an area of œdematous skin. The formication is intense, and in the affected area, while ordinary tactile sensations are dulled, those for temperature and painful sensations are exaggerated. In two or three hours the itching diminishes, and the œdema disappears, leaving a small red papule which itches little, if at all. After another interval of twenty-four hours, or more often rather less, all the phenomena recur, but with diminished intensity; a third, a fourth, and even a fifth recurrence usually takes place, but on each succeeding occasion the itching and swelling are less severe. After the periodic exacerbations have ceased, a small indolent papule persists for weeks, sometimes for months. This periodicity is not observed in all persons, and is certainly most marked in those who suffer most severely. In the same individual the reaction is very much greater after some bites than after others.

Whether the "mosquito" injects a toxin, or whether it is merely in some instances the carrier of a pathogenic microbe, might be worth ascertaining.

DAWSON WILLIAMS.

February 19.

Copper and Oysters.

IN my previous letter (p. 366) I had not gone into details, but Prof. Herdman's remarks on it induce me to do so.

The oysters referred to were brought to me by Mr. G. I. Wells, F.I.C., who had already examined some of them, and found copper to be present in such quantity that it could be readily dissolved out, direct from the oyster, with cold dilute nitric acid.

These observations I fully confirmed. The oysters were, no doubt, very exceptional ones, and they were believed to have caused diarrhœa in persons eating them. Most of them were free from colour, and from these no copper could be detected by direct treatment with dilute nitric acid; whilst from the coloured ones, sufficient could be obtained to easily prove the presence of that metal.

Some of the oysters were dark green, and others a bright sky-blue, the colour being in patches, and in one oyster almost entirely concentrated in the large muscle for closing the shell.

Assay Office, Chester, February 23. W. F. LOWE.

MISS KINGSLEY'S TRAVELS IN AFRICA.[1]

THE record of Miss Kingsley's wanderings in West Africa has been deservedly praised by many reviewers. It contains most of the elements which combine to secure success for a book of travel. The land it deals with is familiar by name to all, but it is practically an unknown land; for few visit it except in an official capacity, and few of the official visitors have the inclination, or it may be the permission, to speak openly of what they have seen. Miss Kingsley has a sprightly manner and a thoroughly unconventional literary style, as beseems a lady travelling in a land so unfrequented of the tourist. The sparkle is, perhaps, too sustained to be altogether natural, and the reticence regarding her own sufferings, which must have been considerable, may perhaps lead readers to under-estimate the difficulty and dangers of her exploits. The book stands alone as a vivid picture of West African life by a writer whose point of view is as nearly impartial as we can ever hope to see. Miss Kingsley is an enthusiastic collector, but not exactly a scientific person; she is sympathetic simultaneously with the cannibal tribesman, the missionary, the trader, and the official, and in her whole book she does not say an unkind word of any one she met. As is usual with the writings of ladies who have travelled, her book is in many respects more outspoken than a man would have made it, while stopping as far short of ethnographic fulness as is necessary in a popular work. The descriptions of tropical nature on the beach and the mountain, in the swamp and the forest, are occasionally brilliant in their pictorial strength.

Yet we cannot, in a notice in a scientific journal, overlook flaws which impair the usefulness of the book if they do not impede its popularity. The journey described lay chiefly in French Congo and Cameroons—French and German possessions respectively—the topography of which is left nearly blank in most of our modern and otherwise up-to-date maps of Africa. In French and German maps, however, the river-systems, mountains, and villages are marked in abundant detail. Comparatively few English readers have a foreign map of Africa at hand to refer to, and few books so urgently demand a good large-scale map as this; yet no map is given, and there are continual references to places for which the average reader will search his atlas in vain. Perhaps a more serious fault is the humorous sparkle of the style, to which reference has already been made. Hyperbole is frequently carried too far, because only persons whose knowledge of the coast and of science in general is at least equal to Miss Kingsley's, can disentangle metaphorical from instructive statements. "Beetles the size of pie-dishes," steamers which "have a mania for bush, and the delusion that they are required to climb trees," the air being "semi-solid with the stinking exhalations from the swamps," or containing "99¾ per cent. of water," and the like, are of course perfectly harmless pleasantries. But their recurrence shakes one's confidence in statements which the reader has no *à priori* means of pronouncing upon, such as the dictum regarding a large earth-worm. "He was eleven inches and three-quarters," or the gruesome observation that "dead black men go white when soaked in water." We feel strongly that those who are fortunate enough to visit regions where few can go, and who are endowed with such exceptional powers of description as Miss Kingsley, should consider the case of serious students who, when they ask for facts, do not care to be offered a cryptic joke.

FIG. 1.—Caravan for Stanley Pool, Pallaballa Mountains, Congo.

[1] "Travels in West Africa, Congo Français, Corisco and Cameroons." By Mary H. Kingsley. Pp. xvi + 744. Illustrated. (London: Macmillan and Co., Ltd., 1897.)

After all, Miss Kingsley's little jokes are lively reading, and they will afford jaded examiners many a laugh years hence, when they appear as solemn assertions taught by the intelligent teacher who "read them in a book of travels." The collection of eighteen species of reptiles and sixty-five species of fishes, brought home from the Ogowé and other rarely visited regions, form a solid contribution to science, no less than sixteen of the fishes being new. These are described in an appendix by Dr. Günther, reprinted from the *Annals and Magazine of Natural History*. Mr. W. F. Kirby also describes eight new species of insects, and catalogues a considerable number.

The narrative touches lightly on the voyage out, gives lively notes of the condition of nature and man in Sierra Leone, the Gold Coast, Lagos and Fernando Po, and then proceeds to give a detailed account of two expeditions which are perhaps the most remarkable ever made by a white woman in equatorial Africa. The first of these includes a description of French Congo, a voyage up the Ogowé in river-steamer and canoe to the borders of Ashongo-land, made famous thirty-five years ago by Paul du Chaillu, where Miss Kingsley was fortunate enough to see gorillas in their natural surroundings. From the Ogowé she made a daring, in fact, considering her report, a reckless journey through the country of the cannibal Fans, accompanied only by natives, and occasionally wading swamps "up to the chin in water" until she emerged on the Gabun estuary. Next came a short but interesting visit to Corisco Island, a Spanish possession; and the last exploit recorded was the climbing of Great Cameroons Peak (13,760 feet) in the German Protectorate, a feat which Miss Kingsley says she was "the third Englishman" to accomplish. The description of the climb is full of interest.

The chapters on fetish, and the long appendix on trade and labour in West Africa are of real value, and, being more serious in their style than the narrative, details may be accepted with some confidence. The literature of fetish lore on the West Coast of Africa is already by no means inconsiderable; and Miss Kingsley applied herself diligently to the task of extending it. She acknowledges great assistance from white residents on the coast, especially from the veteran missionary, Dr. Nassau, who has lived in West Africa since 1851; but she also got much information directly from the natives.

The doctrine of the multiple soul among the Calabar negroes is very well described. These souls are four—the soul that survives death, the shadow on the path, the dream soul, and the bush soul. The bush soul is detachable from the body, but if damaged or killed on its wanderings the body suffers the same fate. Hence old people are held in respect, even if known to be wicked, because their bush souls must be particularly powerful and astute. The soul that survives death is liable to reincarnation either in a higher or lower form. The dream soul is the particular care of witches, who lay traps for it, and return it to the owner on payment. Miss Kingsley believes that common-sense underlies many even of the most revolting fetish customs; for example, the custom of killing the wives of a chief on his death is a safeguard against poison being mixed in his food while he is alive. No trace of sun-worship was detected, nor did tree-worship appear to explain many of the fetish beliefs. An instructive contrast is drawn between the beliefs and customs of the pure negroes of Upper Guinea, and the people of Bantu affinities in the Congo and Ogowé Basins.

The relation of the African native to civilising influences is fully considered. Miss Kingsley, in spite of her frank admiration of the noble characters of the missionaries she met, believes that they are working in an entirely wrong direction, and are responsible for producing many of the evils they try to cure. She considers that missionary teaching develops the emotional parts of a black man's character, which were originally in excess, and does nothing for his industrial powers, which are naturally very feeble. She approves of teaching the natives to work in plantations and at trades actually useful to them in their present style of life, rather than teaching them to read and to become printers, bookbinders, and the like. She would not interfere with polygamy or domestic slavery, both these institutions being in many ways necessary to the negro, and not necessarily retarding his progress in civilisation. With regard to the drink traffic, she shares the official view that the West Coast African is not particularly intemperate, a large part of the imported liquor being sent far into the interior as payment for trade-goods, and a certain proportion being poured away as fetish offerings. Alcohol she holds to be necessary for the preservation of health in the swamps during the rainy season, and trade-gin appeared to be far less deleterious than the native palm-wine.

NOTES

M. VIOLLE has been elected a member of the Section de Physique of the Paris Academy of Sciences, in succession to the late M. Fizeau.

PROF. W. RAMSAY has been elected a corresponding member of the Royal Academy of Bohemia, and also of the Academy of Sciences of Turin.

ON April 21, Sir Archibald Geikie will commence the course of six lectures which he has been invited to deliver at the Johns Hopkins University, Baltimore, on the principles of geology.

THE desirability of holding an International Congress of Mathematicians has been for some time past widely felt, and we are glad to announce that the project is now about to be realised. A Committee has been formed for the purpose of organising a Congress, to be held in Zürich on August 9, 10, and 11, 1897, in which mathematicians from all parts of the world are invited to participate. The Committee includes the following names:—H. Bleuler and H. Burkhardt (Zürich), L. Cremona (Rome), G. Dumas, J. Franel, and C. F. Geiser (Zürich), A. G. Greenhill (Woolwich), A. Hertzog (Zürich), G. W. Hill (West Nyack, U.S.A.), A. Hurwitz (Zürich), F. Klein (Göttingen), A. Markoff (St. Petersburg), F. Mertens (Vienna), H. Minkowski (Zürich), G. Mittag-Leffler (Stockholm), G. Oltramare (Geneva), H. Poincaré (Paris), J. Rebstein and F. Rudio (Zürich), K. Vondermühl (Basle), and F. H. Weber (Zürich). All communications or inquiries relative to the Congress are to be addressed to Prof. Geiser, Küsnacht-Zürich. It is confidently expected that a large number of mathematicians will attend the Conference.

PROF. LOEFFLER, of Greifswald, and Dr. Frosch, assistant at the Koch Institute, have, says the *British Medical Journal*, been entrusted with the inquiry into the foot and mouth disease, for which a sum of 20,000 marks (1000*l.*) has been voted by the German Government.

WE regret to have to record the following deaths:—Mr. Henry Charles Forde, a member of the Council of the Institution of Electrical Engineers, and connected for many years with the construction and laying of submarine cables; Major Charles E. Bendire, honorary curator of the Department of Oology in the U.S. National Museum; Dr. Bernhard Lundgren, Professor of Geology in the University of Lund.

IN consequence of the growing importance of carbide of calcium, and the fact that the mere contact of moisture with this material causes a dangerous evolution of acetylene, the Home Secretary has caused inquiries to be made into the subject, with the result that an Order in Council has been made, bringing carbide of calcium within the operation of the Petroleum Act. Accordingly, from the date on which the Order comes into force—viz. April 1—only holders of a licence under the Petroleum Act may lawfully keep carbide of calcium.

WE learn from the *Lancet*, that the German Commission for the study of the plague will leave Germany for India in a few days. The members are, Prof. Koch, Prof. Pfeiffer (of the Institution for Infectious Diseases), Prof. Gaffky (of Giessen), Dr. Disuderic and Dr. Sticker (of the Imperial Health Office). Prof. Koch will travel direct to Bombay on the completion of his investigations in South Africa, and till his arrival the leader of the Commission will be Prof. Gaffky, who was with Prof. Koch in British India during the great cholera epidemic of 1884, and assisted him in the researches which finally led to the discovery of the comma bacillus.

MR. POULETT WEATHERLEY, who has for some years been travelling in Central Africa, has recently explored Lake Bangweolo. We learn from the *British Central Africa Gazette* that Mr. Weatherley has completed the circumnavigation of the lake, and has taken a number of careful sextant observations. His opinion is that M. Giraud's survey of the lake is a little faulty. Mr. Weatherley visited the tree under which Livingstone's heart is buried at Old Chitambo. He remarks:—"It is a thousand pities that some attempt is not made by people at home, who are interested in Livingstone and his work in Africa, to prevent the exact spot where he died from being hopelessly lost sight of, as it will be in a very few years. When the poor old Mpundu tree falls through fire and decay—it is now fast becoming a mere shell—after having kept guard so faithfully all these years—a quarter of a century now—there is nothing to replace it. Nothing could possibly be more appropriate than the simple rugged tree standing over the spot; no monument could be more inexpressibly solemn, but, unfortunately, it cannot last for ever. The Mpundu must go, and with it, unless prompt steps are taken, goes the knowledge of the site of Livingstone's last halting-place."

IN a paper read before the Royal Botanic Society on Saturday last, Mr. William Martindale, a member of the Council, advocated the establishment by the Society, in their gardens, of an institute for the teaching of botany, which, he suggested, should be similar to the institutes on the continent. He urged that the institute would be of vast importance to colonists and emigrants, who now went to Germany in considerable numbers for instruction. He also stated that the medical and pharmaceutical schools would doubtless supply the institute with many of its students. In the discussion which followed the reading of the paper, Dr. Scott said it was an extraordinary anomaly that not one institution which taught botany in London had a botanic garden. He expressed his entire sympathy with the proposal. Prof. Oliver also spoke in favour of the proposed institution, which, he said, would be welcomed by all the botanists in London. Several other botanists expressed their appreciation of the scheme.

AN interesting lecture was recently delivered before the Sheffield Society of Engineers and Metallurgists, by Mr. Thomas Andrews, F.R.S. For some time Mr. Andrews has studied the various aspects of the loss of strength in iron and steel by reason of use. He has made exhaustive microscopical chemical and physical examination of rails of known age and condition of service on main lines of railway, and has thus obtained much valuable information on the subject. In the course of his remarks, Mr. Andrews showed the difference between the loss of strength from mechanical abrasion and the deterioration of the ultimate crystalline structure of the metal under the fatigue of stress consequent on the presence of internal micro-flaws. He also demonstrated the effect of low temperature in reducing the impact resistance of rails, the influences of corrosion, and the manner in which vibratory stress induced microscopic internal growing flaws in rails. Allusion was made to the influence of various kinds of ballast on the permanent way. The lecturer compared the structure of old rails of long service with that of modern ones, and pointed to the sources of weakness, at the same time indicating the structure best calculated to yield the most durable and safe results. Mr. Andrews expressed a hope that the labours of the Royal Commission on the loss of strength in steel rails would result in a general improvement in the quality and trustworthiness of the metal.

WE have several times called attention to Dr. G. Folgheraiter's interesting observations on the magnetisation of Etruscan vases. Hitherto there has been a slight uncertainty as to whether the magnetisation may not have undergone some modification during the many centuries that have elapsed since these vases were baked. In his latest contribution to the *Atti dei Lincei*, Dr. Folgheraiter dispels any doubts on the matter by his observations on some vases which were pieced together from scattered fragments, discovered in excavations at Arezzo. If the magnetisation of the *terra-cotta* had in any way altered since they were broken, it is clear that the different portions would have been differently affected, and the mended vases would have shown somewhat irregular magnetisation. So far from this being the case, they were found to be as regularly magnetised as those which had been excavated entire, the opposite poles at the mouth and base being exactly 180° apart. The only remaining element of uncertainty is what was the orientation of the vases in the kiln; and Dr. Folgheraiter hopes that further excavations may lead to the discovery of potteries of the Etruscan epoch containing vases *in situ*. Should he be successful, we may look forward to exact determinations of the magnetic elements, which will greatly add to our knowledge of terrestrial magnetism.

DR. JULIUS PRECHT, of Heidelberg, has just published an important thesis on the kathodic rays, Röntgen rays, and other radiations emanating from vacuum tubes; which confirms the view that these rays are of a highly complex nature. Besides the rays capable of being deflected by a magnet according to the law of Biot and Savart (which the author has verified by photography), Röntgen's, Goldstein's, and Lenard's rays are shown to be distinguishable by their chemical and photographic effects. Dr. Precht considers that a portion of the radiation from a discharge tube is not a wave-motion, because the absorption of the rays in passing through paper varies with the time of duration of the radiation: it is suggested that this portion may be electric in its nature. Interference phenomena were obtained with direct and reflected Röntgen rays, and from these their wave-length was found to range from 370×10^{-6} to 830×10^{-6} mm.; and observing that transverse light-waves of this length cannot pass through black paper, the author seems to incline to the theory of longitudinal waves. By such interference experiments, wave-lengths were obtained nearly twice and four times as great as those found by Voller in observing the diffraction produced through a slit.

WHY is it that a dietary consisting entirely of cereals and preserved meat induces the symptoms of scurvy? Dr. A. E. Wright, professor of pathology in the Army Medical School, Netley, has lately discussed the facts bearing upon this question, and he concludes that scurvy is really a condition of acid-intoxication. This theory seems to be supported by the experience of explorers and others who have had to contend with scurvy. There are only three methods which have been definitely shown to exert an influence in warding off and ameliorating the scorbutic condition. Each of these methods consists essentially in the administration of an alkaline food-stuff (blood, fresh vegetables, and lime-juice all come under this denomination). Of each of these methods it may, therefore, be asserted that it is a method which is calculated to ward off and ameliorate a condition of acid-intoxication. Though fresh vegetables and lime-juice are used as remedies for scurvy, both of them are very slow in their action, and Dr. Wright shows that much better remedial agents are alkaline salts, such as carbonate of soda or carbonate of potash. A variety of other salts are available for the purpose; for instance, either the citrate or the acetate, or the lactate, of soda and potash, or, better still, the neutral tartrate of soda and potash. Inasmuch as the remedial agents suggested by Dr. Wright are inexpensive and eminently portable, explorers and navigators should make use of them.

IN the *Annali dell' Ufficio Centrale di Meteorologia*, vol. xvii., Messrs. A. Riccò and G. Saija have discussed at considerable length the meteorology of Mount Etna Observatory, situated at a height of 9650 feet above the level of the sea, on the southern edge of the central crater. Although the observations only cover a period of five years, and are not quite continuous, the results obtained from this peculiar locality are interesting from several points of view, and illustrate the difficulties met with at such elevated stations. During the summer season the observatory is reached from Catania after a ride of about seven hours on mules, but in winter the snow will not bear the weight of the mules; when snow is falling the observers have to use a compass, as all trace of the path is obliterated. To obviate the impossibility of living at the observatory all through the winter, a self-recording meteorograph, by Richard Brothers, which under favourable circumstances acts for forty days, has been erected by the Central Office. For more than six months of the year the monthly means of the shade temperature are below the freezing point, and this low temperature is sometimes recorded in the summer season. The absolute maximum observed was 66·4°, and the minimum, 8·1°. The diminution of temperature with height is, upon an average, 1° for each 328 feet. The amount and frequency of rainfall, &c., are less than in the plain, the number of days being on an average only thirty-seven yearly, of which six are days of rain, the remainder being of snow, or sleet.

As a preface to the *Weekly Weather Report* for the year 1895, the Meteorological Council have just issued a valuable series of mean values deduced from the observations obtained from a large number of stations. The tables show (1) the monthly and yearly results of the daily maximum and minimum temperatures for the twenty-five years 1871–95; (2) the mean rainfall for each month and for the year, for the thirty years 1866–95; and (3) the mean monthly and yearly duration of sunshine for the fifteen years 1881–95. The values are issued in continuation of those published in the preface to the *Weekly Weather Report* for 1891, and supply very useful information relating to the climatology of the British Islands for the periods in question. In the preparation of the data, the observations at the stations of the Meteorological Council have been supplemented, to some extent, by those under the control of the Royal Meteorological Society and the Scottish Meteorological Society. These tables have been supplemented by another series referring to those stations contained in the *Daily Weather Report*, and giving additional information, showing the mean values of barometric pressure for each month and for the year, during the same period, together with the absolute extremes of the daily maximum and minimum temperatures. The highest summer temperatures occur mostly in July, at times reaching 90° at severa places, the maximum being 96° in London in August 1876. The lowes temperature recorded in this latter series is – 5° at Loughborough, in the Midland Counties, in February 1895. The dryest station is Spurn Head, with an annual rainfall of 20·6 inche ; in London the yearly average is 24·8 inches. The greatest amount of sunshine occurs in May; the south-west of England is the sunniest part, on the yearly average, while London only enjoys 25 per cent. of the possible amount.

WE have received from the Geological Survey of Alabama the first part of a Report on the Valley Regions of Alabama. It deals with the geology and economic resources of the Tennessee Valley region, is illustrated by nine photographs, and contains numerous chemical analyses of ores.

THE current number of *Brain* (Part lxxvi.) contains a paper by Dr. A. D. Waller, F.R.S., upon the action of anæsthetics, sedatives, and narcotics upon isolated nerve, with forty-three illustrations showing the effect of various drugs upon nerves. Each of these interesting records is thus a trustworthy autobiographical episode related by the nerve itself.

IN a pamphlet entitled "La Piscifacture Marine," published by the Institut International de Bibliographie Scientifique, Dr. Marcel Baudouin gives an account of the hatcheries for marine fishes in the United States, Canada, Floedevig (Norway) and Dunbar, and pleads for the establishment of similar institutions on the French coast.

WE have received two publications of the U.S. Department of Agriculture:—"Contributions from the U.S. National Herbarium, Vol. v. No. 1," consists of a General Report, by Mr. John B. Leiberg, on a Botanical Survey of the Cœur d'Alene Mountains in Idaho during the summer of 1895. "Bulletin No. 4" of the Division of Agrostology is devoted to a number of papers, by different writers, entitled "Studies in American Grasses."

IN Part ix. of the *Minnesota Botanical Studies* for 1896, Miss Josephine S. Tilden points out an interesting connection between the rare and little known fresh-water alga *Pilinia diluta*, found on wet rocks, and *Stigeoclonium flagelliferum*, of which it appears to be a peculiar form, dependent on vital conditions. Mr. B. Fink describes the mode of pollination of the tomato, which is effected by bees in search of pollen. Mr. F. Ramaley describes certain points in the anatomy of the stem of the Onagraceæ.

IT would be difficult to produce a better short popular account of the discovery of *Pithecanthropus erectus*, by Dr. Dubois, than is contributed to the March number of the *English Illustrated Magazine* by W. K. Marischal. The illustrations are very instructive, and the brief text will be easily understood by the general reader. Another article in the same magazine is of the Jules Verne type, and purports to give an account of communications with Mars and journeys through space in an air-ship.

TH. THORODDSEN'S detailed history of the geography of Iceland has been translated into German by Dr. August Gebhardt. The first part of the work, dealing with the geographical history up to the end of the sixteenth century, has just been published by B. G. Teubner, Leipzig, under the title "Geschichte der Isländischen Geographie." During the past sixteen years Mr. Thoroddsen has been systematically exploring Iceland, and accumulating material for his work, a review of which will be more satisfactorily given when the completed results of his bibliographical and geographical surveys are before us.

NEW editions of several scientific works have come to hand within the past few days. Mr. W. B. Tegetmeier's work on "Pheasants, their Natural History and Practical Management" (London: Horace Cox) has developed into a third enlarged edition. The book contains a very useful account of the natural history, habits, food, and treatment of the various species of pheasants.—Prof. Strasburger's standard work, "Das Botanische Practicum" (Jena: Gustav Fischer), is known to all botanists as an admirable book for the laboratory and the library. It first appeared in 1884, and was reviewed in NATURE shortly after publication (vol. xxx. p. 215). The original volume consisted of six hundred pages; the present edition (the third) runs into 739 pages, the increase of size being made necessary by the many additions to the knowledge of the minute structure of plants during the past twelve years. Prof. Strasburger's "Practicum" became indispensable to the botanical laboratory as soon as it appeared, and the third enlarged and revised edition of it will maintain the position gained by the first.—The fourth edition has been published of Prof. Henry Adams's "Handbook for Mechanical Engineers" (London: E. and F. N. Spon). The book is a collection of notes, definitions, and formulæ, to which ready reference is often required for examination purposes and in general practice.—Messrs. John Wiley and Son, New York, have issued a third edition of "Retaining-Walls for Earth," by Prof. Malverd A. Howe. The book includes the theory of earth-pressure as developed from the ellipse of stress, and a short treatise on foundations, illustrated with examples from practice.—Mr. Edward Stanford has published new editions of three little books by Mr. W. Thynne Lynn. The books are "Celestial Motions" (ninth edition), "Remarkable Comets" (fifth edition), and "Remarkable Eclipses" (second edition). They are so readable and accurate that they thoroughly deserve to be successful.

THE concluding part of a most valuable collection of physical tables has just been issued by the Smithsonian Institution. The work has grown out of a series of meteorological tables compiled by Dr. Arnold Guyot, and first published in 1852. These tables proved so serviceable, and there was such a large demand for them, that when the question of revision for a fifth edition arose, Prof. Langley decided to have an entirely new publication prepared. The first part of the new series (the Meteorological Tables) appeared in 1893; the second volume (the Geographical Tables) was published in 1894; and now we have the Physical Tables, to complete the work, which forms the concluding part of vol. xxxv. of the Smithsonian Miscellaneous Collections. The present volume of tables has been prepared by Prof. Thomas Gray, of the Rose Polytechnic Institute, Terre Haute, Indiana. There are altogether 315 tables of data, referring to all branches of physical inquiry. The tables are well arranged; they have also been carefully selected from the works of well-known investigators, and, as a result, they are easy of reference and can be trusted. One of the many excellent points presented by them is that the authorities from which the physical data have been derived are quoted as foot-notes to the tables. It is thus easy to find the paper or memoir from which the results are taken. A few mathematical tables are included, but only those which are useful to physicists, and which are not easily found elsewhere. Physical chemists may confidently go to the volume for data needed by them, and every one engaged in electrical research will prove the value of Prof. Gray's work. The volume is, indeed, full of facts which investigators often have to spend hours in finding; it is a compendium which no physical laboratory where serious work is done can dispense with. Physicists will be grateful to Prof. Gray for so carefully compiling these tables, and to the Smithsonian Institution for publishing them. The brief introduction on units of measurement and conversion factors will be of assistance to students using the tables.

AN experimental study of an interesting case of chemical equilibrium is contributed by M. Pélabon to the *Comptes rendus* of the Paris Academy of Sciences (February 15). When hydrogen and selenium are heated together for some time, hydrogen selenide is formed; a state of equilibrium being finally reached in which the proportions of hydrogen, selenium, and hydrogen selenide are unchanged by further heating. Similarly, if pure hydrogen selenide is heated, a mixture is finally produced containing the same three substances in equilibrium. It has been previously shown by M. Ditte, that for temperatures above 320° C. the same final system is reached, whether the initial system consist of hydrogen selenide or of a mixture of hydrogen and selenium. At temperatures below 320° C., however, M. Pélabon shows that this is not the case, two distinct curves being obtained, according as the compound of the mixture is used as the starting-point. These curves are those called by M. Duhem ("Traité elémentaire de Mécanique chimique") curves of "false equilibrium," and the hypothesis proposed by him for such systems, especially that part predicting the gradual coincidence of the curves with rise of temperature, is well borne out by the experiments of M. Pélabon.

A CONTRIBUTION to the fascinating problem of the direct production of electrical energy by the combination of carbon and oxygen, is made by Messrs. Liebenow and Strasser in the *Zeitschrift für Elektrochemie* for February 20. They have investigated the so-called Jacques cell, which consists essentially of rods of carbon and iron immersed in fused caustic alkali (see NATURE, vol. liv. pp. 298, 353.) The electrical behaviour of several metals towards fused caustic alkali was first studied. A normal electrode of mercury, covered with calomel, in contact with a solution of potassium chloride, was connected to the fused potash by means of a piece of pipe-stem moistened at one end by the potassium chloride solution, and dipping into the fused caustic potash at the other. The difference of potential between this normal electrode and an iron rod immersed in the fused alkali was then measured. For about forty minutes the potential difference remained almost constant, hydrogen being evolved from the iron, and the fused mass having a greenish colour; suddenly the colour of the melt changed to dark brown, this change being accompanied by a fall of temperature and by a large fall (about 1 volt) in the potential difference between the iron and the mercury; the dissolution of the iron also ceased. The new potential difference remains practically constant for any length of time. Similar phenomena were observed with nickel and silver. Only one value was found for the potential difference between carbon and fused alkali. The differences of potential between iron or carbon in fused caustic potash at about 500° C. and the normal mercury electrode were: active iron, −1·5 volts; passive iron, −0·38 volt; carbon, −1·32 to 1·12 volts. In accordance with these numbers, it is found that a cell consisting of carbon and iron dipping into fused caustic potash, has at first a very small negative electromotive force which rises suddenly, when the iron assumes the passive condition to about + 1 volt. The cell develops a very inconstant current, the iron being very rapidly polarised. This may be remedied to some extent by passing a current of air through the fused electrolyte.

AN interesting reaction of magnesium nitride is described in the current number of the *Berichte*, by E. Szarvasy. This substance readily reacts at the ordinary temperature with absolute methyl alcohol, a mixture of ammonia with trimethylamine being formed, about 40 per cent. of the nitrogen being found in the latter form. It appears that the methyl alcohol acts partly as water, and partly as a methoxy-compound, since the solid residue consists of magnesium hydroxymethylate $OH.Mg.OCH_3$, a white hygroscopic powder which is dissolved by acids with formation of a magnesium salt, methyl alcohol and water. When heated it is converted into magnesia, carbonic oxide, and hydrogen. It seems possible that this reaction may provide a convenient mode of preparation of the trialkylamines.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*, ♀) from India, presented by Mr. B. Dade; a Black-handed Spider Monkey (*Ateles geoffroyi*) from Central America, presented by Miss Radley; six Black-eared Marmosets (*Hapale penicillata*) from South-east Brazil, presented by Mr. John Russell; an Egyptian Jerboa (*Dipus ægyptius*) from Egypt, presented by the Hon. Mrs. Brett; two Blood-breasted Pigeons (*Phlogœnas luzonica*) from the Philippine Islands, two Barred Doves (*Geopelia striata*) from India, presented by Lady Edmonstone; an Upland Goose (*Chloephaga magellanica*), bred in England, presented by Mr. H. Birkbeck; a Black Wallaby (*Macropus ualabatus*, ♂) from New South Wales, presented by Mr. G. J. Manders; a Rough-scaled Lizard (*Zonurus cordylus*), two Cape Bucephalus (*Dispholidus typus*), a Hoary Snake (*Pseudaspis cana*), a Ring-hals Snake (*Sepedon hæmachates*) from South Africa, presented by Mr. J. E. Matcham: two Lataste's Frogs (*Rana latastii*) from Turin, presented by Count M. Peracci; two Himalayan Bears (*Ursus tibetanus*, jv.) from Eastern Asia, three Royal Pythons (*Python regius*) from West Africa, deposited; a Great-billed Rhea (*Rhea macrorhyncha*) from North-east Brazil, a Bauer's Broadtail (*Platycercus zonarius*), two Graceful Ground Doves (*Geopelia cuneata*), a Shielded Death Adder (*Notechis scutatus*) from Australia, two Dunlins (*Tringa alpina*), a Golden Plover (*Charadrius pluvialis*), British, purchased; a Hybrid Pheasant Antelope, ♀ (bred between *Tragelaphus gratus*, ♂, and *Tragelaphus spekii*, ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE ORBIT OF JUPITER'S FIFTH SATELLITE.—In the current number of the *Astronomischen Nachrichten* (No. 3403-4) Dr. Fritz Cohn gives a condensed account of an investigation he has undertaken with regard to the determination of the elements of the orbit of the fifth satellite of Jupiter. The observations used were those made by Barnard, with the 36-inch Lick refractor, from September 9, 1892; and by Herrn H. Struve, with the 30-inch refractor of the Pulkowa Observatory, from October 21, 1893. Fortunately for this investigation, the observations of Struve were very numerous at the opposition of 1894, when extraordinarily bad weather hindered Barnard from making many measures. Limiting ourselves to a simple statement of the results obtained by Dr. Cohn, we may say that the orbit of the fifth satellite lies nearly in the plane of Jupiter's equator, and is very nearly circular in form. Assuming a circular orbit, and finding the differences, observed minus calculated, he was led to the following values for the improvement of the elements, leaving out of account perturbations that arise from the sun and the other satellites, but which, in consequence of the smallness of the distance of the fifth satellite from the primary, are practically insignificant.

1893. *October* 30 9. *Greenwich M.T.*

$$du_0 = +0^\circ\!\cdot\!107 \pm 0^\circ\!\cdot\!078$$
$$d(\Delta) = -0''\!\cdot\!124 \pm 0''\!\cdot\!036$$
$$e = 0\cdot00592 \pm 0\cdot00080$$
$$P_0 = 233^\circ\,32' \pm 6^\circ\,55'$$

The elements, as deduced from the first two years' improved values, were as follows:—

1892. *November* 1. *Greenwich M.T.*

$$u = 226^\circ\!\cdot\!40 \quad u - U = 344^\circ\!\cdot\!46 \quad n = 722^\circ\!\cdot\!63160$$
$$e = 0\cdot00501$$
$$P = 207^\circ\!\cdot\!2 \quad \partial P = 911^\circ\!\cdot\!7$$

The daily motion, n, corresponds to a period of revolution

11h. 57m. 22·6790s. ± 0·0145s.

This daily motion thus requires only the small correction of $-0^\circ\!\cdot\!00140$ to produce, according to Marth's ephemeris, the difference in the period of revolution of + 0·08s.

THE ELLIPTICITY OF THE DISC OF MARS.—In determining the ellipticity of a planet's disc by the more common methods, the error due to the position of the line joining the observer's eyes is liable to make an appreciable variation in the value deduced.

By the use of a small prism in front of the eyepiece this error can be entirely eliminated, as in the case, say, of a double star, the line joining the two components, or in the case of a planet its diameter (equatorial or vertical) can be placed in any direction with regard to the vertical.

Using the Repsold heliometer, Prof. W. Schur has taken advantage of both this method and the favourable recent opposition of Mars to investigate the question of the form of this planet's disc.

The mean values for the oblateness $(a - b/a)$ of the disc, where $2a$ and $2b$ are the equatorial and polar diameters respectively, as obtained from a series of observations made on December 2, 11, 16, 17, were as follows:—

1896	2a (″)	2b (″)	a = a − b/a
Dec. 2	6·265	6·125	1 : 44·7
11	6·310	6·135	1 : 36·1
16	6·210	6·125	1 : 54·0
17	6·240	6·125	1 : 54·3

Taking the mean of these values, Prof. Schur finds for the oblateness of the disc a value of 1/47, the observations being freed as far as possible from all sources of observational error.

THE ROTATION OF VENUS.—Notwithstanding the persistence with which the planet Venus has been telescopically observed, the question of its period of rotation is still open. Schröter advocated a period of 23h. 21m., which was generally accepted until Schiaparelli, in 1890, stated that the time of rotation corresponded to that of revolution, namely, 225 days. Since that date M. Perrotin, Dr. Terby, M. Cerulli, and others have tended to strengthen Schiaparelli's work by endorsing his observations. On the other hand, Schröter was not alone; for M. Niesten, M. Trouvelot, and Mr. Brenner, have all deduced from their own observations that the period must be a short one, namely, about 24 hours. The question, therefore, being, so to speak, in the balance, Mr. Percival Lowell's communication to the current number of the *Astronomischen Nachrichten*, No. 3406, is of more than unusual interest. This observer has done so much for us in the case of the surface-markings of the planet Mars, that it seemed most probable that, turning his attention to Venus, we might have some definite results. Commencing observation on August 24, 1896, with the 24-inch refractor of his observatory, he found that the surface-markings were surprisingly distinct, but resembled lines rather than spots. "A large number of them, but by no means all, radiate like spokes from a certain centre." These lines look purely natural, and have not the artificial appearance of the Martian Canals.

From a great number of drawings made, a comparison showed that the rotation is such "as to keep the markings always in the same position with regard to the terminator." Thus Mr. Lowell's observations indicate that the rotation and orbital period of rotation must coincide, so that Schiaparelli's observations are again endorsed.

Other physical characteristics of the planet's surface, as observed at the Lowell Observatory, are as follows.

No clouds appear to temporarily obscure the surface details. The intense lustre of the disc is shared by all the markings, as if "a bright veil of some sort were drawn over the whole disc." This veil can be hardly anything but atmosphere; for measurements, as in the case of Mars, have given indications of twilight, and therefore of the presence of an atmosphere.

Further, Mr. Lowell states that there seems to be no evidence of polar caps. This observation does not well accord with those made by M. Trouvelot in 1877 and 1878. It will be remembered that this observer not only found very distinct markings which he termed the polar caps, but was able to describe some important details of a varying nature. In a former number of this journal (vol. xlvi. p. 468) it is stated that two of the most interesting features visible on the surface of Venus were the snow-caps at the extremities of the poles. These spots surpassed in brilliancy and importance all that M. Trouvelot had ever observed.

Lastly, Mr. Lowell has found that some markings become less distinct on nearing the central meridian. These changes vary considerably, and are found not to be a matter of obscuration. Since the positions of the markings had not moved relatively to the sun, the change could not have been intrinsic. Mr. Lowell suggests differences in the character of the rock or soil. The impression gained, on the whole, by Mr. Lowell, is that in the markings of Venus "we are looking down on a bare desert-like surface.'

PHOTOGRAPHIC REPRODUCTION OF COLOURS.

THE various methods for producing photographic pictures in colour were described by Sir Henry Trueman Wood at the Society of Arts on February 24, and examples of the results achieved by the different processes were exhibited. The main object of the paper was to bring before the Society M. Chassagne's promising process for the photographic reproduction of colour, but the opportunity was taken to summarise the whole question of colour-photography.

Though the *rationale* of the new process remains a mystery, there can be no question that very remarkable results are produced. Even more striking than M. Chassagne's pictures, however, are some transparencies exhibited at the same meeting by Mr. Bennetto, of Newquay, in Cornwall. For some time there have been rumours that Mr. Bennetto had obtained satisfactory photographs in colours, but the pictures had only been seen by a limited number of photographers before they were shown at the Society of Arts. His photographs are much clearer than those obtained by the Chassagne process, and look almost like water-colour sketches.

A short account of a private exhibition of some of Mr. Bennetto's results appeared in Friday's *Times*, and is here abridged. The methods, and indeed the principle, employed remain the secret of the inventor, and it is intended that they shall remain so until several more details and applications of the invention have been more fully worked out. All that is at present known is that the inventor claims to have discovered a system of colour photography by which can be transferred to a photographic negative, and thence printed on glass or paper, the exact natural colours of the object towards which the camera has been directed. He employs no pigments, his plates have not to be washed with various coloured solutions, and it is not necessary to view his pictures through any combination of tinted glasses. The colours are imprinted on the plate just as are the light and shade in an ordinary monochrome photograph, and are directly visible to the eye, without any subsidiary apparatus. It may be mentioned that Mr. Bennetto, in his earliest experiments, could get no effects with a less exposure than three minutes; now he is able to work with exposures of sixteen seconds.

In strictness, of course, it is not possible to know for certain that a particular result is produced by a particular process unless the nature of that process is also known; and from that point of view, it is perhaps allowable to regard Mr. Bennetto's pictures with some degree of philosophical suspicion. But he has been put to tests which it is difficult to suppose he could have satisfied did he not in fact do what he claims to do. He was requested to focus his apparatus on an easel. When he had done so, he was blindfolded, and on the easel was placed an impossible picture, painted in impossible colours, which he had never seen before. This he photographed and developed, still without seeing the original, with the result that the impossible colours were reproduced in the photograph obtained.

Whatever may have been the methods used, the pictures produced by them attain a high standard of excellence. One of the best specimens shown was a study of a sunrise, taken early one morning in the middle of June 1895, in which the fiery orange of the dawn and the heavy masses of cloud were admirably represented. The clouds, again, were excellent in a typical picture of Cornish seashore scenery, and the tints of the sand and rocks, and their reflections in the pools, were faithfully reproduced. In the case of a rock picture with wonderfully brilliant colouring, it was stated that, when the glass plate on which it was printed was examined under a microscope, not only could each individual mussel on the rocks in the foreground be clearly discerned, but that even the iridescent colours on their shells were plainly distinguishable. Perhaps the picture which best illustrated the capabilities of the process was one of a champagne-bottle standing on a white tablecloth, and surrounded with various fruits. Here there were three or four different whites which were all distinguishable, but which it would probably have taxed the powers of any artist to represent by painting. The gold-foil on the bottle was exactly rendered, and it was possible to tell that it was full by the gleam of the liquid. The inventor looks forward, among other things, to revolutionising by his process the illustration of books and magazines, and hopes to show in the future how to flash a picture on a screen so that a permanent copy may be left behind.

ON THE ALTERNATIONS OF GENERATIONS IN PLANT LIFE.[1]

IN his paper on apospory and allied phenomena (*Lin. Trans. Bot.*, 2nd series, vol. ii. p. 301) Prof. Bower says: "Already the observations of Pringsheim and Stahl have had their effect in demonstrating that no fixed and impenetrable barrier exists between the sporophore and the oophore." The suggestion thus made is far reaching in its consequences; if there be no such fixed and impenetrable barrier, then the distinction between the sporophore and oophore loses at least much of its value, and the anxious assignment of this or that structure to one or the other generation may prove to be labour lost; then the doctrine of the alternation of generations is in peril, and the mind is driven to think of a state of things in which a man should find no impenetrable barrier between himself and his father or his grandmother.

The doctrine of alternation of generations seems, therefore, to deserve reconsideration: and the principal object of the present paper is to endeavour to suggest to the attention of those more capable than myself of forming a conclusion, some considerations towards such a review of at least a part of the subject.

Another question to which I desire to call attention as I proceed is this: whether reproduction is the function of special organs only, or whether it is more or less clearly shown to be a power possessed by the whole organism—a question to which the labours of Weismann have given a fresh interest.

In this review I propose to confine my attention primarily to those classes of plants which produce a cormophyte. I do so, not forgetting that a wider survey of the subject might be yet more valuable. Under the term cormophyte I include the plant of the Characeæ, whether the description be perfectly accurate or not.

I do not propose to trace the life-history of every group of plants; but I have chosen for consideration groups which exhibit, I believe, types of every important variety of the schemes of life-history to be found in those parts of the vegetable kingdom to which the doctrine in question has been thought to have any application.

To prevent any possible misapprehension, let me say at once that when I use language borrowed from the doctrine in question, such as sporophore or oophytic generation, I do so, not as affirming the doctrine or the consequent fitness of the language, but in the endeavour to understand the view taken of the phenomena under discussion on the footing of that doctrine.

Characeæ.—In this group we have a sexual generation. The fertilised archegone becomes a fruit or spermocarp; this is detached from the parent organism. It gives rise to a primary root and a hypha-like prothallus, and from the prothallus a young cormophyte is developed like the parent. The succession of events may then be thus stated:—

Cormophyte producing { Archegone / Antherizoid }
|
Spermocarp or fertilised archegone.
|
Protonema or pro-embryo.
|
Cormophyte.

Now here we must observe that there is one kind of generating cell only, viz. the sexual cell, and that there is no spore in the sense of an asexual cell, and that, as a consequence, there is no sporophytic generation.

On the first blush of the matter, a life-history such as this would seem to present nothing like an alternation of generations. At one time, however, Prof. Vines suggested that the pro-embryo was to be regarded as the sporophore which did not produce spores, but aposporously produced the oophore by direct vegetable growth (see Bower, 2 *Lin. Tr.*, p. 321). He has, however, since altered his opinion, and he now regards the development of the pro-embryo not as indicative of an alternation of generations (Vines on Apospory in the Characeæ, 1 *Ann. Bot.*, 177).

[1] The accompanying paper reached the hands of the editor of NATURE on 31 August of last year. Dr. Scott, in his valuable address as the President of the Botanical Section of the British Association, delivered more than a fortnight after that date, has, like myself, discussed the alternation of generations, apospory and apogamy, and the relations of mosses and ferns. These dates will account for my not referring to Dr. Scott's views; and on the whole I think it better to leave my paper as an independent contribution to these subjects, rather than to attempt to weave into its existing structure any references to the more authoritative contribution of Dr. Scott.—EDW. FRY.

But side by side with this sexual generation, there is evidence of two other modes of propagation amongst the Characeæ.

(i.) It is believed by some botanists to be established beyond doubt that in the case of *Chara crinita* in the regions of the Baltic Sea, if not elsewhere, the unfertilised archegones produce plants like fertilised ones.

(ii.) Some species of *Chara* are propagated by bulbils or agglomerations of cells, by branches known as gymnopodal shoots, or by prothalloid branches.

We are thus in the presence of facts of the last importance on the theory of reproduction. We find an organism with organs specially adapted to and formed for reproduction, and yet the same result is brought about by other parts of the plant, which seem to have no such special organisation.

And, secondly, we find that the result of these short cuts to reproduction excludes or avoids the sexual act.

Muscineæ.—Here the full life-history may be represented as follows:—

Oophore ... {
Spore
|
Protonema
|
Bud
|
Cormophyte, producing { Archegone, Antherizoid }
}
|
Sporophore {
Sporogone (seta and sporangium)
|
Spore
}

But side by side with this somewhat elaborate life-history, the mosses exhibit abbreviated modes of reproduction of varied descriptions—a multiplicity of methods of what I will venture to call, by borrowing a term from a popular branch of applied science, short circuiting.

First we get the production of gemmæ which produce protonema like that arising from the spore, and this protonema, through the intervention of a bud, produces the cormophyte.

These gemmæ are found in a great variety of positions: in the capsules in Encamptodon (*Weissia perichætialis*), in the place of spores (Montagne, "Plantes Exotiques Nouvelles," *Ann. de Sc. Nat. Bot.*, vol. iv. pp. 119, 366): in the terminal cups which probably represent male flowers in the well-known *Tetraphis pellucida*; congregated in balls at the ends of quasi pedicels in *Aulacomnium palustre*; on the ends of the leaves in the *Orthotrichum phyllanthum* (where the fructification is very rare); in *Leptodontium gemmasceus* and *Grimmia hartmanni*; on the upper half of the midrib in *Tortula papillosa*.

The next step in the abridgement of the life circle is exhibited by those cases in which protonema is produced by the cormophyte without the intervention of a gemma. "Pringsheim and Stahl found independently of one another," says Prof. Bower (*ubi sup.*), "that it is possible by cultivation under abnormal circumstances to induce a formation of protonema by direct vegetative growth from the sporogonium of certain mosses." But nature herself, apparently under no abnormal circumstances, brings about the same phenomenon. Schimper has traced the growth of protonema directly from the rhizoids in *Phascum serratum* ("Recherches sur les Mousses," p. 11), and *Polytrichum nanum* and *aloides* (p. 12); from the stems in *Dicranum undulatum* (p. 13); from the under side of the leaf in *Orthotrichum obtusifolium* (Pl. ii. fig. 6); from the mid-rib of the leaf in *Orthotrichum Lyelli* (p. 15); from the perichætal leaves in *Oncophorus glaucus* (p. 18); from the base of the leaf in *Funaria hygrometrica* (p. 19). It has been found growing from the marginal cells of the involucres of the archegone in the strange *Buxbaumia aphylla* (Goebel, on "The Simplest Form of Moss," *Ann. Bot.*, vol. vi. p. 355). Lastly, in *Conomitrium julianum* young plants often grow from the inner side of the calyptra with the intervention of a short piece of protonema (Goebel, "Outlines of Classification," Eng. Tr., p. 173).

But nature goes yet another step forward, and leaves out in some cases at once gemma and protonema; and the cormophyte produces bulbils which at once again grow into cormophytes. Thus on the rhizoids of *Barbula muralis*, *Grimmia pulvinata* and *trichophylla*, and *Trichostomum rigidulum* are formed leaf-buds, which develop into the true cormophyte (Schimper, 10-11): bulbils grow on the stem of *Bryum annotinum* (p. 14); and, lastly, we get the striking phenomenon of young cormophytes produced at the ends of the branches in *Sphagnum cuspidatum*, resembling in everything but in size the parent plant from which they are produced (Schimper, "Torfossoose," pl. 16, fig. 1). This is very striking: here nature has given the slip to spore, to gemma, to protonema, to leaf-bud; short-circuiting can go no further.

The first inquiry I suggest on the foregoing statement of facts is this: Taking the life-history of a moss in its fullest form, is it correct to say that there are two generations involved in it? And this will turn upon what we mean by a generation.

Generation.—If we regard the alternation of generations as it exists in the Medusæ and hydroid zoophytes, to which the expression, now so familiar, was, I believe, first applied by Steenstrup, it will be found that in these creatures, each generation consists of a distinct and independent organism, differing from the case of generations of men in that the one generation is produced asexually by germination, and the other sexually, and that the organisms of the two generations are different in form. The generative zooid or Medusa is detached from its stationary parent: and in like manner the young creature produced by the Medusa is detached from it before it begins to develop into the fixed hydroid colony; in the case of each new generation there is a complete solution of continuity with its parent; there is no physical connection maintained after a certain period, and there is no dependence for nutrition or any other vital process. But when we turn to the moss we find no such division into independent organisms between the oophore and the sporophore, but, on the contrary, a continued physical connection, and dependence of the seta and sporogone on the cormophyte. The two parts are organically connected. The seta and sporange are incapable of an independent existence, and are not detached from the moss plant except by death.

I suppose that a generation might, according to the ordinary understanding, be defined to be the life of an organism either independent in fact or constituted for an independent existence from the time when its whole future was gathered up into one cell to its death: but is not usually extended to include the life of a part of an organism from the time when the future of that part was gathered together into a single cell.

How are we to distinguish a new generation from the growth of a part in an existing structure? I suppose that a new generation means the origination of a new individual; that so long as there is a physical continuity in a given structure, both in fact and in design, we have the same individual; that so long as this exists, the death of a part of the structure does not convert the remaining part, or the parts which may arise from it, into a new individual; and that, in short, we never have a new generation without the solution of continuity, in fact or in design, between the old and the new. If we adopt the view above suggested of a generation, there is not in the life-history of the moss more than a single generation, and there is consequently no alternation of generations.

To extend the definition of a generation so as to include the separate development of dependent parts, would, no doubt, remind us of the fact that in the earliest stages of organisation, growth and reproduction seem hardly to be distinguished; but it seems to me to confound together two things which it is most important to separate when we are considering the course and history of reproduction.

In this connection it is convenient to consider the meaning of the words *ovum* or *ovule*. By these words I conceive that botanists mean a cell resulting from the union of two other cells of different characters, from which cell a new generation starts. The "embryo which begins the new generation is the female or germ cell (ovum, oosphere, germinal vesicle)," says Sachs. That it shall be the beginning of a new generation—of a new being, either independent or constituted for independence, is, I conceive, an essential part of the meaning of the word in question. If so, there is in mosses no ovum and no oophore; for the fertilised archegone produced in mosses is not an independent organism, but a dependent organism or part of an organism; and the really startling fact about this history of the moss appears to me to be this: that whereas in the generality of cases the fertilised ovum is itself and directly the starting-point of a new individual, in the moss the fertilised ovum produces a new growth, and that this new growth by subdivision produces a number of spores, each of which is the starting-point of a new individual. But this process in the mosses does not stand alone. It recalls the mode of reproduction in other cases. In some of the Florideæ the fertilised ovum does not directly reproduce a new individual, but a growth takes place, and the ovum becomes differentiated into two parts—the one sterile, which forms a kind of capsule, and the other fertile, which produces numerous spores: and as in Nemalion and Batrachospermum (Bower on "Antithetic-Alternation," iv., *Ann. of Bot.*, p. 361): in others the growth after fertilisation takes place from an adjoining cell or cells of the procarp (Lejolisia, &c.); or, in other cases, from adjoining procarps to which the fertilising effect is handed on (Corallina, Dudresnaya, &c.), and this results in the formation of corpo-spores (Bower, *ubi supra*). Again, in the Pyrenomycetes, the result of fertilisation is the production of perithecia, or receptacles which again produce asci or sporangia, which in their turn produce spores.

These modes of generation suggest as their probable explanation one or other of two different views. The one view is that the sexual act is in these cases not reproductive, not the starting-point of a new generation—but productive only, and is the starting-point of a new organ or growth in the parent plant—so that in this view the only mode of reproduction is asexual; the other view, which appears to me the more probable, is that the fertilised protoplasm of the ovum is broken up into various parts, and that, notwithstanding the intervening stages of development, a portion of it finds its way into each so-called spore, so that the spore in all these cases is, in fact, a sexually produced cell, and the only mode of reproduction is sexual.

Perhaps some corroboration of this latter view is to be gathered from the cases in which the archegones of mosses have shown a tendency to reduplicate the growths which they produce. W. Theodor Gümbel ("Der Vorkeim—Beitrage zur Entwichlungsgeschichte der Moospflanze. Nova Acta Acad. Cæsar.," vol xxiv. part ii. pp. 578-651) has collected a number of such instances. In the *Polytrichum juniperinum* he has found an archegone producing two setæ and two capsules under one calyptra. In *Hypum pseudoplumosum* he has found two setæ grown together and bearing two capsules; in *Mnium serratum* one seta and two capsules; in *Bryun argenteum* and *Splachnum vasculosum* one seta with two capsule necks and two capsules. These abnormal growths, or some of them, may, perhaps, point to a division of the fertilised protoplasm even in the archegone; and they may be only cases of the earlier beginning of that division which normally takes place after the growth of the sporangium.

If this suggestion should be the true one, it would seem to follow that fertilisation amongst plants may produce one or other of two results: (1) it may directly result in the fertilised ovum capable of producing a new plant, or (2) it may indirectly result in the formation of a number of cells each capable of reproduction; and to this latter form of reproduction that of the mosses should be referred.

Recurring to the brief summary of the modes of reproduction in the Muscineæ, it affords room for much observation. We find apogamy in almost every form, *i.e.* we find various modes, all of which avoid and exclude the sexual union; but the economy of nature goes much beyond that, and excludes the protonema, the gemma, and the leaf-bud. The one thing which is reproduced, whatever else may be omitted, is the cormophyte; this seems to be the one predominant object of nature's care.

Moreover, it will be observed that nature is careless whether she produces protonema from the one generation or the other; it may arise from the sporangium or the calyptra, which are parts of the sporophore, or from the rhizoid stems or leaves, which are parts of the oophore.

It is, moreover, noteworthy from how great a variety of parts the new organisms spring—whether in the shape of protonema or gemma. It seems as though the whole organism, and not any special parts of it only, were teeming with the capacity for reproduction.

Ferns.—The normal life-history may be represented thus:—

Oophore ... ... { Spore | Prothallus { Archegone / Antherizoid }

Sporophore... ... ... { Cormophyte | Sporange | Spore }

So that whilst in mosses the cormophyte produces the spore; in the ferns it produces the fertilised ovum; or, to express it in the language of the theory under investigation, in the mosses the cormophyte is an oophore; in the ferns it is a sporophore.

But side by side with this normal life-history in the ferns, we have abbreviated forms to which much attention has lately been directed.

We have cases of prothallus (capable of producing the two sexual forms) arising not from the spore, but from the sporange in the *Athyrium filix fœmina*, var. *clarissima*, and in *Polystichum angulare*, var. *pulcherrimum*; we have prothallus arising from the fronds—from the apex of the pinnule or one of its segments, or from the surface of the pinnule in *Polystichum angulare*, var. *pulcherrimum*. (Prof. Bower on "Apospory," *ubi sup.*, and Druery, *Jour. Linn. Soc. Bot.*, vol. xxii. p. 437). In *Pteris aquilina* growths have been found from the sporangia "resembling in some cases moss protonemata, in others irregularly shaped prothalli" (Farlow, "Apospory in *Pteris aqulina*, 2 *Ann. Bot.*, 383).

So, too, in the genus *Trichomanes* we find similar growths of prothallus. In *Tr. pyxidiferum* it grows from the base of the sorus; in *Tr. alatum* from the tips of the pinnæ of the fronds, from the cells of the apices or margins, or from the surface of the fronds: and again in the form of flattened strap-like growths from the margins or tips of the pinnules in *Tr. alatum* (Bower, "Some Normal and Abnormal Developments of the Oophyte in Trichomanes, *Ann. Bot.*, 1, 269). *Tr. Kaulfussii* presents growths of gemmæ and outgrowths on the margins of the fronds similar to those of *Tr. alatum* (Bower on "Apospory and the Production of Gemmæ on *Tr. Kaulfussii*," 8 *Ann. Bot.*, 465).

We get other cases in which gemmæ are produced, and that in a variety of ways; and whereas in mosses the gemmæ sometimes give rise to prothallus and never arise from it, in the ferns they seem rather to be produced by the prothallus, and appear to produce the cormophyte by direct vegetative growth. They have been described as growing in large numbers on the margin of the thallus of *Vittaria parvula* and *Monogramme paradoxa*; and on the ends of prothalloid growths in *Tr. alatum*. They have been observed, too, on *Tr. incisum* and in certain of the Hymenophylleæ (Bower, 1 *Ann. Bot.*, 273, 283-4).

But nature goes yet two steps further in this process of short-circuiting. In *Tr. alatum* the prothallus bears flattened expansions from which grow buds, which by the ordinary course of differentiation produce the leaf-stem and roots of a young cormophyte (Bower, 1 *Ann. Bot.*, 287), and the same phenomenon has been observed in *Lastræa pseudomas*, var. *cristata* (Druery, *Jour. Linn. Soc. Bot.*, xxix. 479-481).

Lastly, as in mosses, even the prothallus stage may be squeezed out. We get a vegetative bud developed from the base of the sorus in *Athyrium filix fœmina*, var. *elegans*, or from the side of the sorus in *Aspidium* (Lastræa) *Erythrosorum*, var. *Monstrum vel proliferum* (Bower, 2 *Linn. Tr.*). The growth of such buds and small plants arising from them on the pinnæ of *Asplenium bulbiparum*, *Cystopteris bulbifera* and other ferns is a familiar sight in our garden houses.

We have thus a young cormophyte produced by direct growth from an old cormophyte—a case of the most simple and short reproduction, and I can hardly bring myself to think that reproduction without spore or ovum is justly to be regarded as the case of an alternation of generations, one arising from a sexual ovum, and the other from an asexual spore with the aid of two principles or facts—apospory, which gets rid of the spore, and apogamy, which gets rid of the ovum; such a mode of regarding a simple and direct case of vegetative reproduction seems to me to be unreal, and to savour of scholasticism. Apospory and apogamy are expressions natural enough if we adopt the doctrine of alternation of generations as one which is to be applied to all cases of reproduction in the families concerned, because without some such epicyclic doctrines the facts will not go into the theory; they are formulæ for classes of exceptions on the supposed rule; but it may be doubted whether the exceptions here are not sufficient to destroy the rule.

If we insist on the view of the two generations, we are struck by the confusion which exists between them, for the prothallus, which is part of the oophore, may arise either from the spore or from the cormophyte, and from the sorus, which are regarded as parts of the sporophore; and the prothallus itself may produce either sexual organs, and so an ovum, or it may produce a cormophyte by direct vegetative growth in the form of a gemma or a bulbil, in which case it is difficult to describe it as an oophore.

Another point which strikes the mind on the consideration of the generation of ferns as of mosses, is that the theory of an alternation of generations is applicable only to one out of many modes of generation or schemes of life, and that it fails entirely to explain the others; and that therefore, even if true, it cannot be a complete or sufficient explanation of the facts in question.

But let us for a brief space confine our attention to the full and most complex life-history of which it is suggested to be an explanation. The fertilised archegone of the prothallus of the fern does not become detached from the prothallus, but, on the contrary, establishes a closer relation with it by the formation of a sucker or foot, which communicates with the tissues of the prothallus, and draws from them nourishment for the young cormophyte in the course of its growth. When the prothallus has thus performed its functions, it withers away. There has thus never been any physical severance of continuity between the prothallus and the cormophyte, and from the first to the last moment in the life-history of the fern there has been a continuous physical relation. Now arises the question whether the death of the prothallus is like the death of a parent, or the death of part of an organism—that kind of death without which there can be no life. Is it anything more than the casting off of the leaf in autumn, or of the stipules and bracts in the spring, or of the corolla and the stamen and pistil when their part has been done, or the withering of the cotyledons? Again, I believe that I am right in holding that the prothallus has no adaptation to independent existence; that if the archegone be not fertilised, it does not long maintain its life, and that it is thus in no way fitted for an independent existence. If the view with regard to the meaning of a generation, which I have before suggested, be correct, it would seem that we have no true alternation of generations in the life-history of a fern any more than of a moss; and that, as in the mosses, the sexual union ends in the reproduction of a new individual, not directly, but indirectly only, or (according to another view) in the production of a new part of the existing organism.

A comparison of the life-histories of the mosses and of the ferns discloses, as we have seen, the remarkable fact that in the former the cormophyte is an oophore, and in the latter a sporophore, or, as stated by Hofmeister: "The leafy plant in the mosses answers, therefore, to the prothallium of the vascular cryptogams; the fruit in the mosses answers to the *fern*, in the common sense of the word, with its fronds and sporangia" ("On the Germination, &c., of the Higher Cryptogamia," *Eng. Tr.*, p. 435). If this be correct, it follows that the cormophytes of the two groups have no connection and no relation of descent, for if the fern plant were a modified moss plant, it would obviously belong to the same generation. It follows then that the leaves, the stem, and the whole vegetative structure of the mosses have no genetic connection with those of ferns or of the phanerogams. "The chasm which divides them," says Prof. Goebel (*Enc. Brit.*, s.v., *Muscineæ*, vol. xvii. p. 74), speaking of these two classes of plants, "is the widest with which we are acquainted in the whole vegetable kingdom."

On this hypothesis then it follows that the mosses are to be regarded as the highest point reached by that line of development in which the cormophyte is the oophore, or, in other words, in which the chief vegetative growth is also productive of the ovum, or sexually produced cell; and that the ferns are the first and lowest example of that line of development in which the cormophyte is the sporophore, or, in other words, in which the chief vegetative growth produces only the spore or asexual cell. The mosses, therefore, appear before us without descendants, and the ferns without ancestors.

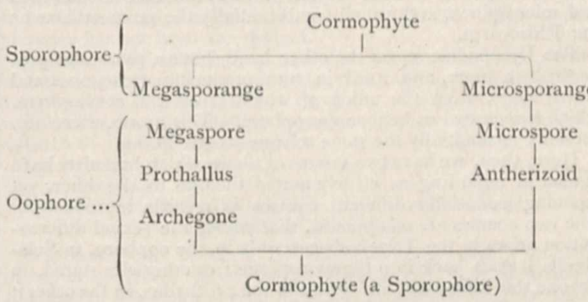
This conclusion seems improbable in itself, but it becomes more strange when we consider the fact that the Hymenophyllaceæ present themselves very much as if they were a link between the mosses and the other ferns; a view which has been long, and still is, maintained by the foremost students of these plants (Bower, "Some Normal and Abnormal Developments of the Oophytes in Trichomanes," i. *Ann. Bot.*, 269, 270). The leaves recall those of mosses, not only in their generally delicate character, but in that they often consist of only one layer of cells, and that, except in one genus, *Loxsoma*, they are without stomata. Again, as far as is known, the product of the spore of the Hymenophyllaceæ is not a prothallus, as in most ferns, but a protonema, as in the mosses. We have already seen that in many cases the protonema of the Hymenophyllaceæ acts like that of the moss, viz. that it produces a bud which produces a cormophyte: and this apogamy appears to be commoner in this group than in any other of the Filices.

If, instead of regarding the successive phenomena of the life-history of the moss and the fern as divided into two distinct generations, we regard them merely as successive events in the history of one and the same organism, and further admit the possibility of a variation in the order of these events, then we can conceive that a moss was the ancestor of the filmy fern. We shall hereafter find other cases in which it appears that the order of succession of events has been changed in allied organisms.

Perhaps this variation in the order of the events may be due to, or at least may be associated with, the different methods adopted by mosses or ferns respectively for retaining that moisture in the presence of which alone the act of fertilisation occurs. The moss is adapted to retain the dew and the rain amongst its leaves and in its perichætal growths; and the long translucent hairs, which characterise the leaves of many of the mosses which especially affect dry situations, are probably of use in retaining this moisture. Mosses are for the most part habitually damp. In the ferns, on the other hand, the presence of moisture during fertilisation is assured by an entirely different method; here we have a plate-like expansion of the prothallus, clinging closely to the damp soil and the archegones and antherizoids situate usually upon the under or damp surface. If these different classes of plants are to retain moisture at different stages of their life-history, it will seem to follow that fructification which requires this moisture must follow in the order of events this act of retaining moisture. It may be that the order of succession in the events of plant life depend, not on obedience to some inherent law or antetypal form, but on physiological necessities of life.

Rhizocarpeæ.—In this group, as is well known, we find, for the first time, the presence of two kinds of spores (so called).

The life-history is briefly this. The cormophyte (which is a sporophore) produces two kinds of sporanges—the megasporange and the microsporange. The megasporange produces megaspores, and the microsporange produces microspores. The megaspores are female and without fertilisation produce a prothallus, which bears archegones; and these archegones are fertilised by antherizoids, proceeding from the microspores. From the archegones thus fertilised, the new cormophyte is produced. The life-history may then be thus summarised:—



In the foregoing statement a difference as regards the prothallus will be observed between the megaspores and the microspores. The female prothallus is developed as a substantive growth, but in the case of the microspore this appears to be much less clear. "In Marsilea and Pilulalaria the antherizoids are produced in the interior of the microspores themselves." In Salvinia each microspore emits a tube which pierces the wall of the sporangium and divides into two parts, of which the terminal part is developed into antherizoids, leaving the single cell of the hinder part as the so-called prothallus (Sachs, Text-book by Bennett and Dyer, 384). It may be permitted to doubt whether that single cell can be regarded as a true prothallus; but even if it be, this is absent in Marsilea and Pilularia, so that here, on the male side, the prothallus has dropped out of the series of events.

Another point must be considered. In the case of the moss and the fern passing through the full circuit of their life-history, there are two points at which the whole future of the plant has been thought of as wrapped up in a single cell, viz. in the spore and in the fertilised archegone: in the case of the rhizocarps and all plants which follow their scheme of growth, including the phanerogams, the future of the plant is gathered into a single cell only once in the life-history, viz. in the fertilised archegone. It seems difficult to consider in the latter case that there is more than one generation.

Can it be rightly said that in the case of the Rhizocarps there is any true spore or any true sporophore? The answer depends on the meaning which we attribute to the word spore.

Of this word many uses are made, to the confusion of thought on such subjects. It is according to the glossary to Kerner's "Natural History of Plants," as edited by Prof. Oliver, "a reproductive cell which becomes free and is capable of developing into a new individual." De Bary, in like manner, applies the term generally to "any cell which as a single cell becomes free and is capable of direct development into a new organism (Bion) without reference to its origin and homology" (cited by Bower, ii. *Linn. Tr.*, 301.) Sachs, on the contrary, would appear to confine the term to such a cell when asexually produced. "The asexual reproductive cells," he says, "usually become detached from the mother plant and dispersed (hence called spores) in order to produce a new generation at a distance from it" (Bennett and Dyer's Translation, p. 203): and in the language which contrasts oophore and sporophore, I suppose this view that the spore is asexually produced is plainly involved.

Now if we take either of these definitions and apply it to the life-history of the Rhizocarps, a curious result appears to follow. Inasmuch as the megaspore produces a prothallus of its own energy, it may fall under the description of a spore, and may be considered as the product of a sporophore and the beginning of an oophore. But neither the microspore nor the antherizoid of Marsilea and Pilularia falls under such a definition, and there seems nothing to separate it from the sporophore as a new generation, and yet the archegone of the megaspore is fertilised by it. If I follow the matter aright, the sporophoric generation on the female side has united with the oophoric on the male side for the production of the young cormophyte. If this be true, there is certainly no hard and fast line between sporophore and oophore, for the cormophyte is the one by one parent and the other by the other parent.

If the capacity to reproduce an organism like the parent be essential to the conception of a spore, then neither megaspore nor microspore is a true spore, and we have no sporophoric generation on either side.

Lycopods.—In this single group we have a most remarkable diversity of schemes of generation.

The Selaginellaceæ (as is well known) produce megaspores and microspores, and present substantially the same scheme as the Rhizocarps.

The Lycopodiaceæ, on the other hand, have a prothallus produced by a spore, and itself in turn producing archegones and antherizoids, from the union of which arises the cormophyte, which is regarded as being a sporophore. This group, therefore, presents substantially the same scheme as the Ferns.

Here, then, we have two groups of plants which botanists have agreed in regarding as closely united the one to the other, yet pursuing essentially different courses as regards reproduction. The two courses are so opposed, that whilst the sexual differentiation arises in the Lycopodiaceæ only in the oophore, in Selaginella it goes back into the sporophore; or otherwise stated, in the one this differentiation begins in the prothallus, in the other it begins before the prothallus by the differentiation of the spores into two kinds. What is the inference? Is it not this? that neither the modes of reproduction, nor the order of events in the life-history are characters of great persistency; or, in other words, that the organism is unstable in all these particulars?

The Lycopods exhibit the phenomenon of short cuts. In *L. cernuum* it has been found that the root tops (*sic*) turn into root gemmæ or bulbs, which produce on germinating young plants much like those from the prothalli (Treub., "Some Words on the Life History of Lycopods," *Ann. Bot.*, pp. 119, 122).

Phanerogams.—The accepted application of the doctrine of the alternation of generations to this class of plants may thus be stated.

The cormophyte of the Phanerogam is, as in the Ferns, a sporophore.

The ovule	=	the megasporange.
The embryo sac	=	the megaspore.
The endosperm	=	the female prothallus.
The pollen sac	=	microsporange.
The pollen grain	=	microspore.
The pollen tube	=	antherizoid.

According to this view, the life-history of a Phanerogam may be thus stated:—

Sporophore:
Cormophyte
— Ovule (Megasporange) | Pollen sac (Microsporange)
— Pollen grain (Microspore)

Oophore:
Embryo sac (Megaspore) | Pollen tube (Antherizoid)
Endosperm (female prothallus)
Cormophyte (a Sporophore)

So that the dividing line between the two generations is, according to the theory in question, drawn in the same way as in the Rhizocarps, and seems open to the same observation of the mingling in pollination of two generations.

With regard to phanerogams, no fact is more familiar than that the embryo, *i.e.* the young oophore, is intimately connected with and is nurtured by the cormophyte, *i.e.* the sporophore, and thus the two so-called generations coexist in close physical union; and, furthermore, it is familiar that the fertilisation of the embryo sac (or megaspore) by the pollen tube (or antherizoid) often produces great changes in the carpels and the other parts of the perianth, and, in fact, in the whole flower-bearing axis; so that the fertilisation of the mother of a future organism is followed by great physical alterations in the structure of the grandmother.

Another familiar fact is this. In Gymnosperms the endosperm is formed long before fertilisation, whereas in the Angiosperms it is formed after that event. Now, as in the Rhizocarps so in the Phanerogams, we have only the supposed female prothallus left, for the pollen is formed without prothallus; and now, in the Angiosperms, we find the prothallus not coming into existence till after the formation of the ovule (or megasporange) and the embryo sac (or megaspore), and the fertilisation of this by the pollen (or microspore). What was regarded as a *pro* embryo is now a *post* embryo: the parent has become the child. The prothallus has, therefore, according to the theory in question, lost its old position of a growth preceding the sexual or, at least, the female organs, and does not arise til after these; it has lost its old function of producing thes organs; and, one may add, it has lost its old form, for it i no longer a prothalloid growth and no longer a substantiv organism, but is reduced to a part of the seed.

In the case of the Cryptogams, the prothallus for the mos part shows its true place in the order of events by gradually withering and dying away when the cormophyte has been started; but in the Phanerogams the endosperm is only entering on its functions when the development of the embryo begins, for it then becomes filled with nutriment, and increases in size. In a word, its duties are essentially connected with the life and growth of the embryo, so that it is functionally, as well as physically, part of the seed.

If the homology of structures so different in form, function, and order of succession, as the prothallus of Cryptogams and the endosperm of Phanerogams is to be maintained, cogent evidence ought, one would think, to be forthcoming.

The Phanerogams, no less than the other groups which we have been considering, give abundant evidence of short-circuiting. It will be enough, briefly, to refer to some instances.

The gemmæ which are found growing on the margins of the leaves of the *Malaxis paludosa* recall curiously the similar, though less complicated organised, structures in the *Tetraphis*, the *Orthotrichum*, and other mosses.

Bulbils are found in many cases on the stem in the axils of the leaves. *Ranunculus ficaria*, *Dentaria bulbifira*, *Lilium bulbiforum* are amongst the plants which present this fact.

Small young plants arise directly on the leaf in certain cases, as in *Cardamine palustris*, where the young plant arises at the bifurcation of the vascular bundles: and in many other cases they arise from the leaves upon the severance of the leaf from the plant, so that an injury to the parent leads to reproduction.

The Begonias are, as is well known, propagated from leaves to a large extent in our greenhouses; the *Hoya carnosa* and the *Acuba japonica* exhibit the same phenomenon.

Buds are formed on the roots of trees, shrubs, and herbaceous plants, which are capable of the direct production of young plants of the same kind as the parent. Every one knows that the gardener avails himself of this familiar fact for the purpose of increasing his stock in a very large number of plants. One point only requires further mention, viz. that the tendency to produce young plants from roots is in some cases produced, and in others is greatly increased by the destruction of the parent plant. This seems to show that the same cells or parts of the plant which, during the continued life of the parent, assisted in its vital functions, have, by reason of its destruction or death, been diverted to new duties. The same part, therefore, is alike adapted to, or at least capable of, nutrition and reproduction.

Buds are formed on and around the underground bulbs of a large number of plants; no mode of reproduction is more familiar to our gardeners.

Buds, again, are produced in some cases on the subterranean stems, as in *Stellaria bulbosa.*

In many cases flowers are replaced by bulbils: *Polygonum viviparum* and *bulbiforum*, *Saxifraga cernua*, *nivalis* and *stellaris*, *Juncus alpinus* and *supinus*, *Aira alpina*, *Festuca alpina* and *rupicaprina*, *Poa alpina* and *conisia* are cases in which perfectly formed flowers are often produced, but in which small bulbils frequently, and especially in alpine or arctic regions, take the place of the flowers. (2 Kerner by Oliver, 454.) These bulbils are detached from the parent plant, and throw roots downwards and stems and foliage upwards. A somewhat analogous growth has been found in the *Nymphæa lotus* var. *monstrosa* (Barber, "On a Change of Flowers to Tubers in *Nymphæa lotus* var. *monstrosa*," *Ann. Bot.* iv. 105). After the development of the sepals, instead of the production of petals and stamens there was formed a bud of green leaves, which developed into a tuber from which a young plant arose. In the persistence of the flower's stalk and sepals, this case differs from that presented by such plants as the *Polygonum viviparum*.

Lastly, one of the most interesting cases of vegetative reproduction is that of parthenogenesis, or the production of seeds by the female plant without the co-operation of pollen. This appears to be established beyond doubt in the case of the *Cælebogyne ilicifolia*, and probably in the cases of the hemp the *Mercurialis annua* and *Gnaphalium alpinum*. This mode of reproduction strikes the mind as very remarkable, because it shows that even in very highly organised plants parts which had been specially provided for reproduction under the stimulus of the pollen cell, still retain the capacity of reproduction even without that stimulus.

It is obvious from these familiar facts that the capacity of reproduction is retained by a great part of the organism in many plants, and that it is not excluded by the fact that the part in question may be highly and definitely organised for some other purpose than reproduction, or that it may be intended, according to the analogy and the common course of nature, for reproduction only after the stimulus of fertilisation.

CONCLUSIONS.

The doctrine (to use an ambiguous word) of the alternation of generations may be regarded in several lights: as a compendious statement of facts; as an analogy; as something to be inferred in ancestral forms from existing ones.

If we mean by a generation the life of an independent organism from the time when its whole future was gathered up in one cell, it seems never to represent the facts of vegetable growth; if by it we mean the dependent life of part of an organism from a single cell, it appears to summarise the facts of the full life-history of ferns and mosses, but not of the Rhizocarps or of Phanerogams.

If we regard the doctrine as an analogy, the points in which the analogy breaks down, and the continued recurrence to exceptions to make it agree with the various facts, seem to rob it of much value.

If the alternation of generations be put before us as a fact which the phenomena of existing vegetable life require us to assume in the past, it seems at least doubtful whether more can be justly said than that amongst many modes of reproduction and many schemes of life-history, an alternation of generations in the sense in which it exists in the mosses and ferns may probably be considered as one; but there seems to be nothing to show that it was ever a dominant scheme of life.

The brief review of familiar facts above given seems to tend towards the following conclusions, which I submit with all deference to those better capable of appreciating the question than I am.

(1) That in the language of Prof. Bower, "no fixed and impenetrable barrier exists between sporophore and oophore," but that, on the contrary, the one is capable of passing over to the other, and that the alternation of generations is not an accurate statement of facts or a useful analogy.

(2) That a truer presentation of the facts is to be found in the statement that fertilisation in a plant does not always result in the direct production of a fertilised ovum capable of producing the cormophyte, as in the Characeæ and the phanerogams, but that it may result in the indirect production of a number of fertilised cells, as in the mosses and some fungi, or, as an alternative view of the same facts, in the direct production of a new part of an existing organism.

(3) That (to repeat the foregoing statement in another form) the different generations in the life-history of any given plant are not separate organisms, but different stages or parts of the same organism.

(4) That when the like events can be found in the life-history of different plants, the order of the succession of events is unstable, and that the first may become last and the last first, according as the physiological circumstances of the plant give scope for the action of that reproductive capacity with which the whole plant seems to be endowed.

(5) That this instability exists, even in the sexual act, as regards its place and time in the order of the succession of events.

(6) That the events which occur in the full life-history of a plant admit of short-circuiting or abbreviation, and that in such abbreviated life-histories the one thing which nature appears to desire to avoid is the sexual act, and that the one thing which it appears to desire to preserve is the cormophyte.

(7) That the passage from the life-history of the moss to that of the fern may be accounted for by a transposition in the order of events, and that by such a transposition a moss may be regarded phylogenetically as the direct ancestor of the filmy fern, and the indirect ancestor of all the other ferns.

(8) That, assuming that there is a germ plasm distinct from somatic plasm, and that the presence of the former is essential for the reproduction of the organism, there is evidence of the wide diffusion of the germ plasm, and that no limit to its presence has yet been ascertained.

(9) And lastly, that the reproductive energy operates in plants in such a variety of ways, and under such varying circumstances, as to make it improbable that the facts of reproduction can, with our present knowledge, be reduced to any one scheme, or referred to any single archetype. EDW. FRY.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—On Tuesday, February 16, Convocation decided to confer by decree the degree of M.A. on Dr. J. S. Haldane, Lecturer in Physiology, and on Dr. W. B. Benham, Aldrichian Demonstrator in Comparative Anatomy.

Messrs. W. W. Fisher (C.C.C.), W. Hatchett-Jackson (Keble), W. S. Church (Ch. Ch.), W. Collier (Exeter), S. H. West (Ch. Ch.), J. E. Marsh (Balliol), and G. W. S. Farmer (Balliol) have been elected members of the Board of the Faculty of Medicine.

The following have been elected Members of the Board of the Faculty of Natural Science:—Messrs. C. Leudesdor (Fellow of Pembroke), D. H. Nagel (Fellow of Trinity), E. H. Hayes (Fellow of New Coll.), J. W. Russell (Merton), J. Walker (Ch. Ch.), F. J. Jervis Smith (Trinity), A. Thomson (Exeter, Professor of Human Anatomy), W. W. Fisher (C.C.C.), and V. H. Veley (University).

On Monday, March 1, Prof. E. E. Barnard exhibited some of his astronomical photographs in the Examination Schools.

Mr. A. C. Le Rossignol (Exeter Coll.) has been elected to an Exhibition in Natural Science at Exeter College on the foundation of King Charles I.

Captain W. de W. Abney, C.B., F.R.S., has accepted the invitation of the Junior Scientific Club to deliver the Robert Boyle Lecture for 1897.

Scholarships and Exhibitions have been announced for competition as under:—In Natural Science, at Merton, New, and Corpus Christo Colleges, on July 6, 1897; in Mathematics, at Ch. Ch. and Hertford Coll., on June 2, 1897; in Classics, Mathematics, Modern History, or Natural Science, on April 27, 1897.

CAMBRIDGE.—Nine members of the Syndicate on Degrees for Women have reported in favour of granting by diploma the title of B.A. to women who pass a final Tripos examination after residing at Newnham or Girton for nine terms. They propose that the like grant should be made retrospectively to women who have already taken the qualifying examinations, and that after the usual periods the higher titles of M.A., D.Sc., and D.Litt. should be open to the titular B.A. Lastly, they regard it as desirable that women should be made eligible to degrees in Arts, Law, Science, and Music, *honoris causa*. A minority report signed by five members advocates that special titles such as *Magistra in Litteris* (M.Litt) should be devised for duly qualified women, on the ground that these would remove any disability under which Cambridge women students may labour for want of a formal degree, while it would preclude any agitation for full membership of the University, with its concomitants of franchise and governing power. They apparently deprecate, for the same reason, the exclusion of students other than those of Newnham and Girton from participating in the proposed concession. The reports have yet to be discussed by the whole Senate, and it is not improbable that they may be referred back to the Syndicate.

The Special Boards of Studies concerned with the Natural Sciences Tripos propose that candidates in physics and chemistry be allowed to send in, for the inspection of the Examiners, notebooks showing the records of practical work done by them, and bearing the signature of their teacher as a guarantee of their *boná-fides*.

Prof. A. W. Williamson, F.R.S., has been appointed an Elector to the professorship of Chemistry and the Jacksonian professorship of Natural Philosophy; and Mr. M. H. N. Story-Maskelyne, F.R.S., an Elector to the chair of Mineralogy.

According to the lists just issued it appears that while there are only ninety-seven candidates for the Mathematical Tripos (Parts I. and II.), there are 144 for the two parts of the Natural Sciences Tripos in the Easter Term.

BY the will of the late Dr. Robert H. Lamborn, states the *American Anthropologist*, the Academy of Natural Sciences of Philadelphia has been bequeathed his entire estate, aggregating about 40,000*l*., the interest of which is to be used for biological and anthropological research.

BY the will of the late Mr. George Gordon Nicol, states the *British Medical Journal*, important bequests have been left to Aberdeen. Of sundry trust funds, the income on which accrues to his wife during her lifetime, 20,000*l*. are to be in trust for the University of Aberdeen, to found bursaries and scholarships or exhibitions to the English Universities, for Aberdeen students who are natives of Aberdeenshire.

THE following are among recent announcements:—Dr. Edwin Klebs, the well-known German pathologist, appointed to be professor in the Rush Medical College, Chicago, will also occupy a position in the post-graduate medical school of the University of Chicago; Dr. A. C. Abbott, Professor of Hygiene in the University of Pennsylvania, to be chief of the Bacteriological Department of the Philadelphia Health Bureau; Dr. Karl Futterer, Associate Professor of Mineralogy and Geology in the Technical High School at Karlsruhe, to be professor; Dr. Pauly, Associate Professor of Applied Zoology in the University of Munich, to be professor, and also director of the Zoological Department of the Forestry Experimental Station at Munich; Dr. Felix to be professor of anatomy at Zürich; Dr. Karl Kaiser to be professor of physiology at Heidelberg.

ON Friday last, at a meeting of the delegates from institutions named in the report of the Cowper Commission on the University of London, Lord Lister moved the following resolution:—"That this meeting of delegates represents to Her Majesty's Government the great injury caused to the educational interests of the metropolis by the delay in establishing a teaching University for London, and urges upon them the necessity of taking immediate steps for the constitution of a statutory commission for the reconstruction of the University of London on the lines of the recommendations of the Cowper Commission." The motion was seconded by Prof. Rücker and carried unanimously. Lord Lister said that his varied experience had shown him how much more beneficial to the progress of medical science and to the instruction of students the Scottish system of teaching and examination was than the purely examinational system of the University of London. After remarks in support of the resolution by other speakers, Lord Reay said that in no other country in Europe would such a company of distinguished men of science and of learning have urged on its Government the necessity of founding a teaching University without the Government at once acceding to their wishes.

EVERY one interested in educational matters knows that each report of the U.S. Commissioner of Education is a mine of information upon educational progress throughout the world. The seventh of these annual reports, referring to events and developments during the year ending June 30, 1895, has just come to hand. It is in two volumes, each running into about twelve hundred pages. Though largely taken up with information referring to elementary schools, higher education is very fully dealt with, both statistically and from the pedagogical point of view. The movement for the admission of American students to French universities is surveyed. A measure has been secured which enables students from the United States to enter the faculty of sciences in French universities as candidates for the degree of licentiate on the basis of their American diplomas. After the degree has been attained, the doctor's degree may be secured on substantially the same terms as in Germany. An account is given of continuation and trade schools in Germany, especially in Berlin. It shows how the German school authorities endeavour to prepare for skilled labour, and thus increase the productiveness of their sources of wealth. A chapter on the condition of the agricultural and mechanical colleges in the United States, endowed by the national land grants of 1862 and 1890, is preceded by an historical review of early attempts to introduce the subjects of physics, chemistry, manual arts, and agriculture into schools. There is also a chapter on American medical schools. Information on many other educational subjects will be found in the recently-published report.

SCIENTIFIC SERIALS.

Symons's Monthly Meteorological Magazine, February.—Water at unusually low temperatures. On November 30, the observer at Camden Square found that the water supply for the wet bulb thermometer on a Glaisher screen was not frozen, though the air temperature was 29·1°, and that congelation would not take place after stirring the water. The water was afterwards subjected to chemical examination; the somewhat negative character of the results seems to show that the exposure to a smoky atmosphere in the open glass vessel had increased the tendency to resist freezing. In another glass vessel on the same screen, more protected from radiation, but more exposed to the wind, the water was frozen into a solid mass.—An attempt to determine the velocity equivalents of wind-forces estimated by Beaufort's scale, by R. H. Curtis. This is a summary of a paper read before the Royal Meteorological Society on December 16, 1896, a notice of which has already appeared in our columns. In the discussion which followed, the opinion was generally expressed that the publication of velocities obtained by the use of the usual factor 3, which assumes that the cups of the anemometer move with one-third of the wind velocity, should be discontinued, the results being considerably in excess of the true values. The revised factor, as deduced by Mr. Dines and others, is found to be nearer 2·2.—A tornado at Este's Park, Colorado, by H. C. Rogers. The height of the Park is 7500 feet above sea-level. The chief interest in the paper lies in the usual impression that tornadoes are generally restricted to the plains. Information upon this point is desirable, also as to whether they escape notice owing to their force being less, or whether they occur less frequently because the conditions of heat and moisture necessary for their formation do not exist.

Memoirs (Trudy) of the St. Petersburg Society of Naturalists, vol. xxvi., 1896: Section of Botany.—Can algæ assimilate free nitrogen? by P. S. Kossovich.—It is known that Schloesing and

Laurent had proved, in 1892, that soil which contains both algæ and bacteria does assimilate free nitrogen from the atmosphere, but it was desirable to ascertain how far pure algæ, without bacteria, are endowed with the same capacity. This work was undertaken by the author, under the guidance of A. Koch. The result is that pure cultures of *Cystococcus* and, very probably also, of *Stichococcus* do *not* assimilate free nitrogen. On the contrary, a soil which contains both algæ and bacteria can be enriched to a considerable extent with nitrogen absorbed from the atmosphere. The algæ aid, in such cases, the bacteria in their work of assimilation, as they enrich the soil with hydrocarbons, which are required for the growth of the former. A sort of symbiosis thus takes place between the algæ and the bacteria; but, of course, it would be premature to maintain that no algæ whatever can absorb free nitrogen. —Materials for the Flora of the Turkestan Highlands: the Basin of the Zerafshan, by V. Komaroff. This is a detailed work in which a list of 362 species is given, and is preceded by a general sketch of the vegetation of the valley of the Zerafshan (this latter has already been referred to in a previous issue). —Physiological researches into the growth of elementary organisms, by K. A. Stameroff. The influence of light on the speed of growth of hyphæ of *Mucor*, *Penicillum*, and *Saprolegnia*, of rhyzoids of *Marchantia polymorpha*, and of the pollen of various plants, were studied, and complete results, both positive and negative, were obtained.—An addition to the lists of the flora of the Government of Novgorod, by V. Komaroff; and on the same flora, by A. Kolmovsky and A. Antonoff.

Vol. xxvi. 2, 1896: Section of Zoology and Physiology.— Some observations on the embryonic development of *Neomysis vulgaris*, var. *Baltica*, by Jul. Wagner, with five plates, fully summed up by the author in German.—Observations on spermatogenesis with spiders, by the same author, with two plates, and also fully summed up in German.—Note on the influence of a permanent current on the muscle irritated through the nerve, by A. D. Grigorieff.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 4.—"On the Condition in which Fats are absorbed from the Intestine." By B. Moore and D. P. Rockwood. Communicated by Prof. E. A. Schäfer, F.R.S.

In these experiments the solubility of the mixed fatty acids of beef suet, mutton suet, and lard in the bile of ox, pig and dog was determined at body temperature, and found to vary between 1 and 7 per cent. That the greater part of the fatty acids is *not* dissolved as soap is shown by the ready solubility in ether of the precipitate thrown down on cooling, and the ease with which it saponifies with sodium carbonate.

Undoubtedly a small portion of the fatty acids added combines with the alkali of the bile to form soaps, for the reaction, which is at first alkaline to litmus, changes afterwards, becoming strongly acid. The solubility of the mixed fatty acids in bile is only in part due to the bile salts, for a more concentrated solution of these than bile itself did not dissolve nearly so large an amount of fatty acids. And, again, mere removal of the "pseudo-mucin" from bile greatly diminishes its solvent action on fatty acids, although the "pseudo-mucin" redissolved in sodium carbonate has no solvent power.

The contents of the intestine were removed in dogs during fat absorption and filtered. The filtrate decomposed and dissolved neutral fats at the temperature of the body. This effect is due to the simultaneous action of pancreatic juice and bile. A similar result was obtained by acting on neutral fats with pancreas and bile, while pancreas alone decomposed the neutral fats into fatty acids, but did not dissolve them.

The solubilities stated above are quite sufficient to account for the removal of all the fat of the food from the intestine as dissolved fatty acid, since they exceed the concentrations found in the intestine of other materials, such as sugars and albumoses, which are removed in solution. Other experiments, however, on the reaction of the intestine during fat absorption, lead the authors to think that all the fat is not absorbed as dissolved fatty acids, but that these are replaced to a variable extent (in some animals to a very large extent or completely) by dissolved soaps.

The reaction of the contents of the small intestine to litmus during fat absorption in the dog is at the pylorus neutral, faintly acid or faintly alkaline; from here onwards the acidity increases, reaches a maximum about the middle of the small intestine, and then becomes less acid, to change to alkaline at a point situated about three-fourths of the way along the intestine. The reaction to methyl-orange and phenolphthaleïn explains this; the contents are alkaline to methyl-orange from pylorus to cæcum, and, equally completely, acid to phenolphthaleïn, showing that the acid reaction to litmus in the upper part is due to weak organic acids, while the alkaline reaction in the lower part is due to fixed alkali, accompanied by dissolved carbonic acid. The alkaline reaction to methyl-orange in the upper part, where it is acid to litmus and phenolphthaleïn, shows that in that part there is an excess of bases, above that quantity necessary to combine with all the inorganic acids, which are combined with weak organic acids (probably fatty acids). In the lower fourth or thereabouts, where the reaction is alkaline to litmus, there cannot be any fatty acids present in solution. Therefore any fat that is absorbed as free fatty acid must be taken up from the upper three-fourths of the intestine, where the reaction is acid to litmus.

In the white rat during fat absorption the contents of the small intestine is alkaline to litmus from pylorus to cæcum, and is never acid for a greater distance than two or three inches below the pylorus; in this animal, therefore, nearly all the fat must be absorbed in solution as soaps.

February 11.—"On the Regeneration of Nerves." By Robert Kennedy, M.A., B.Sc., M.D., Glasgow. Received January 7.

The author gives the clinical histories of four cases of division of nerves, in which restoration of function had not occurred at periods varying from a few weeks up to eighteen months from the date of section. Secondary suture was performed, and the sense of pain commenced to return in from two to five days, and sensation speedily became perfect. Motion was not recovered till a late date.

He concludes that this early return of function is due to restored conductivity of the divided nerves, and that the theories which have hitherto been advanced to account for return of sensation apart from reunion of the nerve, are inapplicable to cases in which *early* return of sensation occurs from suture, performed after the lapse of *several months* from the time of section. The tardy and imperfect return of motion is explained on the ground that the muscles have undergone great trophic change, as a result of long separation from their trophic centres.

From the histological changes found in the portions removed at the operations, he concludes:

(1) That there is no evidence of ascending degeneration of the kind described by Krause after interruption of a nerve.

(2) That the old axis-cylinder and myeline sheath are destroyed in the peripheral segment, and in the ultimate portion of the central segment.

(3) That young nerve fibres are developed in the peripheral segment, as well as in the end of the central segment, and that even while there is no connection between the two ends.

(4) That these young nerve fibres originate within the old sheath of Schwann from the protoplasm and nucleus of the interannular segment, the new axis-cylinder being developed from the protoplasm, while the nuclei remain attached to the sides of the new fibres.

(5) That so long as the conductivity of the nerve is not re-established, the development of the young fibres proceeds only to a certain stage, which may be regarded as a resting stage, as the fibres after three and eighteen months respectively present identical characters.

(6) That cicatricial intercalary segments may contain young nerve fibres from end to end without re-establishment of function, if the amount of cicatricial connective tissue in the mass is sufficient to prevent by its pressure the passage of impulses.

February 18.—"Note to the Memoir, by Prof. Karl Pearson, F.R.S., on Spurious Correlation." By Francis Galton, F.R.S. Received January 4.

This note was intended to serve as a kind of appendix to the memoir of Prof. K. Pearson, the author believing that it might be useful in enabling others to realise the genesis of spurious correlation. It was important, though rather difficult, to do so, because the results arrived at in the memoir, which are of serious interest to practical statisticians, have at first sight a somewhat paradoxical appearance.

The diagrams which accompanied the paper show how a table of frequency of the various combinations of two independent and normal variables may be changed into one of A/C, B/C, where C is also an independent and normal variable in respect to its intrinsic qualities, but subjected to the condition that the same value of C is to be used as the divisor of *both* members of the same couplet of A and B. In short, that the couplets shall always be of the form A/C_n, B/C_n, and never that of A/C_n, B/C_m.

Physical Society, February 26.—Mr. Shelford Bidwell, President, in the chair.—Mr. J. H. Vincent read a paper on the photography of ripples. If mercury is used as the medium, all waves less than 1·3 cm. long come under Lord Kelvin's definition of a ripple; that is to say, they are waves whose lengths are less than such as are propagated with minimum velocity. Vibrations in mercury of about 200 per second and upwards generate waves whose propagation is controlled almost entirely by surface tension, and these waves are therefore classed as "capillary ripples." Their speed of propagation is of the order of about one foot per second. They are invisible owing to their high frequency, and not in consequence of the velocity of their propagation. It is usual to examine them by some stroboscopic method. Mr. Vincent obtains photographs of the disturbed mercury surface by the sudden illumination of an electric spark. The spark is about half a centimetre in length, and it lasts about one two-hundred-thousandth part of a second. Its brightness is increased by an auxiliary spark-gap. The optical arrangement consists of two lenses, one in the path of the incident light, and another to converge the reflected light from the mercury surface into a photographic camera. Ripples are set up in the mercury by a stylus attached to a tuning-fork. For this purpose it is generally sufficient to give a slight blow to the prongs; but when continuous vibration is required, the tuning-fork can be connected by a thread to an electrically-driven fork, as suggested by Mr. Watson. The first photograph shows a series of circular waves, set up by a single stylus attached to a fork vibrating 180 times a second. Fixed points at known distances, just above the mercury surface, enable the wave-lengths to be deduced rom the photographs; and, as the frequency is known, the surface-tension may be easily calculated. In a second photograph, two styluses are attached to the same prong. Dark lines are seen to radiate from the region between the centres of oscillation; these are the lines of minimum disturbance—hyperbolas, of which the centres of disturbance are the foci. This photograph illustrates "interference" similarly to the optical methods of Young and Fresnel. A third photograph shows the formation of elliptical curves of disturbance, being the loci of the intersection of two series of circles, corresponding one to each of two centres of vibration. Unlike the system of hyperbolas, these ellipses are not at rest, but travel outward from the sources. In order to render these ellipses stationary it would be necessary to change one of the *sources* into a *sink*, towards which the circular waves might converge; the photograph would then correspond to the optical device of M. Meslin, who obtains interference fringes by means of a screen placed between two point centres, one a *source*, and the other a *sink*. The phenomena of interference and diffraction are well shown in a photograph of a point source and a reflecting line. The reflector here is one side of a triangular piece of microscope cover-glass. The interference lines are due to the mutual action of incident and reflected rays; they are analogous to Lloyd's single-mirror fringes. Other photographs exhibit analogues of "spherical aberration" and "forced vibration." Mr. Vincent acknowledged his indebtedness to Mr. Boys for the recommendation of attempting the photography of capillary ripples. Mr. Boys congratulated the author upon the way in which the experimental difficulties had been overcome. The results would bear a good deal of close examination, and they would be found to present analogues of the greatest service in demonstrating the phenomena of acoustics and optics. Such photographs were far better than geometrical pictures drawn by instruments. For example, in the photograph illustrating the regions of minimum disturbance by lines radiating from a two-point source, it was easy to make out the positions where the two series of waves were half a period behind one another. The crests and troughs appeared as a set of dark and light concentric alternating circles, broken up into short arcs by radiating lines, the loci of minimum disturbance; all the crests on one side of any particular radiating line were seen to correspond to troughs on the other side, so that the field of disturbance was mapped out as in acoustics. One set of phenomena yet awaited illustration by this photographic method, and that was "diffraction" from a grating. It might be possible to use as an exciter a comb with chisel-shaped points. He did not think it would be possible to go quite so far as to reproduce analogues of spectral analysis. Since wave-length varies with surface-tension it was possible to vary the wave-length by dropping a little ox-gall or soap solution upon the mercury surface. Mr. Blakesley asked why no reflections occurred from the sides of the mercury retainer. Mr. Boys said the waves were lost at the edges of the meniscus. The mercury was kept in position by an annular ring of thin glass. Mr. Appleyard suggested that the analogue of refraction might be obtained by an alteration of the surface-tension over a small area, by amalgamation or other means. Mr. Vincent thought this could be done, but that it would be very difficult. The President proposed a vote of thanks to the author.—Mr Elder then read a paper, by Mr. Beckit Burnie, on the thermo-electric properties of some liquid metals. The investigation was made with a view to determining the effect of melting upon the thermo-electric properties of certain metals. The metal to be tested is contained in a W-shaped glass tube, of which one limb can be cooled and the other heated. Thus one limb can contain molten, and the other solid, metal. Copper-wires are plunged, one into each limb, and through these connection is made with a galvanometer. The thermal-junctions, therefore, are copper-hot metal, and copper-cold metal. The temperature is deduced from a separate thermal-couple, calibrated by a mercurial thermometer. Curves are drawn coordinating temperature and electro-motive force. It is found that their slope depends upon the rate of cooling or heating of the metals; this is particularly the case with bismuth. The effect is attributed to the variation in crystalline structure of the metal under test, at different rates of solidification. With tin the change is less marked, and with lead it is unnoticeable. At or about the melting points, there is considerable change of slope in the curves. Here, again, the effect is smallest for lead; somewhat greater with tin; and remarkably large with bismuth; the latter changing from an exceedingly active thermo-electric metal to one resembling lead. A great change occurs also with mercury at the melting point, indicating a difference in the Peltier effect between solid and molten metals.—A vote of thanks to Mr. Beckit Burnie was proposed by the President, and the meeting adjourned until March 12.

Linnean Society, February 18.—Dr. D. H. Scott, F.R.S., Vice-President, in the chair.—Mr. J. E. Harting exhibited under a glass case the nest of a wren built of moss in the dried body of a rook which had been hung up as a scare-crow in Gloucestershire. Similar instances of the kind had been recorded (*Essex Nat.* ii. 205 and iii. 25). He called to mind the nest of a swallow in the dead body of an owl mentioned by Gilbert White, and referred to other cases which had been collected by a former President of the Society (Bishop Stanley, "Hist. Birds"). For instances of nests of the hoopoe placed in the desiccated bodies of unburied men, he referred to the experience of Pallas in Russia and of Swinhoe in China.—On behalf of Mr. D. T. Gwynne Vaughan, Dr. D. H. Scott gave the substance of a paper on the morphology and anatomy of certain *Nymphæaceæ*.—Mr. J. H. Burrage read a paper on the adhesive discs of *Ercilla spicata*, Moq.

Entomological Society, February 17.—Mr. R. McLachlan, F.R.S., Vice-President and Treasurer, in the chair.—Messrs. Champion and Jacoby exhibited the collection of Phytophagous Coleoptera made by Mr. H. H. Smith in Grenada and the Grenadines for the West India Exploration Committee of the Royal Society.—Mr. F. C. Adams exhibited rare Diptera taken in the New Forest during the preceding year, and including *Callicera ænea* and *Nephrocerus flavicornis*.—Mr. M. Burr showed an example of an undetermined species of locust taken in the Post Office at Bedford Street, Strand, and six new species of Acrydiidæ of different genera.—The Secretary exhibited a Cicada larva from which a fungus, probably *Cordyceps sobolifera*, was growing, which had been sent to the Society from Venezuela, with an inquiry as to its real nature.—The Rev. Dr. Walker showed a series of Coleoptera, Hymenoptera, and Diptera, collected in the Orkney Islands during the previous season.—Mr. Tutt exhibited bred examples of the extreme radiate variety of *Spilosoma lubricipeda*. This variety occurred naturally in Heligoland, and its existence in Great Britain was probably attributable to accidental importation.—Mr. Jacoby and Mr. Champion communicated a list of the Phytophagous Coleoptera obtained by Mr. H. H. Smith in St. Vincent, Grenada, and the Grenadines, with descriptions of new species.

Geological Society, February 19.—The following officers were elected:—President: Dr. Henry Hicks, F.R.S. Vice-Presidents: Prof. T. G. Bonney, F.R.S., Lieut.-General C. A. MacMahon, J. J. H. Teall, F.R.S., and Dr. Henry Woodward, F.R.S. Secretaries: J. E. Marr, F.R.S., and R. S. Herries. Foreign Secretary: Sir John Evans, K.C.B., F.R.S. Treasurer: Dr. W. T. Blanford, F.R.S. The medals and funds were awarded as announced in NATURE of January 14 (p. 256). The President delivered his anniversary address, which dealt with some recent evidence bearing on the geological and biological history of Early Cambrian and Pre-Cambrian times.

EDINBURGH.

Royal Society, February 15.—Prof. Geikie in the chair.—A paper, by Prof. Crum Brown and Dr. Bolam, on the electrolysis of potassium ethyl-sulphone-acetate was read by the former. The electrolysis of this salt takes place in a manner quite analogous to that of potassium acetate, the product corresponding to ethane $(CH_3)_2$ being ethylene di-ethyl-sulphone $(CH_2.SO_2.C_2H_5)_2$.—A paper by Lord Kelvin, on configurations of minimum potential energy in clusters of homogeneous molecules, with application to the theory of crystalline forms, was read by Prof. Tait.—Dr. Beattie described further experiments, conducted by Lord Kelvin, Dr. Smolan, and himself, on the apparent and real diselectrification of solid insulators by flame, by air in contact with white-hot metal, by ultra-violet light, and by Röntgen rays (see p. 343).—Prof. Gibson read a paper on photo-chemical action.—Prof. Tait read a paper on the compressibility of salt solutions. On the hypothesis that the compressibility of an aqueous solution of a salt is inversely proportional to its internal pressure, an attempt is made to find the *effective* volume of the dissolved salt, as compared with its volume in the solid form. The experimental data have been employed also to find the nature of the changes in the (nearly constant) ratio $(D-1)/S$, where D is the density of the solution, and S the mass of salt in 1 of water. It diminishes slowly with increase of S in all the cases examined, with the single exception of common salt, where it increases slowly. Its actual value has a wide range, being nearly unity for magnesium sulphate, and little more than 0·5 for ammonium sulphate.

MANCHESTER.

Literary and Philosophical Society, February 9.—Dr. Edward Schunck, F.R.S., President, in the chair.—On hypoiodous acid and hypoiodites, by R. L. Taylor. The author referred to the work done on the subject by Schönbein, by Lunge and Schoch, by Schwicker, and, more recently, by Walker and Kay, and pointed out that, when an aqueous solution of iodine is treated with an alkali, a solution is obtained which bleaches much more strongly than chlorine water or hypochlorites. He also investigated the action of aqueous solution of iodine on mercuric oxide, and finds that hypoiodous acid is formed, but possesses very feeble bleaching properties, which, however, are greatly increased by the addition of a small amount of alkali. Hypoiodous acid also appears to be formed by the action of iodine water on certain silver salts; but this solution is much less stable, and loses 90 per cent. of its bleaching power in five minutes.

PARIS.

Academy of Sciences, February 22.—M. A. Chatin in the chair.—Note on the sixth volume of the "Annals de l'observatoire de Bordeaux," by M. Lœwy. The present volume contains a memoir by M. Rayet on the climate of Bordeaux, one by M. Kromm on the Comet 1893 III., and further observations relating to a revision of the austral zones of Argelander.—On the physiological *rôle* of the leucocytes, with especial reference to wounds in the cornea, by M. L. Ranvier. From the observations cited it is maintained that the so-called inflammatory phenomena are really physiological, differing only in intensity from those observed during embryonic development.—On the existence of anode rays analogous to the kathode rays, by M. de Heen.—Photography of the electric radiations of the sun and the solar atmosphere, by the same.—Note on some photographs obtained through plates of various metals, by M. de Sanderval.—Description of the photographic method, allowing of the production of positives in two colours, by M. A. Graby.—On the quadratic integrals of the equations of mechanics, by M. Lévi-Civita.—Remarks on the preceding communication, by M. Appell.—On the formation of the solar system, by M. du Ligondès.—A reply to the objections raised by M. Wolf to M. Faye's theory.—Automatic recording of the bending in the testing of metals, by M. Ch. Fremont.—New method for producing transparent crystals, by M. Ch. de Watteville. If the crystal is kept slowly rotating during its growth, its lustre and transparency are much increased.—On pyrosulphuryl chloride, by M. A. Besson. This substance can only be obtained pure by fractional distillation under reduced pressure. Its boiling point is 53° C. under 15 mm. pressure, 142° C. at 765 mm., and its melting point − 39° C. The reactions with hydrogen bromide, hydrogen iodide, hydrogen sulphide and phosphide are given.—Anethol and its homologues, by MM. Ch. Moureu and A. Chauvet. The method of preparation described is a simplification of the original synthesis of Perkin.—On the soluble oxidising ferment causing the decolorisation of wine, by M. P. Cazeneuve.—On the examination of white wines for coal tar dyes, and the differences between these colours and the caramel colours, by MM. Alb. d'Aguiar and W. da Silva. The reagent employed is amylalcohol acting upon the wine rendered alkaline with ammonia.—Experimental researches on the mechanism of cutaneous hyperemia, by MM. Jacquet and Butte.—On the part played by recurring images in the irradiation phenomena shown by short flashes of light, by M. Aug. Charpentier.—Absorption of nitrogen and hydrogen by the blood, by M. Christian Bohr. The absorption of nitrogen by blood is always somewhat greater than that absorbed by water under similar conditions, and this difference is much increased if oxygen is present along with the nitrogen.—A new generic type of mycomycetes, by M. E. Roze.—The use of sulphate of iron for the destruction of the parasitic cryptogamia of the vine, by M. Croquevielle.—On a crystallised mineral (metabrushite) formed in a leaden coffin, by M. A. Lacroix.—On the Cretaceous beds in the region of Mondégo, by M. Paul Choffat.—The second international ascent of the *Aérophile*, by MM. Hermite and Besançon. The highest point reached was about 15,000 metres, and the minimum temperature − 66° C.

AMSTERDAM.

Royal Academy of Sciences, November 28, 1896.—Prof. vande Sande Bakhuyzen in the chair.—Prof. van Wÿhe exhibited a number of anatomical preparations fixed by means of formol, and discussed the conception of the spinal nerve as a complex of two independent nerves.—Mr. Hamburger dealt with the influence of respiration upon the size and shape of the blood corpuscles. In the minute blood-vessels of the tissues the red and the white blood corpuscles undergo a swelling; in the capillaries of the lungs they shrink again. Notwithstanding the swelling the *red* corpuscles show, on microscopic examination, a decrease of diameter. This is to be ascribed to their losing their biconcave flattened form under the given circumstances, and their tendency to assume the globular shape. The swelling is accounted for by the fact that under the influence of CO_2 the proportion of water-absorbing substances increases in a greater measure in the blood corpuscles than in the serum. This brings about a disturbance in the osmotic equilibrium, in consequence of which the blood corpuscles absorb water and swell.—Mr. Jan de Vries presented a paper on geometrical proofs of theorems in number.—Prof. van der Waals presented, for publication in the Academy's *Proceedings*: (1) On behalf of Prof. C. A. J. A. Oudemans, a paper, entitled "Notice sur quelques champignons nouveaux." (2) On behalf of Prof. Kamerlingh Onnes: (*a*) A paper by Mr. L. H. Siertsema, on temperature-coefficients of aneroids. As causes of the usually rather high temperature-coefficients of aneroids are adduced 1° the expansion of the metal, 2° the decrease of the elasticity-coefficients of spring and vacuum box, 3° the expansion of the residual air in the box. An investigation into the consequences of 1° shows that this cause can produce only a small part of the temperature-coefficient. If this cause be left out of account in a first approximation, then the temperature-coefficient λ, when deduced from 2° and 3°, is found to be $\lambda = p(\alpha + \eta) - A\eta$, in which p represents the pressure of the air in the box at 0°, α the expansion-coefficient of air, η the quantity by which the variation of the elasticity-coefficient of the spring is measured $[E_t - E_o(1 - \eta t)]$, and A the barometric pressure. A comparison with what has been observed experimentally on this point shows that the formula is not in opposition with experience. For a complete numerical comparison, however, more data would be required. (*b*) An account of some further experiments made by Dr. Zeeman in the Leyden Laboratory, concerning the influence of magnetism on the lines of the spectrum (see pp. 347, 370). (3) On behalf of Mr. J. D. van der Waals, junr., some observations on the law of corresponding states, in which the results of an investigation concerning alcohol and ether by Battelli are compared with those arrived at by Young.—Prof. Lorentz, on the entropy of a gas. The author considers the connection between Boltzmann's H-function and the entropy.—Prof. Schoute, on the position of the sixteen foci of a circular cubic and a bicircular quartic.

DIARY OF SOCIETIES.

THURSDAY, MARCH 4.

ROYAL SOCIETY, at 4.30.—Experiments on the Absence of Mechanical Connection between Ether and Matter: Prof. Lodge, F.R.S.—Second Report on a Series of Specimens of the Deposits of the Nile Delta. Communicated by desire of the Delta Committee: Prof. Judd, F.R.S.—The Palæolithic Deposits at Hitchin and their Relation to the Glacial Epoch: Clement Reid.—Luminosity and Photometry: Prof. J. B. Haycraft.
ROYAL INSTITUTION, at 3.—Greek History and Extant Monuments: Prof. Percy Gardner.
SOCIETY OF ARTS, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.
LINNEAN SOCIETY, at 8.—On a Trichoderma parasitic on *Pellia epiphylla*, Corda: W G. P. Ellis.—New Species of Perichæta from New Britain, &c.: Dr. W. B. Benham.
CHEMICAL SOCIETY, at 8.
SANITARY INSTITUTE, at 8.—Objects and Methods of Inspection: Dr. J. F. J. Sykes.
CAMERA CLUB, at 8.15. Captain Abney, C.B., F.R.S.

FRIDAY, MARCH 5.

ROYAL INSTITUTION, at 9.—Some Curiosities of Vision: Shelford Bidwell, F.R.S.
GEOLOGISTS' ASSOCIATION, at 8.—Some Properties of Precious Stones: Prof. Henry A. Miers, F.R.S.

SATURDAY, MARCH 6.

ROYAL INSTITUTION, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh.
ESSEX FIELD CLUB (at Buckhurst Hill), at 7.—The Post-Pliocene Non-Marine Mollusca of Essex; A. S. Kennard and B. B. Woodward.—Variation of Lepidoptera: J. W. Tutt.

MONDAY, MARCH 8.

IMPERIAL INSTITUTE, at 8.30.—Imperial Aid to Solar Research, with an Account of Recent Eclipse Expeditions: J. Norman Lockyer, C.B., F.R.S.
ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Recent Discoveries South of Hudson Bay: Dr. Robert Bell.
SANITARY INSTITUTE, at 8.—Factories, Workshops, and Offensive Trades: Prof. A. Bostock Hill.
CAMERA CLUB, at 8.15.—Some Recent Investigations relating to X-Ray Work: Campbell Swinton.

TUESDAY, MARCH 9.

ROYAL INSTITUTION, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.
ROYAL HORTICULTURAL SOCIETY, at 1.—Microscopic Gardening.
ANTHROPOLOGICAL INSTITUTE, at 8.30.
PHARMACEUTICAL SOCIETY, at 8.
INSTITUTION OF CIVIL ENGINEERS, at 8.—Papers to be further discussed: The Main Drainage of London: J. E. Worth and W. Santo Crimp.—The Purification of the Thames: W. J. Dibdin.—Paper to be read, time permitting: The Mond Gas Producer Plant and its Application: H. A. Humphrey.
ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Demonstration on the Making of Pictures: W. L. Wyllie.
ROYAL VICTORIA HALL, at 8.30.—Cyprus: A. H. Smith.

WEDNESDAY, MARCH 10.

SOCIETY OF ARTS, at 8.—The Prevention of Fires due to the Leakage of Electricity: Frederick Bathurst.
GEOLOGICAL SOCIETY, at 8.—Volcanic Action in Guatemala in relation to Earthquakes in the British Isles: A. Gosling.—The Red Rocks near Bonmahon on the Coast of Co. Waterford: F. R. Cowper Reed.—On the Depth of the Source of Lava: J. L. Lobley.

THURSDAY, MARCH 11.

ROYAL SOCIETY, at 4.30.
ROYAL INSTITUTION, at 3.—Greek History and Extant Monuments: Prof. Percy Gardner.
SOCIETY OF ARTS, at 4.30.—Prevention of Famine in India: Sir Charles Alfred Elliott, K.C.S.I.
MATHEMATICAL SOCIETY, at 8.—On a Law of Combination of Operators bearing on the Theory of Continuous Transformation Groups: J. E. Campbell.—A System of Circles associated with a Triangle: Prof. Steggall.
INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—On some Repairs to the South American Company's Cable off Cape Verde, 1893 and 1895: H. Benest.
CAMERA CLUB, at 8.15.—Forty Years Mountaineering: Hon. Justice Wills.

FRIDAY, MARCH 12.

ROYAL INSTITUTION, at 9.—The Source of Light in Flames: Prof. A. Smithells.
PHYSICAL SOCIETY, at 5.—A Mechanical Cause of Homogeneity of Structure and Symmetry Geometrically investigated, with special application to Crystals and to Chemical Combination (illustrated by Models): William Barlow.
ROYAL ASTRONOMICAL SOCIETY, at 8.
MALACOLOGICAL SOCIETY, at 8.
ANATOMICAL SOCIETY (University College), at 4.
INSTITUTION OF CIVIL ENGINEERS, at 8.—The Inverness Section of the Inverness and Aviemore Railway: H. F. Brand.

SATURDAY, MARCH 13.

ROYAL INSTITUTION, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh.
ROYAL BOTANIC SOCIETY, at 4.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Les Piles Électriques: Ch. Fabry (Paris, Gauthier-Villars).—A Study of the Sky: Prof. H. A. Howe (Macmillan).—Journal of Malacology, Vol. v. (Dulau).—The Universal Electrical Directory, 1897 (Alabaster).—Whitaker's Titled Persons, 1897 (Whitaker).—Remarkable Eclipses: W. T. Lynn, 2nd edition (Stanford).—Remarkable Comets: W. T. Lynn, 5th edition (Stanford).—Celestial Motions: W. T. Lynn, 9th edition (Stanford).—Relics of Primeval Life: Sir J. W. Dawson (Hodder).—Domestic Science Readers: V. T. Murché, Book v. (Macmillan).—Le Cause Première: E. Ferrière (Paris, Alcan).—A New Poultry Guide for British Farmers and others: K. B. Baghot-De la Bere (Seeley).—Untersuchungen über den Bau der Cyanophyceen und Bacterien: Dr. A. Fischer (Jena, Fischer).—Calendario del Santuario di Pompei, 1897 (Valle di Pompei).—Contributions to the Analysis of the Sensations: Dr. E. Mach, translated by C. M. Williams (Chicago, Open Court Publishing Company).—Researches upon the Antiquity of Man: H. C. Mercer (Ginn).—Vorlesungen über Mathematische Physik: J. Kirchhoff, Vierte Auflage, herausgegeben von Prof. Dr. W. Wien, Erster Band: Mechanik (Leipzig, Teubner).

PAMPHLETS.—Report for 1896 on the Lancashire Sea-Fisheries Laboratory at University College, Liverpool (Liverpool).—The Culture of Vegetables for Prizes, Pleasure and Profit: E. K. Toogood (Ulverston, Holmes).

SERIALS.—Familiar Wild Flowers: F. E. Hulme, Part 1 (Cassell).—English Illustrated Magazine, March (198 Strand).—Longman's Magazine, March (Longmans).—Himmel und Erde, February (Berlin).—Chambers's Journal, March (Chambers).—Contemporary Review, March (Isbister).—Good Words, March (Isbister).—Sunday Magazine, March (Isbister).—Transactions and Proceedings of the Botanical Society of Edinburgh, Vol. xx. Parts 2 and 3 (Edinburgh).—Brain, Part 76 (Macmillan).—Century Magazine, March (Macmillan).—Scribner's Magazine, March (Low).—Muret-Sanders Encyclopädisches Wörterbuch, Lfg. 1, Teil 2 (Grevel).—Memoirs and Proceedings of the Manchester Literary and Philosophical Society, Manchester, 1896-7, Vol. 41, Part 2 (Manchester).—Lloyd's Natural History: Butterflies, W. F. Kirby, Parts 7 and 8 (Lloyd).—Astrophysical Journal, February (Chicago).—Journal of Physical Chemistry, Nos. 3, 4, 5 (Ithaca).

CONTENTS.