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TECHNICAL CHEMISTS AS "MADE IN GERMANY."

Chemische Technologie an den Universitäten und technischen Hochschulen Deutschlands. By Dr. Ferdinand Fischer, Professor in the University of Göttingen. (Braunschweig: Vieweg and Sohn, 1898.)

THIS is only a pamphlet of 54 pages, but it deals with matters of the utmost importance in the industrial struggle of this country with Germany. At intervals during the last twenty years the note of alarm has been sounded in this country with respect to the state of our chemical industries as compared with the development in this direction going on abroad, and especially in Germany.[1] The newspaper press has from time to time called attention to this matter; the modern revival in technical education has been largely influenced by such representations and, as a sign of the times, a special sub-committee was appointed by the Technical Education Board of the London County Council for the purpose of inquiring into the teaching of chemistry in London, the report of this committee having been published early last year. It is perhaps unnecessary to point out that, in spite of our recent efforts to recover lost ground, and to bring our chemical industries up to that position of supremacy which they held before the war of 1870–71, our educational machinery is still so far behind that of our Teutonic colleagues and competitors, that the German universities are now largely recruited by English and American students who are preparing for careers as chemical manufacturers. In stating that this condition of affairs is discreditable to our country, we are only paying our German friends that homage due to a nation which has all along recognised the supreme importance of the bearing of science upon industry. While we have been expending large sums in promoting "Polytechnics" of our own type, the Germans have been extending and improving their educational institutions so as to provide the highest and most specialised kind of instruction by the best experts that their country could supply. In brief, we have been "playing to the gallery" while the Germans have been addressing themselves to the private boxes and stalls; and if any doubt exists as to which kind of performance is producing the greatest effect upon the development of the chemical industries of the respective countries, we need only refer to our Patent Office records and the Board of Trade returns.

Under the title "Das Studium der technischen Chemie an den Universitäten und technischen Hochschulen Deutschlands," Dr. Fischer published a small work in 1897, from which it appears that for many years the question of introducing a general State examination for chemists has been undergoing discussion in German chemical circles. The subject has been further considered since 1897 by an Imperial Commission of inquiry (*Enquêtecommission*), composed of ministers and representatives of science and industry, and also by a union of German chemists, composed of professors and manufacturers, at several congresses. The results of these deliberations and the views of the various authorities have all been brought together in the present pamphlet by Dr. Fischer, and we recommend our chemical manufacturers to pay very serious attention to its contents.

In plain English, Germany has taken alarm at the symptoms of revival in industrial activity and in technical education going on here and elsewhere. It is not for the writer to say whether this alarm is well-grounded or not. But the Germans are justly proud of their supremacy in this branch of industry, and they are determined to keep well to the front. In a speech made in the Prussian Parliament, on March 8 of last year, Dr. Böttinger, referring to the subject of a State examination, said:—

"Wenn auch die Fragen noch nicht definitiv erledigt sind und noch vielfach schweben, so ist doch nicht zu übersehen, und wir können die Hoffnung aussprechen, dass wir hierin etwas Positives erreichen werden, was zur Hebung Deutschlands auf diesem Gebiete beitragen wird, so dass Deutschland bleiben wird, was es bisher war: der *primus omnium* auf dem Gebiete der Chemie."

We prefer to give this and the following extracts from the same speech in the speaker's own words, as much of their force would be lost by translation:—

"Ich möchte vor Allem an den Herrn Cultusminister die Bitte richten, diese Frage, betreffend die Weiterbildung unserer Chemiker, als eine dringliche zu betrachten, und die Geldfrage nicht zu sehr in den Vordergrund treten zu lassen. Meine Herren, wir müssen vermeiden, dass wir Chemiker zweiten Ranges erziehen; wir müssen erstreben, dass auch unsere deutschen Chemiker Chemiker erster Qualität sind, dass auch für sie das Wort 'made in Germany,' wenn ich so sagen darf, eine weitere Auszeichnung ist, wie überhaupt auch die Professoren und Lehrer an unseren Hochschulen das *primus omnium* sind und bleiben" (p. 14).

"Meine Herren, ich möchte doch betonen, dass Eile Noth thut, und diese Frage nicht auf die lange Bank geschoben werden darf. Denn die im gewissen Grade souveräne Stellung Deutschlands auf dem Gebiete der Chemie wird eifersüchtigst verfolgt, vor Allem noch von Frankreich, England und Nordamerika, wo man mit aller Energie gegen uns vorzugehen sucht" (p. 17).

"Ich will nicht alles das wiederholen, auf was ich im letzten Jahre hier verwiesen, und will nur betonen, es waren nicht leere Worte, nicht leerer Schall, sondern es waren ernste Wahrheiten, die auf persönlicher Beobachtung der Verhältnisse basirt waren. Auch im vergangenen Jahre hatte ich weitere Gelegenheit, mich zu überzeugen, wie ernstlich wir aufpassen müssen. Ja, ich möchte sagen, unsere deutschen Chemiker müssen alles aufbieten, damit es heisst: *Sauve-toi*" (p. 17).

The outcome of these discussions, as Dr. Fischer tells us in the preface to his pamphlet, is a very decided expression of opinion, both by the Imperial Commission and by the German Chemical Union, that the subject of technical chemistry or chemical technology is one of essential importance to their welfare as a manufacturing nation, and that it should be more taken up by the Universities than has hitherto been the case. It is pointed out that about 95 per cent. of all chemical students become technologists, and that with the exception of Berlin and Göttingen, which possess chairs of Applied Chemistry, very few of the Universities give special recognition to this subject.

[1] See a paper by the writer of this notice in NATURE, vol. xxxiv. p. 324.

That the vaunted supremacy of Germany in chemical industry is not a mere political cry, prompted by patriotic bias, appears with stern reality in every speech or resolution recorded in the pages before us. Neither is there any hesitation in assigning this supremacy to its true causes; to State recognition of science and to the association of science with industry. The statement of Dr. Duisberg, adopted by the German Chemical Union at their Hamburg meeting, and presented to the Ministry, contains the following statements :—

"Die chemische Industrie Deutschlands, eine Quelle unseres Nationalwohlstandes, ist Dank den vereinten Bemühungen von Wissenschaft und Technik und Dank der Unterstützung, die ihr immer von Seiten der Reichs- und Staatsregierungen zu Theil geworden, auf eine Höhe gelangt, die den Neid aller mit uns auf dem Weltmarkte concurrirenden Nationen hervorgerufen und diese veranlasst hat, zur Hebung dieser Industrie und dieser Wissenschaft grössere Anstrengungen als bisher zu machen. . . . Es hiesse an unserer Nation Frevel begehen, wollten wir stehen bleiben und nicht Alles einsetzen, um im Wettkampfe der Völker auf chemischem Gebiete stets an der Spitze zu sein."

The same point, the marching of the men of science hand in hand with the technologists, is insisted upon by Dr. Böttinger in the speech already referred to, and this authority makes the further statement that (presumably in Germany) the want of technical chemists is even now perceptible. In a former speech Dr. Böttinger told the country that the total value of the exports of chemical products amounted in 1896 to 340 million marks: he pointed out that the larger portion of the raw materials used in preparing these finished products were imported into Germany from foreign countries, and he adds this very significant remark :—

"Diese Industrie ist eigentlich ursprünglich keine deutsche gewesen. Ein grosser Theil dieser Industrie hat zuerst in England und Frankreich existirt, sie ist dann aus jenen Ländern—besonders derjenige Theil, der sich auf die höhere, auf die rein organische Chemie bezieht—zu uns herübergegangen, und wird ausschliesslich oder fast ausschliesslich heute von uns der Weltmarkt mit deren Producten versorgt."

While unanimity prevails as to the desirability of founding chairs of technical chemistry in the German universities, the decision of the other question, the establishment of State examinations for technical chemists, is for the present deferred, since there is a division of opinion on this subject. Many of the professors of the universities and technical high schools have expressed their views, and it is obvious that the point will be a difficult one to settle when we find such names as those of Ostwald, A. v. Baeyer and Otto Witt, who are opposed to the examinational scheme, confronted by the names of Duisberg, Böttinger, Holtz, Lunge, &c., who are in favour of it.

Not the least striking feature of the speeches recorded in this pamphlet is the earnestness of the plea, put forward more especially by Dr. Böttinger, on behalf of the great national importance of chemistry, and the direct relationship of this science to various ministerial departments of the Imperial Legislature. The speaker even allows himself to be carried away by a poetical simile in comparing the unobtrusiveness of the chemist, as contrasted with his importance, to the aroma of the violet which flowers in concealment but delights man with its fragrance. He quotes also the sayings of English statesmen like Lords Beaconsfield and Rosebery, and Mr. A. J. Balfour, who have at various times called attention to German supremacy in the chemical industries. Reference is made also, to an article in the *North American Review*, the writer of which states that the nation which possesses the best chemists is bound in the long run to come to the fore-front. Dr. Böttinger distinctly suggests a falling off in German activity in the domain of inorganic chemistry :—

"Tüchtige anorganische Chemiker muss man heute be uns, ich möchte fast sagen, mit der Lanterne suchen; sie zu finden, ist oftmals vergeblich" (p. 33).

He deplores the migration of American students from the German high schools to Paris to learn this branch of the science; he even laments that the discovery of argon and helium did not proceed from one of their own laboratories, and he takes genuine alarm at the incursion made by the Americans into the manufacture of astronomical instruments, although, as he concedes, the glass for the lenses is of German make.

That Germany has taken alarm at the progress being made in other countries is manifest on every page of the pamphlet before us. The writer of this notice is inclined to believe that Dr. Böttinger and others take a pessimistic view of their own position; but the policy of "forewarned, forearmed" is obviously the moving principle of the present agitation. That which is of most importance to us here is the lesson conveyed by the manner in which our rivals propose to meet the competition which threatens the supremacy of their chief industry. They are urging the Government to establish chairs of technical chemistry in their universities. In this country there is a very widespread notion that technical chemistry cannot be taught in educational institutions at all. The leading chemical nation in the world has come to a different conclusion. If our chemists are anxious to know what this technical chemistry is, we commend to their notice a statement in the memorial of the German Chemical Union :—

"Technical chemistry as a branch of general chemistry is not, as is often erroneously supposed, the transference of chemical science to practical applications, but it is a science in itself . . . the flowering and thriving of which we owe to German chemical industry."

Dr. Duisberg and others lay it down as a general principle that the students of this subject should not be taken too deeply into all the details of technology, but that they should possess a general knowledge of raw materials, apparatus and processes; that they should be made to appreciate the difference between laboratory and factory operations; that the chemistry of technical processes should be taught in special courses of lectures, and the construction of plant illustrated by exact drawings and by inspection of works.

There are many other points in this compilation of Dr. Fischer's, which are full of significance for our own country; but enough has been culled from the pamphlet to show which way things are going in Germany. We could, I am afraid, supply our Teutonic competitors with a painful number of illustrations of methods of how not to teach technical chemistry—illustrations of the very highest (negative) value. It is often, and justly, urged by the critics of our educational methods that we are the slaves of the examination system. But there is another demon that has come into our midst of late years, which also wants exorcising—the statistical demon. The committees of most of our educational establishments seem to have the one idea that success is measured by numbers of students turned out. The following statement, by Prof. Naumann, might profitably be stereotyped into an aphorism for the use of some of our technical instruction committees and kindred bodies :—

"Der deutschen chemischen Industrie kommt es nicht auf die Zahl der gelieferten Chemiker an, sondern auf ihre Qualität."

In concluding this notice, it is difficult to refrain from instituting a comparison between the methods adopted by the Germans and ourselves for dealing with the same problem of foreign competition. Instead of catering for the highest kind of work, and aiding existing teachers and institutions to do such work, we seem to prefer adopting a policy of broadcast smattering. If any bold advocate points to signs of decadence in any particular industry, the statistical juggler is always at hand to prove that he is mistaken. When we have achieved supremacy in any department and meet with competition, the educational machinery is the last line of our defence which is strengthened instead of being, as in Germany, the first. That we have been enabled in the past to achieve eminence without technical education is sometimes even now used as an argument that technical education is unnecessary. Our chemical manufacturers will do well to take Dr. Fischer's pamphlet, and the lesson which is contained therein, as a very serious sign of the coming struggle. So far as organic chemical products are concerned, the expression "made in Germany" is one of which that nation may now well be proud.

R. MELDOLA.

SEWAGE PURIFICATION AND SEWERAGE.

The Purification of Sewage; being a brief Account of the Scientific Principles of Sewage Purification and their Practical Application. By Sidney Barwise, M.D. (London), M.R.C.S., D.P.H. (Camb.), Medical Officer of Health to the Derbyshire County Council. Pp. xii + 150. (London : Crosby Lockwood and Son, 1898.)

Sewerage. The Designing, Construction, and Maintenance of Sewerage Systems. By A. Prescott Folwell, American Member Society of Civil Engineers. First Edition. Pp. x + 372. (New York : John Wiley and Sons. London : Chapman and Hall, Ltd., 1898.)

THE question of the hour is—What steps are to be taken for the disintegration of sewage without the addition of chemicals? Going a little outside this, Dr. Sidney Barwise has collected a certain amount of information which he thinks may be useful to his fellow medical officers of health. He points out that during recent years

"great advances have been made in our knowledge of the changes which sewage undergoes in purification, and not a few conclusions of wide-reaching importance established ; and it is hoped that the presentation in this little work of some of the results thus obtained will be found useful by engineers and others, officials who wish to avail themselves of the latest researches of chemists and biologists upon the questions of sewage purification."

Although the work may be said in a certain sense to be an elementary text-book, it is something more, as the author has collected in handy though somewhat sketchy form a number of the more important observations on the chemistry and bacteriology of the decomposition of sewage. After describing sewage, its varieties, the changes that it undergoes, and its chemistry, Dr. Barwise indicates the effects of river pollution and the processes by which the water becomes purified ; he goes on to give an account of "land treatment" of sewage, of precipitation, precipitants, and tanks, filtration or nitrification ; and then describes in detail some of the special forms of sewage filters, especially Mr. Dibdin's filter, used in the experiments carried on by the London County Council ; Colonel Ducat's filter, Garfield's coal filter, the Lowcock filter, and the Scott Moncrieff and Cameron filters.

Perhaps the most important feature of this work is that in which the author has attempted to compare the different sewages with which various experiments have been carried on in this country and in America. There can be little doubt that this question of comparative composition of sewage is one of great importance in determining what the various processes are capable of achieving, and therefore which process is best fitted for use in any special region. Taking the chlorine content as an index of the strength of sewage, it is evident, for example, that very different results would be obtained with any system in which an attempt is made to deal with, say, the Lawrence (Mass.) sewage, which contains 43 parts of 100,000 of total solids, and 4·8 parts of chlorine ; or the Exeter sewage, with 54·4 parts total solids and 5 parts chlorine ; and London sewage, which contains 123·5 parts total solids and 15·2 of chlorine ; or, again, the Berlin sewage, which contains 218·3 parts of total solids per 100,000 and 21·8 of chlorine. There can be no doubt, however, that with many of the bacteriolytic methods described, remarkable results have been obtained, and statistics are given indicating the amount of purification brought about by each system ; but the author very wisely in his conclusions points out that before it is possible to answer the question, "What processes shall we adopt to purify our sewage?" there must be information given as to the nature of the sewage, the facilities for disposal of sewage on land, the necessity that may arise for precipitation, the amount and nature of manufacturing waste, and the facilities that exist for complete oxidation of the effluent. The author has taken a considerable amount of trouble to collect trustworthy statistics, and were this part alone before the reader it would be worth reading ; but apart from this, the book contains a considerable amount of information—in some instances loosely put together, and not always sufficiently fully set forth—and, taking the work for what it claims to be, it should prove not only of interest but of assistance to those who are engaged in advising sanitary authorities as to what measures it will be necessary to take in order that the requirements of the various Rivers Commissioners may be complied with.

The second book is drawn up on essentially different lines; it is written by a practical engineer, and is largely the outcome of his own experience, though he does not pretend to confine his statements to those based on his own personal observation. On going over the work one cannot but be struck by the fact that, although it is intensely practical, and should prove of very great assistance to young engineers, clerks of works, and in fact to all who have to do with sewer construction, the information is so arranged that it may be utilised in the classroom for the instruction of engineering pupils; for the way in which the author treats the three parts of his subject—designing, construction, and maintenance—must commend itself not only to the practical engineer, but to the teacher in the technical institute and the engineering college.

As regards the requirements of a system of sanitary sewerage, Mr. Folwell lays down the two propositions: (1) that sewage, and all the sewage, be removed without any delay to a point where it may be properly disposed of; (2) that it be so disposed of as to lose, permanently, its power for evil. He describes in order the various methods that from time to time have been adopted to attain these ends. Dry sewage methods and systems, pneumatic systems, water carriage systems, combined and separate systems—first speaking generally, and then giving in some detail the principles involved in, and the data required for, successful sewage disposal, as regards amount of sewage, the flow in sewers, flushing and ventilation, the design, detailed plans, specifications, contract estimate of cost, &c. In a second part, devoted to construction, he goes into the question of preparation, laying out the work, oversight and measurement of work, and practical sewer construction. In the third part he speaks specially of maintenance, of house connection and drainage, and of the maintenance of the sewer itself, dealing specially with flushing and cleaning.

Many parts of this work will be useful to engineers and surveyors in this country, as the question of sewage disposal is, in many of its aspects, the same in America as in Europe, and the following "aphorisms" appeal to all alike: "Many diseases may be contracted by taking into the stomach certain germs which are found to be excreted by those already sick of such a disease, and these germs will exist for days in sewage having any amount of dilution"; "ordinarily sewage does not putresce until from twenty-four to sixty hours after its discharge"; "the only true destruction of the dangerous characteristics of sewage is that effected by oxidation and by removal of the disease-germs"; "oxidation does not destroy but merely transforms the putrescible organic matter into harmless mineral compounds"; and so on.

It is very strongly insisted that corporations are perhaps more inherently selfish than are single individuals, and that consequently corporations have little hesitation in offending their neighbours, or interfering with their hygienic conditions, if they can only manage to do this to their own advantage from a health point of view; and we are glad to see that he insists that engineers should carefully guard themselves against fostering this weakness of those who are their clients. As an example of the different conditions that hold in America and in this country, one has only to turn to the consumption of water in certain of the large cities to know that in most cases the American sewage is far more dilute than the sewage running in the drains of our own large cities. From a table given, including twenty-five American cities, it is seen that there are only three that have a water consumption of under fifty-five gallons per head, whilst eleven cities consume over one hundred gallons per head—from one hundred and twelve to one hundred and ninety-nine gallons; then, too, the consumption is rising steadily from 10 to 100 per cent. every ten years, an increase that is marked throughout. As a result of this the quantity of sewage is steadily increasing, and of course it is becoming more dilute. As one would naturally expect, also, the quantity of storm water is, in many parts of America, a far more important one than it can ever be in this country. We are thus not surprised to see that in Toronto, in 1891, gaugings in different districts made over a period of three days gave a discharge varying between fifty-three gallons per head per diem to three hundred and sixteen gallons. The author remarks that Mr. Gray, who gives these figures, offers no explanation for the high average indicated by this last figure. The very fact that we have these differences, however, should render the book more valuable to English engineers. The suggestions offered in connection with the problem of dealing with these enormous quantities of sewage, may afford hints for dealing with the much smaller quantities that have to be coped with on this side of the Atlantic.

DR. DREYER ON DARWINISM.

Peneroplis, eine Studie zur Biologischen Morphologie und zur Species-frage. Von F. Dreyer. Pp. ix + 119. Plates v. (Leipzig: Engelmann, 1898.)

DR. DREYER'S work on *Peneroplis* is of great interest, not only because of the valuable observations which it contains, but as an indication of the way in which an increasing number of German zoologists regard the problem of animal evolution.

The main part of the work is devoted to a description of the form-varieties of shells of *Peneroplis*, as seen in a sample of sand from the shore of the Red Sea. The description is illustrated by figures of more than two hundred specimens, chosen as examples of the various ways in which the "typical" spiral form may be departed from.

Dr. Dreyer has rightly called his essay "eine Studie zur Species-frage"; for there is no doubt that the conception of a species, which is necessary in attempting to deal with many problems of modern biology, must be based on a knowledge of the whole series of varieties exhibited by the species. And further, this knowledge must be obtained in the way in which Dr. Dreyer has obtained it, by the careful study of a large number of individuals, taken in the first instance at random. Many of the distorted ideas about animal variation which are evident in writings on the subject arise from the belief that variation can be profitably studied in museums, by comparing "typical" specimens with the one or two striking deviations from the type which the curator has chosen to exhibit. There is, however, an additional element, essential to a right conception of a species; and this Dr. Dreyer has not given. He gives admirable drawings and descriptions of a great number of form-varieties, but he does not tell us how often each variety occurred in the 25,000 specimens examined. A table, showing the frequency with which every variety drawn was actually observed, would have added so greatly to the value of the work that it would have been well worth the labour involved in making it.

The essay is apparently published in the hope of stimulating others to undertake an experimental investigation of some of the factors which determine the shapes of rhizopod shells; and the author seems to have undertaken his study of *Peneroplis* as a preparation for experimental work of the same kind. Every reader will wish Dr. Dreyer a full measure of success in the difficult task he has set himself to accomplish.

For the reason just given, little attempt is made to use the observations recorded as a basis for generalisation; but the last chapter contains certain criticisms of current biological doctrines, which seem based upon fundamental misconceptions. It is difficult to convey an exact idea of a writer's meaning by quoting short extracts, but the following passages express Dr. Dreyer's position fairly well. In discussing the conception of animal evolution he says:

"Gesetzt aber auch, die genealogische Entwicklung im ganzen oder in diesem oder jenern ihrer Zweige befände sich vollständig und sicher in unserem intellektuellen Besitz, so hätten wir hiermit eine Entwicklung, die wir naturgesetzlich eben so wenig verständen, wie die einzelnen Lebensformen, aus denen sie sich zusammensetzt."

It is, of course, perfectly conceivable that we might know the exact genealogy of all living species, or of some of them, without knowing anything of the process by which the modifications undergone by the ancestral species has been effected; but the statement that species are susceptible of modification in the course of generations, if it is true, is itself the statement of a natural law; so that Dr. Dreyer's meaning is difficult to discover.

Darwin's hypothesis concerning the process by which specific modification has been effected is dealt with as follows:

"Nun ist die Selektionslehre einmal falsch, denn sie steht in krassem Widerspruche zur Wahrscheinlichkeitsrechnung, und wenn sie richtig wäre, würde sie ein Verständniss der uns als leibhaftige Probleme entgegentretende Organismen im nichts berühren, ebensowenig wie . . . diese oder jene Äste eines Baumes damit 'erklärt' sein können, dass sie der Gärtner nicht weggeschnitten hat.

"Wenn also die Ergebnisse der Descendenz forschung problematisch sind und, wenn sie sicher wären, oberflächlich, so ist die Selektionslehre in sich hinfällig, und wenn sie richtig wäre, wäre sie nichtig.

"Es wird nunmehr Zeit dass die jung aufwachsene Biologie von dieser ihrer englischen Krankheit erhole und mannbar werde."

It would be interesting to have a more detailed exposition of the author's reasons for saying that the theory of Natural Selection is in contradiction to the laws of Probability. No case has yet been described in which the phenomena of variation and inheritance have been shown not to obey the law of Probability. If Dr. Dreyer knows of such a case, he would do well to publish his knowledge.

The remainder of the criticism is worth serious notice, in spite of the bad taste shown in the last paragraph, because the objection to the use which is often made of the theory of Natural Selection is perfectly just. It is quite true that a plausible hypothesis about the utility of an organ or of a function is not a proof that it has been produced by natural selection; and when such a phenomenon as Death itself is "explained" by ingenious guess-work of this kind, one feels that much must be forgiven to a hostile critic. But these things are no essential part of the Darwinian theory. Darwin laid down two fundamental propositions—*first*, that the differences in structure between individual animals of the same race or species are associated with differences in the death-rate and power of producing offspring, so that the number of descendants left by an individual is a function of its structure; and, *secondly*, that the effect of differential fertility, associated with structural differences, is often sufficient to change the character of the race or species in the course of successive generations.

These are essentially physiological propositions, which admit of direct experimental verification or disproof. The experimental testing of these two propositions would open up a fascinating field of knowledge, which has been left almost untouched since Darwin himself wrote.

Darwin was so fully occupied in forcing men to recognise the broad fact of structural variation, that he had little time to demonstrate the relation between variation and death-rate. Nevertheless, naturalists have been content for forty years to rest a great generalisation on his work alone, without themselves attempting to amplify it by direct observation and experiment. It is time that a systematic study should be made of the relation between structural abnormality and death-rate, under definitely determined conditions of environment, in a large number of species. If the relation postulated by Darwin generally exists (as the writer believes), it is time that it should be properly demonstrated. If it does not exist, it is time that the belief in natural selection should be given up.

But it is the business of naturalists to formulate the processes of nature as well as they can; and whether the process of Natural Selection interests Dr. Dreyer or not, we ought to want to know certainly whether it occurs. The statement that such a process does affect animals generally, is either a natural law of great importance, or it is untrue. If it is true, it is as absurd to call it "nichtig" because it does not formulate *all* the processes of a living organism, as it would be to call it useless because it does not enable one to foretell tomorrow's weather.

W. F. R. WELDON.

OUR BOOK SHELF.

Elements of Sanitary Engineering. By Mansfield Merriman, Professor of Civil Engineering in Lehigh University. Pp. 216. (New York and London: Chapman and Hall, 1898.)

THE author of this book deals with the whole range of sanitary science, including an historical notice of sanitation from the time of the Israelites in Egypt; the classification of diseases; statistics of mortality as affected by sanitation; bacteriology; the effect of filth, impure drinking water and foul air on health; water supply, storage and filtration; construction of reservoirs and supply of water to towns; sewerage, both for cities and houses; and the disposal of garbage and town refuse. In the introductory chapter the elements of sanitary science which are essential to sanitary engineering are briefly outlined, and in the historical notes it is shown how the filthy habits of the people in early times led to direful epidemics of plague. It is pointed out that "the teachings and practice of the Christian Church during the Middle Ages regarded cleanliness as one of the luxuries which was inconsistent with godliness, while bodily filth was considered as a work of inward piety and holy sanctification. The example set by the monastic orders was imitated by the people at large; bathing was unknown, houses and clothing were filthy, and the streets served as receptacles for garbage and human excreta." Some interesting statistics are given to show how the death rate has decreased as sanitary science has advanced. The annual death rate of the population of London in the latter half of the seventeenth century was nearly 80 per thousand; in the eighteenth century, about 50 per thousand; and soon after the middle of the nineteenth century, about 24 per thousand; and now ranges about 20·5 per thousand. An efficient system of sewerage and water supply has been known to reduce the death rate in large towns in England and the continent from typhoid, from a rate of 2·2 per thousand inhabitants to 0·4 per thousand. The cholera epidemic which visited Hamburg in 1892, caused 8976 deaths, being at the rate of 134 per thousand in Hamburg, where the water supply was proved to be impure and to contain the cholera bacillus; while in Altona and Wandsbeck, adjoining the city, where the water was properly filtered before being supplied, the rate was respectively 23 and 22 per thousand.

This book, which is written for American students of sanitation, does not contain anything that is not known to sanitary engineers of this country. Naturally, in such a small compass it was not practicable to deal with any of the subjects treated in an exhaustive manner; nor can the work be regarded as a text-book, but rather as a well-written and able digest of matters which come within the range of the sanitary engineer.

La Cytologie Expérimentale. By A. Labbé. Pp. viii + 187. (Paris: Carré, 1898.)

THIS neat little book has the attractive form and style which characterises many French science manuals, and shares with them the defects inherent in any attempt to convey the difficult results of refined biological research in short paragraphs, even when written in the clearest of languages. At the same time we must add that it does not profess to be a complete text-book or treatise on the subject, and it is perhaps best described as a series of notes on some modern results of the study of the cell, by a zoologist. Artificial protoplasm and artificial karyokinetic figures are misleading terms to the beginner, and the scraps of information here gathered can be of little or no use to more advanced readers. The action of physical and chemical agents on the structure, metabolism, and movements of the cell seems curiously incomplete, in a French work, without reference to the yeast-plant; and although the notes on chemotaxis are interesting, they might have been rendered more valuable had the botanical side of the question been more fully dealt with. Indeed, throughout the work we notice a lack of appreciation of the work of plant-physiologists, *e.g.* as regards geotropic and heliotropic curvatures—no doubt inevitable where the author is a zoologist, the domain of each subject being now so wide that no one writer can deal adequately with both. Klebs' work on the effects of the environment in modifying the reproduction of algæ, for instance, is not mentioned.

The reciprocity between nucleus and cytoplasm; experimental modifications of cellular reproduction; adaptation to the environment; "tropisms and tactisms"; and cellular differentiation, are the other subjects dealt with.

While finding fault to the extent we have done, it is only fair to add that the subject-matter, so far as it is treated, is fascinating from every point of view, and many of the facts given are extremely interesting—*e.g.* those concerning the artificial separation of the nucleus from animal ova, those on "*cyto-symbiose*" and adaptation to parasitic life, those on intercellular connections, &c. Much more ought to have been said, we think, concerning the discoveries of botanists, especially in connection with the last two subjects.

The illustrations are numerous, well executed, and to the point; and praise must be accorded the glossary and the index to the bibliography, so far as it goes. Finally, we welcome this little book of notes, in the hope that it will be the forerunner of a more masterly treatise on an important and fascinating subject.

Studien über Hirsche (*Gattung* Cervus *im weitesten Sinne*). Heft I. Untersuchungen über mehrstangige Geweihe und die Morphologie der Hufthierhörner im Allgemeinen. By Dr. H. Nitsche. Pp. xi + 102. Plates xii. (Leipzig: W. Engelmann, 1898.)

WHETHER the work of which this first instalment is before us is intended to be a monograph of the *Cervidae*, or whether it is to be restricted to morphological considerations, future parts will decide. The present section deals solely with the morphology of antlers and their relations to the horns of other ruminants. In discussing antlers, most English zoologists of recognised position have confined their attention to normal examples. Not so Dr. Nitsche, who is apparently of opinion that the clue to the homology of the diverse structure of these appendages in different species is to be found in abnormalities, especially such as display a double or triple beam. Such abnormalities are classed under four types, in three of which the additional antler is more or less like the original form, while in the fourth the additional and normal portion together resemble an ordinary antler. Whether the result of these studies will have any important bearing on the classification of the *Cervidae*, cannot well be considered till the appearance of the later parts.

In the meanwhile attention may be directed to the author's very lucid account of the distinctions between the cranial appendages of the Pecora; such distinctions being admirably illustrated in Plate xii. To put it shortly, the author, in opposition to the view of M. Lataste, regards antlers as true outgrowths, or apophyses, from the frontal bones; these processes are at first covered with hairy integument, after the shrivelling-up and removal of which the exposed bare portion eventually falls off from necrosis at the base. In the following year the whole process of growth and shedding is repeated. On the other hand, in the remaining three families of the Pecora, to wit, *Giraffidae*, *Antilocapridae*, and *Bovidae*, the appendages originate as independent bony epiphyses, which become subsequently welded to the frontals. In the giraffe the horns, as these appendages should be called in all the members of the group, are clothed only with hairy skin. In the prongbuck a deciduous and forked horny sheath is superadded to the hairy skin. On the other hand, in the *Bovidae*, the hairy skin is lost, and the bony core is covered simply with a non-branched and non-deciduous horny sheath. The epiphysial origin of the horn-cores of the *Bovidae* is illustrated by a figure of the frontal region of a young chamois.

These distinctions between antlers and the different types of horns are certainly the clearest and neatest that have come under our notice ; and they naturally lead the author to the conclusion that the *Cervidae* form one group, and the other three families mentioned a second division of the Pecora. If his views obtain acceptation, they refute the late Prof. Garrod's theory of the near relationship of the musk-deer to the *Bovidae*.

Whether or no his predilection for abnormalities will bear any good fruit, the author has evidently devoted much pains-taking labour to the present fasciculus ; and the issue of the remaining parts of the work will be awaited with interest. R. L.

Recent Advances in Astronomy. By A. H. Fison, D.Sc. Pp. vi + 237. (London : Blackie and Son, 1898.)

IN the course of half a dozen essays the author of this volume of the "Victorian Era Series" has attempted to give an account of a few of the more interesting problems of modern astronomy. While the book is admirably written throughout, the subject-matter is in some respects not sufficiently up to date. For example, in the essay on the "life of a star," which is otherwise exceedingly interesting, there is practically no reference to the spectroscopic evidence bearing on the subject ; and again, in that on the "analysis of starlight," there is no account of the different kinds of stellar spectra and their probable relationship to each other, most of this chapter being concerned with motion in the line of sight.

One of the best essays is that on Mars, which summarises what we know of that planet, as well as the various speculations to which such knowledge has led.

The book is notably free from errors for a first edition ; but we may point out that the discovery of carbon in the sun was not made in 1887, as stated on p. 187, but was announced by another investigator altogether in 1878.

It is unfortunate that, either for want of time or opportunity, the author has not gained a closer acquaintance with recent spectroscopic investigations. Had he done so, his book would have been much improved. Nevertheless, the selected subjects are treated in an able manner, and the book deserves to be widely read.

Among the Celestials. By Captain Francis Younghusband, C.I.E. Pp. 261. (London : John Murray, 1898.)

THE inspiring volume entitled "The Heart of a Continent," in which Captain Younghusband gave a straightforward record of ten years' travel in Manchuria, across the Gobi Desert, through the Himalayas, the Pamirs, and Chitral to India, was reviewed at length in these columns in 1896 (vol. liv. p. 130). The present volume has been abridged from the original work, by omitting geographical details which, though of service to geographers and travellers, are not of interest to the general public. The previous book will be published in two parts. The first part, now before us, deals with Captain Younghusband's travels in the Chinese Empire, a chapter on the outlook in Manchuria being added. The second part will describe experiences and impressions obtained during travels in the borderland between British and Russian territory in Central Asia.

There should be many readers for Captain Younghusband's interesting narrative in the form it is now presented.

A Cotswold Village: or, Country Life and Pursuits in Gloucestershire. By J. Arthur Gibbs. Pp. xvi + 431. (London : John Murray, 1898.)

FIELD naturalists, and all other admirers of natural life and scenes, will read this volume with pleasure. The book is of the gossipy kind, and village characters and customs figure prominently in it; but many keen observations are recorded, and the descriptions of pastoral scenes will delight all who love the country.

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.*]

Production of Magnetisation by Circularly Polarised Light.

IN NATURE for January 5, Prof. Fitzgerald points out that a beam of circularly polarised light sent through a substance absorbent in consequence of syntony with the vibration ought to produce magnetisation of the substance. The result of the experiments he has set on foot will be awaited with much interest.

In the *Proceedings* of the Royal Society for February 17 of last year Prof. Fitzgerald pointed out also that the Zeeman and Faraday effects are related phenomena. I may mention that in the *Phil. Mag.* for December 1890, I gave a very slight sketch of experiments I had carried out from time to time during several years previously, with the view of discovering the effect which theory had seemed to me to prove ought to be produced by the passage of circularly polarised light through a medium showing the Faraday effect. I have made many experiments of this kind with a bar of Faraday's heavy glass, looking for the production and disappearance of a magnetic field (with the excitation and quenching of the beam) by means of an induction coil wrapped round the bar. Calculation shows that the effect in such a case should be very small—so small as perhaps to be quite inappreciable. The investigation is, however, being resumed with improved apparatus and arrangements which I hope may not be entirely without result.

ANDREW GRAY.

Magnetic Perturbations of the Spectral Lines.—Further Resolution of the Quartet.

FOR some time past I have been in hope that, with the strong magnetic field now at my disposal in the Physical Laboratory of the Royal University of Ireland, I might perhaps be able to effect some further resolution of the spectral lines. For example, in the case of a line which is converted into a triplet (normal type) by a magnetic field of strength 20,000, or thereabouts, it is possible that each constituent of this triplet may become further resolved into a doublet, or a triplet, when the strength of the field is increased to 40,000 or 50,000 C.G.S. units.

Although I cannot yet affirm that the normal triplet becomes further resolved in very intense fields (but symptoms of a further resolution into doublets are sometimes seen), yet, on the other hand, it has been placed beyond all doubt that the "quartet" form becomes further resolved when the strength of the field is increased.

The quartet form, it will be remembered, consists of two strong side lines with two fainter lines between them—the latter pair corresponding to the middle line of the normal triplet. When the strength of the magnetic field is gradually increased, the side lines begin to separate into pairs ; and ultimately, what was at first a quartet stand forth as a sextet of well-defined sharp lines. We may take it, therefore, that the quartet form has ceased to exist as a distinct type, except for this one peculiarity, viz. that in it the separation of the middle pair is considerably greater than that of the side pairs.[1] The exact ratio of these separations I have not yet determined with precision, but I hope to give measurements on this and some other matters at an early date.

It is not to be understood that this further resolution raises any new difficulties in the way of theoretical explanation, for, as I have already pointed out (*Phil. Mag.*, February 1899), the purely precessional perturbation of the orbit which gives rise to tripling pure and simple is by no means likely to be unaccompanied by other subsidiary perturbations of more or less intensity, such as oscillations of the plane of the orbit, apsidal motions, and so on, and such perturbations as these explain the existence of types other than the normal triplet. In fact, things appear very much more natural, as well as more interesting, now that we know that the triplet pure and simple is likely to become the exception rather than the rule.

THOMAS PRESTON.

Dublin, February 9.

[1] On the contrary, D_2 is a sextet of *equally spaced* lines.

The Density of the Matter Composing the Kathode Rays.

IN a note which appeared in NATURE of January 19, I indicated a method by which an approximate limiting value could be deduced for the density of the matter composing the kathode rays. The result arrived at was that this must be small compared with 10^{-15} grams per cubic centimetre. This estimate seems to be confirmed by results recently published by E. Riecke (*Wied. Ann.*, 66, p. 954) on the reaction-pressure exerted on the movable kathode-vanes of an electric radiometer. A theoretical investigation leads the author to the result, that this pressure is equal to mu^2, in the notation of my former note (m, mass per unit volume; u, velocity of the particles). His numerical results give an average of about ·04 dynes per square centimetre for the pressure, and he deduces for u, theoretically, the value $9{\cdot}6 \times 10^8$, or, say, 10^9 roughly. Using these numbers, m comes out about 4×10^{-20}.

Queen's College, Belfast, February 11. W. B. MORTON.

Earthquake Echoes.

AN earthquake disturbance, as recorded at a station far removed from its origin, shows that the main movement has two attendants—one which precedes, and the other which follows. The first of these by its characteristics indicates what is to follow, whilst the latter in a very much more pronounced manner repeats at definite intervals, but with decreasing intensity, the prominent features of what has passed. Inasmuch as these latter rhythmical but decreasing impulses of the dying earthquake are more likely to result from reflection than from interference, I have provisionally called them *Echoes.* Although I see an explanation for the orderly arrangement and features of the precursory vibrations, it is sufficient if I confine my remarks in this note to the reverberations which apparently succeed an earthquake.

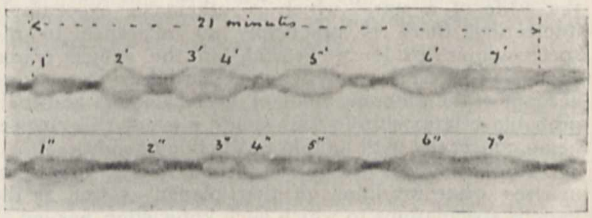
If it can be shown that our world resounds with earthquake echoes, hypotheses at once suggest themselves as starting-points for new investigation.

It is, therefore, of importance that before the idea of earthquake reverberations should be crystallised, the evidence we have of the supposed vibrational repetition should be carefully scrutinised, and that opinions should be expressed respecting the interpretations of observations like the following. When an earthquake is comparatively small, and has originated as a single effort at no great distance (one or two thousand miles) from the observing station, the seismogram shows a single set of preliminary tremors, of short duration, a single set of pronounced vibrations corresponding to an irregularly delivered originating impulse, and finally a series of concluding vibrations which rise and fall in value every three or four minutes. That which appears on a seismogram as a two-blow earthquake terminates with dual reinforcements. As illustrative of this, I may refer to the Isle of Wight seismogram of the South Indian Ocean earthquake of August 31, 1898, copies of which have been sent to the members of the Seismological Investigation Committee of the British Association, and to their various co-operating stations. We have apparently here two large disturbances followed by pairs of echoes. If we closely examine the first pair of these responses (the second pair being too small to exhibit details), we find that its subdivisions roughly agree in character with those observable in the collection of movements which make up the primary impulses. Calling the first maximum 1, and its following echoes 1′, 1″, and 1‴; and the second maximum 2, and its following echoes 2′, 2″, and 2‴, the time intervals expressed in minutes between these various phases are

1 to 1′ = 12.	1′ to 1″ = 8.	1″ to 1‴ = 4.
2 to 2′ = 10.	2′ to 2″ = 7·5.	2″ to 2‴ = 3·5.

In considering these intervals it must be remembered that 1 is greater in amplitude and period than 2, whilst 1′ is similarly greater than 1″, &c. Now, seismological observation appears to point to a result that is difficult to accept, viz. that the smaller the amplitude of a wave, and the shorter is its period, the higher, apparently, is the velocity of its propagation. Should this be so, then it follows, as is indicated by the above series of intervals, that the smaller echoes should return more quickly than those which precede them. A much more certain observation is made when this earthquake is regarded as resulting from a single impulse, and what has been treated as the second maximum is examined as its echo. We then see that the five crests, constituting what has been called the first blow or impulse, are repeated in what has been called the second blow by a five-crest echo, the intensity of each component corresponding with that of its primary. After this we get another five-crest group, followed by two groups each of four crests, beyond which point rhythmical recurrence is lost. A very good illustration of what may be multiple echoes is found in the Isle of Wight seismogram for June 29, 1898. This is a very large earthquake, which probably caused the whole of the earth to pulsate, and its preliminary tremors indicate that it originated at a very great distance. It had a duration exceeding three hours. The main disturbance shows more than fourteen maxima of motion which have a fairly symmetrical arrangement to the right and left of a central dividing line.

Between these first movements and the first set of responses, which commence suddenly, a faint but very uncertain likeness may be seen. When, however, we compare the responses, amongst themselves they apparently show a repetition in form and a uniformity in their time of recurrence that can hardly be the result of accident. To facilitate such a comparison two series of these concluding vibrations are here photographically reproduced, the first series being placed above the second.



It will be noted that the triangularly-headed echo 1′ is not unlike 1″; its spherically-formed successor 2′ is repeated in 2″; and so we may continue through the series until we reach the gourd-formed 6′ and 7′, reflected in corresponding shape by 6″ and 7″. Other points of likeness may be seen between 4 and 5 and between 5 and 6. I may add that if the photogram had been made longer, then three groups of waves would have preceded 1′, which would correspond in form and time with three groups preceding 1″.

The time intervals between these corresponding groups are respectively as follows: from 1′ to 1″, 2′ to 2″, &c.: 30, 31, 30·5, 31, 31, 29 and 28 minutes. We here appear to be dealing with a series of vibrational groups, each of which took almost exactly half an hour to travel to and fro between two reflecting surfaces or districts. If the waves were compressional in character, the distance between these surfaces would be about 8000 kms.; but if they travelled with the velocity of the waves of shock, this distance would be reduced to something under 3000 kms. From their period and amplitude it is probable that the distance lies between these values.

The main point at issue, and the one to be answered before we enter into further speculations, is whether seismograms showing this musical repetition can be interpreted in the manner here suggested. The concluding vibrations of an earthquake have usually been regarded as a disorderly mob of pulsatory movements resulting from spasmodic impulses, which gradually grow feebler as the activity at a seismic centre becomes exhausted. The question before us is whether an earthquake dies by a process analogous to repeated and irregular settlements of disjointed materials, or whether it is simply a blow or blows which come to an end with musical reverberations inside the world. For the present my opinion inclines to the latter, and I see in the earthquake followers the likeness of their parents.

The observational confirmation of the existence or non-existence of these echoes requires a special arrangement of apparatus, installed in a dry, well-ventilated room, having a proper site, and free from tremors. In the dark, damp stable where I work, I regret to say that the frosty nights have brought with them vigorous and persistent tremors, and as a good observing season has now commenced, beautiful seismograms are being spoiled. The last to suffer was that of a magnificent set of waves which arrived from Mexico on the night of January 24. JOHN MILNE.

February 1.

Is Natural Selection all Metaphor?

THE Duke of Argyll, in his reply to Mr. Herbert Spencer, says "in the Darwinian theory there is no selector" (NATURE, February 2, p. 317). Though we have not yet discovered a principle or factor which plays the part of the breeder in nature, it by no means follows that "natural selection" is "all metaphor," nor yet, as has been often stated, an altogether misleading phrase. The rôle of the breeder or artificial selector is, I believe, often misunderstood. If we consider what the art of breeding mainly consists in, we may come to the conclusion that even the phrase "artificial selection" is, to a considerable extent, misleading and metaphorical. It seems to me the art of breeding consists mainly in two things, viz. (1) producing prepotency, and (2) preventing intercrossing. Prepotency is produced and maintained by inbreeding. The object of preventing intercrossing is to arrest, as far as possible, variation and reversion. If it can be shown that in nature prepotency often arises either as a sport or through inbreeding, and that prepotency by arresting the "swamping effects of intercrossing" plays the part of the fences of the breeder and the cages of the fancier, we shall be justified in looking upon prepotency as a "selector," and in finding more than metaphor in the phrase "natural selection." We already know that amongst insects a sport may displace the parent form; and if, instead of searching for evidence of intersterility as suggested by Romanes, we search diligently for evidence of prepotency, we may ere long discover the "selector" —the factor that in nature, under the control of utility, plays the part of the breeder.

J. C. EWART.

Geometry *versus* Euclid.

To a great many people the assertion that the teaching of geometry from Euclid's book in the schools—and especially in the preparatory schools—is a positive hindrance to the teaching of science will be regarded as paradoxical, if not, indeed, erroneous. Yet I *do* make the assertion; and I base my confidence in its truth mainly on the experience which I have gained as an examiner of boys who have finished their school education.

Geometry is about the oldest of the sciences, and Euclid's venerable work bears all the characteristics of a book compiled at a remote time when such science as existed was a kind of mysterious possession in the hands of a few experts to whom intricate technicality of language was (as Swift would say) a principle of great emolument. The inventor of a new science is only too prone to build it up with an elaborate and technical system of definition and nomenclature, hoping thereby to emphasise its importance and to cultivate a wholesome awe in the uninitiated. In this way is established a particular kind of jargon which becomes distinctive of the science, and of its professional exponents.

The growth of such a system is well exemplified in other domains than that of science. For example, there is not, I think, any game in vogue in England which possesses such an elaborate technical jargon as that of golf, and the rule which is always observed in such matters is here strictly recognised—viz. the less the intrinsic merit of the subject, the more elaborate the accompanying jargon.

We are all very familiar with the Euclid jargon. Some of us, indeed, have somehow come to believe that no proof of a proposition can possibly be valid unless it is presented in this orthodox form.

A modern Euclid for the use of schools is sometimes a model of soul-destroying systematisation. I have before me such a work in which the process of arriving at the conclusion that two angles of a triangle are equal if the sides opposite to them are equal, reminds me of the process of walking across a lawn over the surface of which have been stretched innumerable threads in various directions for the purpose of tripping up the unwary.

The number of heads under which a well-taught modern boy will arrange the most simple proposition is wonderful: "general enunciation," "particular enunciation," "hypothesis," "construction," "demonstration," "conclusion" must all figure, or else the proof is "no good." Only a boy who has been careless says, "if two triangles have three sides of the one equal to three sides of the other, the triangles are equal in all respects" —a very simple truth which I received once in the following form from a boy who was much more careful of the orthodox jargon: "if two triangles have two sides of the one respectively equal to two sides of the other, each to each, and likewise also their bases, or third sides, equal, then shall the three angles of the one triangle be equal to the three angles of the other triangle, and the triangles shall be equal in every respect."

Observe that in the Euclid jargon nothing ever simply "is" —it always "shall be."

In finding fault with Euclid as a book for beginners I have, of course, no right to charge it with the enormous number of definitions, and the dissertations on the various kinds of propositions ("positive," "contra-positive," &c.) which some of the school-books set right in front of the beginner before the first proposition of the first Book is reached.

Still, it is by no means the paragon of logical clearness that it is commonly alleged to be. Take, for instance, its very first definition: "a point is that which has no parts." This is an excellent definition of *absolute nonentity*, but not of anything that can be pictured in the mind. Some editors of Euclid, feeling that there is something wanting in this definition, have (they think) vastly improved it by saying that "a point is that which has *position* but no magnitude"—as if *position* is more easily grasped than *point*. Then again (still at the threshold of the subject) the beginner is taught to believe that he is getting a very definite conception of a right line in the definition, "a right line is that which lies *evenly* between its extreme points" —as if the meaning of "evenly" is at once beyond question.

But of all the elementary conceptions in Euclid that of an *angle* is the one which most puzzles a beginner, and remains unrealised for the longest time. "An angle is the *inclination* of two straight lines to one another." Here again we have one obscure term defined by another equally obscure; and we know by experience that, unless the conception is presented in a very different way, the obscurity will be permanent.

Moreover, it is possible to point out a self-contradiction in Euclid. Thus his definition of a circle makes it to be a disc— "a circle is a plain figure *bounded by one line* called the circumference"—so that, clearly, the whole of the space inside (or, possibly, outside) the circumference *is the circle*, whose mere boundary is the circumference; and, if so, two circles can, of course, intersect in an infinite number of points—over an extensive area, in fact; but this is contradicted by Euclid in the tenth proposition of Book III., according to which one circle cannot intersect another in more than two points.

These, it may be admitted, are comparatively minor considerations, and the defects might be corrected by judicious teaching.

It is chiefly in the way in which the fifth and sixth Books of Euclid are apprehended by boys that the necessity for a change in the system of teaching is to be seen.

Those mediæval technicalities "duplicate ratio," "subduplicate ratio," "sesquiplicate ratio," and some others are drummed into the heads of boys as if they were terms of the utmost scientific importance. What mathematician ever uses such terms, or even thinks of them in his investigations?

The simple and extremely important fact that the areas of two similar figures are to each other as the squares of corresponding linear dimensions is presented to the beginner in the nineteenth proposition of the sixth Book in the words "similar triangles are to one another in the duplicate ratio of their homologous sides"—a statement which is singularly deficient in accuracy inasmuch as it omits to say precisely what two qualities or quantities connected with the triangles are thus related (colours, shapes, sizes, or what?); and the result is absolute confusion in the minds of a very large number of boys.

Let me illustrate this by a few *bona fide* examples. In reply to the question, "What are similar triangles, and what is the relation between their areas?" the following answers were received:—

(1) A triangle is similar to another triangle when their sides are proportional, and when the homologous sides of one are in duplicate ratio to the homologous sides of the other.

(2) If two triangles have the sides about an angle in each proportional and the other angles of the same affection, the triangles are similar. Similar triangles are proportional to the bases on which they stand, and are to one another in the duplicate ratio of their homologous sides.

(3) Similar triangles are those which are equal in area to each other and are in the same proportion to each other as the duplicate ratio of their homologous sides.

(4) When the angles are similar the areas are similar, when the areas are similar the angles are similar, when the sides are similar the areas are similar.

(5) Similar triangles are equal in all respects—sides equal to sides, angles equal to angles, areas equal to areas. Similar triangles are to each other as their bases.

(6) Similar triangles are to one another in the duplicate or subduplicate ratio of their homologous sides. Their areas are as the square or square root of their bases according as it is in the duplicate or subduplicate ratio.

(7) Similar triangles are to one another as their bases. They are also to each other in the duplicate ratio of their homologous sides.

(8) Triangles are said to be similar when they have their corresponding sides equal and are equal in area. Similar triangles are to one another in the duplicate ratio of their homologous sides.

Each of these exhibits a pleasing variety and a liberal-minded, large-hearted toleration of conflicting views.

Such examples might be multiplied almost indefinitely, and they show clearly the impotence of the dictum "similar triangles are to one another in the duplicate ratio of their homologous sides" to convey any real knowledge to the mind of the ordinary learner. "Duplicate ratio" and "homologous" are mere sounds, to the latter of which violence is often done, inasmuch as I have frequently met with "homolicus" and "harmologous" sides.

Now, as regards the amount of time which is spent in the schools by young boys in acquiring the elementary facts and conceptions of geometry from Euclid's book, I know that very many months are occupied in attaining to the twelfth proposition of the first Book. I have before me, in fact, a fair-sized treatise written for the purpose of guiding boys along Euclid's exact path to this proposition.

There is absolutely nothing in the first twelve propositions that could not be taught far more effectively to a boy of ordinary intelligence in a few days, if only a rational style of teaching geometry were adopted; but if the exact language and pedantic professionalism of the school Euclids must be followed, to the weariness of the boy's mind and the quenching of his interest, it becomes a very long process indeed—ending, in the case of a large number, in utter failure.

Moreover, the current practice which insists on compelling boys to study geometry in an order and language characteristic of mediæval times, when no physical sciences existed, is a hindrance to the study of such sciences now, inasmuch as geometry is one of the foundations of all exact science; and it is obvious that if an intelligent knowledge of geometry is postponed, the physical sciences must be kept back also.

The plea that Euclid's book is unrivalled as an exposition of clear logical method and arrangement, and, as such, must be the foundation on which to build geometry, is vain—for the simple reason that it is not in England (where Euclid is worshipped), but in France and Germany (where Euclid is unknown as a text-book), that the great discoverers in geometry have been produced.

The late M. Paul Bert, Minister of Public Instruction in France, published a little book on the proper method of teaching geometry to beginners, in which he severely satirised the faults of the existing procedure; and, again, the late Rev. W. A. Willock (father of Dr. Sophie Bryant), in his "Elementary Geometry of the Right Line and Circle," has similar excellent remarks on this subject. "It is almost certain," says Dr. Willock, "that Euclid wrote his 'Elements' not for boys, but for grown-up, hard-headed thinking men."

Certain concessions have been made to the advocates of reform, led chiefly by Mr. Hayward—notably by the University of Oxford and the Civil Service Commissioners; and, in the existing state of affairs, it is not reasonable to expect more.

It will be clear from the foregoing that, in my opinion, a more rapid progress in the study of science generally would ensue from any system which would facilitate and accelerate the understanding of geometry by boys in the very elementary stage; and to this end I would suggest that the initiative should be taken by the Universities of Oxford and Cambridge. Our vast system of competitive examinations renders it necessary that a fixed source of authority on the order of deduction in geometry should exist. Such a source is Euclid at present; but a better one might, without serious difficulty, be drawn up by a University Committee, and its adoption by the schools and colleges throughout the country would follow as a matter of course. The chief difficulty is to avoid "fads"; but I learn, from conversation with a distinguished master in the largest of our public schools, that sympathy would not be wanting in an attempt to improve existing methods.

GEORGE M. MINCHIN.

The Cataloguing of Periodical Scientific Literature.

SOME three years ago, I alluded, in a work on "The Theory of Bibliography" (pp. 81–82), to the importance of learned societies undertaking to catalogue the literature they produce.

I pointed out that it was already necessary to supply tables of contents to each journal, bulletin, &c., issued, and that a very slight amount of extra care would transform such tables of contents into technical *Catalogues* of articles, useful alike to the librarian and student—of which extra copies might be struck off at no expense. I referred to the noteworthy efforts of the R. Istituto Lombardo di Scienze e Lettere in registering the articles of foreign scientific journals in its *Bulletin*, and showed the advantages which would accrue if each society *did its own work first*.

I am happy to state that the society referred to has taken my remarks in the spirit in which they were written; and, in publishing vol. xxx. of its *Rendiconti* in 1897, has issued accompanying sheets ("Titoli da ritagliare per le schede dei Cataloghi per Autori e per Oggetti") containing full titles (printed on one side only) of the articles appearing in the volume, under *Author*, *Subject* (and *Place*).

MELZI, GILBERTO.—Sopra alcune rocce dell' isola di Ceylan.
Rend. Ist. Lomb., serie 2, vol. xxx. p. 89. (Milano, 1897.)

CEYLAN.—G. Melzi.—Sopra alcune rocce dell' isola di Ceylan.
Rend. Ist. Lomb., serie 2, vol. xxx. p. 89. (Milano, 1897.)

GEOLOGIA: CEYLAN.—G. Melzi.—Sopra alcune rocce dell' isola di Ceylan.
Rend. Ist. Lomb., serie 2, vol. xxx. p. 89. (Milano, 1897.)

(*It would be advantageous to give the full pagination*, e.g. *pp.* 89–102.—*F.C.*)

The advantages of such a course are obvious.

If each English learned society followed suit, and catalogued its own publications at the moment of issue, it would be only necessary to send the results to a central bureau (say the Royal Society), and the work of cataloguing our scientific periodical literature would be half-finished. There would still remain the task of editing—of sorting, classifying, and of occasional amplification or excision: but such work would be immensely lightened and facilitated if the preliminary actual cataloguing were already accomplished and in print.

This is the first and fundamental principle of co-operation in regard to the literature of the learned societies. Perhaps the Royal Society has already urged its application? If not, may I take this opportunity of drawing attention to the matter?

FRANK CAMPBELL
January 16. (of the Library, British Museum).

Plague in China.

IN the "Encyclopædia Britannica" (ninth edition, vol. xix. p. 168), Dr. J. F. Payne writes: "It is remarkable that of late years reports have come of the occurrence of Oriental plague in China. It has been observed in the province of Yunnan since 1871 . . . it appears to be endemic, though there are rumours of its having been brought from Burmah, and become more noticeable after the suppression of rebellion in that province [1872]." However, the following passage I have lately found in Hung Liang-Kih's "Peh-Kiang-Shi-Hwa" (British Museum copy, 15,316, *a*, tom. iv., fol. 4, *b*), bears witness to the much earlier occurrence of the pest in Yunnan, inasmuch as the author, who was born in 1736, and died in 1809, speaks of his contemporary dead thereby:—"Shi Tau-Nan, the son of Shi Fan, now the Governor of Wang-Kiang, was notorious for his [poetic] gift, and was only thirty-six years old when he died. . . . Then, in Cháu-Chau [in Yunnan] it happened that in daytime strange rats appeared in the houses, and lying down on the ground, perished with blood-spitting. There was not a man who escaped the instantaneous death after being infected with the miasma. Tau-Nan composed thereon a poem, entitled "Death of Rats," the masterpiece of his; and a few days after, he himself died from this '*queer rat epidemic.*'"

KUMAGUSU MINAKATA.

7 Effie Road, Walham Green, S.W., February 11.

A SIMPLE SPECTROSCOPE AND ITS TEACHINGS.

I.

SPECTRUM analysis is now becoming so far-reaching, especially in inquiries having to do with the conditions of the various celestial bodies, that there are many who are anxious to know something of its teachings. To some of these, however, the terms used by men of science, a very necessary shorthand, are unfamiliar and appear hard to understand, because the opportunity of seeing the things they are intended to define, and which they generally do define in most admirable fashion, has never presented itself. I propose, therefore, to attempt to show that there is nothing recondite about these terms; that it is possible without any expensive apparatus for every one, who will take a little trouble, to observe the phenomena for himself, after which the meanings of the terms employed will present no difficulty whatever.

One key to the hieroglyphics, the light story, which is hidden in every ray of light, is supplied to us by the rainbow. It teaches us that the white light with which nature bountifully supplies us in the sun's rays, is composed of rays of different kinds or of different colours; and it is common knowledge that there is an almost perfect analogy between these coloured lights and sounds of different pitches.

The blue of the rainbow may be likened to the higher notes of the key-board of a piano, and the red of the rainbow, on the other hand, may be likened to the longer sound waves, which produce the lower notes; and as we are able in the language of music to define each particular note, such as B flat and G sharp, and so on, so light-waves are defined by their colours or wave-lengths.

What nature accomplishes by a rain-drop, we can do with a prism or a grating. A prism is a piece of glass or other transparent material through which the light is bent out of its course or *refracted* in the process. A grating is a collection of wires, or scratches on glass or metal; equidistant, very near together and all parallel. When light passes through or is reflected by such a system it is said to be *diffracted*, and one result that we are concerned in, is very similar to that of passing light through a prism.

It is rapidly becoming a familiar fact to many that when a ray of white light is refracted by a prism, or diffracted by a grating, a band of colour similar to a rainbow is produced, and that this effect follows because white light is built up of lights of every colour, each colour having its own special length of wave and degree of refrangibility. Our rainbow band is called a spectrum.

Such a glass prism or grating is the fundamental part of the instrument called the spectroscope, and the most complicated spectroscope which we can imagine, simply utilises the part which the prism or grating plays in breaking up a beam of white light into its constituent parts from the red to the violet. Between these colours we get that string of orange, yellow, green and blue, which we are familiar with in the rainbow.

For sixpence any of us may make for ourselves an instrument which will serve many of the purposes of demonstrating some of the marvellously fertile fields of knowledge which have been recently opened up to us. From an optician we can get a small prism for *6d.*; get a piece of wood from 20 to 10 inches long (the distance of distinct vision), 1 inch broad and ½ an inch thick. On one end glue a cork 2 inches high; at the other end fasten, by melting the bottom, a stump of a wax candle of such a height that the dark cone above the wick is level with the top of the cork. Then glue the prism on the cork, so that by looking sideways through the prism the coloured image, or spectrum, of the flame of the candle placed at the other end of the piece of wood can be seen.

We get a band of colour, a spectrum of the candle flame, built up of an infinite number of images of the flame produced by the light rays of every colour. But, so far, the spectrum is impure because the images overlap. We can get rid of this defect by replacing the candle by a needle.

If we now allow the needle to reflect the light of the candle flame, taking care that the direct light from the candle does not fall upon the face of the prism, we then get a much purer band of colour, because now we have an innumerable multitude of images of the thin needle, instead of the broad flame, close together. The needle is the equivalent of the slit of the more complicated spectroscopes used in laboratories.

We can vary this experiment by gumming two pieces of tin-foil with two perfectly straight edges on a piece of glass so that the straight edges are parallel and very near together. In this way we have a slit; this should be fixed close to the candle and between it and the prism.

Now the light of the candle is white, and the preceding experiment tells us that such light gives us a band containing all the colours without any breaks or gaps. We have what is called a *continuous spectrum.*

The Continuous Spectrum.

If we burn a piece of paper, or a match, or ordinary coal-gas, we get a white light identical to that given us by the candle; solids which do not liquefy when made white-hot, and liquids which do not volatilise under the same

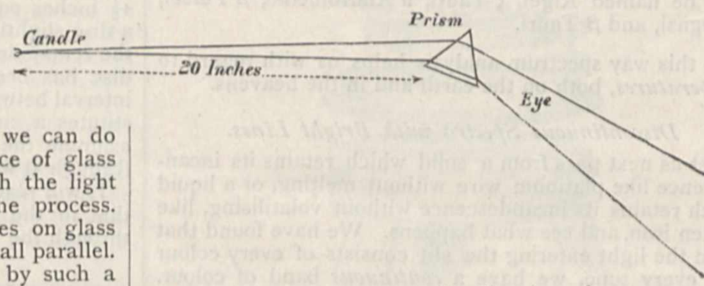


FIG. 1.—Arrangement of candle, prism and eye.

condition; and some dense gases when heated, do the same.

This effect is produced because there is light of every wave-length to produce an image of the needle (or the slit); these images blend together continuously from one end of the spectrum to the other.

Let us then consider this fact established, namely, that solid or liquid bodies and dense gases, when heated to a vivid incandescence, give a continuous spectrum. Under these circumstances the light to the eye, without the spectroscope, will be white, like that of the candle.

The Length of the Continuous Spectrum varies with Temperature.

If we put a poker in a fire, it becomes red-hot; if we heat a platinum wire by passing a feeble current of electricity along it, it becomes red-hot like the poker.

In both cases examination by means of the prism shows that the red end only of the spectrum is visible. But if the poker or wire be gradually heated more strongly, the yellow, green, and blue rays will successively appear. Finally, when a brilliant white heat has been attained, the whole of the colours of the spectrum will be present.

Hence we learn that if the degree of incandescence be not high, the light will only be red. But, so far as the spectrum goes—and it will expand towards the violet, as the incandescence increases, as before stated—it will be continuous.

The red condition comes from the *absence* of blue light; the white condition comes from the gradual addition of blue as the temperature increases.

One of the laws formulated by Kirchhoff in the infancy of spectroscopic inquiry has to do with the kind of radiation given out by bodies at different temperatures. The law affirms that the hotter a mass of matter is the further its spectrum extends into the ultra-violet.

Gaslight is redder than the light of an incandescent lamp because the latter is hotter. The carbons in a so-called arc-lamp give out a bluish-white light because they are hotter still.

By similar reasoning from experiment we are bound to consider the bluish-white stars, the white stars, the yellow, red and blood-red stars to indicate a decreasing order of temperature.[1]

We shall not go far wrong in supposing that the star with the most intense continuous radiation in the ultra-violet is the hottest, independently of absorbing conditions, which, in the absence of evidence to the contrary, we must assume to follow the same law in all.

An inquiry into the facts placed at our disposal by stellar photographs, shows that there is a considerable variation in the distance to which the radiation extends in the ultra-violet, and that the stars can be arranged in order of temperature on this basis.

Judged by this criterion alone, some of the hottest stars so far observed are γ Orionis, ζ Orionis, α Virginis, γ Pegasi, η Ursæ Majoris, and λ Tauri. Of stars of lower, but not much lower, temperature than the above, may be named Rigel, ζ Tauri, α Andromedæ, β Persei, α Pegasi, and β Tauri.

In this way spectrum analysis helps us with regard to *temperatures*, both on the earth and in the heavens.

Discontinuous Spectra with Bright Lines.

Let us next pass from a solid which retains its incandescence like platinum wire without melting, or a liquid which retains its incandescence without volatilising, like molten iron, and see what happens. We have found that when the light entering the slit consists of every colour and every tone, we have a *continuous* band of colour. If there be any defect in the light we must have a *discontinuous* one, for the reason that an image of the slit cannot be produced in any particular part of the spectrum if there be no light of that particular colour to produce it when we deal with coloured flames or vapours or gases rendered incandescent by electricity.

There are many artificial flames which are coloured, and if their light be analysed in the same way as the light of the candle, a perfectly new set of phenomena present themselves.

Let us again make use of our improvised spectroscope, and allow the needle to be illuminated by the flame of a spirit lamp into which salt is gradually allowed to fall; we see at once why the flame is orange-coloured. It contains no red, yellow, green, blue, or violet rays, so that we should not represent the spectrum by

V I B G Y O R

as in the case of the candle, but simply by

Y

We see one image of the needle coloured in orange. We have passed from the spectrum of polychromatic to that of monochromatic light—from white light to coloured light—from light of all wave-lengths to light of one wave-length; from an infinite number of slit images giving a continuous band of every colour, to one image of the slit produced by light of one refrangibility, the colour of the image depending upon the refrangibility. What we shall see in passing from the spectrum of the candle to that of sodium vapour in the spirit lamp is shown in the accompanying woodcut.

That we are truly dealing with an image of the needle (or a slit) can be proved by using a slit of any shape. This can be shown by slightly altering our needle ex-

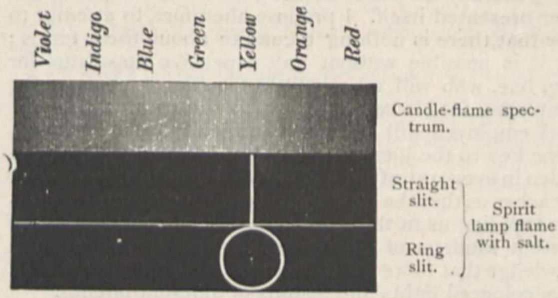


FIG. 2.—A continuous and a discontinuous spectrum.

periment. Take a piece of glass and a piece of tin-foil 1½ inches square, cut out of the centre of the tin-foil a disc slightly larger than a threepenny-piece, and gum the remainder on the glass. In the centre, where the disc has been cut away, gum a threepenny-piece. The interval between the threepenny-piece and the tin-foil constitutes a circular slit. Let it replace the needle, and examine the flame of the spirit lamp charged with salt through it with the prism as before.

It will readily be grasped, from what has been stated, that in the case of coloured flames, the light passing through the spectroscope being only red, or yellow, or

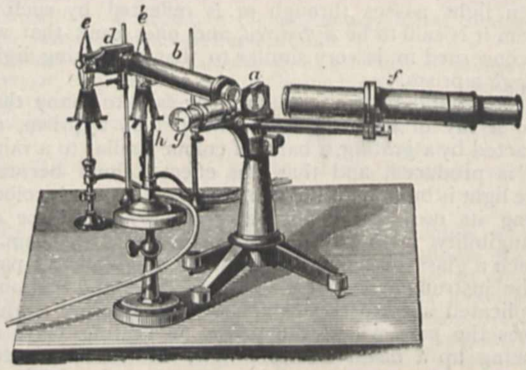


FIG. 3.—Observation of flame spectrum with ordinary spectroscope with comparison prism. *a*, prism; *b*, collimator; *d*, slit; *e e'*, flames to be compared; *f*, observing telescope; *g*, scale illuminated by *h* and reflected by the second surface of the prism into the telescope.

green, as the case may be, will go to build up an image of the slit in the appropriate part of the spectrum, and that the image thus built up will take the form of a line or circle, according to the slit we use.

Many chemical substances, salts or various metals, become luminous by inserting them into flames, as we have treated common salt (chloride of sodium). With each metal the colour imparted to the flame is different. The resulting spectrum is called a *discontinuous* spectrum, because it is only here and there that images of the slit are produced; because some coloured rays, and not all, are present.

[1] On this point I wrote as follows in 1892: "An erroneous idea with regard to the indications of the temperature of the stars has been held by those who have not considered the matter specially. It has been imagined that the presence of the series of hydrogen lines in the ultra-violet was of itself sufficient evidence of a very high temperature. The experiments of Cornu, however, have shown that the complete series of lines can be seen with an ordinary spark without jar. Hence the high temperature of such a star as Sirius is not indicated by the fact that its spectrum shows the whole series of hydrogen lines, *but by the fact that there is bright continuous radiation far in the ultra-violet.*"

The usual laboratory arrangement for observing the spectra of flames is shown in the woodcuts.

Further, the system of images of the needle (or slit)

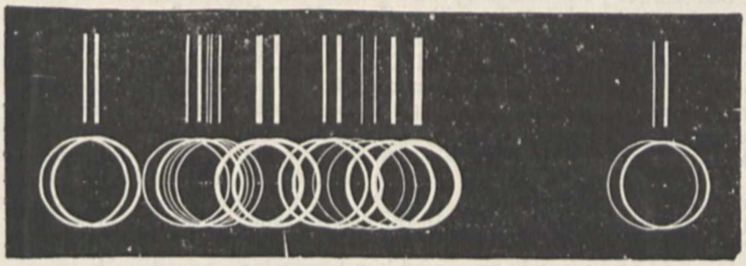


FIG. 4.—The spectrum of a complicated light-source as seen with a circular and a line slit.

varies for each substance, and it is on this ground that the term *spectrum analysis* is used, because we can in this way recognise the various substances in the flame.

But we are not limited to flame temperatures; substances in a state of gas or vapour may be made to glow by electricity. At these higher temperatures very complicated spectra are produced, and again the spectrum is special to each chemical substance experimented on; the images of the needle (or slit), occupying different positions along the spectrum according to the nature of the source of light.

Fig. 3 gives us a laboratory prism spectroscope of small dispersion; with the more complicated spectra the phenomena are often better seen if more than one prism are employed. Fig. 5 shows an instrument in which four prisms are used.

For accurate measures of the wave-lengths of the lines a grating is employed as shown in Fig 6.

It is in the case of the more complicated spectra that the wave-length has to be specially considered from the point of view of defining the position of a line. It is not enough to say, as was said in the case of the sodium line, that it is located in the orange.

The lengths of the various light-waves are very small. The wave-length of the sound-wave of the middle C of a piano is about 4 feet, while the wave-length of yellow light as defined by that of a line very accurately measured

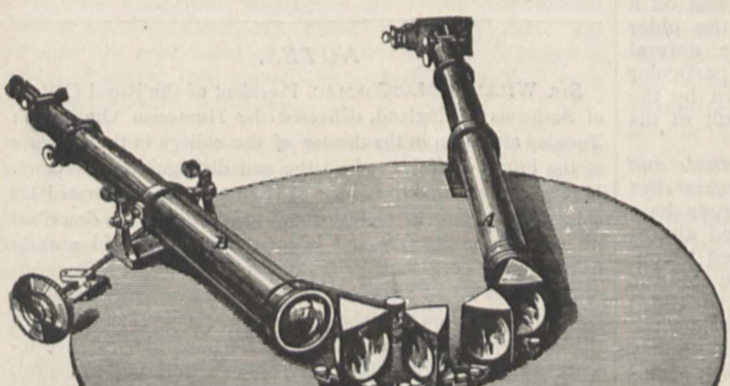


FIG. 5.—Steinheil spectroscope with four prisms.

is ·0005895 of a millimetre, that is 5895 ten-millionths of a millimetre; so that there are 43,130 waves in a British inch. The unit of wave-length usually employed is the ten-millionth of a millimetre. These wave-lengths get shorter as we pass from the red to the violet.

So much then in general for the radiations given out by light sources, and the manner in which the spectroscope shows them, and the student records their positions.

Spectrum analysis was established when experiment proved that no two substances which give a line spectrum give the same order of lines from one end of the spectrum to the other; in other words, the line spectrum of each chemical substance differs from that given by any other.

Here then is one of the secrets of the new power of investigation of which the spectroscope has put us in possession: we can recognise each element by its spectrum, whether that spectrum is

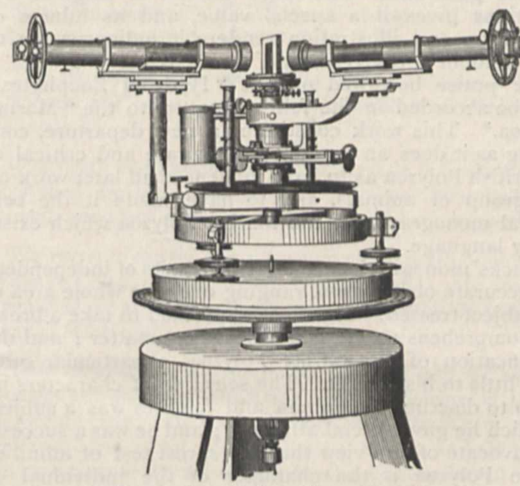


FIG. 6.—Angström's grating spectrometer.

produced in the laboratory or is given by light travelling earthwards from the most distant star, *provided the element exists both here and there.*

It is in this way that spectrum analysis helps us with regard to chemistry; the spectrum varies according to the chemical substance which produces it.

Flutings.

The earliest spectroscopic observations revealed the fact that in some spectra the lines, instead of being irregularly distributed along the spectrum, were arranged in an easily seen rhythmic fashion. Such allocations of lines are called flutings, as a succession of them gives rise to an appearance strongly recalling the flutings of a Corinthian column seen under a strong side light.

Our improvised spectroscope helps us here too; use the candle and straight slit in front of it as before, but shorten the slit, and only allow the blue light from the base of the candle flame to pass through it to the prism. We see two or three sets of flutings. These are the flutings of carbon, and they are amongst the most beautiful examples known and are thoroughly typical.

NORMAN LOCKYER.

(*To be continued.*)

THOMAS HINCKS, F.R.S.

IT is little more than a month since an obituary notice of George James Allman appeared in these pages, and death has now claimed another distinguished worker in the same field. The Rev. Thomas Hincks, who died at Clifton on January 25, was but six years younger than Allman, having been born at Exeter on July 15, 1818. Allman's best-known works are his monographs on Gymnoblastic Hydroids and Fresh-water Polyzoa. Hincks' monographs on the same subjects, "A History of the British Hydroid Zoophytes" (1868) and "A History of the British Marine Polyzoa" (1880) are, by an unusual coincidence, more widely known and appreciated than any of his other works. The former was published while the sheets of the "Gymnoblastic Hydroids" were passing through the press, and Allman's opinion of it, recorded in his preface, may fitly be quoted here:—"Eminently critical, with the descriptions accurate and lucid, and with the figures abundant and expressive, it is the most complete systematic work on the Hydroida hitherto published. The large amount of original observations gives it a special value, and its fulness of description and illustration renders it indispensable to every student of the Hydroida."

The praise bestowed on the "Hydroid Zoophytes" must be accorded in the fullest measure to the "Marine Polyzoa." This work constitutes a new departure, containing as it does an account so accurate and critical of the British Polyzoa as to have influenced all later work on this group of animals, and to have made it the best general monograph on the marine Polyzoa which exists in any language.

Hincks' monographs are the ripe results of independent and accurate observation, ranging over the whole area of the subject treated. He was accustomed to take a broad and comprehensive view of his subject-matter; and the classification of the marine Polyzoa in particular owes not a little to his insight. The selection of characters by which to discriminate genera and families was a subject to which he gave special attention; and he was a successful advocate of the view that the surest test of affinities in the Polyzoa is the character of the individual or zoœcium rather than that of the entire colony. The encrusting Cheilostomes formerly known as *Lepralia*, and the erect bilaminate species formerly referred to the genus *Eschara*, were thus distributed among widely separated genera, whose characters probably rest on a firmer foundation than those recognised by the older naturalists. Questions connected with the natural history of zoophytes always excited Hincks' particular interest; and many curious phenomena shown by the living forms have become familiar as the result of his observations.

Most of Hincks' papers appeared in the *Annals and Magazine of Natural History*, between the years 1851 and 1893. Hydrozoa at first came in for the larger share of his attention, but latterly the Polyzoa claimed almost the whole of it. The series of papers entitled "Contributions towards a General History of the Marine Polyzoa" were republished in a collected form in 1894; and one of Mr. Hincks' last pieces of work was the preparation of an index to this series, containing many important additions, which appeared in 1895. This volume is a most valuable record of systematic work, carried out in an admirable manner. The publication of papers on systematic zoology may be of very doubtful benefit in unskilful hands; but of Mr. Hincks' work it can only be said that he enlightened all that he touched. Difficult questions were treated as by the hand of a master, and his wide knowledge and logical faculty led him to conclusions which in most cases command assent.

Thomas Hincks was the son of the late Rev. William Hincks, formerly professor of natural history at Toronto, grandson of the late Dr. Thomas Dix Hincks, professor of Hebrew at Belfast, and nephew of the late Sir Francis Hincks, a distinguished Canadian statesman, at one time governor of Barbadoes, and of the late Dr. E. Hincks, the well-known Egyptologist. He was educated at Manchester New College, York, taking the degree of B.A. at London in 1840, and became minister of the Mill Hill Chapel at Leeds in 1855, resigning in 1869 in consequence of the failure of his voice. He afterwards lived at Taunton, and subsequently for many years at Clifton, where he died.

Mr. Hincks' name appears in the list of those who attended the seventh meeting of the British Association at Liverpool in 1837. He took an active part, at the earliest stage, in the preparations for the recent meeting of the Association at Bristol; but failing health unfortunately prevented him from taking any share in its proceedings last September. He was of active habits, devoted to open-air labour in his garden until comparatively near the close of his life, and it was probably owing to this that he was able to continue his scientific work until a year or two ago. He was a man of singular refinement and dignity, a correct and convincing speaker, and was distinguished for the zeal with which he threw himself into all charitable and philanthropic work at Leeds, in spite of the heavy and exhausting scientific work which he undertook at a time occupied by absorbing pastoral claims. He was a conspicuous example of the type of naturalist, common in this country, who earn for themselves distinction during the leisure spared from the performance of other duties. He became a Fellow of the Royal Society in 1872, shortly after leaving Leeds. He married in early life Elizabeth, daughter of Mr. John Allen, of Warrington, who, with two daughters, survives her husband.

Mr. Hincks was the friend of Allman, Busk, and Principal Dawson, as well as of Canon Norman, Prof. McIntosh and Prof. F. A. Smitt, of Stockholm, whose important works on the Polyzoa, published in Swedish, he did so much to make known to English naturalists.

The writer of these lines is indebted to Mr. W. A. Shenstone for most of the personal details, but he is able to add his own grateful testimony to the kindness and courtesy shown by Mr. Hincks in his correspondence with those who applied to him for information.

The study of zoophytology is the poorer by the loss of one whose work will endure. S. F. H.

NOTES.

Sir William MacCormac, President of the Royal College of Surgeons of England, delivered the Hunterian Oration on Tuesday afternoon in the theatre of the college in the presence of the Prince of Wales and a large and distinguished company. He rapidly reviewed the events of Hunter's life, enumerated his chief contributions to biological and surgical science, described his methods in research and in instruction, and paid a warm tribute to the astonishing range of his investigations, the magnitude of his actual achievement, and the far-reaching influence he had exercised on the subsequent development of surgery. In the course of his address, the *Times* reports him to have remarked: "In the first instance Hunter's work was biological, his range including both the animal and vegetable kingdoms, and the mineral kingdom as well, and to illustrate his investigations he became a collector. But he was chiefly and finally a surgeon, and to the development of surgery he brought all the knowledge and all the training which he had acquired in other branches of science. He carries us beyond mere handicraft and detail into the region of general principles and law. The surgery of the Middle Ages was a trade, Ambroise Paré and Jean Louis Petit converted it into an art, John Hunter elevated it to the rank of a science. Hunter's life and work inspired his successors with the spirit of observation, investigation, and experiment. We see this exemplified in his great followers Cline, Abernethy, Astley Cooper, Travers, Green, Brodie, Lawrence, and others since their time. They have been makers of English surgery, and each in turn has done much to raise it to that high standard which it has always maintained."

IT is interesting to learn that "it is not the intention of the Government to move the Geological Museum from Jermyn Street." This is the reply (reported in the *Standard* of February 10) which was given by the Right Hon. A. Akers-Douglas to a question asked in the House of Commons by Sir F. Powell. Those who are accustomed to make practical and scientific use of the Geological Survey and of the Museum in Jermyn Street, will hail this decision with satisfaction.

IN the House of Commons, on Thursday last, Mr. Akers-Douglas announced that it is proposed to commence the new buildings in front of the South Kensington Museum within the next few weeks. He said that all the new buildings on the east side of the Exhibition Road will be devoted to the art collections. The existing science building on the east side of the road will be the only portion which will continue to be used for science purposes. The new science buildings will be erected on the west side of the road.

IN reply to a question referring to the Imperial Institute, asked in the House of Commons on Tuesday, Mr. Chamberlain said: "I believe that a conference of representatives of the Government, the Imperial Institute, and the London University will shortly take place to consider whether a part of the Institute buildings can, with due regard to all existing interests, be made available for the accommodation of the London University, as reconstituted by the Act of last Session. Until the result of the deliberations of the conference is known it would be premature to consider what, if any, further steps should be taken in the matter."

Mr. W. H. PREECE, C.B., F.R.S., having on Wednesday attained his sixty-fifth birthday, retires from the position of Engineer-in-Chief and Electrician to the Post Office, but it is hoped that his services will be retained by the Postmaster-General as consulting engineer.

AT the anniversary meeting of the Royal Astronomical Society on Friday last, Mr. Frank McClean, F.R.S., was awarded the gold medal of the Society for his photographic survey of stars in both hemispheres, and other contributions to the advancement of astronomy.

THE Board of Agriculture have appointed a departmental committee to inquire into and report upon the working of the Diseases of Animals Acts in so far as they relate to glanders, and to consider whether any more effective measures can with advantage be taken to prevent the spread of that disease.

ON Friday last Mr. W. W. Skeat, of Cambridge University, left England upon a scientific expedition to the southern portion of Siam lying immediately to the north of the Protected States of the Malay Peninsula. Mr. Skeat is accompanied by two zoologists—Messrs. Evans and Annandale, of Oxford—and by Mr. Gwynne-Vaughan, formerly of Christ's College, Cambridge, as botanist. Later on several other scientific members are to join the party. The expedition will investigate the fauna and flora of the region mentioned, as well as the ethnology of its inhabitants, and it is expected will last about a year.

DR. D. T. MACDOUGAL, of the Botanical Department of the University of Minnesota, has been elected director of the laboratories of the New York Botanical Gardens, and will begin his duties in that institution upon the completion of the museum and laboratory building in July. The main horticultural houses of the garden, covering nearly three acres, are now in process of construction, and will be ready for use during the current year.

A REPORT from Krasnoyarsk states that the remains of a balloon, and the bodies of three men, have been found between Komo and Pit, in the province of Yeniseisk, by two Tunguses, a tribe inhabiting the Taimur peninsula, in northern Siberia. It is suggested that the dead men are Herr Andrée and his companions, but the information so far received is not sufficient to justify any conclusion being arrived at. The latest news is from Stockholm, and it reports that a telegram has been received there from M. Reuterskiöld, the Swedish Minister in St. Petersburg, in which he states that he has to hand a telegram from the Governor-General of Eastern Siberia confirming the statements of the two Tunguses. The Governor adds that he has despatched a mining inspector to conduct investigations on the spot.

THE Department of Science and Art informs us that a horticultural congress will be held at Ghent in June next.

THE twenty-ninth general meeting of the Institution of Mining Engineers will be held in North Staffordshire on Wednesday, February 22.

THE death is announced of Dr. Dareste de la Chavanne, distinguished by his investigations in animal teratology, and formerly president of the French Society of Anthropology.

WE regret to see the announcement of the death of the Rev. William Colenso, F.R.S., of New Zealand. He was distinguished as a naturalist, and made many valuable investigations of Maori antiquities and myths.

THE *Athenaeum* announces the death of the well-known zoologist and geologist, Dr. Franz Lang, of Soleure, at the age of seventy-eight. He was for many years teacher of natural history at, and rector of, the Kantonal-Schule, and also one of the presidents of the Swiss Naturforschende Gesellschaft.

Mr. A. A. CAMPBELL SWINTON will give a lecture on "Electric Discharges in Vacuo, and the Röntgen Rays," at the Glasgow Philosophical Society, on March 1.

WE learn from the *Lancet* that the Cameron prize of the University of Edinburgh, which is conferred on persons who have made valuable additions to the subject of practical therapeutics, has, on the recommendation of the Faculty of Medicine, been awarded by the Senatus Academicus to Dr. Monckton Copeman, of the Local Government Board, London, in recognition of his researches on the employment of glycerine for destroying pathogenic organisms in vaccine lymph.

THE question of the future water-supply of London, which has agitated the minds of many, was dealt with on February 8, at a meeting of the Sanitary Institute, by Mr. R. E. Middleton. He maintained that our magnificent river (the Thames) can afford a more than sufficient supply of water of the best quality, and at far less expense, than the suggested scheme for procuring a supply from Wales. Sir Douglas Galton, who occupied the chair at this meeting, said it had been abundantly shown that the filtration of water, as practised in London, gave us a most admirable supply at the present time. Major Flower remarked that the Staines Reservoir, now in course of construction, would, when completed, meet all requirements, and obviate the necessity of going to a distant source for the supply of water.

WE learn from the *British Medical Journal* that, on February 2, a new Bacteriological Institute was formally opened in the Univerity of Louvain. The Institute is on a large scale, and the installation and equipment are in accordance with the most advanced ideas. Every facility for research is provided. The stables, kennels, and other quarters for animals are built around a vast garden, and all the arrangements show careful regard for the health and comfort of the animals. A special department in the new Institute will be devoted to the preparation of therapeutic serums of different kinds, tuberculin, &c. At the congress on tuberculosis, held in Paris last summer, Prof. Denys gave an account of a new tuberculin which he had used with considerable success; he proposes to continue his work in this field, and is hopeful of success.

THE consent of the Privy Council has been obtained for the regulations as to the keeping, dispensing, and selling of poisons adopted by the Pharmaceutical Society on January 11. By the adoption of these regulations, it becomes unlawful for any person who is not a pharmaceutical chemist, or a chemist and druggist within the meaning of the Pharmacy Act, to retail, dispense, or compound poisons for the public. Bottles or boxes, or other vessels containing poisons, have all to be labelled, and have some distinctive mark to call attention to the dangerous character of the contents. Also in the keeping of poisons, each poison must be kept on one or other of the following systems, viz.: (*a*) In a bottle or vessel tied over, capped, locked, or otherwise secured in a manner different from that in which bottles or vessels containing ordinary articles are secured in the same warehouse, shop, or dispensary; or (*b*) in a bottle or vessel rendered distinguishable by touch from the bottles or vessels in which ordinary articles are kept in the same warehouse, shop, or dispensary; or (*c*) in a bottle, vessel, box, or package kept in a room or cupboard set apart for dangerous articles. Similar precautions have to be taken as regards the bottles or boxes in which poisons are sold or dispensed.

A CORRESPONDENT has called our attention to a statement which has appeared in various newspapers as to a peculiar characteristic of Mr. Gladstone's eyes. There is no doubt that Mr. Gladstone had striking and powerful eyes, but, according to the statement referred to, he also possessed nictitating membranes, which he occasionally used to paralyse his opponents in argument. We have asked the opinion of a distinguished authority upon the story, and he expresses the conviction that it is "all nonsense." He adds: "The nictitating membrane is not present, either in human eyes or in those of apes, except as a rudimentary crescentic fold at the inner corner, too small to cover the eye; and the muscles which, in birds and some mammalia, cause the membrane to advance, are wholly wanting in men and apes. In birds the whole mechanism is very elaborate: in mammalia it is comparatively simple. If Mr. Gladstone possessed a nictitating membrane, and a power of moving it, he must have thrown back behind the hypothetical "missing link" ancestry of the human race. Moreover, the nictitating membrane, when present, as may be seen in five minutes in any fowl-house, does not cover the eye during waking life, and is not transparent. It is only drawn across the surface momentarily, from time to time, as a means of cleansing it. Mr. Nettleship, who operated on Mr. Gladstone for cataract, would, of course, be able to speak positively as to the suggested malformation."

FROM the beginning of this month the weather over these islands has been of a very abnormal character, the shade temperature culminating in a maximum of about 67° in the neighbourhood of London on the 10th inst.—a reading which was about 5° higher than any shade temperature in February during at least the last sixty years. In connection with this abnormal temperature a series of gales has swept the country from end to end, in such rapid sequence that the seas have been lashed into fury on most of our coasts, and much damage has been caused by floods in various localities. The rainfall has also been very considerable, especially in the northern and western parts of the country.

AT the Royal Geographical Society on Monday, Prof. Norman Collie, F.R.S., gave an account of two journeys taken during 1897 and 1898 through that part of the Canadian Rockies that lies between the Kicking Horse Pass on the south and the source of the Athabasca River on the north. The most interesting problem connected with the first journey which presented itself to Prof. Collie and his party was whether a lofty mountain seen from the slopes of Mount Freshfield, from which it lay distant about thirty miles in a north-westerly direction, might be Mount Brown or Mount Hooker, which were supposed to be 16,000 feet and 15,000 feet high respectively. For nearly seventy years these peaks had been shown in maps as the highest points in the Rocky Mountains, but it appears that they are not so distinguished. The peak climbed by Douglas, and said to be 17,080 feet high, turns out to be more probably the Mount Brown of Prof. Coleman, having a height of 9000 feet. Prof. Collie's journeys lead him to the conclusion that there is only one Athabasca Pass, and on each side of its summit may be found a peak—Mount Brown, 9000 feet high, on the north—the higher of the two—and Mount Hooker on the south. Between them lies a small tarn, 20 feet in diameter—the Committee's Punch-bowl. The peaks to the south, amongst which the party wandered last August, were new, and they probably constituted the highest point of the Canadian Rocky Mountain system.

THE new form of electric lamp, invented by Prof. Walter Nernst, of the University of Göttingen, and briefly described in these columns several weeks ago (p. 132), was exhibited and explained by Mr. James Swinburne at the Society of Arts on Wednesday in last week. The part of the lamp which emits the light consists a of a little rod of highly refractory material, mainly thoria, supported between two platinum electrodes. Such a substance at ordinary temperatures is a non-conductor of electricity, but when heated it becomes an electrolyte, and it is upon this difference that the action of the lamp depends. When the lamp is required for use, it is first gently heated—with the smaller sizes an ordinary match suffices—until it begins to conduct; the current then passes and further heats the rod until it attains a temperature of intense incandescence and gives out a brilliant white light. In some circumstances this method of starting the lamp might not be regarded as a very great inconvenience; in others it certainly would. Prof. Nernst has, therefore, designed an automatic lamp, lighted simply by turning a switch, in which the required heating of the rod is effected by means of a platinum resistance arranged close to it, which is automatically cut out as soon as the rod becomes hot enough to conduct. The life of the rods used, running at an efficiency of $\frac{2}{3}$ of a candle-power per watt, including the resistance, is more than 500 hours in good specimens. The lamp works equally well on alternating and direct currents, and does not need to be enclosed in a vacuum.

WORKMEN who work in compressed air are sometimes the victims of a peculiar malady which has been designated caisson disease or compressed air disease. Dr. Thomas Oliver has made observations of several cases of this kind of illness, and he comes to the conclusion that the symptoms are best explained by the theory that the malady is due to increased solution, by the blood, of the gases met with in the compressed air, and the liberation of these gases during decompression. The increased solution of the gases is, of course, due to the greater pressure upon the person of the caisson worker.

IN one of the last numbers of the U.S. *Monthly Weather Review* (October 1898), Mr. H. Earlscliffe makes a suggestion of the possible utilisation of fog, which should call forth all the inventive genius of America. He states that in California there are vast areas of valuable land where the water supply is insufficient, but which are frequented by heavy fogs from the ocean. These fogs generally occur at night during the dry summer months, when moisture is most needed, and are dissipated early in the morning by the sun. Neither science nor art can at present suggest any feasible method of condensing the moisture, and causing the fog to descend in drops of rain. What is needed is some simple mechanical arrangement by which the fog particles shall be intercepted and forced to drip or glide downward to the ground, or to catch them as the leaves of the trees do. Such devices as the explosion of dynamite are likely to be too expensive in comparison with the return they make.

IN *Ciel et Terre* of the 1st inst. there is an article by M. Lancaster, Director of the Meteorological Division of the Brussels Observatory, entitled "Frost and Anti-cyclones." At a recent meeting of the Royal Meteorological Society, Mr. W. H. Dines read a paper on the winter temperature and height of the barometer in north-west Europe, in which he stated that the winter temperature did not depend upon the height of the barometer, and that it was just as likely to be cold when the barometer is below the average as when it is above the average. M. Lancaster draws attention to his paper in *Ciel et Terre* in 1895, in which he comes to nearly the same conclusion as Mr. Dines; and he states that the tables of monthly mean barometric pressures for Brussels from 1833 to 1898 show that during the seven months of December, which gave the highest mean barometric values, only one, that of 1879, had a temperature below the average. In ten months of January, with exceptionally high barometric pressure, the temperature, however, was below the average; while out of eight months of February, with high pressures, only one (1887) had a temperature below the average. The careful scientific work of both authors is beyond question; it may be mentioned, however, that Mr. Dines' paper met with considerable criticism, and, unless meteorological text-books are to be rewritten, the matter calls for further careful inquiry, with the view of seeing that no fallacy underlies the investigation.

IN the *Revue scientifique* of January 7, we learn that on October 31 a small monument was erected at the small village of Saint-Lothaire in the Jura, to Charles Marc Sauria, the original inventor of matches. The writer of the paper, Dr. Cabanès, tells us that Sauria was born in 1812, and was the son of General Sauria. He always showed a keen interest in scientific inventions of all kinds, and while studying for the medical profession at the college at Dôle, obtained some chemicals from an apothecary, and spent all his spare time in trying to make a match which would light by striking, while his fellow students were enjoying themselves. In the winter of 1830-31 his efforts were crowned with success. Sauria confided his inventions to his professor, M. Nicolet. Sauria gained but little profit from his invention, which he could not afford to patent, and spent the greater part of his days as a simple country doctor. It is interesting to learn that matches were invented independently in 1832 by Frederic Kammerer, an Austrian, who seems to have died in great poverty; and the same discovery is also attributed to the Hungarian Irinyi.

WE have received a reprint of a paper, published by Prof. Edward S. Morse in the November number of *Appleton's Popular Scientific Monthly*, entitled "Was Middle America peopled from Asia?" Prof. Morse answers the question in the negative, reviewing the arguments of the Asiaticists, and supports his conclusions by pointing out the absence of any evidence of interchange of social commodities.

AN important paper on physiographical problems raised by the distribution of temperature and salinity in the waters of the northern Pacific, is contained in *Petermann's Mitteilungen* for January. The discussion is chiefly based on the work of the U.S. s. *Albatross* between 1890 and 1895, and of the Russian vessel *Vitiaz*, under Makarow, in 1887. Considerable light is thrown on the movements of the deeper waters in the Bering and Okhotsk Seas, and in the western and central Pacific generally.

Petermann's Mitteilungen gives an account of the work of the international Glacier Commission appointed by the Geological Congress at Zürich in 1894. The Commission has issued a preliminary discourse by Prof. F. A. Forel, and three annual reports. The result of widest general interest arrived at, so far, is that periodic variations of climate are much more marked in the central regions of continents than on the borders. Coast-lands, and especially those of the Atlantic, are exceptional regions, in which characteristic dry periods are not, in general, recognisable. The advance and retreat of glaciers show corresponding differences.

WE have received the second number of *La Cultura Geografica*, a new illustrated review, published twice a month at Florence. It is to contain short articles on all branches of geography, but special attention will be paid to the geography of Italy, terrestrial physics, anthropogeography, and the history and teaching of geography. Among the subjects treated in the last issue are Danubian Italy, the poles of low temperature, the vertical distribution and grouping of the lakes of the province of Trent, &c.

THE volume of *Proceedings* of the Indiana Academy of Science, recently published, contains the results of a statistical inquiry into the variations of two species of Etheostoma living in lakes in the State. The paper is a contribution from the zoological laboratory of the Indiana University, the director of which, Prof. C. H. Eigenmann, explains that for the purpose of making a detailed comparison between the faunas of two units of environment, a biological station has been established on Turkey Lake, Kosciusko County, Indiana. Five miles from this lake is another lake of different shape and depth—Tippecanoe Lake. The two lakes are on opposite sides of the watershed separating the St. Lawrence from the Mississippi Basin. A physical survey has been made of these lakes, and the physical and biological conditions of the two lakes are being studied as two units of environment within which it is proposed to determine the extent of variation in the non-migratory vertebrates, the kind of variation, whether continuous or discontinuous, the quantitative variation, the direction of variation, and the annual or periodic variation and the effect of selection.

A PAPER by Mr. W. J. Moenkhaus, on the variation of specimens of *Etheostoma caprodes* and *E. nigrum* in two lakes, is one of a series projected to illustrate the points referred to in the foregoing note. The chief results are summarised as follows: (1) In *Etheostoma caprodes* the males are more variable than the females in the ratio of ·507 : ·468. In *Etheostoma nigrum* the females are more variable than the males in the ratio of ·402 : ·454. (2) The specimens of both species in Turkey Lake differ from those in Tippecanoe Lake in every structure examined. (3) The variation in the two species is determinate for the lake—that is, both species are modified in the same way by the same lake with but one exception. (4) This difference is not the result of selective influence, but apparently the direct effect of the environment.

A recent number of the *Bulletin de la Société de Géographie* contains a paper by M. Edouard de Sainville on his sojourn on the lower course of the Mackenzie River between 1889 and 1894. A descriptive account of the region and its Indian and Eskimo inhabitants is given in some detail. Amongst other observations of interest, M. de Sainville notes the entire absence of phthisis among the natives, and the occurrence of colds only on contact with civilisation. The experiment was tried of opening a soldered zinc case from Winnipeg in a perfectly healthy camp, and distributing the contents; next day every member developed a violent cold, which was cured by the administration of camphor.

Bulletin No. 162 of the Michigan State Agricultural College Experiment Station is devoted entirely to the subject of forestry, one of very great practical importance to the State.

The *Bulletin* of the Illinois State Laboratory of Natural History publishes a list, by Mr. Adolph Hempel, of the Protozoa and Rotifera found in the Illinois river and adjacent lakes at Havana, Ill. In the Protozoa are included *Volvox* and other allied forms. We have received also the Biennial Report, by the director of the same State Laboratory.

In view of the encouragement of new industries in the tropical possessions lately acquired by the United States, the U.S. Department of Agriculture (Division of Botany) has issued, in the form of *Bulletin* No. 21, an account, by Mr. S. J. Galbraith, of the culture of Vanilla, as practised in the Seychelles Islands.

In an article in the *Journal* of the Royal Horticultural Society for January, on the "Origin of Species-inducing Varieties," the Rev. G. Henslow states his conviction that it is not a rich soil which first induces doubling in plants, but a poor one; but, let the doubling be once thoroughly set up in the plant's constitution, and it then seems that a rich soil will probably enhance it. We have received also, from the Royal Horticultural Society, a very full programme of arrangements for the year 1899.

The December (1898) issue of *Himmel und Erde* contains an interesting article, by Herr G. A. L. Rumker, on the photography of lightning, which is illustrated by a beautiful reproduction from a photograph of "ribbon" lightning obtained at the Hamburg Observatory. Dr. F. Koerber continues his article on spectrum analysis, treating of the spectra of the planets and their satellites.

The *Verhandlungen* of the German Zoological Society, containing reports, papers, and other communications presented to the eighth annual meeting held at Heidelberg last June, have been published by Mr. W. Engelmann, under the editorship of Prof. Dr. J. W. Spengel.

Mr. J. A. Harvie-Brown has sent us a copy of his paper, read at the International Congress of Zoology last August, on "a correct colour code, or sortation code in colours, to serve for mapping the zoo-geographical regions and subregions of the world, and also to be of use as an eye-index for librarians." Accompanying the paper are specimens of colours which it is suggested should be used for book-shelves or bindings to indicate, in accordance with the proposed code, the regions to which the works refer.

Prof. H. Osborn has just published a useful pamphlet on the "Hessian Fly (*Cecidomyia destructor*, Say) in the United States," forming *Bulletin* No. 16, new series, of the U.S. Department of Agriculture, Division of Entomology. It is accompanied by a map of the distribution of the insect in the States, and several illustrations of its various stages, parasites, &c. Its original habitat is unknown, but it is now found in most countries of Europe, being specially abundant and destructive towards the eastern parts; in the north and west (including England) it is rarely destructive, and appears to have been either overlooked, or to be of recent introduction. In the States, it first attracted attention in Long Island in the year 1778, and was supposed to have been introduced, a year or two before, with fodder or bedding with the Hessian troops, whence its popular name; and this belief Prof. Osborn considers to be not improbably correct. From Long Island the insect extended its ravages in all directions at the rate of about twenty miles per year, and, as shown by the map, it has now invaded the whole of the eastern half of the States, except the south-eastern and the extreme southern States; and has likewise been found in California, about San Francisco. Outside Europe and the States it has been found near Wellington, New Zealand, in 1888, only two years after its presence in England had been verified by entomologists.

There are other wheat midgets besides the Hessian Fly, but the characteristic symptom of the attacks of the latter is the breaking down of the stalk, owing to its being weakened by the grub domiciled within. If the stubble, chaff, &c., is burned, or the field deeply ploughed over as early as possible, future injury may be much minimised, if not altogether prevented. The fly chiefly attacks wheat, rye, and barley, but has occasionally been found on grasses. Its abundance, or otherwise, depends much on climatic conditions, and is liable to be reduced by numerous parasites, chiefly small *Hymenoptera*. These, as well as the life-history of the insect, are fully discussed in the pamphlet referred to in the present note, which also includes a full account of the various remedies which have been suggested for its attacks, and a bibliography.

The additions to the Zoological Society's Gardens during the past week include a Guinea Baboon (*Cynocephalus sphinx*, ♀) from Africa, presented by Mrs. Mellin; a Macaque Monkey (*Macacus cynomolgus*, ♂) from India, presented by Mr. Hamilton Baker; two Night Herons (*Nycticorax griseus*), European, presented by Mr. Chas. Humberset; a Woodcock (*Scolopax rusticula*), European, presented by Captain Bewicke; two Black-necked Lizards (*Agama atricollis*) from Natal, presented by Mr. W. Champion; a Bennett's Wallaby (*Macropus bennetti*) from Tasmania, an Australian Cassowary (*Casuarius australis*) from Australia, a Two-wattled Cassowary (*Casuarius bicarunculatus*) from the Aroo Islands, a Bennett's Cassowary (*Casuarius bennetti*) from New Britain, deposited; a Brush-tailed Kangaroo (*Petrogale penicillata*, ♀) from New South Wales, a Blue-crowned Parrakeet (*Tanygnathus luzonensis*) from the Philippines, four Bearded Titmice (*Panurus biarmicus*, 2 ♂, 2 ♀), European; two Long-tailed Grass Finches (*Poëphila acuticauda*, ♂ ♀) from North-west Australia, a Hobby (*Falco subbuteo*) British, purchased.

OUR ASTRONOMICAL COLUMN.

Wolf's Comet, 1898 IV.—A. Thraen gives, in the *Astronomische Nachrichten*, an ephemeris for observation of this comet (Bd. 148, No. 3544).

Ephemeris for Berlin Midnight.

1899.		α. h. m. s.		δ. ° ′		Br.
Feb. 16	...	6 13 48	...	−10 39·0	...	0·80
20	...	14 39	...	9 55·2	...	·74
24	...	15 53	...	9 11·6	.	·69
28	...	17 28	...	8 28·9	...	·64
Mar. 4	...	19 24	...	7 47·3	...	·59
8	...	21 39	...	7 6·9	...	·55
12	...	24 11	...	6 27·9	...	·51
16	...	27 0	...	5 50 5	...	·47
20	...	6 30 4	...	− 5 14 8	...	0·44

During the period the comet moves in a north-easterly direction, its path lying about midway between the belt of Orion and Sirius. From March 8 to 10 it will be passing near the fourth mag. double star β (11) Monocerotis.

COMET CHASE, 1898 VIII.—E. F. Coddington gives, also in *Ast. Nach.*, No. 3544, a revised ephemeris and table of elements for this comet, which he has computed from observations made by him at Mount Hamilton on November 23, December 7 and December 16, 1898.

Elements.

T = 1898, Sept. 20·15344 G.M.T.

$$\left.\begin{aligned} \omega &= 4^\circ\ 37'\ 59''\cdot9 \\ \Omega &= 95\ \ 51\ \ 35\cdot9 \\ i &= 22\ \ 30\ \ 20\cdot3 \end{aligned}\right\} 1899\cdot0$$

$\log q = 0\cdot358892.$

Ephemeris for Greenwich Midnight.

1899.	α h.	m.	s.	δ °	′	″	Br.
Feb. 16	11	3	0·99	+36	47	38·3	0·91
20	11	0	58·16	37	15	10·3	·87
24	10	58	49·87		38	16·7	·83
28		56	39·81		56	47·8	·79
Mar. 4		54	31·44	38	10	40·0	·75
8		52	28·31		19	50·9	·71
12		50	33·54		24	26·6	·67
16		48	50·19		24	32·9	·63
20		47	20·60		20	25·6	·59
24		46	6·59		12	20·8	·55
28		45	9·42	38	0	36·7	·51
April 3	10	44	16·87	+37	36	49·3	0·48

Comparison of the elements leads to the orbit being considered almost parabolic, and hence there is no probability of its being identical with that of Comet 1867 I., as has been suggested. The comet is now rapidly receding from the sun and decreasing in brightness. It is moving slowly westwards between the pairs of stars γ, ξ and λ μ Ursæ Majoris.

VARIATION OF SPECTRUM OF ORION NEBULA.—Much has been recently said as to whether the spectrum of this nebula is different in different regions. There seems to be no doubt that in different parts certain lines are intensified or reduced relatively to others, but observers are not yet agreed as to the reality of the difference, many ascribing it to physiological causes. Prof. J. E. Keeler, with the Lick 36-inch refractor, has examined it with reference to this matter (*Ast. Nach.*, No. 3541). Near the star Bond 734 the strongest line was $H\beta$ (F). With the slit on the Huyghenion region, near the trapezium, the strongest line was the chief nebula line (λ 5007), while $H\beta$ and the second nebula line (λ 4959) were about equally bright, but much less intense than the chief line. Still keeping the slit in this region, the vertical aperture of the spectroscope was diminished without altering the resolving power. When the brightness was sufficiently reduced, $H\beta$ and the line λ 4959 disappeared, leaving λ 5007 alone visible. Thus in one part of the nebula $H\beta$ alone was visible, in another λ 5007. This is inexplicable on physiological grounds, and would seem to point to real differences in the composition of the nebula.

LATITUDE DETERMINATION.—In the determination of latitude by Tallcott's method, the apparent mean declination of a pair of stars has to be deduced from observations of the star corrected by constant factors dependent on the position of the stars. To facilitate these reductions H. Kimura, of the Tokyo Observatory, gives formulæ and tables for constructing mean star factors (*Ast. Nach.*, Bd. 148, No. 3541). There are also four special tables of these constants given for the particular latitude $\phi = 39^\circ\ 8'\ 10''$, which is that chosen for a number of stations for the coming international work of determining latitude variation.

LYNN'S "REMARKABLE COMETS."—A new edition—the seventh—of this handy little volume has been published by Mr. Edward Stanford. The periodic comets which may be expected to return this year are stated by Mr. Lynn as follows: Spring—The comet of 1866, connected with November meteors (period, 33¼ years). Summer—Tuttle's comet (period, 13¾ years), Tempel's second periodical comet (period, 5¼ years), and Holme's comet (period, nearly 7 years). Winter—Finlay's comet (period, 6½ years).

THE THEORY OF THE STASSFURT SALT DEPOSITS.

"THE formation of the salt deposits at Stassfurt, Wieliczka, and other places, so far as they are of an oceanic origin, cannot receive a detailed explanation until the conditions of equilibrium affecting the salts dissolved in sea-water have been subjected to a systematic investigation.

"First of all, it must be ascertained what grouping the radicals assume in the solid state; that is to say, what solid substances separate out as sea-water is evaporated. Further experiments will then show us how the composition of sea-water is affected by the presence of the various solids, and whether, and to what degree, changes take place—loss of water of crystallisation, formation of double salts, and kindred phenomena—as the composition of the solution alters, until finally the water is wholly evaporated, and a stable system of solids is left behind."

The comprehensive programme of work thus indicated by Dr. Meyerhoffer in 1895 has been seriously entered upon, and the first instalment of results appears in a recent number of the *Zeitschrift für Physikalische Chemie*, vol. xxvii. p. 75.[1]

The investigation promises to be of great interest and importance, viewed both from the theoretical and practical standpoints. The problem of determining the conditions under which a series of salts have been deposited during the concentration of a dilute solution, is very much more complicated than might at first sight appear, and can only be solved by the application of methods and principles that are of recent discovery. The researches that render the investigation possible have been mainly conducted during the past few years in the laboratory of Prof. van 't Hoff; and those who are acquainted with the admirable "Études sur les equilibres chimiques" (translated into English by Dr. Ewan), and with the later publications of van 't Hoff, will know how ably he has developed the theory of equilibrium as applied to the existence of hydrates and of double salts.

The plan of work, with respect to the Stassfurt deposits, is as follows. The chief dissolved substances in sea-water consist of salts formed from Cl, SO_4, Na, K and Mg; the first problem is, therefore, the complete investigation of the salts and solutions producible from these radicals. Even within these limits the investigation is too complicated; so that, first of all, systems formed by water with the chlorides and sulphates of K and Mg are dealt with. Then the consideration is extended to such systems with the addition of rock salt, and the first part of the investigation is concluded.

In the second part the less soluble and less abundant components of the deposits will be considered. Calcium, in the first instance, will receive attention; and then the compounds of boron, bromine, and iron.

The groups of substances to be dealt with are as follows:—

(1) Group formed from the sulphates and chlorides of K and Mg.
 $MgCl_2$ and its hydrates.
 Sylvine, KCl and K_2SO_4.
 $MgSO_4$ and its hydrates; Carnallite, $MgCl_2$, $KCl.6H_2O$.
 Schönite, $MgSO_4$, $K_2SO_4.6H_2O$, and potassium astrakanite $MgSO_4$, $K_2SO_4.4H_2O$.
 Kainite, $MgSO_4$, $KCl.3H_2O$, and Langbeinite $2MgSO_4$ K_2SO_4.

(2) With the addition of NaCl.
 NaCl and Na_2SO_4 and their hydrates.
 Astrakanite (Blödite), $MgSO_4$, Na_2SO_4, $4H_2O$.
 Glaserite (Penny's salt), $K_3Na\,(SO_4)_2$.

(3) With the addition of Calcium.
 $CaCl_2$ and its hydrates.
 Tachydrite, $CaCl_2.2MgCl_2.12H_2O$.
 Gypsum, $CaSO_4.2H_2O$, Anyhdrite $CaSO_4$, and their double salts, such as Krugite, Glauberite, Polyhalite, Syngenite, Mamannite, &c.

(4) With the addition of Boron, Bromine and Iron.
 Boracite, Stassfurtite.
 Magnesium bromide.
 Potassium ferrochloride, &c.

The first instalment of the research, now published, deals exclusively with the hydrates of magnesium chloride. The

[1] Über Anwendungen der Gleichgewichtslehre auf die Bildung oceanischer Salzablagerungen, mit besonderer Berücksichtigung des Stassfurter Salzlagers. Von J. H. van 't Hoff und W. Meyerhoffer.

limits of existence of the following hydrates within $-33°\cdot6$ C. and 186° C. (the temperature at which water begins to decompose magnesium chloride) have been investigated :—

$MgCl_2.12H_2O$, $MgCl_2.8\alpha H_2O$, $MgCl_2\ 8\beta H_2O$, $MgCl_2\ 6H_2O$, $MgCl_2.4H_2O$, $MgCl_2.2H_2O$.

It is impossible within the limits of this notice to discuss the details of the investigation, but the brief indication here given of the nature and scope of the inquiry may serve to direct attention to a research which is obviously of wide interest.

THE NATURAL HISTORY OF CORDIERITE AND ITS ASSOCIATES.[1]

THE last quarter of the present century has witnessed an extraordinary outburst of petrological activity, due, in a large measure, to the application of precise mineralogical methods to the study of the constituents of rocks. The petrologist, and through him the geologist, owes, therefore, an enormous debt of gratitude to the mineralogist ; at the same time, the benefits have not been wholly one-sided. Mineralogy is becoming something more than a mere catalogue of the crystallographic, chemical and physical characters of museum-specimens, and this is largely due to the influence of petrology. It may end in breaking down the artificial systems of classification which are in vogue, and introducing others more in accordance with genetic principles.

A good illustration of the advantage of studying minerals from the natural history point of view may be obtained by considering some facts relating to the modes of occurrence and origin of corundum, spinelle, sillimanite and cordierite—four minerals which are so frequently found together that they have been called the "faithful companions." Corundum is crystallised alumina (Al_2O_3), true spinelle is an aluminate of magnesia ($MgO.Al_2O_3$), sillimanite is the silicate of alumina ($Al_2O_3.SiO_2$), and cordierite is a silicate of alumina and magnesia ($2MgO.2Al_2O_3.5SiO_2$). The mutual replacing properties of ferrous oxide and magnesia, and of ferric oxide and alumina complicate the composition of the spinelles and cordierite. All the minerals contain alumina, and it is this fact which determines their paragenesis. They occur, usually in combinations of two or more, under the most diverse geological conditions :—

(1) As the constituents of foliated crystalline rocks of more or less doubtful origin.

(2) As the products of contact-metamorphism round plutonic masses.

(3) As the constituents of inclusions in plutonic rocks, dykes, lavas and agglomerates.

(4) As the direct products of the crystallisation of igneous magmas.

(5) As the direct products of the crystallisation of artificial silicate-magmas.

Cordierite-gneisses are found in many parts of the world in association with biotite-gneisses and other foliated crystalline rocks. Various views have been expressed as to their origin. Some petrologists are content to refer them to the Archæan system ; others regard them as due to the contact or thermodynamic metamorphism of ordinary argillaceous sediments ; and others as rocks of mixed origin, containing both igneous and sedimentary material. The last view, as applied to certain members of the group but not to all, derives support from the fact that where cordierite-rocks occur as contact products, they always belong to the inner zone, and sometimes give distinct evidence of the intimate intermixture of igneous and sedimentary material.

Cordierite-rocks, often containing sillimanite and a green spinelle, have been recognised, during the progress of the Geological Survey, at many points in the Southern Highlands of Scotland, in the counties of Aberdeen, Banff, Forfar and Argyle, and quite recently corundum has been detected in some of these ; so that the list of the "faithful companions" is now complete so far as Scotland is concerned. It is doubtful at present whether all the Scottish cordierite-rocks are of the same age and mode of origin. Some are contact-rocks, but others may, for the present at least, be more safely classed with the older crystalline-schists. All are undoubtedly the result of the metamorphism of highly aluminous rocks.

A very interesting case of the occurrence of all four minerals in rocks due to contact-action has been described by Salomon. It occurs in the southern part of the Eastern Alps round the great mass of tonalite, of which Monte Adamello forms the culminating point.

Inclusions, derived either from a contact-zone or from the crystalline-schist formation, containing two or more of the minerals in question, have been observed in igneous rocks occurring under the most diverse conditions in many parts of the world. They have been found, for example, in the tonalite of Monte Aviolo ; in the kersantite-dyke of Michaelstein in the Hartz ; in the andesitic lavas of the Eifel, the Siebengebirge and the south-east of Spain ; and, finally, amongst the ejected blocks of the Laacher See and Asama Yama in Japan. There is evidence, moreover, that in most of these cases the minerals, or some of them, occur not only as constituents of the inclusions, but also as the direct products of crystallisation from the igneous magmas. Thus, in the mica-andesite of Hoyazo (Cabo di Gata) cordierite occurs in two forms : (1) as irregularly bounded grains up to the size of a hazel-nut, and (2) as sharply defined idiomorphic crystals in a glassy base. The former are inclusions ; the latter are crystals which have separated from the magma. Rock-fragments, consisting very largely of a cordierite-gneiss from which the isolated grains of cordierite have been derived, are also very common in this andesite. Osann, who has described this very interesting case, points out that the abundance of indigenous cordierite, coupled with the presence of numerous inclusions of cordierite and cordierite-gneiss, points to the conclusion that portions of the foreign rock have been dissolved, and that a magma of exceptional composition has thus been formed, out of which cordierite has crystallised. Many other cases are known in which the solution of foreign aluminous material has so modified a magma that members of the group under consideration have crystallised out of it. Moreover, it is not necessary that the minerals should be present in the foreign material. It is sufficient that the necessary chemical constituents should be present. Thus a basalt from Köllnitz in Carinthia has involved fragments of an argillaceous rock, and partially dissolved them. The normal basalt is holocrystalline, but in the neighbourhood of the inclusions it becomes glassy, and crystals of spinelle and cordierite, which are absent, both from the basalt and the inclusion, occur. The partial solution of the fragments evidently modified the composition of the basalt, so that it cooled as a glass after cordierite and spinelle had separated out. It is interesting to note, in passing, that the addition of alumina to the basaltic magna has tended to prevent crystallisation. This effect of alumina is well known to glass-makers.

The formation of corundum in an igneous rock as the consequence of the solution of argillaceous material is well illustrated by the case described by Prof. Busz. The mineral occurs round inclusions of clay slate in a felsite from South Brent. Many cases of the presence of corundum in igneous rocks under conditions which prove that it must have crystallised out of the magma, are now well known ; and amongst the most interesting are those recently found in Hastings County, Canada, where the mineral occurs in dykes of syenite. In these, however, there appears to be no evidence that the excess of alumina is due to the solution of argillaceous rocks.

The remarkable synthetic experiments of Dr. Morosewicz give a complete and satisfactory account of the chemical and physical conditions under which corundum, spinelle, sillimanite and cordierite separate out of alumo-silicate magmas ; and, therefore, of many of the natural occurrences above referred to. Alumina is soluble in magmas agreeing in composition with albite, nepheline and anorthite, or with mixtures of these, and crystallises out as corundum on prolonged cooling at high temperatures. If both silica and alumina are present in excess of that necessary to form felspar, sillimanite is formed until the excess of silica is used up, and then the remaining excess of alumina crystallises out as corundum. The presence of magnesia determines the formation of spinelle, or of cordierite, or of both, according to the excess of alumina and silica above that necessary to form felspar with the soda, potash and lime present. All these phenomena may be verified within the range of temperature in a Siemens' furnace, such as that used in glass-works. The minerals obtained are in every way similar, except as regards size, to those which occur in nature.

It thus appears that the "faithful companions" may be formed either by the metamorphism of sedimentary deposits, or

[1] Abstract of the presidential address delivered to the Geologists' Association, by J. J. H. Teall, F.R.S., on February 3.

as the result of the crystallisation of igneous magmas of exceptional composition. In many cases, if not in all, the presence of these minerals in igneous rocks is the result of the solution of argillaceous material. It seems fair to conclude, from their general absence from masses of granite and other igneous rocks, that the absorption of argillaceous sediments has not taken place on any large scale. But in drawing this inference caution is necessary because, under plutonic conditions, the presence of water may lead to the formation of micas instead of them. Fused biotite gives rise to spinelle, and fused muscovite to sillimanite and corundum.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. G. Sims Woodhead has been appointed professor of pathology in succession to the late Prof. Kanthack.

The Balfour studentship, of the annual value of 200*l.*, for original research in biology, especially animal morphology, has been awarded to Mr. J. Stanley Gardiner, Fellow of Gonville and Caius College, for three years from March 25, 1899. Grants from the Balfour fund of 50*l.* each have been made to Mr. J. S. Budgett, of Trinity College, in aid of his researches on the development of polypterus, and to Mr. L. A. Borradaile, of Selwyn Hostel, in aid of the expenses of his proposed journey in company with Mr. Gardiner, the Balfour student.

DR. H. E. ANNETT has been appointed demonstrator of tropical pathology in the newly-founded school of tropical diseases in Liverpool.

WE are asked to state that the offices of the National Association for the Promotion of Technical and Secondary Education have been removed from 14 Dean's Yard to 10 Queen Anne's Gate, Westminster, S.W.

AT the annual meeting of the shareholders of the Patent Nut and Bolt Company (Limited), held on Monday at Birmingham, it was resolved that the company should contribute 5000*l.* to the fund which is being raised for the establishment of a University in Birmingham.

THE London School Board have strongly protested against the application of the London County Council to the Science and Art Department to be recognised as the organisation responsible for science and art instruction in the County of London. A memorial has been drawn up and presented to the Lord President of the Council, asking him not to assent to the application of the County Council, and giving reasons why the Board should be largely represented upon whatever authority was given control over science and art instruction in London.

A COPY of the address delivered at the recent annual meeting of the Association of Technical Institutions, by Earl Spencer, has been received. In the address, the importance attached to a thorough system of technical instruction in America and Germany is pointed out, and the intimate and necessary relations which exist between technical and secondary education are mentioned. Just as it is difficult to give technical instruction without a foundation of good secondary education, so secondary education is retarded and often completely stopped by the poor education of pupils who come from the primary schools to seek it. Earl Spencer made special reference to this lack of system in educational efforts, and remarked that in order to secure sound and good technical education for the population as a whole, many defects of primary education will need to be remedied.

THE Calendar of the Department of Science and Art has been issued. As in former years, the volume contains a history and general description of the Department, with a summary of the rules, and a list of the science and art schools and classes. The total number of individual students who presented themselves for examination in science subjects of the Department in 1898 was 157,306. The six subjects in which the most students were examined are—mathematics (stages 1, 2, 3), 35,945; physiography, 24,877; inorganic chemistry, 23,966; practical plane and solid geometry, 20,238; machine construction and drawing, 18,073; building construction, 13,653. Of the subjects in which practical examinations were held, the first four are—inorganic chemistry, 15,012; magnetism and electricity, 2550; organic chemistry, 1195; sound, light and heat, 1141.

SOCIETIES AND ACADEMIES

LONDON.

Royal Society, January 26.—"On the Structure and Affinities of Fossil Plants from the Palæozoic Rocks. III. On *Medullosa anglica*, a new Representative of the Cycadofilices." By D. H. Scott, M.A., Ph.D., F.R.S., Hon. Keeper of the Jodrell Laboratory, Royal Gardens, Kew.

The existence of a group of fossil plants, combining in their organisation certain characters of the Ferns and the Cycads, has been recognised, of late years, by several palæobotanists. The convenient name, Cycadofilices, has recently been proposed to designate the group in question, which now includes several, somewhat heterogeneous, genera, among which *Lyginodendron*, *Heterangium*, and *Medullosa* may be mentioned.

No stem of a *Medullosa* has hitherto been recorded from this country, though specimens of *Myeloxylon*, now known to have been the petioles of *Medullosa*, are frequent in the calcareous nodules of the Lower Coal-measures.

The author has recently had the opportunity of investigating several excellent specimens of a new species of *Medullosa* from the Ganister Beds of Lancashire. These fossils are of special interest on several grounds; they are considerably more ancient than any members of the genus previously described, they are the first English specimens recorded, they are preserved in a more complete and perfect form than any others at present known, and lastly, the greater simplicity of their structure causes the essential characters of the genus to stand out with greater clearness than in the more complex species. The specimens were discovered by Mr. G. Wild and Mr. J. Lomax, in material from the Hough Hill Colliery, Stalybridge.

The species, which is very distinct from any form previously described, will be known as *Medullosa anglica*.

The most complete specimen of the stem has a mean diameter of rather more than 7 cm., including the adherent leaf-bases, which, to judge from the most perfect specimens, almost completely clothed the surface of the stem. The arrangement of the leaves was a spiral one, and in the only case where the phyllotaxis could be determined, the divergence proved to be 2/5.

In two of the specimens the external characters of the fossil are well shown. The habit of the stem, clothed with the long, almost vertical, overlapping leaf-bases, may have been not unlike that of some of the tree-ferns, such as *Alsophila procera*.

The vascular system of the stem consists of three (or locally four) steles, anastomosing and dividing at long intervals.

Each stele of *Medullosa anglica* is surrounded by a zone of secondary wood and bast, and shows the closest agreement in structure with the single stele of a *Heterangium*, so that the stem of this *Medullosa* might well be concisely described as a polystelic *Heterangium*.

The course of the leaf-trace bundles was followed very completely in consecutive series of transverse, and in longitudinal, sections. On becoming free the trace is a large concentric bundle; as it passes obliquely upwards through the cortex, the trace loses its secondary tissues, and undergoes repeated division into a number of smaller bundles, each of which has collateral structure. These collateral strands have in all respects the same arrangement of their elements as the well-known bundles of *Myeloxylon*.

The base of the leaf received a large number of bundles, consisting of the ultimate branches derived from the subdivision of several of the original leaf-traces. This distribution of the bundles is peculiar and unlike that in any known plants of Cycadean affinities.

The petioles branched repeatedly, the finest ramifications of the rachis having a diameter of about 1 mm. only, but retaining in essentials the "*Myeloxylon*" structure. The leaf was thus a highly compound one; the structure of the leaflets associated with the rachis, agrees well with that of the *Alethopteris* leaflets, figured by M. Renault.

The roots, never previously observed in any species of *Medullosa*, were of triarch structure, with abundant formation of secondary wood, bast, and periderm. The author is indebted to Mr. J. Butterworth and Mr. G. Wild, for specimens which have thrown important light on the connection between root and stem.

While *Medullosa* combines, in a striking manner, the characters of Ferns and Cycads, the author is not disposed to regard it as having lain very near the direct line of descent of the latter group. It is more probable, as Count Solms-

Laubach has suggested, that the Medulloseæ represent a divergent branch, which has left no descendants among existing vegetation.

Physical Society, February 10.—Annual General Meeting.—Mr. Shelford Bidwell, F.R.S., President, in the chair.—The report of the Council was read by Mr. H. M. Elder. Dr. Atkinson then presented the Treasurer's report, and showed that although there was only a small balance in the bank, the financial position had somewhat improved. The list of Fellows lost to the Society by death was read. After some remarks with regard to the library and the subscriptions, votes of thanks were passed to the Council, the auditors, and to the other officers of the Society. The President then moved a vote of thanks to the Chemical Society for the use of the rooms at Burlington House. Council and officers for the forthcoming year were elected as follows: President, Prof. Oliver J. Lodge, F.R.S.; vice-presidents who have filled the office of president, Dr. J. H. Gladstone, F.R.S., Prof. G. C. Foster, F.R.S., Prof. W. G. Adams, F.R.S., the Lord Kelvin, F.R.S., Prof. R. B. Clifton, F.R.S., Prof. A. W. Reinold, F.R.S., Prof. W. E. Ayrton, F.R.S., Prof. G. F. Fitzgerald, F.R.S., Prof. A. W. Rücker, F.R.S., Capt. W. de W. Abney, C.B., F.R.S., Shelford Bidwell, F.R.S.; vice-presidents, T. H. Blakesley, C. Vernon Boys, F.R.S., G. Griffith, Prof. J. Perry, F.R.S.; secretaries, W. Watson (Physical Laboratory, South Kensington) and H. M. Elder (50 City-road, E.C.); foreign secretary, Prof. S. P. Thompson, F.R.S.; treasurer, Dr. E. Atkinson; librarian, W. Watson. Other members of Council: Prof. H. E. Armstrong, F.R.S., Walter Baily, R. E. Crompton, Prof. J. D. Everett, F.R.S., Prof. A. Gray, F.R.S., E. H. Griffiths, F.R.S., Prof. J. Viriamu Jones, F.R.S., S. Lupton, Prof. G. M. Minchin, F.R.S., and J. Walker.—The newly-elected President, Prof. Oliver Lodge, then took the chair, and an ordinary meeting was held. In his address he referred to the heavy death-roll of the Society during the past year, and to the tribute paid to the memory of John Hopkinson at Cambridge University. Prof. Lodge then commented on the quickness with which scientific discoveries were now applied to practice, and to the interest taken in such applications by men of science. He did not know whether this was due to the example and inspiration of Lord Kelvin, or to the progress of education among the public. He regretted that the public were so ignorant of scientific subjects. Rapidly reviewing the work done in physics during the past year, he spoke of the experiments of Righi, Preston, Michelson, and J. J. Thomson, and called attention to a prediction, lately published in NATURE by Prof. G. F. Fitzgerald, with regard to the probability of being able to obtain magnetic effects by passing circularly polarised light through absorptive media. After commenting upon the important position now occupied by terrestrial magnetism among the sciences, and the advantages of the publication now known as *Science Abstracts*, Prof. Lodge said there was one event of exceptional significance to physics, that had happened during the past year, an event of which science would feel the effect for centuries to come—the Government had decided to begin to establish a national laboratory. He wished to congratulate Sir Douglas Galton, and himself, on the speedy result of their urging the matter upon the British Association. He thought the thanks of the Physical Society were due to the Committee appointed by the Treasury, especially perhaps to Prof. Rücker, as acting-chairman of that Committee, and to Mr. Chalmers, who represented the Treasury, for the way in which the work had been brought to an issue. There was much for which the present Government deserved praise during the past year; he wished there could be added to their laurels the inauguration of a University for London. Prof. Lodge then went on to the specific subject of his address—the opacity of conducting media to light and to electric waves generally, emphasising the brilliant work of Mr. Oliver Heaviside in unifying phenomena apparently different, discussing the effect of boundaries, and dealing specially with the question, first attacked by Maxwell, of the theoretical opacity of gold-leaf. (This part of the address will be published in full in the *Phil. Magazine*.) Prof. Ayrton said, with regard to the attenuation of electric waves by the earth, that Mr. Whitehead, some months ago, came to the conclusion that when the primary and secondary coils were placed flat on the earth at a distance from one another, nearly all the energy of the primary was absorbed by the earth before reaching the secondary. The degree of absorption was so great that Mr. Whitehead had hesitated to publish his theoretical results until experiment should confirm them. Prof. Lodge concurred with Mr. Whitehead's result. Three cases were to be considered. In the first, one horizontal coil is superposed to the other, with sea-water or some other absorbing medium between them; in this case the absorption at moderate distances is not excessive. But, of course, if the coils are formed of cable sheathed with iron, as in the recent experiments made by the Royal Commission, the iron itself prevents the progress of electric waves from primary to secondary. In the second case the coils are wholly in the same horizontal plane. The earth, owing to its great magnitude, behaves almost as a perfect conductor; if the coils are now near the earth, there is no normal magnetic force between them—it is all tangential. In the third case the coils are opposed to one another, both being vertical, and near to the earth. The high conductivity of the earth is here acting to the advantage of wave propagation, for the image of the primary coil is in phase with the coil itself, and the total effect is approximately doubled.—Prof. Carey Foster then took the chair, and Prof. Oliver Lodge read a paper by Mr. Benjamin Davies, on a new form of amperemeter and voltmeter with a long scale. These instruments are already well known, although no account of them has actually been published. They are of the moving-coil, long-range, portable type, with a very uniform scale from zero to maximum. The magnetic circuit has only one air-gap, which is generally the space between a central cylinder of iron or steel and a concentric tube of iron, modified in various ways for facilitating the adjustment of the magnetic induction and the placing of the coil. The central cylinder is bored axially, and one side of the rectangular coil is pivoted at the top and bottom of the hole thus made. The second side of the coil moves in a circular path in the annular air-gap. Photographs of the instruments in several modified forms were exhibited. Prof. Ayrton said the instruments appeared to be very successful; he could bear witness of their value, particularly as regards the length of range. The general principle by which long-range was to be obtained on moving-coil, portable, instruments, was developed some ten years ago by M. Carpentier of Paris, who used a central magnet surrounded by a concentric hollow cylinder, with only one side of the coil in the magnetic gap between them; but it was not then a portable form of instrument, for the coil was suspended. Prof. Ayrton had himself worked in this direction in the "static station-voltmeter," in that instrument there were three magnetic circuits arranged to give staticism; this was described in 1892 or 1893.—The Vice-President (Prof. Carey Foster) proposed a vote of thanks to the author, and the meeting adjourned until February 24.

Chemical Society, February 2.—Prof. Dewar, President, in the chair.—The following papers were read:—Maltodextrin, its oxidation products and constitution, by H. T. Brown and J. H. Millar. Pure maltodextrin, isolated from the products of starch hydrolysis, yields, on very careful oxidation, a carboxylic acid which the authors term provisionally maltodextrinic acid A, and to which they assign the constitution

$$C_{12}H_{21}O_{10}.O.C_{12}H_{20}O_9.O.C_5H_9O_5\,;$$

this on further oxidation yields a maltodextrinic acid B,

$$C_{12}H_{21}O_{10}.O.C_5H_9O_5$$

and maltose. The constitution

$$C_{12}H_{21}O_{10}.O.C_{12}H_{20}O_9.O.C_{12}H_{21}O_{10}<,$$

is assigned to maltodextrin, the sign $<$ denoting the open carbonyl.—On attempts to prepare pure starch derivatives through their nitrates, by H. T. Brown and J. H. Millar.—The stable dextrin of starch transformations, and its relation to maltodextrin and to soluble starch, by H. T. Brown and J. H. Millar. A stable dextrin is obtained at an early stage in the diastatic transformation of starch, and yields a carboxylic dextrinic acid on cautious oxidation. The following constitutions are assigned to the dextrin and the dextrinic acid respectively:—

$$O_{39}\begin{cases} C_6H_{11}O_5 \\ (C_{61}H_{10}O_4)_{39} \\ C_6H_{11}O_5< \end{cases} \qquad O_{39}\begin{cases} C_6H_{11}O_5 \\ (C_6H_{10}O_4)_{38} \\ C_5H_9O_5 \end{cases}$$

Propylbenzenesulphonic acids, by G. T. Moody.—The chemistry of the so-called nitrogen iodide. Part I. The preparation and properties of nitrogen iodide, by F. D. Chattaway and K. J. P. Orton. Well-defined crystals of nitrogen iodide are slowly deposited on adding ammonia to dilute potassium hypoiodite solution; they are copper-coloured and have a density of 3·5. Part II. The action of reducing agents on nitrogen iodide, by F. D. Chattaway and H. P. Stevens. Part III. The composition of nitrogen iodide, by F. D. Chattaway. Nitrogen iodide, however prepared, has the composition $N_2H_3I_3$. Part IV. The action of light on nitrogen iodide, by F. D. Chattaway and K. J. P. Orton. Nitrogen iodide is decomposed by light, yielding nitrogen and hydrogen iodide; slight hydrolysis also occurs with formation of ammonium hypoiodite and ammonia. Part V. The action of alkaline hydrates, of water and of hydrogen peroxide on nitrogen iodide, by F. D. Chattaway and K. J. P. Orton. Alkaline hydrates hydrolyse nitrogen iodide with formation of ammonia and an hypoiodite; some decomposition occurs simultaneously, nitrogen and hydrogen iodide being produced. Water causes a similar decomposition, but the hypoiodous acid and hydrogen iodide in this case react with liberation of iodine. Hydrogen peroxide in potash solution decomposes nitrogen iodide with formation of ammonia, potassium iodide and a little iodate, whilst oxygen and nitrogen are evolved. Part VI. The action of acids on nitrogen iodide, by F. D. Chattaway and H. P. Stevens. Part VII. Theory of the formation and reactions of nitrogen iodide, by F. D. Chattaway and K. J. P. Orton. Iodine and aqueous ammonia react with formation of equimolecular quantities of ammonium iodide and hypoiodite; the latter then decomposes with formation of nitrogen iodide in accordance with a reversible reaction. —An isomeride of amarine, by H. L. Snape and A. Brooke. The action of chlorosulphonic acid on paraffins and other hydrocarbons, by S. Young.—Derivatives of dibenzylmesitylene, by W. H. Mills and T. H. Easterfield. Dibenzoylmesitylene on reduction yields dihydroxydibenzylmesitylene, which on further reduction gives dibenzylmesitylene.—On pseudocampholactone and pseudolauronolic acid, by F. H. Lees and W. H. Perkin, jun. Camphoric anhydride is converted by aluminium chloride in chloroform solution into isolauronolic acid and a new lactone, ψ-campholactone; the latter on hydrolysis yields a mixture of two isomeric acids of the composition $C_9H_{16}O_3$.—Nitrocamphor as an example of dynamic isomerism, by T. M. Lowry.—Position-isomerism and optical activity; the methylic and ethylic salts of benzoyl-, and of ortho-, meta- and paratoluyl-malic acid, by P. Frankland and F. M. Wharton. A considerable quantity of data respecting the rotations of the aromatic derivatives of methylic and ethylic malate is given.—Some regularities in the rotatory power of homologous series of optically active compounds, by P. Frankland.—On brasilin and hæmatoxylin, by A. W. Gilbody and W. H. Perkin, jun.

Zoological Society, February 7.—Prof. G. B. Howes, F.R.S., Vice-President, in the chair.—Mr. F. E. Beddard, F.R.S., read a paper on the cerebral convolutions of the gorilla, in which he reviewed our previous knowledge of the subject, and recorded his own observations on five brains of this animal which he had in his possession.—A communication from Dr. R. O. Cunningham, contained a note on the presence of supernumerary bones occupying the place of prefrontals in the skulls of certain mammals. These bones had recently been observed by the author in skulls of *Macropus giganteus* and *Phascolomys platyrhinus*.—Mr. G. E. H. Barrett-Hamilton read a paper on the mice of St. Kilda, of which he recognised two species—*Mus hirtensis*, sp. nov., a representative of *M. sylvaticus*, and *M. muralis*, sp. nov., representing *M. musculus*. Both of these species showed good distinctive characters from their well-known prototypes.—A communication was read from Prof. W. Blaxland Benham containing a detailed anatomical account of the structure of *Notornis*, based on the examination of a young female specimen of this bird recently received at the Otago Museum, Dunedin, New Zealand.—A communication was read from Mr. E. N. Buxton, containing some notes on the herd of bisons living in the Emperor of Russia's forest of Bielovege in Lithuania, which he had made during a visit to that place in the past autumn.—Mr. G. A. Boulenger, F.R.S., described two new species of lizards, under the names of *Lacerta jacksoni* and *Chamaesaura annectens*, from specimens contained in a collection of reptiles recently sent to the British Museum by Mr. F. J. Jackson, C.B., from the interior of British East Africa.—Mr. Boulenger read the second part of a memoir, entitled "A Revision of the African and Syrian Fishes of the Family *Cichlidae*." Owing to the large amount of material contained in collections recently received from Lake Tanganyika and the Congo, the author had been obliged to make an alteration in the plan of arrangement proposed in Part I. of the paper, and instead of dividing the family into nine genera, he had found it necessary to recognise nineteen genera. The present part contained a synopsis of all the known African and Syrian genera, an enumeration of all the species, and definitions of the genera *Tilapia*, *Steatocranus*, *Docimodus*, and *Paretroplus*, and their species, several of which were described as new.

EDINBURGH.

Mathematical Society, January 13.—Dr. Morgan, President, in the chair.—Elementary notes, by Mr. C. Tweedie.—Against Euler's proof of the binomial theorem for negative and fractional exponents; a note on continued fractions; a proof of the binomial theorem when the exponent is a positive integer, by Mr. R. F. Muirhead.

PARIS.

Academy of Sciences, February 6.—M. van Tieghem in the chair.—New researches relating to the action of sulphuric acid upon acetylene, by M. Berthelot.—The Hall phenomenon and Lorentz's theory, by M. H. Poincaré. The application of the theory of Lorentz to the Hall phenomenon leads to the conclusion that if the conductor is very strongly charged the electromotive force produced should change in sign. The author points out that although it would be of great interest to examine this experimentally, the result, if in agreement with the above conclusions, would not necessarily prove the Lorentz theory to be true, as a similar expression can be got in other ways.—Life in a confined space, by M. d'Arsonval. The apparatus described is so arranged that after the carbon dioxide produced by the breathing of the animal has been absorbed by soda lime, the diminution of pressure thus produced within the closed apparatus is caused to bring together chromic acid and hydrogen peroxide, the oxygen thus being automatically evolved, and the composition of the air remaining constant.—New facts relating to the sub-periosteal amputation of the elbow. Autopsy of an elbow totally amputated twenty-eight-years ago, by M. Ollier. —Remarks by M. Lœwy on the presentation to the Academy of the eighth volume of the *Annales de l'Observatoire de Bordeaux*. —On a theorem of M. Hadamard, by M. A. Hurwitz.—Molecular theory of friction of polished bodies, by M. Marcel Brillouin.—Disruptive discharge in a vacuum. Formation of anode rays, by M. André Broca.—On the effects of light at very low temperatures, by MM. Auguste and Louis Lumière. A sensitised gelatino-bromide plant, immersed in liquid air and exposed for a short time to light, shows no appreciable tint on developing. Quantitative experiments showed that with plates of maximum sensibility, to produce equal effects, the exposure at $-191°$ must be about four hundred times as great as at ordinary temperatnres. Plates immersed in liquid air and allowed to regain ordinary temperatures without exposure, undergo no change in any of their properties.—On the employment of sodium peroxide in the study of the respiratory function, by MM. Desgrez and Balthazard. In respiratory studies in a confined space, the products of the reaction between water and sodium peroxide (oxygen and caustic soda) are just those necessary to absorb carbon dioxide and replace it with oxygen.—Formaldoxim as a reagent for detecting minute traces of copper, by M. A. Bach. The chlorhydrate of trioximidomethylene $(CH_2:NOH)_3HCl$ gives in presence of caustic potash and traces of copper salts, an intense violet coloration. This violet tint is clearly perceptible in a solution containing one part of copper sulphate in 1,000,000 of water.—On the oxidation of some ureas, by M. Œchsner de Coninck.—Studies of the latent heat of vaporisation of piperidine, pyridine, acetonitrile, and capronitrile, by M. W. Louguinine. — New observations on the development of aromatic principles by alcoholic fermentation in presence of certain leaves, by M. Georges Jacquemin. The addition of an extract of vine-leaves containing glucosides to the must before fermentation causes a distinct improvement in the flavour of the resulting wine.—On methyloctenonal, by M. G. Leser. A study of the products arising from the action of hydroxylamine, aniline, and methylaniline upon this β-ketonic aldehyde.—On crystallised fibrin, by M. A. Maillard. The crystallised fibrin was noticed in some antidiphtheric serum tubes which had been standing for some months.—On the nature of the sugar in diabetic urine, by M.M. G. Patien and E. Dufau. The differences frequently obtained between sugar estimation, by Fehling and by the polariscope, are often due to the fact that lead sub-acetate does not completely precipitate the lævorotatory substances present in urine. If acid mercurous nitrate is used as the precipitating agent, the two methods agree.—Influence of light on the formation of living nitrogenous substances in the tissues of plants, by M. W. Palladine.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 16.

ROYAL SOCIETY, at 4.30.—On the Reflex Electrical Effects in Mixed Nerve and in the Anterior and Posterior Roots: Miss Sowton.—The Characteristic of Nerve: Dr. A. D. Waller, F.R.S.—Observations on the Cerebro-spinal Fluid in the Human Subject: Dr St. Clair Thomson, Dr. L. Hill, and Prof. Halliburton, F.R.S.—The Thermal Deformation of the Crystallised Normal Sulphates of Potassium, Rubidium, and Cæsium: A. E. Tutton.

ROYAL INSTITUTION, at 3.—Toxins and Antitoxins: Dr. Allan Macfadyen.

LINNEAN SOCIETY, at 8.—On the Genus *Lemnalia*, Gray, with an Account of the Branching Systems of the Order Alcyonacea: Gilbert C. Bourne.—On some African *Labiatae*, with Alternate Leaves: J. H. Burkill and C. H. Wright.—Report on the Marine Mollusca obtained during the First Expedition of Prof. A. C. Haddon to the Torres Straits: James Cosmo Melvill and Robert Standen.

CHEMICAL SOCIETY, at 8.—On the Absorption Spectrum and Constitution attributed to Cyanuric Acid: W. N. Hartley, F.R.S.—Ballot for the Election of Fellows.

FRIDAY, FEBRUARY 17.

GEOLOGICAL SOCIETY, at 3.—Annual General Meeting.

QUEKETT MICROSCOPICAL CLUB, at 8.—Annual General Meeting.

SATURDAY, FEBRUARY 18.

ROYAL INSTITUTION, at 3.—Mechanical Properties of Bodies: Lord Rayleigh, F.R.S

MONDAY, FEBRUARY 20.

SOCIETY OF ARTS, at 8.—Cycle Construction and Design: Archibald Sharp.

IMPERIAL INSTITUTE, at 8.30.—Thirty-eight Years in Queensland: Hon. Sir, Horace Tozer, K.C.M G.

VICTORIA INSTITUTE, at 4.30.—Life: Prof. Beale, F.R.S.

TUESDAY, FEBRUARY 21.

ROYAL INSTITUTION, at 3.—Morphology of the Mollusca: Prof. E. Ray Lankester, F.R.S.

SOCIETY OF ARTS, at 8.—Vitreous Enamels: Cyril Davenport.

ZOOLOGICAL SOCIETY, at 8.40.—On a Portion of Skin, named *Neomylodon listai*, from a Cavern near Consuelo Cove, Last Hope Inlet, Patagonia. With a Description of the Specimen by Mr. A. Smith Woodward: Dr. F. P. Moreno.—On the Formation of the Coral-Reefs of the North-west Coast of Australia: Surgeon P. W. Bassett-Smith.—On a Collection of Reptiles and Batrachians made by Mr. J. D. La Touche in North-west Fokien, China: G. A. Boulenger, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Paper to be further discussed: The Lake Superior Iron Ore Mines, and their Influence upon the Production of Iron and Steel: Jeremiah Head and Archibald P. Head.

ROYAL STATISTICAL SOCIETY, at 5.—Comparative Statistics of Australasian Railways: Price Howell.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Demonstration with Violet Electric Waves for Actuating Photographic Apparatus, and for Photographing Lightning in Daylight: F. H. Glew.

WEDNESDAY, FEBRUARY 22.

SOCIETY OF ARTS, at 8.—Electric Traction, and its Application to Railway Work: Philip Dawson.

GEOLOGICAL SOCIETY, at 8.—On Varieties of Serpentine and Associated Rocks in Anglesey: Prof. T. G. Bonney, F.R.S., and Miss C. A. Raisin.—Remarks on the Genera *Ectomaria*, Koken, and *Hormotoma*, Salter; with Descriptions of British Species: Miss. J. Donald.

INSTITUTION OF MINING ENGINEERS (Stoke-upon-Trent), at 11.30.—The following Papers will be read or taken as read:—Historical Sketch of the First Institute of Mining Engineers: Bennett H. Brough.—Further Notes on Pit-props: Prof. H. Louis.—The Working of the Boiler Explosions Acts, 1882 and 1890: E. G. Hiller.—Alternating Currents and their possible Applications to Mines: Sydney F. Walker.—Notes on Coal-cutting Machinery: L. W. de Grave.—Safety Explosives: W. J. Orsman.—The Occurrence of Anhydrite in the North of England: C. E. de Rance.—Sulphur-Mines in the South of Spain: Arthur P. Wilson.

THURSDAY, FEBRUARY 23.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Efficiency of Man, or Economic Coefficient of the Human Machine: Dr. Marcet, F.R.S., and R. B. Floris.—Some Experiments bearing on the Theory of Voltaic Action: J. Brown.—Deposition of Barium Sulphate as a Cementing Material of Sandstone: Dr. F. Clowes.

ROYAL INSTITUTION, at 3.—Toxins and Antitoxins: Dr. Allan Macfadyen.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

FRIDAY, FEBRUARY 24.

ROYAL INSTITUTION, at 9.—Coherers: Prof. Oliver Lodge, F.R.S.

PHYSICAL SOCIETY, at 5.—The Joule-Thomson Thermal Effect: E. F. J. Love.—(1) A Study of an Apparatus for the Determination of the Rate of Diffusion of Solids dissolved in Liquids; (2) Note on the Source of Energy in Diffusive Convection; Albert Griffiths.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Loss of Heat from Buildings: R. Gordon Mackay.

SATURDAY, FEBRUARY 25.

ROYAL INSTITUTION, at 3.—Mechanical Properties of Bodies: Lord Rayleigh, F.R.S.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—A Digest of Metabolism Experiments: Drs. Atwater and Langworthy (Washington).—De la Méthode dans la Psychologie des Sentiments: Prof. F. Rauh (Paris, Alcan).—La Photographie Animée: E. Trutat (Paris, Gauthier-Villars).—Medical Works of the Fourteenth Century: Rev. Prof. Henslow (Chapman).—The Story of the Mind: J. M. Baldwin (Newnes).—Les Formes Épitoques et l'Évolution des Cirratuliens: M. Caullery and F. Mesnil (Paris, Baillière).—The Foundations of Zoology: Prof. W. K. Brooks (Macmillan).—Commercial Cuba: W. J. Clark (Chapman).—Remarkable Comets: W. T. Lynn, 7th edition (Stanford).—General Physiology: Prof. Max Verworn, translated and edited by Dr. F. S. Lee (Macmillan).—Siddhánta-Darpana, a Treatise on Astronomy: M. S. S. C. Simha, edited, &c., by Prof. J. C. Ráy (Calcutta).

PAMPHLETS.—Biblical Antiquities: C. Adler and I. M. Casanowicz (Washington).—Manchester Museum, Owens College Museum Handbooks, Publication No. 24 (Manchester).

SERIALS.—Bulletin de la Académie Royale des Sciences, &c., de Belgique, 1898, No. 12 (Bruxelles).—Bulletin from the Laboratories of Natural History of the State University of Iowa, December (Iowa).—Atlantic Monthly, February (Gay).—Encyklopädie der Mathematischen Wissenschaften, Band 1, Teil 1, Heft 2 (Leipzig, Teubner).—Quarterly Journal of Microscopical Science, January (Churchill).—Monthly Weather Review, November (Washington).—Among British Birds in their Nesting Haunts: O. A. J. Lee, Part xiii. (Edinburgh).—Bulletin of the New York State Museum, November (Albany).—Quarterly Journal of the Geological Society, February (Longmans).—Agricultural Gazette of New South Wales, December (Sydney).—Himmel und Erde, February (Berlin).—Proceedings of the American Association, August 1898 (Salem).

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