THURSDAY, MARCH 17, 1898.

THE CHEMISTRY OF THE METALS.

A Treatise on Chemistry. By H. E. Roscoe and C. Schorlemmer. Vol. ii. The Metals. New edition completely revised by Sir H. E. Roscoe, assisted by Drs. H. G. Colman and A. Harden. Pp. 1192. (London: Macmillan and Co., Ltd., 1897.)

NEARLY twenty years have elapsed since the appearance of this part of Roscoe and Schorlemmer's well-known treatise, and as in the interval much important work has been done in connection with the classification of the elements, with metallurgical processes, with chemical manufactures and new theories bearing upon our views of the constitution of salts, the condition of dissolved substances and other important questions have been proposed, it is obvious that the time has come when a new edition is urgently needed. It may at once be said that the revision has been accomplished with great care, with full knowledge, and, speaking generally, with a great measure of success.

The introductory chapters, which occupy 150 pages, naturally contain the most debateable matters, concerning which, probably, there will always be considerable differences of opinion, relating as they do to such subjects as the characteristics of metals, to valency, to classification and other subjects which are less matters of fact—for there is usually not much dispute about the facts—than of inference, and must therefore assume different aspects according to the degree of importance with which they are invested in different minds.

Take, for example, the consideration of those properties of the metals which seem to some people to mark off these substances very clearly from the remaining elements, which are commonly referred to as non-metals. Of course any attempt to arrange natural things into groups, the members of every one of which are distinguishable sharply from the members of other groups, fails hopelessly when such attempt is carried too far; but this need not prevent such attempts from reaching that measure of partial success which is practically useful. It is, in fact, impossible to avoid classification, for no sooner does a series of facts or phenomena become known than the mind involuntarily proceeds to arrange them into groups, and the pretence on the part of a few modern chemists that *no* scientific distinction can be drawn between metals and non-metals is not likely to be permanently maintained. The want of definiteness on this point in the book before us is to be regretted. We are told (pp. 5, 6) that "although the division into metals and non-metals is thus seen to be one which does not admit of exact definition, it is none the less true that the metals as a class do possess certain generic properties which the non-metals either do not possess at all or exhibit only in a very slight degree," and it is a little surprising to find that "among these properties that of metallic lustre may be specially mentioned." What then about iodine, graphite and tellurium, which most people agree to place among non-metals?

Undoubtedly any attempt to provide a definition which shall be comprehensive enough to include not only the seven ancient metals, but such things as arsenic, antimony, titanium, as well as the true metals—sodium and the rest which have been made known in modern times—must fail; but that is not a reason for refusing to recognise in the great majority of those elements which show a disposition to form oxides of more or less pronounced basic character, certain other characters, chemical and physical, which, taken together, afford a useful criterion of the true metal, while for those elements which only imitate the metals in one character or more and fail in the rest, the term "metalloid," so long misapplied, might be appropriately retained. The true metal is malleable, with a good conducting power for heat and electricity, and forms no gaseous or vaporisable compound with hydrogen. The semi-metal or metalloid is brittle, a bad conductor, and in many cases produces a gaseous hydride.

The general adoption of Mendeléeff's scheme of classification of the elements has no doubt served to increase the difficulty felt as to the distinction of metal from non-metal; but even in the periodic table the non-metals are confined to the top right-hand corner, and display amid great physical diversity an assemblage of chemical characters which marks them off as a class.

Naturally there are elements which recall in respect to one set of relations the features of a metal, and in respect to another those of a non-metal, and these of course stand between; but to refuse to recognise these distinctions would be as inconvenient as a proposal to do without "orders" in botany because all botanists are not agreed about the diagnostic characters of every order in the vegetable world.

The authors have made a change of some importance in the sequence in which the metallic elements are taken for study in this volume. In the first edition they were grouped into families more or less entitled to be regarded as "natural"; but are now taken in the order of the periodic system. There is, however, a sort of acknowledgment of the inconvenience of this plan for the arrangement of matters for study, inasmuch as it is departed from at the very outset, sodium and not lithium being the metal first described. It must, however, be admitted that the authors have dealt with this difficult question in the liberal spirit proper to scientific men. They point out that while the arrangement of the elements in the order of their atomic weights has brought into view the remarkable relations among their properties which are formulated in the so-called "periodic law," and that this system stands upon a very firm basis of fact,

"the system will doubtless undergo modification as our knowledge increases, for difficulties occur which cannot at present be explained. Thus elements sometimes occur in the same group between which only a limited amount of analogy can be traced and, on the other hand, elements which have a good deal in common are sometimes separated widely."

This being admitted, it is a very doubtful advantage to have adopted the system, interesting and suggestive as it is, as the order for the contents of the book. This, however, is not of serious consequence inasmuch as the

volume is provided with a good index, and old-fashioned people who might be disposed to look for copper, silver and gold elsewhere will have no difficulty in finding a good and clear account of them, notwithstanding that they are sandwiched in between the metals of the alkalis and the metals of the alkaline earths.

The volume concludes with the history of those two remarkable substances argon and helium, and winds up by pointing out that "the existence of two substances having the properties of argon and helium is not in any way indicated in the periodic classification of the elements, and it is probable that their discovery will lead to modifications of that hypothesis," a statement with which even the most fanatical of periodic chemists will find it difficult to disagree.

One is tempted to think that, if we were not so familiar with it, *hydrogen* is the element upon which, in connection with any system of classification, wonder must be concentrated. Undoubtedly a positive element, similar in general chemical character to a metal, yet its volatility removes it far from any acknowledged metal, and its low atomic weight separates it in the periodic scheme from all the other gaseous elements. Its nearest allies are the metals of the alkalis, and towards them it stands, so far as physical character is concerned, much in the same relation as nitrogen to arsenic and antimony or oxygen to selenium and tellurium. And even as to chemical relations its position is analogous to that of nitrogen or of oxygen, notwithstanding that among the negative elements chemical activity generally diminishes as atomic weight increases; while in the series Li, Na, K, Rb, Cs, chemical activity increases with atomic weight.

The question of the molecular weights of the metals is one of great interest. It has been known for a long time, from the vapour densities of mercury, cadmium, and zinc, that the molecules of these metals are monatomic, while the semi-metal arsenic forms in the state of vapour a molecule composed of four atoms. Potassium and sodium are unmanageable, and no other metal is volatile enough to afford by this process any trustworthy results. But attempts have been made to estimate the molecular weights of a great many metals by observation of the depression of the freezing points of certain fusible metals—for example, of tin, lead, or bismuth (Heycock and Neville), or of the lowering of the vapour pressure of mercury (Ramsay) by solution in these fluids of determinate quantities of the metals under consideration. The general result of these experiments tends to the conclusion that in nearly all such cases the molecules are composed of one atom only. There is evidently room for further experimental inquiry in this direction, for there seems at present to be some conflict of testimony. The molecule of arsenic in the vaporous state is undoubtedly As_4, and its chief oxide is also admittedly As_4O_6. In like manner the molecule of antimonious oxide is Sb_4O_6, and by analogy one must conclude that the vapour of antimony, although not actually observable, must be tetratomic or Sb_4. When these vapours condense, either to the liquid or solid state, it would be contrary to all experience in other cases to suppose that they dissociate, and that the four atoms part company from each other. Yet this is what the results derived from freezing point or vapour pressure experiments would lead to. There is also the curious fact that the theory of Dulong and Petit, which states that specific heat in the solid elements is inversely as the *atomic* weight, points to the atom, and not any congeries of atoms, as the physical unit in the solid. So that, for example, arsenic and cadmium, so different as regards vapour density, agree in atomic heat; thus—

	Specific Heat	×	Atomic Weight	=	Atomic Heat
Arsenic	·0814 (Regnault)		74·4	=	6·05
Cadmium	·0542 (Kopp)		111·3	=	6·03

Probably in the solid the molecules settle down into some tactical relation to one another, in consequence of which the atoms of neighbouring molecules are brought as near together by cohesion as the atoms in any one molecule are by chemical attraction.

Turning again to the volume before us, there is much that must be interesting to readers of all classes, and especially in connection with the metallurgy of such metals as sodium and aluminium, concerning which Sir Henry Roscoe is in a position to give trustworthy information. As is well known, sodium was first obtained in 1807 by Sir Humphry Davy, who got it by the electrolysis of caustic soda. Subsequently Gay-Lussac and Thénard succeeded in decomposing that compound by means of metallic iron at a high temperature, but up to quite recent times it has been usual to manufacture it by distilling a mixture of dry sodium carbonate and charcoal, the metal passing over accompanied by the escaping carbonic oxide. But even in well-conducted operations the yield of metal corresponded to not more than about one-third of the theoretical amount.

A great improvement was introduced by Mr. Castner some fifteen years ago when he replaced sodium carbonate by caustic soda, and employed an intimate mixture of iron and carbon as the reducing agent. It is now interesting to learn that he has accomplished another great advance which consists in adapting the original method to manufacturing purposes, and we are told that whereas—

"in the year 1807 Davy, with his battery of 100 cells, found it impossible to produce the effects of decomposition on pieces of soda of more than fifteen or twenty grains in weight, the process has now been so amended that the plant at the works of the Aluminium Company, Limited, at Oldbury, manufactures about five tons of sodium per week."

What becomes of so large a quantity of this strange metal, considering that the Aluminium Company no longer makes aluminium, and sodium is no longer used for this purpose anywhere, is a question which naturally arises. And the answer is supplied pretty well by the book. Sodium is used for the manufacture of cyanides, the consumption of which in the process of extracting gold from poor ores and tailings must be now enormous. It is also used for the manufacture of sodium peroxide, for the production of metallic magnesium, and in the preparation of certain complex carbon compounds, of which the most important commercially is antipyrine.

The history of the metal aluminium has also many points of interest. The discovery of the metals sodium and potassium by Davy placed in the hands of chemists

new and very powerful agents, by which it became possible to isolate from their compounds several elements the existence of which was well recognised, but which had previously resisted all attempts to obtain them in a separate state. Among these was aluminium, which was seen for the first time in 1828 by Wöhler, who succeeded in decomposing the chloride by potassium. With the substitution of the cheaper sodium for potassium, and the occasional replacement of the chloride by the fluoride of aluminium, this was practically the method adopted by the experimentalist and manufacturer alike down to quite recent years. The Aluminium Company, already referred to, was formed for the purpose of working such a process with the use of sodium obtained more abundantly and cheaply than before by Castner's process. All this is now changed. So long ago as 1854 aluminium was deposited in the metallic state by the electrolysis of the fused chloride of aluminium and sodium according to the method introduced by Bunsen. It was also stated to have been obtained by the electrolysis of aqueous solutions of certain aluminium compounds, but this appears to have been a mistake. The method now adopted consists in subjecting to the electric current pure alumina in a fluid state, that is fused alone or dissolved in melted cryolite.

Now that the energy of falling water is being turned to account on a large scale, works have been established at Neuhausen near the falls of the Rhine, at Niagara, and at Foyers in Scotland, for the production of the current by means of vast dynamo machines, and its application, among other chemical manufactures, to the reduction of aluminium.

Little else remains to be said of the book except by way of commendation. A few minor matters have been passed over rather slightly. Thus the solubility of calcium sulphate in water containing chlorides is a matter of some importance from a technical point of view; and the simple statement of the text (p. 437), that "according to Anton 1 part of gypsum dissolves in 122 parts of a saturated solution of sodium chloride," is neither very precise, nor is it of much practical use. A long series of determinations of the solubility of calcium sulphate in chlorides is provided by the work of Lunge (*J. Soc. Chem. Ind.*, 4, 31), and by that of Tilden and Shenstone (*Proc. R. S.*, 38, 331). As regards the temperatures supposed to be indicated by the colours developed upon the surface of steel in the process of tempering, it has been shown, more especially by Turner, that these colours can be *successively* developed by protracted heating to the same temperature, and under any circumstances are not to be interpreted to within a considerable range of degrees. As the interesting lead tetrachloride has been properly mentioned, the more stable tetracetate (Hutchinson and Pollard) should have been noticed at the same place.

The whole of such a volume as this should be read attentively by every serious student of chemistry; and if this treatise does not displace all other English text-books devoted to mere description, it will be solely on account of the unfortunate but unavoidable high price, a consideration which necessarily influences so many students in their choice. W. A. T.

SUBMARINE CABLE TESTING.

Student's Guide to Submarine Cable-Testing. By H. K. C. Fisher and J. C. H. Darby. Pp. 165. (London: *The Electrician* Printing and Publishing Co., 1897.)

THIS practical and useful little book is designed as its title indicates, and, as its authors state in their preface, to meet the requirements of young students in this particular branch of submarine cable engineering, and to endeavour to place before them in as concise and lucid a manner as possible, not only the practical problems involved in the study of cable-testing, but also the simple algebraical formulæ necessary for their solution.

Many of the large submarine cable companies now demand that their employés shall qualify themselves in electrical subjects, and shall pass certain examinations before being considered eligible for promotion from the lower to the higher grades of the service.

This very proper requirement on the part of the companies has resulted in stimulating their staffs to greater exertions; but it has been found that the ordinary text-books in circulation are either too theoretical and advanced for beginners, or fail to deal with and thoroughly explain just those particular points upon which they seek instruction.

The authors of the little work under review—practical electricians and cable engineers themselves—were constantly being asked for information upon these points, and their first effort to meet this demand upon their time and patience took the form of a small pamphlet entitled "Notes on Practical Cable-Testing," of which a small number was printed and issued privately.

This first effort was so far appreciated, as to encourage them to hope that a more ambitious work, carried out on the same lines, might be found still more useful; and although, as the authors modestly remark in their preface, "the scope of the present work is bounded by the requirements of the electrical examinations for supervisors, and the ordinary electrical outfit of all the company's stations," we venture to think they have so far succeeded in their purpose, that this book will be found of practical value, not only to those for whom it was originally written, but to all desirous of studying and understanding this most interesting subject.

As we have already observed, too many of the existing text-books are the works of theorists who do not concern themselves with the practical features of the matters upon which they write; in fact, who do not possess the necessary practical experience themselves, which would enable them to do so satisfactorily; and we think, therefore, that this little book will be accepted, and rightly so, as a useful contribution not only to our knowledge, but also to submarine cable bibliography.

The work is divided into two parts: the first dealing with simple testing, such as the measurements of resistances and of electrostatic capacity, together with the testing of batteries for electromotive force and interna resistance; and the second, with the various known methods which are adopted for the localisation of faults in submarine cables.

In a book of this description it would be invidious to criticise too closely, or we might be tempted to question some of the definitions of terms in the opening chapter, such as "Farad—the practical unit of capacity" and "Shunt—a conductor, usually a resistance box, for leading into another channel part of a current that is too powerful for the immediate purpose."

The idea, however, seems to have been to convey to the reader the practical sense of things, and not to split hairs as to choice of terms. The chapter on that electrical *pons asinorum*, the theory of the Wheatstone Bridge, is especially clear and well put, and the student who reads and digests it thoroughly may cease to frown at the name of Kirchhoff, the sum of whose quantities has frequently an aggravating habit to the student mind, of equalling nothing.

Paragraphs 54–55, pp. 55–59, explaining the necessity for ascertaining the proper time constants to be allowed in charging long cables, whose resistances it is required to measure, are very important to learners, and should be carefully studied. Three simple rules are given for determining these constants in the cases of (1) a perfect cable, (2) a broken cable, and (3) a faulty cable, and it is suggested that an ordinary metronome, such as is used in beating time for music, will be found of great assistance in measuring the time for charging and discharging.

Articles have recently appeared in the technical journals, and some discussion has followed, upon the relative merits of the "scale zero" as opposed to the "false zero" method, for fault localisation especially. Upon this head the authors remark: "We will now describe the 'false zero' method. We consider this method by far the best and most accurate . . . especially with a faulty cable"; and again at p. 54, with special reference to Mance's method for eliminating the resistance effect of an earth current, they observe: "It may be pointed out here that the statement that R, the resistance equivalent to the E.C. varies inversely as c, the current to line, is not quite correct in the case of faulty cables. If the testing current be reduced or increased, it slightly *reduces* or *increases* the E.M.F. due to *polarisation of the fault*, and therefore the current set up thereby, but we have not found this error to be as a rule appreciable."

The tests for the measurement of capacity are clearly explained as far as they go, and numerous references are given to various text-books and other publications, to enable the student to follow out for himself the study of the effect of the phenomenon of absorption upon different dielectrics.

In the second part of the book, a description of the various tests employed for localising partial faults, and total breaks in submarine cables, is prefaced by a few interesting preliminary remarks upon the nature of these faults, and their behaviour under the influence of the testing current.

It is interesting also, and instructive, to note the headings under which they are grouped, such as those due to submarine borers, to chemical action, *fish-bites*, punctures, &c.

We must, however, take exception to the expression "Kennelly's law" in the description of his tests for total breaks. A "law" in this sense must be absolute and unchangeable, whereas Kennelly's "*rule*" that, "when the exposed area of a break is constant, its resistance varies inversely as the square root of the current strengths passing through it" is only true between certain limits of current. Kennelly pointed this out himself, and Schaefer has since demonstrated that beyond 25, and up to 50 milli-amperes, the resistance varies inversely as the 1·3th root of the current strengths.

The authors have endeavoured to make the various sections of their book complete in themselves, and have added a number of diagrams of connections for signalling on cables, which form a new feature in works of this description, and which, with the various tables of temperature coefficients, will no doubt be found useful.

We may add that nearly all the examples are actual tests of cables, and are given very fully in the hope that they may tend to throw a practical light upon the explanations of the various tests.

In conclusion, we feel it incumbent upon us to recommend every student of submarine cable engineering to add this little volume to his library.

BRITISH MOTHS, AND THE GENUS DIANTHŒCIA.

The Lepidoptera of the British Islands. A Descriptive Account of the Families, Genera and Species indigenous to Great Britain and Ireland, their Preparatory States, Habits and Localities. By Charles G. Barrett, F.E.S. Vol. iv. Heterocera. Noctuæ. 8vo, pp. 402. (London: Reeve, 1897.)

THE fourth volume of Mr. Barrett's elaborate work includes ninety-eight species (three of which, however, are regarded by the author as doubtfully British) distributed among thirty genera of the *Noctuæ Trifidæ*, to which group belong by far the larger part of the European stout-bodied, night-flying moths. This gives us an average of something like four pages to each species, though many of the notices run to six or seven pages; and on such a scale it will require twenty volumes to complete the life-histories of our British Lepidoptera.

Mr. Barrett is well known as one of the best of our practical entomologists, and the history of every species is worked out with extreme care, the observations of numerous lepidopterists throughout the British Isles being freely utilised, in addition to those of the author himself. The foreign range of each species is also briefly indicated, though the character and extent of the book prevents almost any allusion to allied species not occurring in Britain, except so far as such notices are absolutely necessary to elucidate British species.

Considerable space is devoted to the genus *Dianthœcia*, which includes eight or nine British species, most of which are coast-frequenting insects with us, the moths being found flying over *Silene* in the evening, often on precipitous sea-cliffs, where it is not unfrequently a task of some difficulty and danger to capture them. The larvæ are described by Mr. Barrett as "smooth, plump, with the head small, usually feeding on or in the blossoms or seed-vessels of plants belonging to the *Caryophyllaceæ*."

Britain is called by the French entomologists, *le pays de variétés*; and the British species of *Dianthœcia* are

extremely variable with us, especially in outlying parts of our islands, where isolation tends to encourage variation. Mr. Barrett's account of the variation of *D. conspersa*, Esper, an unusually widely-distributed species with us, is well worthy of the attention of scientific naturalists, and alone furnishes a sufficient reply to any persons who may imagine that our British Lepidoptera may be regarded as worked out. These notes are too long to reproduce in their entirety, as they extend to nearly two pages; but we may perhaps be allowed to quote a few sentences relative to the variations exhibited by *D. conspersa* in the Scottish islands, the entomology of which has only been systematically investigated within the last twenty years or so.

"It is in the Shetland Isles that the most extraordinary forms are found—the white markings utterly suppressed, or the stigmata alone white, or yellow, or pale ochreous, or black-brown and only indicated by blacker margins; the subterminal line only indicated by its attendant black clouds, and sometimes the whole surface of the fore-wings smoky-black or olive-black, with but a faint dappling of blacker lines and crescents; on the other hand, some specimens in these islands are of the form in which the ground colour is intensified, but the markings, though curtailed, sharply white. This last form is also found in the West of Ireland, and a specimen now before me from Sligo is singularly rich in its deep dark colour and snowy blotches. Specimens from the Hebrides are extremely beautiful, the white markings variegated with yellow and greenish-yellow, or even orange-yellow. Those from Orkney are somewhat similar, or with the white markings small but clear. Although there are so many apparently local strains of variation, all are intimately connected by intermediates, so that, except in some degree in Shetland, it is impossible definitely to separate the species into varieties. . . . Mr. McArthur, who has collected very extensively in [the Shetland] Islands, assures me that the darkest suffused and nearly unicolorous forms are found mainly on the East coasts, more particularly of the island of Unst, where the rocks among which the food-plant grows are of a very dark colour; while on the West coast, where the rocks are of a paler colour, the forms found are more nearly normal, with intermediate varieties. Also that in the Hebrides, along with rocks ornamented with yellow lichens, he has found those varieties of the moth having an orange- or olive-yellow tinge. This is the more remarkable in that the moth does not appear there to sit upon the rocks, or to give up its usual habit of hiding in the daytime among herbage."

Another very interesting species of the same genus is *Dianthœcia Barrettii*, Doubleday, which was originally captured by Mr. Barrett at the Bailey Lighthouse at the Hill of Howth, near Dublin. It has scarcely been taken anywhere but on this hill, except singly at the Land's End, Ilfracombe, Tenby, Carnarvonshire, and perhaps in the south of Ireland. Mr. Barrett, in common with several other lepidopterists, now regards it as a variety of the continental *Dianthœcia luteago*, Hübner, remarking: "There is at first sight no resemblance between them, yet, with the exception of the colour, no distinction of any importance can be found." In the larva the spiracles are said to be black in *D. Barrettii*, and flesh-coloured, encircled with black in *D. luteago*.

But before the identity of the two forms can be taken as established, broods of each should be reared in different larva-cages by the same observer, and the differences between them carefully noted at each stage. It may be that *D. Barrettii* is only an incipient species at present; but it is equally probable that further observation may show that it is abundantly distinct from *D. luteago*. We incline to think that it is a little premature to class the two forms together, even tentatively, without better evidence.

We hope that Mr. Barrett will succeed in completing the great work on which he has now made such good progress, and which is likely to remain a most valuable record for all time of the state of our knowledge of the British Lepidoptera at the end of the present century. We cannot speak of the plates, as we have only the smaller edition, without illustrations, before us while writing. W. F. KIRBY.

OUR BOOK SHELF.

A Suggested Improvement of the Current Theories of the Tides. By J. H. S. Moxly. Pp. 43. (London: Rivingtons, 1898.)

IN this brochure, Mr. Moxly expresses his dissatisfaction with the theory of the tides, as ordinarily accepted, and submits an alternative explanation. Although he opposes the views generally held, he does not exhibit that spirit of antagonism and adopt the language of abuse that too frequently disfigures the writings of those who dissent from authoritative teaching. Where it has been necessary to refer to the papers of Airy or of Darwin, these names are generally mentioned with the respect due to their great reputation, and therefore, though we are as thoroughly opposed to Mr. Moxly as he is to the mathematicians just mentioned, we shall endeavour to adopt the same courtesy towards him that he has shown towards others.

The author considers that the tides are heaved up by the earth's gravity. The differential attraction of the sun and moon simply gives an opportunity for the earth's gravity to display itself in this manner. This action is illustrated by reference to a football. When the leathern covering is injured, or a seam gives way, the inner india-rubber case bulges out through the opening in the outer cover. "The pressure of the outer case had been removed from one region of the ball, and the pressure of the part which remained did the rest. This, I take it, is exactly how the pressure of the earth's gravity produces the tide." We are all prepared to admit with the author, that the tide-raising force is directly opposed to the action of the earth's gravity, though we might not adopt his phraseology. But another elementary proposition shows that the tide-raising force varies inversely as the cube of the distance of the disturbing body, and we fail to derive this from the football illustration, or from anything directly asserted in the pamphlet, though we notice that some mathematical formulæ are quoted in which the third power of the disturbing force is given. Moreover, by another illustration drawn from the observation of pressure applied to a water-bed, the author concludes that the crest of the tidal wave will always be directly under the moon. We understand this to apply to a uniformly ocean-covered earth. From this it is to be gathered that Mr. Moxly does not consider that the angular distance between the tidal crest and the moon is a function of the depth of the ocean, which in the wave theory of the tides it clearly should be.

But the test of the accuracy of a theory must at last rest in the comparison of its results with those of observation. Mr. Moxly admits this, and therefore a considerable part of the pamphlet is devoted to showing that his theory explains observed facts. Unfortunately,

we are not able to follow the author very clearly in this part of his treatise; but so far as can be seen, the conclusions are inadequate. For instance, the tide at Kerguelen is triumphantly pointed to as proving the coincidence of the tidal crest with the moon's passage over the meridian; but there is no reference to Fiji, where the tide lags some six hours, and the conditions for observation appear equally favourable. We do not propose to follow the author in his discussion of such niceties as the diurnal tide, and prediction for a particular port. If any other remark be needed to indicate the character of the work, it will be found on p. 40: "the swaying of the axis of the tidal spheroid about the axis of the earth's rotation gives us a clear explanation of the production of the phenomenon of nutation."

A Practical Physiology: a Text-Book for Higher Schools. By Albert F. Blaisdell, M.D. Pp. vi + 448. (Boston, U.S.A., and London: Ginn and Co., 1897.)

THIS is not a handbook for the physiological laboratory, but a school lesson-book on elementary anatomy, physiology, hygiene, nursing, and ambulance work. A manual of this kind can hardly be otherwise than superficial, but the information it contains ought to be accurate as far as it goes. In the present case, however, signs of carelessness abound throughout; and the teaching, when not absolutely erroneous, is often misleading. A few instances will suffice to give an idea of the traps which await the unwary student of these pages. Peyer's patches are stated by implication to consist of glands which secrete intestinal fluids. In a figure representing the heart and great vessels, the innominate artery is called the "right subclavian," the left common carotid appears as the "right common carotid," and the left subclavian is labelled the "left common carotid." In a diagram intended to illustrate intestinal absorption, the veins of the mesentery are represented as inosculating with the lacteals. "The power which the pancreatic juice possesses of acting on *all* the food-stuffs appears," it is asserted, "to be due mainly to the presence of a specific element or ferment known as *trypsin*." It is impressed on the student that he should learn how to tie a "reef" knot. But in the figure given to illustrate the directions of the text (which are correct), the author has delineated an unmistakable "granny." After these specimens of erroneous and careless treatment of the subject, it is of minor importance to note that in the repeated denunciations of the use of alcohol and tobacco, inserted, as the preface informs us, in compliance with the laws of most of the States, little or no attempt is made to distinguish between the effects of ordinary and toxic doses of these substances. A book like the present is far more likely to retard than to advance the cause of elementary physiological teaching in schools. F. A. D.

Die Photographische Praxis. Part i. By Prof. H. W. Vogel. (Berlin: Gustav Schmidt, 1897.)

OUR first words must be to congratulate Prof. Vogel that he has recovered from the illness that has delayed for three years the completion of this section of the new edition of his "Handbuch der Photographie." The part now issued is the first part of the third volume, and deals with photographic studios and apparatus (excluding lenses, which are treated of in a previous volume) and the negative processes with collodion and with gelatine emulsions. The chief differences between this and the previous edition are that the practice of photography is now regarded from a general rather than from a merely "professional" point of view, portable apparatus and shutters being considered, and that chapters are given on the use of colour sensitised plates and film photography. Collodion, on account of its continued application in the reproduction processes, retains the premier position; gelatine following with about the same number of pages devoted to it. Considering the space given to the various branches of the subject, it is surprising that some of the most important advances made during the last ten years or so are not represented. We refer to advances of immediate practical importance, such as the methods of determining the exposure required, recent methods of determining the sensitiveness of plates, and the efficiency of shutters. Intensification also is dealt with in a very inadequate manner. But looking at the volume as a whole, it is a valuable addition to photographic literature, and the opinions and preferences of its distinguished author must always be of interest to English students.

The Miner's Arithmetic and Mensuration. By Henry Davies. Pp. x + 316. (London: Chapman and Hall, Ltd., 1898.)

THIS little volume comprises a collection of questions in arithmetic, the larger number of which are purely and simply arithmetical, ranging from compound addition to cube roots, whilst a smaller number illustrate the mode of solving some of the simpler numerical problems with which the miner has to deal. The work is naturally more or less elementary, and the formulæ given appear to be in most cases fairly correct; in some instances, however, as in the formulæ given under the head of "the barometer," simplicity has been gained only at the expense of accuracy.

The book seems well calculated to serve its purpose, that of enabling the miner to learn how to answer some of the easier numerical questions usually set in the mine manager's examination, without requiring from him any particular mental effort. Whether it is, however, upon the whole a good thing that the pupil, as well as his teacher, should have a collection of rule of thumb methods, that tax merely their memories, without appealing at all to their intelligence, is quite another matter.

Inspector-General Sir James Ranald Martin, C.B., F.R.S. By Surgeon-General Sir Joseph Fayrer, Bart., K.C.S.I., LL.D., &c. Pp. xvi + 203; plate i. (London: Innes and Co., 1897.)

THE name of Sir James Ranald Martin is known to few, and the details of his career to still fewer. It is for this reason that the volume before us will be welcomed by all interested in the birth and development of the medical profession, and sanitary science in India. Sir Ranald Martin left sanitary science, in the broadest sense of the term, and the position of the medical officer in India, in positions very different to those in which he found them. It would have been difficult—indeed, impossible—to have found a better biographer than Sir Joseph Fayrer, whose intimate knowledge of all that concerns medicine in India is absolutely unrivalled. So far as we are aware, the *rôle* of biographer is new to Sir Joseph; we can only say that from apparently scanty material he has constructed a biography accurate, interesting and instructive.

The biographer, put shortly, describes Sir Ranald's early life and early work in India, following him through the disastrous Burmah campaign 1824–26. Then follows a record of his public services in India. Amongst these, perhaps, the most striking are the inauguration of a system of medical statistics and the sanitary improvement of Calcutta. In 1840, at the age of forty-four, Sir James Ranald Martin returned to London, and took up his residence in Grosvenor Street. From this onwards, with the exception of some time devoted to literary work, which bore fruit in the shape of his treatise "On the influence of tropical climates on European constitutions," he devoted himself entirely to administrative work in connection with medicine and sanitary reform in India. His services in this direction met with but tardy public recognition, for it was not until 1860, sixteen years

before his death, that he obtained his C.B. and knighthood. His memory has been perpetuated in that branch of the profession which he so adorned by the establishment, at Netley, of the Martin Memorial Gold Medal, which is presented to the surgeon on probation who takes the highest place in military medicine at the final competition. The biography is exceedingly pleasant reading, and the author has done well to incorporate in it letters from many interesting persons to Sir Ranald, and also some extracts from official documents, in the compilation of which he was concerned. F. W. T.

The Chemistry of the Garden: a Primer for Amateurs and Young Gardeners. By Herbert H. Cousins, M.A. Pp. xv + 141. (London: Macmillan and Co., Ltd., 1898.)

THIS little book is very clearly and pleasantly written. It contains much valuable practical information respecting garden soils, the use of artificial manures in horticulture, the preparation and application of effective fungicides and insecticides, and various other matters. The book is designed for the use of persons who have not received a scientific education, and we should think it will exactly meet their wants; there is, however, much in it that will well repay the perusal of a higher class of readers. There are a few minor points which seem open to criticism. "Pod-plants" is not a good distinctive name for the *papilionaceæ*, as the *cruciferæ* are also podded. The popular use of the word "germ," as descriptive of certain races of living beings, should surely be discouraged as fundamentally incorrect. Nor is there any advantage gained by speaking of "muriate of potash," though the term still lingers in commerce. If a person who knows nothing is to be taught, it is surely needless to burden him with archaisms which he must unlearn if his education proceeds any further. Agricultural chemists will, we think, demur to the same valuation being applied to the nitrogen of ammonia and to the nitrogen of insoluble organic manures. R. W.

The Naturalist's Directory, 1898. Pp. 125. (London: Upcott Gill, 1898.)

THE sub-title explains that this book is "for the use of students of natural history, and collectors of zoological, botanical, or geological specimens, giving the names and addresses of British and foreign naturalists, natural history agents, societies and field clubs, museums, magazines, &c." The volume is more remarkable for what it omits than for what it includes, and disappointment will be saved by not referring to it for the addresses of well-known naturalists.

The Teacher's Manual of Object-Lessons in Domestic Economy. By Vincent T. Murché. Vol. i. (Standards I. and II.) Pp. 250. (London: Macmillan and Co., 1898.)

THIS manual is, the preface informs us, "designed primarily to meet the requirements of the Education Department in the Class Subject of Domestic Economy, as laid down in the Code for 1897." It will be serviceable to the teacher in indicating what to show, do, and describe during object-lessons on materials used for food, and it contains a large amount of clearly explained and well-arranged facts about common things.

Storm and Sunshine in the Dales. By P. H. Lockwood; with a preface by H. G. Hart. Pp. 94. (London: Elliot Stock, 1898.)

A BOOK containing many personal observations on outdoor nature, expressed simply and sympathetically. The author is a fervent admirer of the natural beauties of Yorkshire dales, and his descriptions may lead others to share his enthusiasm, notwithstanding the fact that the scenes he depicts are mostly "glimpses of the obvious."

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.*]

A Dust Shower.

PARAGRAPHS have recently appeared in several of the daily papers to the effect that a dust storm had been encountered off the west coast of Africa by the mail steamer *Roslyn Castle*, and that the dust had fallen on the deck for 900 miles. I was fortunate enough to secure a sample of this dust, which actually fell on the deck, with the following note affixed:—

"Ship covered with fine red dust off west coast of Africa. Lat. 22·5 N. Long. 17·25 W. February 15, 1898."

"Dust fog encountered with for 900 miles. February 18, 1898."

This dust is extremely fine, and consists chiefly of minute grains of quartz and flakes of brown mica, some of the former being well rounded.

I cannot find any trace of glass or other thing to suggest a volcanic origin to the dust; but it is undoubtedly a very fine sand, in all probability derived from the Sahara, although no mention is made of the direction of the wind when the dust fell.

Although cases of volcanic dust being transported for long distances are fairly frequent, those of sand appear to be less so.

Sir A. Geikie ("Text-Book of Geology," p. 337) mentions two cases of the transportation of sand from the Sahara; in the first instance it fell in the Canaries, in the second it was traced as far as Boulogne-sur-Mer. In the present case the distance of transport is probably greater than the one, and less than the other. C. ST. A. COLES.

The Solution of Quadratic Equations.

IN your issue of February 24 a review appears of "Chambers's Algebra for Schools." Your reviewer concludes with a lament of the probable uselessness of protesting against the method of solving quadratics by "completing the square."

Your reviewer might do something towards removing this "national fetish" if he would explain what method is taught elsewhere, to replace this out-of-date procedure. Before this vigorous onslaught, I feel ashamed to confess that I can recall no general elementary method, that does not depend on the completion of the square.

In my desire to free myself from a possibly antiquated "cult," I am, however, willing to undergo this humiliation, in the hopes that I and others may be brought more on a level with the times. E. CUTHBERT ATKINSON.

Rugby, March 6.

IN answer to Mr. Atkinson's letter, I will explain, as briefly as I can, what appears to me to be the proper way of discussing quadratic equations.

As soon as the pupil can easily factorise such an expression as $x^2 - 5x + 6$ into the product $(x - 2)(x - 3)$, it is not very difficult to make him see that 2 and 3 are the only values of x which make $x^2 - 5x + 6$ equal to zero; or, in other words, that the equation $x^2 - 5x + 6 = 0$ can be solved when the expression on the left hand has been factorised.

It is exceedingly important that the factorising of polynomials and the solution of equations should be treated as cognate, or rather equivalent problems. A quadratic equation should always be reduced to the form $ax^2 + bx + c = 0$: then the expression on the left-hand may be factorised by inspection, or else multiplied by such a quantity that the result can be conveniently expressed as the difference of two squares; $4a$ (that is, four times the coefficient of x^2) will always do, sometimes a smaller number. This should be illustrated by numerical examples: for instance, if the equation is $2x^2 + 3x - 7 = 0$, multiply by 8: then $16x^2 + 24x - 56 = 0$, that is $(4x + 3)^2 - 65 = 0$, and $x = \frac{1}{4}(-3 \pm \sqrt{65})$. When a boy is able to appreciate general formulæ, he may be led to see that

$$4a(ax^2 + bx + c) = (2ax + b)^2 - (b^2 - 4ac) = (2ax + b)^2 - (\sqrt{b^2 - 4ac})^2$$

and hence to use the "solution by formula" when he cannot find the roots by inspection.

Mr. Atkinson may perhaps say that this method "depends upon completing the square"; this is true in a sense, of course; but the point of view is really different from the "method of completing the square" usually found in text-books. Practically, the usual method is clumsy, and inferior to the solution by formula; and from the theoretical point of view it is objectionable, because it obscures the real nature of the problem. And I feel sure that many teachers and examiners will agree with me in saying that the educational value of the process is practically *nil:* bright boys go on to the general formula, dull ones follow the rule mechanically, and might just as well be drilled in the use of the general formula itself. G. B. MATHEWS.

WEST INDIAN RESOURCES.[1]

AS expert adviser in botanical and agricultural questions to the recent West India Commission, Dr. Morris undertook the preparation of a lengthy report dealing with the economic resources of those Colonies, the causes of whose distress were the subject of investigation. This paper formed Appendix A of the Report of the Commissioners which was issued last autumn, and the praise bestowed on it as an interesting and valuable survey by one who was specially qualified both by general and local knowledge to undertake the task, induced the Secretary of State for the Colonies to rescue it from the oblivion which is the fate of many important papers appearing in Blue Books. Mr. Chamberlain's desire to have it published in a form more accessible and convenient for the public here and in the Colonies, has resulted in its being converted into an independent volume, and now appears as the first number of an Additional Series of the *Kew Bulletin*. For this purpose the work has been revised and enlarged, a full account of the botanical organisation of each Colony, and lists of books and papers containing further information, being added.

After all that has been dinned into our ears for a long time past about the absolute necessity for the Mother Country to assist the sugar-planters by bounties or countervailing duties, it is refreshing to find a book, every page of which contains an unbiased statement of the natural resources of these unfortunate Colonies. As Mr. Thiselton-Dyer states in a prefatory note: "Dr. Morris's residence in the West Indies, his repeated visits to them, and his intimate knowledge of their conditions, have enabled him to produce an account as accurate as it is impartial of their natural and economic resources, which is certainly more complete than anything hitherto available. Why the West Indian Colonies have failed to reach success, and in what direction the path to it lies in the future, can be readily understood by any one who will take the trouble to read these pages."

The Colonies dealt with have an area about equal to that of Great Britain and Ireland, with the population of Wales. Out of the entire area little more than 2 per cent. is now under cultivation, and only 7 per cent. of the estimated cultivable area. In fact, while about a million and a half acres are being cultivated, over twenty million acres more are suitable for bearing crops. Guiana has an extent of country equal to two Ceylons quite untouched; Trinidad has the wealth of the Straits Settlements going to waste; and the unworked soils of Jamaica could be made to produce the prosperity of at least four Colonies the size of Mauritius. As is well known, the Colonies have long depended almost wholly on the sugar trade as the staple industry, everything else being unworthy of consideration by the planters. Minerals are of comparatively trifling value, being limited practically to gold in Guiana and pitch in Trinidad. Essentially the true wealth of the colonists lies in the products and resources of the rich and fertile soil. In some of the islands it has of late years been recognised that it is as well to be prepared to cultivate more than one kind of produce; but, taken as a whole, we may regard the Colonies as given up to sugar growing, and, as Dr. Morris states:

"In most of the Colonies the situation is undoubtedly aggravated by their almost entire dependence on one industry. This is a source of grave danger in more ways than one. It is dangerous commercially, for any great depreciation of prices immediately affects the whole community. It is dangerous agriculturally, for adverse seasons or hostile tariffs may plunge at any moment the entire labouring population into great distress. Again, the growth of a single crop lends itself sooner or later to the spread of disease, and it rarely leads, owing to the neglect of other resources, to the production of the largest profit. To these may be added the narrowing effects produced on those engaged in the industry, and their inability or disinclination when a crisis comes to take up any other industry."

A dozen chapters are devoted to giving a full account of the past and present of each section of the Colonies—Guiana, Barbados, Trinidad, Tobago, Grenada, St. Lucia, St. Vincent, Dominica, Montserrat, Antigua, St. Kitts-Nevis, and Jamaica. As bearing upon the question of the mistake of relying upon a single industry, Guiana affords us some interesting facts. It is the largest and most valuable of our possessions in the neighbourhood, its capabilities of development are practically unlimited, and yet it is one of the most distressed of the Colonies. The region was ceded to us by the Dutch in 1815, it has an area of 109,000 square miles, a dozen large rivers flowing into the Atlantic, and a population of a little over a quarter of a million, or less than three persons to a square mile. The inland districts are practically uninhabited, nine-tenths of the population clinging to the coast. Under the Dutch sugar, coffee, and cotton were extensively cultivated, but with the transfer to the British Crown the planters gradually concentrated their energies more and more on one article and neglected the others. In 1829 the sugar yield was 46,026 tons, coffee 9,230,486 lb., and cotton 1,596,171 lb. By 1849 the coffee and cotton estates were rapidly disappearing, and in 1887 the returns showed 134,876 tons of sugar, while all other exports had practically ceased. It is this grasping at the most valuable prize, and utterly neglecting all opportunities in other directions, that has led to the downfall of this naturally wealthy country. "The whole activity of British Guiana during the last sixty years has been confined to the narrow strip of land along the coast. In spite of the vast extent of rich and fertile lands in the interior, with the exception of the gold industry, nothing has been done to develop them, and consequently the Colony is now in so critical a condition, owing to its entire dependence on a single industry, that its very existence as a civilised country is in jeopardy." With the knowledge that under another régime coffee and cotton were successfully grown in the district, it would be absurd to suppose, as some contend, that the soil can produce nothing else than sugar. The land devoted to sugar canes is a stiff clay, and fit for little else; but then it forms only the one-thousandth part of the total area of Guiana, and, as Dr. Morris remarks, there is nowhere such an extensive area of rich and fertile lands, with a comparatively healthy climate, and within easy reach of such good markets, as the Crown lands of this district. They can grow nearly every tropical product in demand, either in the New or the Old World.

Suggestions are made and particulars given as to increasing the resources of the country by adding profit-

[1] "A Report on the Agricultural Resources and Requirements of British Guiana and the West India Islands." By D. Morris, C.M.G., M.A., D.Sc., F.L.S., Assistant Director, Royal Gardens, Kew. *Kew Bulletin of Miscellaneous Information*, Additional Series I. Pp. viii + 165, and Map. (London: Eyre and Spottiswoode, Her Majesty's Stationery Office, 1898.)

able industries to the now seriously depressed sugar trade. More than a third of the population is composed of coolies from India, and this explains the importation of 50,000,000 lb. of rice annually; but as the conditions are favourable to the cultivation of rice on the spot, it is surprising that no steps have been taken to establish rice fields, if only for purposes of home consumption. The United States import bananas to the value of two millions sterling annually, but British Guiana makes no attempt to place any fruit on the market, although one shipping company offered to take 10,000 bunches of bananas every fortnight. Coffee, cacao, cocoa-nuts, cattle rearing, and other paying industries are recommended, and also the utilisation of the extensive forests for the production of valuable timber, guttapercha, indiarubber, &c. At present the forest lands bring in a revenue of 48,000*l.* in "acre money," nearly all of which is swallowed up in the cost of collection. Under competent management these forests could be made to contribute largely to the wealth of the Colony.

But there is evidently a stubborn determination on the part of a large proportion of the colonists in the West Indies to ridicule every proposal for the introduction of new industries, and notwithstanding the ruinous experience of recent years, they insist upon regarding sugar, and sugar only, as the sole means of salvation. Any person with an open mind who attends meetings in London at which the sugar planters or their representatives discuss West Indian affairs, cannot help being struck by the general desire to leave out of consideration questions relating to subsidiary industries. Still, in spite of this unwillingness to have other things to fall back upon, subsidiary industries are making some headway, and the out-and-out supporters of sugar growing cannot but admit that this is so. At the meeting of the Royal Colonial Institute on March 8, the lecturer stated that in the four essentially English islands of Barbados, Antigua, St. Kitts and Nevis, sugar is the sole possible staple; while in the five islands, Dominica, St. Lucia, St. Vincent, Grenada and Tobago, occupied by people differing from those in the other four in language and customs, the cultivation of sugar has given place to cacao, coffee, spices, and other products. Grenada, which sixty years ago contained 119 sugar estates, is now quite independent of sugar. Colonel Duncan has established on the island the largest and most valuable nutmeg plantation in any part of the New World. Are the misfortunes of the sugar-growing islands to be attributed to the "essentially English" character of their inhabitants?

Jamaica supplies us with a good illustration of the wisdom of selecting suitable marketable commodities for cultivation, in addition to the staple industry. As in other islands sugar was here once the one great object of cultivation, and in the year 1805 the exports were 150,352 hogsheads of sugar and over 5,000,000 gallons of rum. Even within recent years sugar, rum, and molasses formed the bulk of the trade, for in 1881-82 out of the total exports, valued at 1,178,594*l.*, the sugar products amounted to 910,027*l.*; but by 1895-96, when the total exports had increased to nearly 1,900,000*l.*, the sugar products had declined to little more than 360,000*l.* The serious depression in Jamaica dates back many years, and when it was hinted to the colonists that it would be well to introduce other cultural industries to assist in warding off the threatened crash, the idea was received with scorn and contempt. Thirty years ago Captain Bush, an American trader, began to encourage fruit growing, but for some years the venture made very slow progress, for by 1879 the fruit exports did not amount to 23,000*l.* It was realised, however, that the time had arrived to do something to save the island, and as there were no indications of an improved sugar trade, fruit had to come to the front, and by 1889 the exports had risen to 320,323*l.*, and by 1895-96 to 536,811*l.*, three-fifths of this trade being in bananas. From this it will be gathered that the fruit trade of the island is already far more valuable than that of sugar. One of the defects of the new industry is that there is not sufficient attention given to the manner in which the various fruits should be packed for the markets, an art in which our foreign competitors excel. In addition to sugar and fruit Jamaica has under cultivation coffee, cacao, allspice, ginger, fustic, &c., so that the entire failure of sugar would not now be anything like so disastrous as it would have been a quarter of a century ago.

All through this excellent and comprehensive report on a very difficult question, it is to be observed that the author does not propose anything with the object of hastening the end of the great sugar industry, but he recognises the necessity for supplementing, not supplanting, the staple trade by the introduction of a variety of cultural industries which would increase the wealth of the Colonies to an appreciable extent. In an appendix Dr. Morris propounds, at the request of the Chairman of the Commission, a scheme for the establishment of a Department of Economic Botany, and for agricultural instruction for developing the resources of the Leeward and Windward Islands and Tobago, and for affording assistance to the experimental cane cultivation to be carried on, in continuance of present efforts, in British Guiana, Barbados, and Antigua, at an estimated annual cost of 27,000*l.*, a scheme which, it is hoped, will be found to be accepted by the Government when Mr. Chamberlain brings the proposal for assistance before the House of Commons shortly.

H. H.

ON THE BREEDING HABITS OF THE GREY SEAL.

THE grey seal (*Halichærus grypus*) is to be met with on many parts of the British coasts, from Orkney and Shetland, throughout the Hebrides, on the north and west coasts of Ireland, and occasionally on the south and east, on the coast of Wales, in the Wash, more rarely in the Solent, and as far south as Jersey (*Zoologist*, 1884, p. 337); hence greater opportunities for observing it, and learning something of its habits, have occurred than has been the case with the ringed, bearded, and hooded seals. Moreover, several observers have contributed information on its breeding habits and on the condition of the young soon after birth. The following may be cited. So long ago as 1837, Mr. J. Wilson, writing on the habits of Scottish seals (*Mag. Zool. and Bot.*, i. p. 539), states that the young of the grey seal is "born above high-water mark in the end of September or beginning of October, and is at first covered with white hair, which is retained for many weeks, but shed before it takes to the water." His observations are confirmed by Edmondston, who, in his account of the seals of Shetland ("Zetland Isles," vol. ii. p. 294), remarks of the grey seal that the young are brought forth in September, October, or November. Nilsson and some other writers who have followed him have expressed the opinion that the breeding season of this species is in February; and Bell, in an attempt to explain this discrepancy ("Brit. Quad.," 2nd edition, p. 267), has suggested that the milder climate of Britain permits of pairing taking place much earlier than in Scandinavia. From the united testimony, however, of other observers, there can be no doubt that this is a mistake, and that the breeding season is in the autumn. Prof. Collett, of Christiania, who some years since contributed an excellent paper on the grey seal to the *Proceedings* of the Zoological Society (1881, pp. 380-87),

states that on the Fro Islands, off Trondhjem's Fiord, Norway, to which this species resorts in the breeding season, "the greater part give birth to their young in the last week of September, most usually on the 29th or 30th, or October 1—some a few days earlier and some later, but never after the middle of October." He adds: "The seals probably begin to breed at the age of four years, or at the earliest three years, and give birth to only one young one annually. The young seal at its birth is clothed with a wool-like covering, which falls off after the lapse of a fortnight. . . . The pups pass the first three weeks of their life on land until they have shed their woolly coat, often on exactly the same spot where they have been born, and pass their time exclusively in receiving nourishment from the mother and in sleeping."

As to the length of time the woolly coat is retained, some difference of opinion has been expressed. Prof. Collett, as above stated, believes that it is shed in about a fortnight, or between a fortnight and three weeks; and he derived his information from Mr. F. Borthen, the proprietor of the Fro Islands, who furnished him on several occasions with particulars concerning the seals during their stay at this group of islands. Mr. J. Wilson, already mentioned, states, somewhat vaguely, that the woolly coat is retained for many weeks. Dr. R. Ball, who furnished so much information to William Thompson, of Belfast, for his work on the natural history of Ireland, writing of the grey seal (*Trans. Roy. Irish Acad.*, vol. viii.) has observed more precisely that the very young females are generally "of a dull yellowish white, with rather long hair *which falls off in about six weeks* after birth, and gives place to a shorter and more shining coat of a warm dingy yellow, variously blotched with blackish grey, the whole gradually becoming more dull, and a general dark shade spreading over the back as the animal advances in age."

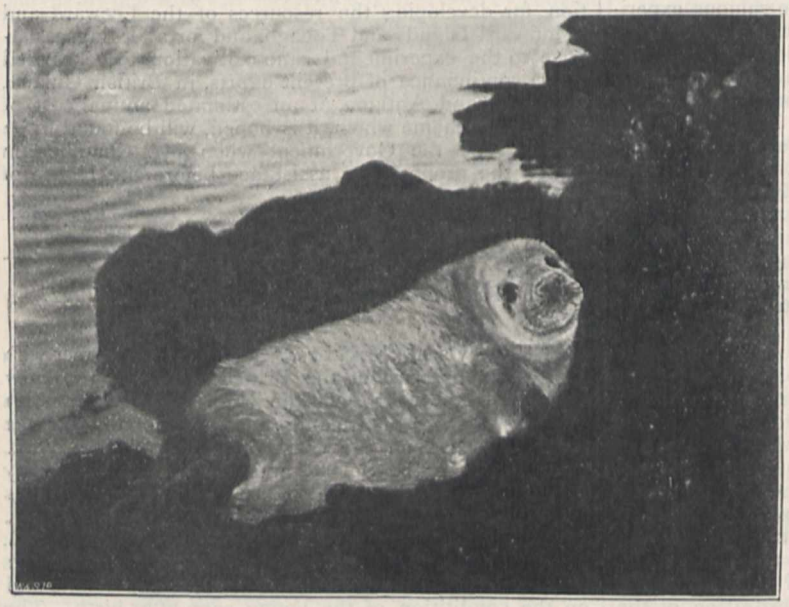


FIG. 1.—Young Grey Seal shortly after birth.

On December 24, 1881, one of the Trinity pilots, whilst off the Long Sand in the Lynn Roads, saw a large seal watching over the dead carcase of a recently born young one. On attempting to capture the old one she immediately showed fight, and had to be killed before she could be secured. This animal measured seven feet in length and five feet nine inches in girth behind the fore-flippers. It was identified as a grey seal by Mr. Thomas Southwell, of Norwich, who, in giving an account of the circumstance (*Zoologist*, 1882, p. 187), described the young one as being "of a beautiful silvery white, the muzzle sooty grey, a slight tinge of the same colour being visible on the back of the head, and for some distance along the spine."

The appearance presented by the young grey seal shortly after birth is well shown in the accompanying illustrations (Figs. 1 and 2), from photographs taken by Mr. Henry Evans, of Jura, during a visit to the Haskeir Rock in the Hebrides. Haskeir is a small rock about twelve miles west of North Uist. It is a great resort of grey seals, which breed there in October and November. It was formerly the custom with fishermen to visit this rock during the time it was frequented by the seals, and to kill them with clubs for the sake of their skins; but it is satisfactory to know, on the authority of Mr. Henry Elwes (*The Ibis*, 1869, p. 25), that this practice was put a stop to some years ago by Sir John Orde, the proprietor of the island.

From the foregoing remarks it will be evident that the suggestion (p. 346) that "the white coat is not improbably shed *in utero*," is not borne out by the testimony of the writers quoted. Nor is it only with the grey seal that this curious state of things exists. Dr. R. Brown, writing of the seals of Greenland (*Proc. Zool. Soc.*, 1868), states that the Greenland seal (or harp seal, as it is sometimes termed from the peculiar distribution of dark colour on the back) brings forth two young at a birth; that the pup "retains its white woolly coat for a fortnight or three weeks, and, *like the grey seal*, it refuses to enter the water until this is lost." Confirmation of this is to be inferred from the remark of Prof. Collett (*l.c.*), that the young grey seals during the first three weeks of their lives on land are "by no means so strictly confined to a dry place of rest, as is the case with the harp seal, which, so far as we know, never enters the water voluntarily *in its woolly coating*."

As to the common seal (*Phoca vitulina*), which pairs in September, and produces a single young one—sometimes two—in the month of June, it will not be irrelevant to refer here to the condition of the young at birth. A few years ago, towards the end of May, the late Mr. A. D. Bartlett purchased of a dealer in Liverpool four adult common seals, which were carefully transported to the Zoological Gardens. On June 9, one of them gave birth to a young one, whose appearance is thus described by Mr. Bartlett (*Zoologist*, 1881, p. 383): "It was covered with a rather thick coat of hair; its eyes very bright and wide open; it turned and rolled about, divesting itself of the outer covering of hair, which formed a complete mat upon which the young animal lay. For the first hour or two after its birth it was very active, and within three hours after its birth was swimming and diving about in the water like an adult animal. It uttered a low soft *bah*, or single call note, and looked about after its mother, and crawled towards her when she came out of the water. The mother would turn upon her side to let the young one suck. The latter was 32 inches long, and weighed 20 lbs. at its birth."

The difference between the common seal and the other species mentioned, as regards the condition of the young at birth and the shedding of the coat, is curious, and is perhaps to be accounted for in some measure by the different nature of their haunts at the time the young are born. The Greenland and grey seals bring forth their young upon rocky out-of-the-way islands, where they stand little chance of being molested, and consequently there is no need to get the young hurriedly to sea. The common seal, though breeding also on wild coasts, very often deposits the young on a sand-bank at no great distance from a fishing village, and subject sometimes to be submerged at high tides. On such banks the stay of the parent seals must be comparatively brief, for were the young not speedily able to take care of themselves, many would perish soon after birth. Thus it would seem that the greater activity of the young common seal is correlated with its conditions of life.

We have an analogous case in the difference to be found at birth in the rabbit and hare. The young rabbit born underground, where it is more or less removed from danger, is helpless and blind at birth; the young hare, deposited in a "form" on the surface, where it is more exposed to enemies, is born clothed with fur and with the eyes open. The rabbit stands in no need of early or rapid development; the young hare, on the contrary, must quickly leave the nursery and learn to shift for itself. So it may be with the seals.

J. E. HARTING.

FIG. 2.—An older pup, still retaining woolly coat.

SIR RICHARD QUAIN.

SIR RICHARD QUAIN, Bart., M.D., F.R.C.P., F.R.S., President of the General Medical Council, died on March 13, at the advanced age of eighty-one years. He had been ill for more than twelve months, and during the last half-year of his life was entirely confined to bed. His last appearance in public was when his paper on the "Cause of the First Sound of the Heart" was read before the Royal Society in June, on which occasion the President made a touching reference to the extraordinary courage which Quain displayed. His life had been one of ceaseless activity, good health, and overflowing spirits; and when overtaken by disease he appeared not to regard or understand rest, physician though he was. The paper just referred to was written in bed, and he left his bed to present and defend it. But no one was surprised at this who knew the story of the man's life.

Richard Quain was an Irishman, born at Mallow, Co. Cork, on October 30, 1816. As a child he was precocious. He was thoroughly grounded in English and the classics; distinguished himself at the public examinations, and at fifteen entered on an apprenticeship of five years as an apothecary. Even at this age he resolutely fought the cholera when it swept over Limerick. No doubt experience of this kind, and thus early, gave Quain courage and readiness in dealing with disease as a practitioner; but influences of more scientific bearing were to shape his career. The year 1837 finds him in London at University College, with a galaxy of teaching talent around him: Sharpey, Graham, Grant, Elliotson, Jones Quain the anatomist, and Richard Quain the surgeon and author of "The Arteries"—his cousins, from the same district—and as an instructor in practical surgery the great Liston, with whom Quain came to be on terms of intimate friendship. The clever young Irish lad, enjoying such advantages, immediately made his way to the front at College and University; and at the end of his curriculum as a student, obtained the coveted post of Resident Medical Officer at the Hospital.

It was shortly after this that Quain produced the brilliant research on the nature of fatty degeneration with which his name is associated for all time, and established his reputation as an original observer and thinker. Simple as the doctrine appears to us at the present day, fifty years ago it was a startling pronouncement by a young man fresh from his medical studies that fat may be, and often is, a product of the decomposition of muscular tissue, and that this change goes on in the living body. The ideas of life, nutrition, and death were greatly influenced by the doctrine. This, let us remember, was many years before Bauer and Voit, working with phosphorus in starving animals, furnished the proof experimentally and quantitatively; and Quain's claim was freely admitted by Virchow and Paget.

Although he was one of the founders of the Pathological Society, an early Secretary of it, and a frequent exhibitor at its meetings, Quain produced no other original work in this direction. His activities were being diverted into other channels. He quickly became popular as a practitioner; and having secured the valuable appointment of physician to the Brompton Hospital for Consumption, he was presently recognised as an authority on tuberculosis and diseases of the heart. Quain's personal qualities—the interest he displayed in his patients, his kindness, cheeriness, and cleverness in diagnosis and treatment—enabled him to turn to advantage his opportunities in practice; and whilst he was still comparatively young, he rose to the front rank of London consultants.

His heart was, for all this, even more closely set on the public work associated with Medicine. Medical education, medical research, medical relief at hospitals—these were the subjects at which he mainly worked, and with an energy and avidity which appeared to grow rather than wane as time passed and he attained in his old age the highest positions in the profession. A senator

of the University of London; chairman of the Brown Institution, with Burdon-Sanderson, Klein, Greenfield, Horsley, and their equally distinguished successors working as professors there; one of the most prominent Fellows of the College of Physicians, which was passing through a critical period of its history; and finally President of the General Council of Medical Education and Registration, of which he had been for thirty years a member—Quain had his hands full. Yet he never appeared to grudge his time to a friend in want of advice; and he was always keen and ready for the latest information in science. He had little time for ordinary literature. His nights were spent in writing—but in writing letters. It is true that he projected and edited the great Dictionary of Medicine with which his name is associated, and he wrote a few of the articles in it; but he produced—one might say "of course"—no book of his own. He had no patience for work of such a kind. Neither was he, nor could he have been, a teacher. He was much too quick in the workings of his mind to undertake instruction in laborious fashion.

Sir Richard Quain enjoyed the priceless privilege of the close personal friendship of many of the leading men of his time—Carlyle, Landseer, John Delane, Robert Lowe, and many others, particularly men belonging to the professions and the fine arts. He was a warm-hearted, generous friend, who never spared himself when he could be of service to others, particularly young workers at the medical sciences. His position was unique—won entirely by his ability and ceaseless energy—and cannot possibly be filled by another.

NOTES.

THE International Meteorological Conference which met in Paris in 1896 appointed a permanent Committee on terrestrial magnetism and atmospheric electricity, and submitted to the Committee a number of questions for report. In order that these questions may be well discussed, it has been decided to hold an international conference on terrestrial magnetism and atmospheric electricity in connection with the forthcoming meeting of the British Association at Bristol, which will begin on September 7. Letters of invitation are being sent out by the Committee; and all foreigners who propose to attend the conference may obtain tickets of membership of the British Association, free of charge, on application to the Assistant General Secretary of the Association. Among the subjects to be discussed are: the calculation of monthly means with and without taking disturbed days into account; the publication of the monthly means of the components X,Y,Z, and the differences ΔX, ΔY, ΔZ, of the monthly means from the preceding means; the establishment of temporary observatories, especially in tropical countries; and the relative advantages of long and short magnets. The decisions of the conference upon these questions will be reported direct to the International Meteorological Conference. But though the first business of the conference will be to report upon the questions submitted to them, papers and communications on other subjects connected with terrestrial magnetism and atmospheric electricity are also invited. It is desired that such papers be sent to the Committee some time before the opening of the British Association meeting.

A NUMBER of Fellows of the Royal Society have expressed a wish that a portrait of Lord Kelvin, who served as President from 1890 to 1895, should be placed in the apartments of the Royal Society, and a Committee is now being formed to carry out this object.

A BILL to amend the law with respect to vaccination was introduced in the House of Commons on Tuesday, and was read for the first time. The Bill provides that glycerinated calf lymph, the valuable properties of which were described in NATURE a few weeks ago (p. 391), shall be placed within the reach of all, and that no parents shall be required to submit their children for vaccination by means of anything but calf lymph. Vaccination will continue, as at present, to be obligatory; but vaccination by anything but calf lymph will cease to be compulsory. At present children must be vaccinated within three months after birth, but it is proposed to extend this period to twelve months.

IN the summer of 1897 a recommendation was made to the Government of India in support of the establishment of a physical laboratory in that country for advanced scientific teaching and research. The Government of India has now reported that the initial outlay on a physical laboratory of the kind described would be 60,000 tens of rupees, and that they are unable, in the present state of the finances, to entertain the scheme.

MAGDALEN COLLEGE, Oxford, announces that a Fellowship in Medical Science will be given by the College next October. From the terms of the announcement it appears that on this occasion the Fellowship will be bestowed merely for proficiency in the sciences related to medicine, as tested by examination; but that original work in these sciences will be fully recognised as a claim to distinction. The offering of this Fellowship affords new proof of the interest which Magdalen College—that has already done so much—still takes in the advancement of natural science.

WE regret to announce that Sir Henry Bessemer, F.R.S., the distinguished metallurgist and engineer, died on Tuesday evening.

THE eighth general meeting of the German Meteorological Society will be held at Frankfort-on-Main on April 14–16.

TOWARDS the end of the year 1896, at the request of a large number of distinguished men of science, philosophy and literature, Mr. Herbert Spencer agreed to have his portrait painted by Prof. Herkomer, for presentation to one of our national collections. The portrait is now finished, and will be sent to the next exhibition of the Royal Academy. In time it is intended to offer the picture to the Trustees of the National Portrait Gallery for hanging upon their walls.

WE learn from *Science* that the New York Zoological Society has secured the 100,000 dollars needed to enable it to take possession of the site provided by the city for a Zoological Garden. The total amount subscribed is 103,550 dollars, which included thirteen subscriptions of 5000 dollars each. According to the terms of the agreement between the Society and the city, as effected last year with the Commissioners of the Sinking Fund, the Society is under obligation to raise 250,000 dollars for buildings and collections, of which sum 100,000 dollars must be in the Society's treasury on or before the 24th of this month, and it was agreed that the Society could not take possession of the site until that amount had been provided.

AN Executive Committee of the Royal Zoological Society, Dublin, has made an appeal for subscriptions towards the erection of a "Haughton Memorial Building" in the gardens of the Society, in recognition of the important services rendered to the Society by the late Rev. Dr. Haughton, F.R.S., who for twenty-one years acted as its honorary secretary, and discharged the duties of president for five years. The form which the building will take has not yet been decided, but the Council of the Society propose that it should be one with a useful purpose. Sub-

scriptions in support of this scheme for perpetuating Dr. Haughton's memory may be sent to Prof. D. J. Cunningham, Hon. Secretary, Royal Zoological Society, Dublin.

THE death is announced of Prof. Kirk, Fellow of the Linnean Society. Prof. Kirk (says the *Times*), who was of Scotch extraction, spent the greater part of a long life in the Colony of New Zealand. In connection with the Department of Woods and Forests he rendered valuable official service. He was a distinguished botanist, and his "Forest Flora of New Zealand" is the standard work upon the forest growths native to the islands. Since the production of his principal work he has continued, from time to time, to publish interesting monographs upon New Zealand timbers. A very valuable report on the trees suitable for forest cultivation in the Colony was issued by him in 1886, at which time he held the position of Conservator of State Forests in New Zealand; and he is understood to have been engaged up to the moment of his death upon a great work devoted to the botany of Australasia. Prof. Kirk was an eminent member of the New Zealand Institute, and his loss will be much deplored in scientific circles, both in England and Australasia.

WE regret to announce that Dr. Ferdinand Hurter, who had been in weak health for some time past, died suddenly at his residence near Liverpool last Saturday. Dr. Hurter was a native of Schaffhausen, in Switzerland, where he was born in 1844. He early turned his attention to chemistry and its practical applications, and after serving an apprenticeship to a dyer in Winterhun, he pursued the same science at Zürich Polytechnic, whence he proceeded to Heidelberg, where he took his Doctor's degree in 1866. In the following year he came to reside in England, and was appointed consulting chemist to Messrs. Gaskell and Deacon at Widnes. On the formation of the United Alkali Company, he occupied the same position of principal chemist to that firm. In addition to much work connected with his own profession, he will also be remembered for his investigations of photometric subjects, and particularly for a very thorough inquiry, which he made some years back in co-operation with Mr. Driffield, into the action of light on the photographic film. Some of the scientific results to which he was led in the cause of the inquiry have been questioned; but his work had great effect in improving the artistic character of photographic reproduction, by his discussion of the effects of varying the exposure, and his insistence on the truthful rendering of tone. Dr. Hurter was prominently connected with the local scientific societies, having occupied the position of President of both the Chemical and Physical Societies of Liverpool.

THE first number of the new volume of the *Rendiconti del Reale Istituto Lombardo* contains the conditions and particulars of the prizes offered for competition in 1898 and 1899. Most of these prizes are open to all nations; but the essays must be written in Italian, French, or Latin, and forwarded under a motto to the Secretary of the Istituto Lombardo, Palazzo di Brera, Milan. The prizes of general interest are the following: (1) The Institute's prize of 1200 lire for the most complete catalogue of extraordinary meteorological events from the most ancient times down to 1800, excluding auroras and earthquakes, which have already been catalogued. Last date, May 1, 1899. (2) The Cagnola prize of 2500 lire and a gold medal (value 500 lire) for a critical review of the theory of electric dissociation, with new experiments. Last date, April 30, 1898. (3) The Brambilla prize of 4000 lire to whoever shall have introduced into Lombardy the most useful new machinery or industrial process. Names to be sent in by April 30, 1898. (4) The Secco-Comneno prize of 864 lire for the best description of the Italian phosphate beds, and proposals concerning their exploitation. Last date, April 30, 1902. All essays must be accompanied by an envelope bearing the motto outside, and the name and address of the competitor inside.

A VERY valuable volume on the sanitary circumstances and administration of 220 urban districts of England and Wales has been issued as a supplement to the report of the medical officer in the twenty-fourth annual report of the Local Government Board (1894–95). The volume summarises the results of the general sanitary survey of urban districts organised by the late Dr. F. W. Barry, and carried out under his supervision during the period 1893–95. It contains the results of one of the most important pieces of administrative work ever undertaken by the Medical Department of the Local Government Board, and as a trustworthy statement of the sanitary conditions of urban districts is invaluable. The districts are arranged in alphabetical order, and under each is described the conditions of dwellings and their surroundings, water supply, sewerage and drainage, methods of excrement and refuse disposal and removal, and conditions and nature of supervision over registered premises and trades. The general character and efficiency of the administration of the sanitary authority of each district is described under a separate heading. The present report, with the one previously published on port and riparial districts, contains the results of the sanitary survey of 396 districts, the topographical positions of which are shown upon a map. It is to be regretted that a survey of such distinct value to public health could not be made to embrace the whole of England and Wales.

A PRACTICAL demonstration of Dr. Carl Linde's method of producing extreme cold and liquefying air was given in the rooms of the Society of Arts on Monday and Tuesday; and the apparatus employed is described by Prof. J. A. Ewing in the current number of the Society's *Journal* (March 11). The method, it may be remembered, is a regenerative one; that is to say, the cold produced by the treatment of one portion of air is communicated to the portion which is next coming on to be treated, with the result that the air undergoes continuous cooling, which is only limited by the leakage of heat into the apparatus from outside. In Dr. Linde's apparatus the step-down or drop in temperature is produced by letting compressed air escape through a small orifice from a region of high pressure to one of low pressure. As air is not a perfect gas, in the thermodynamic sense, it is slightly cooled by the expansion it undergoes, even though it does no work. The fall of temperature is little more than a quarter of a degree for each atmosphere of difference in pressure between the two sides of the orifice; but Dr. Linde has shown that this small amount is enough to furnish the step-down necessary in a regenerative process. The gas, cooled slightly by passing through the orifice, gives up its cold to gas which is approaching the orifice. The passage through the orifice cools that gas further, and so on, with the result that a cumulative cooling proceeds. A temperature of − 200° C., or lower, may thus be obtained without much difficulty. The machine exhibited at the Society of Arts circulated about 15 cubic metres per hour in a circuit in which the fall of pressure was from 200 atmospheres to 16 atmospheres. About 0·9 litres of liquid air was produced per hour, with a continuous expenditure of three horse-power. Dr. Linde is constructing a machine of 120 horse-power for the Rhenania Chemical Works at Aix-la-Chapelle, which is to be applied to the improvement of the Deacon process of chlorine manufacture. This machine is expected to produce 50 litres of liquid air per hour.

ATTENTION has recently been called, in two communications, to sources of error likely to arise in temperature determinations by means of thermometer readings. One of these has reference to the possibility of minute errors arising from expansion of the

attached scale, when that form of thermometer is used. Opportunity for the determination of the amount of this error has offered itself at the Physikalisch-Technischen Reichsanstalt. Two pairs of thermometers, each pair being made of similar glass, and one pair divided on the stem, and the other on the scale, have been rigorously tested. The result is that the third place of decimals is not trustworthy if precautions have not been taken to remove the effects of the expansion of the scale. The other has reference to the accuracy of thermometric readings when the instrument is exposed in a medium whose temperature is rapidly changing. Dr. Hergesell, of Strassburg, in his investigation of the temperature of the air at considerable elevations, as derived from heat-registering apparatus carried in balloons, has been led to the conclusion that in order to ascertain the temperature of the air, it is necessary to take into account two corrections which can have a very important effect upon the result. One of these corrections, depending upon the velocity with which the registering apparatus is carried through the air, he has endeavoured to determine by actual experiment made in the Seewarte at Hamburg. The thermograph was mounted upon the whirling apparatus used for testing the anemometers, and driven with various degrees of velocity varying from zero to seven metres per second. The thermograph was warmed to about 30° C., and precautions taken to ensure uniformity in the distribution of the temperature. The arms were then rotated, and when the temperature of the thermograph had fallen to that of the testing-room, the resulting curves show the rate of cooling under the varying velocities.

THE second correction, which Dr. Hergesell calls the "inertia coefficient" in the paper referred to above, depending upon the variation of density of the surrounding medium, cannot be determined experimentally with the same ease. The author prefers to use the temperature recorded on the thermogram at equal, but considerable, altitudes on the ascending and descending journey. At an altitude above 4000 m. it may be assumed that the daily variation of temperature ceases, and therefore the difference of time at which the two readings are taken is immaterial. Dr. Hergesell makes use of the record of the balloon journey made February 18, 1897, from Paris. The temperature records in ascending and descending are arranged as functions of the atmospheric pressure, and show on the whole a tendency to regular deviation from each other. The greatest separation occurs at a pressure of 400 to 500 mm., while at 200 mm. the curves tend to become parallel. Dr. Hergesell assigns to the "inertia coefficient," which at the usual atmospheric pressure is unity, a value four times as great in a density corresponding to a pressure of 500 mm. In thermographs as at present arranged, the difference arising from these two sources of error, between the reading indicated and the true temperature, may amount to as much as 12°.

THE eleventh annual report of the Liverpool Marine Biology Committee has lately appeared, containing an account of the work done at the biological station at Port Erin during 1897. The year has been comparatively uneventful, but among the recent developments of the work of the station we notice a scheme for the simultaneous observation and record of surface organisms at different stations in the Irish Sea. Attention may be called to an obvious error on p. 13, in regard to the specific gravity of the sea-water in the tanks.

MR. H. L. CLARK has described the development of a viviparous Synapta which is abundant among algæ attached to mangrove roots in the West Indies. His observations induce him to support Ludwig's views concerning the degraded rank of the Synaptidæ in opposition to Semon's interpretations. In regard to the ancestry of Echinoderms as a whole, he again opposes Semon, and finds himself in close agreement with Bury; but, as the development of *Synapta vivipara* is direct and without metamorphosis, it is obvious that his criticisms of Semon's work cannot be regarded as final.

A RECENT number of the *Journal of the Society of Arts* contains an excellent review of the late outbreaks of plague in Bombay, by Mr. H. M. Birdwood. An account is given of the organised endeavours of the Government to combat the scourge, and some real idea of its extent may be gathered from the statement that up to the end of last year 56,000 deaths from plague had been reported for the whole Presidency, but that the actual number was probably not less than 70,000. Opinion appears to be unanimous that the utter disregard of the poorer natives for the commonest sanitary laws, and the horrible houses and "chawls" in which they principally live, are largely responsible factors for the firm hold which the disease has taken in the city of Bombay. The eminent authority, Dr. Cleghorn, who was deputed by the Government of India to study the position of affairs in Bombay, has vividly described the housing of the native population there. He tells us that the so-called chawls are mostly great buildings five to seven stories high on the flat principle, each flat containing a long corridor with rooms about 8 feet by 12 feet in size opening into it on either side; these rooms were usually inhabited by six to eight or even more persons, and the state of filth in these corridors, which are practically the receptacle for refuse from all the rooms, is indescribable. Each chawl contains from 500 to 1000 persons, and 70 per cent. of the native population are housed in this way. Dr. Cleghorn further goes on to say that such places were only to be seen in Bombay, and the marvel is not that so much plague abounded, but that it had not carried away at least half of the population. To cope with this terrible legacy of past generations of responsible authorities is no light task, but the Government are devoting their most earnest attention to carrying out a large and important scheme for the sanitary renovation of Bombay. It is discouraging in the highest degree to find that, despite all the heroic efforts which have been made to cope with the scourge, it has appeared with renewed strength, and an epidemic has been established for a second season in Bombay.

WE have received from the Director, Mr. N. A. F. Moos, the Report of the Bombay Magnetic and Meteorological Observatory for the year 1896. In addition to the general tables giving the readings of the self-recording magnetic and meteorological instruments, the report contains an account of the absolute measurements made during the year in order to standardise the self-recording instruments. In an appendix a short account is given of the disturbances produced on some of the self-recording instruments by the earthquake on June 12, 1897. Enlarged copies of the photographic trace of the disturbed instruments are included, which add considerably to the interest of the report. From the character of the disturbances the Director concludes that the disturbance of the magnetic instruments was not entirely of a mechanical nature, but that the earthquake did really produce a disturbance of the magnetic elements. The appendix also contains a discussion of fifty years' observations of declination made with one of Grubb's declinometers at the observatory.

THE United States Weather Bureau has published a discussion of the Floods of the Mississippi River, prepared by Mr. Park Morrill, the Forecast Official in charge of River and Flood Service. The paper refers to the chief characteristics of that river and of the basin that is drained by it, and contains valuable and trustworthy information as to the rainfall (which is the principal cause of the floods) and drainage under normal conditions, by means of a large number of tables and charts. These show that the difference in the amount of summer and winter rainfall is very great, the former being five or six times the latter

in some districts. The floods occurring during the last twenty-six years, during which time trustworthy gauge readings are available, have been specially investigated; this period embraces six notable flood-years. The downfall of water in each of these has been computed, and the results are given in tabular form; the most destructive floods occurred in 1882, 1890 and 1897. In the latter year the river rose higher than was ever known below Cairo, but the duration of high water was exceeded in 1882 and 1884. One of the duties of the Weather Bureau is to issue warnings of impending floods, and it is satisfactory to note that ample notice is usually given. Indeed, so completely was the public warned on this last occasion that the Bureau was criticised for needlessly alarming the people in the threatened districts, but subsequent events fully justified its action.

FOLLOWING a recent example, the Royal Geographical Society has issued the first number of a "Year-Book and Record," designed to afford information respecting the constitution and working of the Society, and its annual progress. It seems somewhat strange that so useful a publication should not long ago have come into vogue; but we gladly welcome the newcomer as tending very considerably to enhance an interest in geography. Following the charter and bye-laws, an interesting account is given of the library and its contents, as well as of the map-room. Her Majesty's Government give 500*l.* per annum to the latter on condition that the public have access to the maps and charts. The illustrations are a pleasing feature, and give point and variety to the subject-matter. They comprise a view of the Society's house in Burlington Gardens, and selected parts of the interior, together with sundry plans; while very satisfactory reproductions are given of the two Royal medals and of the special medals which have been awarded from time to time for eminent services to geography. Some indication of size might well have been given here; if we mistake not, the gold Stanley medal was of quite heroic proportions—far larger than the illustration would make it appear. The list of recipients, beginning with Richard Lander, who received a Royal medal in 1832 for his discovery of the course of the River Niger, and the accompanying statement of the grounds of each award, is of distinct interest in this publication, connecting as it does the geographical progress of the past with the present. A long catalogue of pictures and busts is given. In another issue it would be useful, for reference, to supply painters' and sculptors' names.

HERR F. E. SUESS communicates to the *Verhandlungen* of the Austrian Geological Department some details of the earthquake at Graslitz between October 25 and November 7 of last year. It appears that the disturbance belonged to the group called "Vogtland-Erzgebirge" by Credner, and it is remarkable that at the end of the Graslitz earthquake the centre of disturbance seems to have moved to another locality as yet undetermined.

WE have received a paper by Prof. Dr. Eduard Richter, of Graz, containing an account of soundings and temperature observations made by the author in the lakes of Carinthia, Carniola, and Southern Tirol. The data discussed form the basis of the second part of the Atlas of the Austrian Lakes, produced under the joint editorship of the author and Prof. Penck, and published in the Vienna *Geographische Abhandlungen*.

THE *National Geographic Magazine* for January contains an article by Mr. Robert Stein, of the U.S. Geological Survey, on "Three Weeks in Hubbard Bay, West Greenland": the author, anxious to gain experience in Arctic work, was landed by Peary in his last expedition. Another paper, by Mr. W. J. McGee, deals with the "Modern Mississippi Problem," defined as being "not that of navigation, not even that of normal regimen as a great river, but that of the floods to which the stream is subject."

"THE Mechanics of Soil Moisture" forms the subject of a paper by Mr. Lyman J. Briggs, published by the United States Department of Agriculture. In it the author explains in simple terms such of the physical properties of liquids, including surface tension and viscosity, as are necessary to explain the retention and motion of water in the soil. To scientific students of agriculture, such an insight into the elementary laws of capillary phenomena will be useful in enabling them to explain the why and wherefore of the differences between heavy and light soils.

IN a *brochure* of six pages, on "Æther, its Nature and Place in the Universe," by Dr. Hugh Woods, published by the *Medical Magazine* Publishing Company, the author, after propounding his views on the existence of the ether and the why and wherefore of certain laws of nature, concludes by remarking: "The theory opens up far too wide a field for one man to traverse, however cursorily, especially when he can devote only a few leisure minutes to the difficult and laborious task." With this opinion we are certain that all who have read the paper will unanimously concur.

THE "Electrical Trades' Directory and Handbook," noticed in last week's NATURE, contains 1174 + clix pages in all, including the pages of advertisements. The extensive character of the electrical and allied industries may be gauged by the great size of the new volume of this Directory.

AN English edition of the two volumes of "Audubon and his Journals," the American edition of which was reviewed in NATURE of February 24 (pp. 386–7), has just been published by Mr. John C. Nimmo. Every field club and naturalists' society should add the volumes to their libraries, for they are full of interesting notes on outdoor natural history, and on the character and methods of a naturalist whose name is familiar to all observers of nature.

A SECOND edition of Prof. Heinrich Weber's systematic treatise on algebra, the "Lehrbuch der Algebra" (Brunswick: Vieweg und Sohn) is in course of publication, and the first volume of the new edition has just appeared. The scope and value of this masterly work has already been indicated in NATURE (vol. lv. pp. 25 and 481, November 12, and March 25, 1896). In the new edition the plan and method of the original work has been retained. About fifty pages of new matter have been added; corrections have been made where necessary, and paragraphs which appeared slightly obscure have been elucidated, while the section on the theory of elimination has been considerably enlarged.

AN ingenious actinograph, devised by Dr. Hurter and Mr. V. C. Driffield, has been sent to us by Messrs. Marion and Co. By means of a small double slide-rule, and a sliding set of curves movable at right angles to the motions of the rules, the variables concerned in photographic exposure are shown in their varying relations to one another. To find the time of exposure, the scales corresponding to the light, the lens, and the speed of the plate are set in their proper positions, and then the correct exposure can be read off. For photography under various conditions, such as views, portraiture, interiors, and copying, a table of factors are given. By using the actinograph intelligently a photographer may be confident of obtaining a good negative.

APPARATUS for simple experiments in physics, such as are described in manuals and text-books used in elementary physical laboratories, now take a prominent place in the catalogues o

scientific instrument makers. A catalogue just received from Messrs. W. and J. George, Ltd., the successors to the late firm of Becker and Co., contains illustrations and prices of apparatus described in the volumes on practical physics by Schuster and Lee, Stewart and Gee, Watson, and Glazebrook. Similar catalogues have lately been published by Messrs. Griffin and Sons and Messrs. Philip Harris and Co. It is satisfactory to know that scientific instrument makers are beginning to understand the necessity of producing simple apparatus at a low price, now that students of physical science are expected to gain their knowledge by individual experience, even in the most elementary stages of the subject. What some of them have yet to learn, however, is that the apparatus is not intended as toys, but as a means of obtaining quantitative results; and unless this end is attainable, the instruments are of little value.

THE annual report for 1896-97 of the Director of the Field Columbian Museum, Chicago, is of interest to curators of museums, and records much progress. It is profusely illustrated by photographs of the rooms, and case-objects. In the division of economic botany, what is called a monographic installation of material exemplifying the North American forest trees is being pursued. The elements of the series comprise a branch, flowers, and fruit from the same tree, a photograph of the tree in summer, and in winter, a seven-foot length of trunk, and transverse section, a two-foot map, coloured to show the distribution of the species, and ornamental cabinet specimens. In the department of zoology the cases have been painted black inside. The report on the expedition and field work is of unusual interest. An account is given of the party which entered Somaliland under Mr. Elliot. He regards the collections made as very valuable, and probably the most important, especially as regards quadrupeds, ever brought out of any country by an expedition. Casts of heads and parts of bodies showing the muscles of the large animals were made, which will prove of the utmost service during mounting. Besides these, over 300 photographic negatives are in hand illustrating the scenery, the people, and also the animals, both living and dead. The last-named will be used in conjunction with the casts. It may be noted that the museum mostly does its own printing.

THE additions to the Zoological Society's Gardens during the past week include two Prairie Marmots (*Cynomys ludovicianus*) from North America, presented by Mr. J. Maurice Glyn; a Spotted Ichneumon (*Herpestes auropunctatus*) from Nepal, presented by the Rev. Sidney Vatcher; a Great Eagle Owl (*Bubo maximus*), European, presented by Captain Betram Goff; two Indian Chevrotaints (*Tragulus meminna*, ♂ ♂) from India, a Mantell's Apteryx (*Apteryx mantelli*), an Owen's Apteryx (*Apteryx oweni*) from New Zealand, two Cardinal Grosbeaks (*Cardinalis virginianus*) from North America, eight Undulated Grass Parrakeets (*Melopsittacus undulatus*) from Australia, a Brown Gannet (*Sula leucogastra*) from South America, a Black Lark (*Melanocorypha yelloniensis*, ♂) from Siberia, four Chinese Quails (*Coturnix chinensis*) from China, a Black Woodpecker (*Picus martius*), a Solitary Thrush (*Monticola cyanus*), European, purchased; a Leopard (*Felis pardus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

CONSTANT OF ABERRATION.—Prof. C. L. Doolittle, from observations made at the Flower Observatory of the University of Pennsylvania, contributes a paper on this subject to the *Astr. Jour.* 428. He states "that in view of the present interest in the values of the astronomical constants, the investigation is published earlier than was intended. The result is preliminary in the sense that it is derived from a limited amount of material, which will ultimately be combined with other data."

Küstner's method was employed, and he obtains a result of 20″·572 ± 0″·009, which is even larger than his recent deduction of 20″·55 from his South Bethlehem observation.

Since the adoption, then, of 20″·47 at the Paris Conference, the four most recent deductions all give higher values, viz. 20″·55 (Doolittle), 20″·533 (Fergola), 20″·57 (Finlay), and 20·572 (Doolittle).

WINNECKE'S COMET (*a* 1898).—This comet will make its perihelion passage in a few days—March 20. In *Astr. Nach.*, No. 3480, Dr. Hillebrand publishes a continuation of the ephemeris, which shows that the comet is on the borders of Aquarius and Capricornus, having passed between α and β Capricorni some few days ago. It is moving slowly in an easterly direction, but is badly placed for observation; so that it is unlikely to be seen again in ordinary telescopes until its next return in 1904.

NEW VARIABLE STARS.—We learn from the *Astronomical Journal*, No. 428, that the variability of the star S.D.M. −20°·2007, announced by Mr. Perry in No. 398 of that *Journal*, has been confirmed by Mr. Parkhurst, and in consequence the definite notation 2689 Z Puppis has been assigned to it.

The star in Gemini, announced as variable by Mr. Anderson in *Astr. Nach.* 3463, has also been confirmed by Mr. Parkhurst, and accordingly it has been called 2404 X Geminorum.

ASTRONOMICAL SERIALS.—The *Berliner Astronomisches Jahrbuch* for 1900 has recently been issued, under the editorship, as before, of Prof. Bauschinger, Director of the Rechen-Institut at Berlin. It contains particulars of the solar eclipse which will occur on May 28 of that year, and will be visible as total in the States of Georgia and South Carolina. Leaving North America the shadow band crosses the Atlantic, and strikes Europe on the coast of Portugal near Oporto, passing over Spain and Algeria.

The *Jahrbuch* contains the elements of all the small planets up to No. 425, which was discovered December 28, 1896, by M. Charlois; also opposition elements of a selected number.

The data and arrangement are the same generally as in previous years, but some important changes are contemplated in the planetary table for future years.

In the *Bulletin de la Société Astronomique* for this month there are several reproductions of the partial eclipse of the moon which took place on January 7. The photographs illustrating the various phases were taken by MM. Quénisset and Touchet; one at maximum is from a negative taken by M. Rudaux.

In the same *Journal* there is a summary of Prof. Schiaparelli's fifth "Memoir on Mars," containing his observations made during the opposition in 1886. The author has not given a general chart of the planet for this year, but his observations of 1886 happily complete our aerographical knowledge, by a rigorous examination of the north-polar region. A fine chart illustrating this region accompanies the paper, together with various aspects of the planet on different dates.

Five instantaneous photographs of Jupiter are also reproduced from photographs taken by Prof. Barnard at the Lick Observatory with the 36-inch telescope.

THE SPITSBERGEN GLACIERS.

ON Monday last Sir W. Martin Conway delivered a lecture before the Royal Geographical Society, in which he described the principal results of his second expedition to Spitsbergen, undertaken in conjunction with Mr. E. J. Garwood, in July and August 1897. It will be remembered that in the previous summer Sir Martin Conway, with several companions, for the first time explored, with any thoroughness, certain parts of the interior of the main island of Spitsbergen, throwing much new light on the physical features of the island and their mode of origin. In that year the principal attention was directed to the country south of Ice Fiord, between it and Bell Sound, the result being to show that this region was by no means the ice-clad country it had previously been considered. The principal object of last year's expedition was to examine a new section of the interior, north of Ice Fiord, which was still believed by some to be covered with an ice-sheet similar to that found in Greenland. Two districts in particular were chosen as the field of operations, the one (named by the lecturer Garwood Land) occupying the area between the extremities of Wijde Bay and Ice Fiord in the west and the sea in the east; the other lying west of the line joining the heads

of Wijde Bay and Ice Fiord. For this second region Sir Martin Conway has revived the old English whalers' name for Spitsbergen as a whole—King James Land.

Although the routes naturally did not extend over a very large area, considering the comparatively short time available for the exploration, Sir Martin Conway had a most interesting story to tell of a fight against difficulties, such as are presented to the explorer by few, even of the most remote regions of the world. His graphic descriptions, reinforced by the unusually fine representations of scenery supplied by Mr. Garwood's photographs, brought home to his hearers the chief characteristics of the country in a way which could only be surpassed by an actual visit to the scenes described. He also gave the meeting an instructive study of the problems in physical geography which he thinks may be solved by his examination of the country. Garwood Land was first visited, a landing being effected at the foot of the Nordenskiöld Glacier, near the head of Klaas Billen Bay, one of the principal branches of Ice Fiord. The route led a little east of north, progress being difficult at first on account of the labyrinth of crevasses which intersect the glacier, and afterwards by reason of dense fog, and violent snowstorms. Particularly forcible was the lecturer's description of the white curtain of fog in which he and his companions were enwrapped for days together, and which in time caused a dazed feeling as if they had taken entire leave of the solid earth, and were floating in some unsubstantial nebula. The steep snow slopes entailed arduous labour in dragging the sledges, but after the fourth camp had been left some high snow domes were reached, from the summits of which views down broad valleys to the east and north were obtained, displaying a succession of plateau-fronts or bluffs of rock with *névé* both below and above them. The scenery, as seen by the evening light, was described as superb, the panorama being a glorious mass of colour. Returning to the coast, the travellers next proceeded to King's Bay on the west coast of the island in 79° N., and thence penetrated inland into an interesting region of peaks and glaciers, several of the former being climbed. The principal mountain group is known as the Crowns, and lies between the two main branches of the King's Glacier. The peaks of this region present striking characteristics, well shown by the photographs displayed on the screen. The weather during this expedition was the most perfect imaginable. A week at Horn Sound, near the south end of the island, during which Mount Hedgehog, one of the highest peaks of the Hornsunds Tinder, was climbed, concluded the expedition. Dense fog was again encountered here, and the difficulties of the ascent were altogether out of proportion to the comparatively small elevation above sea-level, the extent of the actual climb (in the Alpinist's sense of the word) far exceeding that in the case of many of the more difficult summits of the Alps.

The principal geographical result of his second visit to Spitsbergen is, Sir Martin Conway considers, the discovery that neither of the districts visited, nor, in fact, any large part of the islands except New Friesland and North-East Land, is covered by an ice-sheet. As long as a flowing body of ice is contained within definite mountain ranges, it is a *glacier*, and the districts visited were both merely glacial and mountain areas. The importance of distinguishing clearly between the two types of ice-bearing country was strongly insisted upon by the lecturer, on account of the different natural processes to be seen at work in the two. The insignificance of the excavating action of ice was stated, perhaps, somewhat too uncompromisingly; but at any rate, as was shown by Sir Martin Conway, the forces acting on the land-surface beneath an ice-sheet are mainly conservative; while in a glacial region, the rock-faces which rise above the general surface are exposed to rapid denudation, and great developments of surface-form are going forward. The "eating-back" processs, recognised as a powerful agent of denudation in the case of rivers, was held to be equally effective in that of glaciers, although, of course, the result is due to aerial denudation, not to glacial erosion. The work of the glacier is to carry away the débris, the accumulation of which would otherwise arrest the process of denudation. Examples were given by the lecturer from the Bernese Oberland and the Karakoram Himalayas, in which the present surface features are, in his opinion, due to this eating-back process, which has entirely modified the original longitudinal drainage of the mountain masses. The great bluffs of the Oberland—the Eiger, Mettenberg, and Wetterhorn—show a striking resemblance to those of Spitsbergen's Sassendal.

At the close of the lecture Mr. E. J. Garwood gave some interesting details regarding the geological features of the country traversed, adding besides some graphic descriptions of the marvellous effects of colour, which give to the scenery of Spitsbergen such a unique character. Among the points touched upon was the presence in Spitzbergen, contrary to the formerly accepted idea, of a snow-line some 1200-1500 feet above sea level. The contrast in the surface features above and below this line is most marked, the lower slopes showing as well-marked a denudation curve, with gullies due to flowing water, as may be seen in our own islands, while the upper regions show the abrupt rock-faces due to frost denudation. In the case of the Crowns this has acted along the vertical joint-planes of the carboniferous limestone rocks which form, as it were, a golden crown above the purple Devonian shales of which the more gradual, lower slopes are composed. Mr. Garwood also gave an account of the en-glacial streams, which often flow in a direction at right angles to that of the main valley, and which, on the retreat of the glacier might leave behind deposits similar to the kames and eskers which have so puzzled geologists in other countries. The remarkable ice-tunnels observed may be due, he thinks, to the arching up of ice-bridges over crevasses, when these are closed up by the movement of the glacier.

A short discussion followed, devoted chiefly to the theory propounded by the lecturer with regard to the action of glaciers in modifying the surface features of a country.

Prof. Bonney, while allowing that the action supposed undoubtedly makes itself felt in certain cases, doubted the admissibility of a comparison between a plateau region like Spitsbergen and a region of narrow ridges like the Alps. The V-shaped Alpine valleys as a rule follow the lines of dip and strike, just as they do in unglaciated regions, while everywhere evidences of pre-glacial structure are to be found. From what we know of the climate of the Alps before the glacial epoch, we may conclude that in more remote times practically no glaciers existed. The characteristics noted by Sir M. Conway are, he considered, rather to be accounted for by the two distinct disturbances which have operated in the Bernese Oberland. The phenomenon adduced is, therefore, probably not more than a secondary cause in the moulding of the features of a country.

Mr. J. E. Marr doubted whether the side-glacier, shown in Sir M. Conway's diagram as hanging like a tear-drop on the mountain side, could be properly described as cutting back through the mountain wall behind it. It was important to keep clearly in view that the wearing-back process, even in the case of glaciers, was really due to the action of the weather at their head.

Sir Erasmus Ommanney expressed his high appreciation of the work done by Sir M. Conway and Mr. Garwood, and of the manner in which the results had been presented.

Dr. J. W. Gregory agreed in the main with Prof. Bonney, holding that though the phenomenon alluded to was no doubt a true cause, it was very uncertain whether it were a primary one.

Sir Henry Howorth considered that Sir M. Conway's theory had at least this in its favour—that it was consistent both with the laws of physics and of ice. He called attention to the change of climate which Spitsbergen has undergone in recent geological times, and to the fact of its belonging to the area of land rising in level around the North Pole.

THE LAKE SUPERIOR IRON ORE REGION.

AT the present time the conditions and prospects of American competition in the iron trade call for very serious consideration. The aggregate value of iron and steel exported from the United States to Great Britain and the continent is now considerable, the official figures for the first nine months of 1897 giving a value of 45,693,000 dollars, as compared with 34,549,000 dollars for the corresponding period of 1896. With this increase in the exports, there was a decrease in the imports from 16,361,000 dollars in the first nine months of 1896 to 10,032,000 dollars in the corresponding period of 1897. The rapidly increasing intensity of American competition is thus apparent. The exportation of iron and steel is not a result merely of depressed conditions in the United States, but of lower cost of production, brought about by enforced economy in labour, by the great discoveries of cheaply worked ore, and by the increased

efficiency of the mining and metallurgical plant in use. Undoubtedly the greatest advantage possessed by the United States is that in the Lake Superior region they have the most extensive supplies of cheap and rich iron ores known to exist. It is to the sudden development and unparalleled richness of these deposits that the United States chiefly owe their cheap pig iron. It is, therefore, a matter of extreme satisfaction that an authoritative description of these deposits has been prepared by Mr. Horace V. Winchell for English readers in the form of an admirably illustrated monograph,[1] covering seventy pages of the *Transactions* of the Federated Institution of Mining Engineers, and dealing with the history, geography, geology, and mining industry of the iron-ore region. Only forty years have elapsed since the first regular mining of iron ore was begun in the district, and during that time up to January 1, 1897, the total output was as follows :—

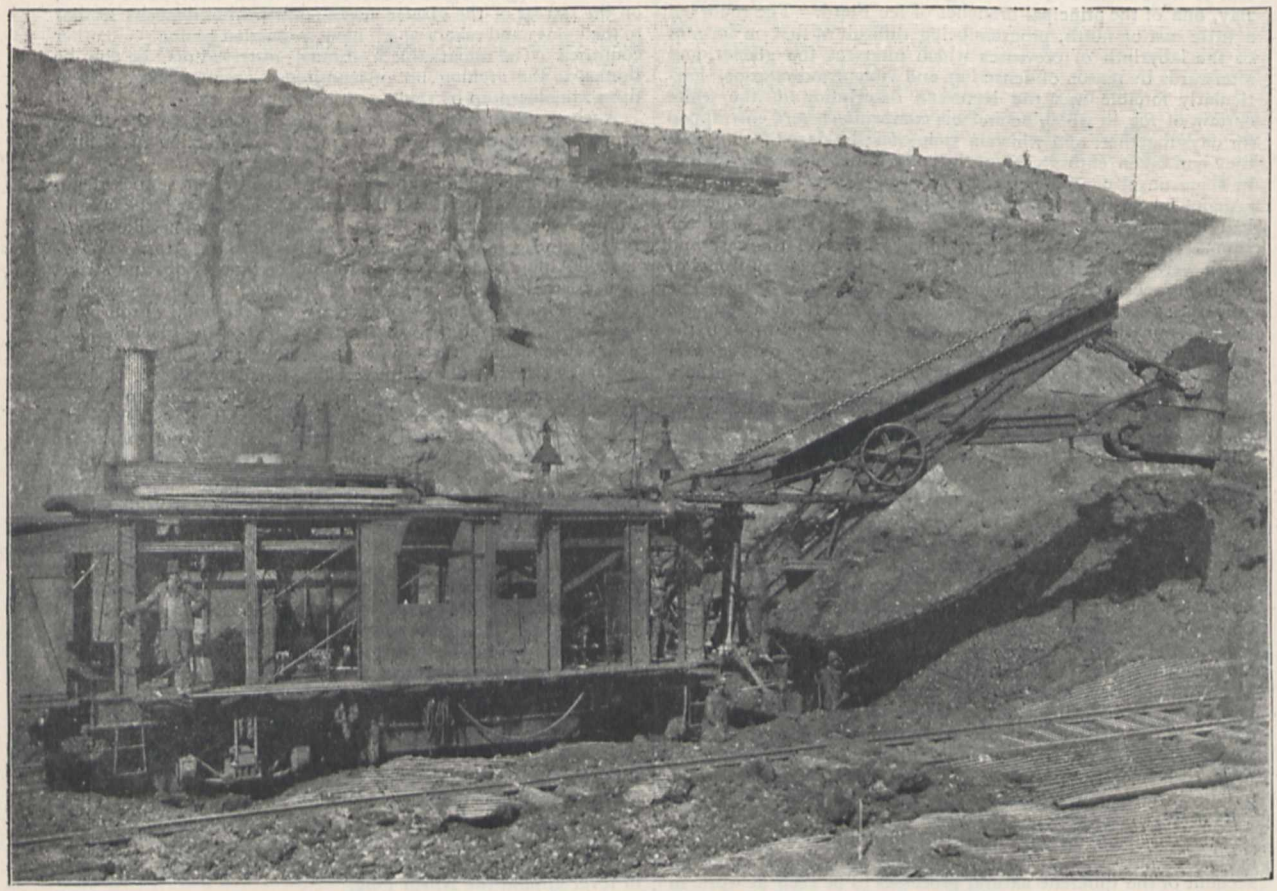
Range.	First year.	Tons.
Marquette ...	1856 ...	46,538,187
Menominee ...	1880 ...	22,994,428
Gogebic ...	1884 ...	20,788,787
Vermilion ...	1884 ...	9,220,235
Mesabi ...	1892 ...	8,074,583
Miscellaneous ...	... ...	2,320
Total production to date ...		107,618,540

According to the official statistics, the production in 1896 was as follows :—

Range.	Tons.	Per cent. of total.
Mesabi ...	3,082,973 ...	29·18
Marquette ...	2,418,846 ...	22·89
Gogebic ...	2,100,398 ...	19·88
Menominee ...	1,763,235 ...	16·69
Vermilion ...	1,200,907 ...	11·36
Total ...	10,566,359 ...	100·00

The iron-ore belts or ranges are situated chiefly in the States of Michigan and Minnesota. The beds occur in rocks of pre-Silurian, and probably of pre-Cambrian age, the determination of the geological age resting wholly on structural evidence. As to the genesis of the ores, there has been much speculation. The principal theories are (1) the obsolete one that the ores are of eruptive origin ; (2) that they are mechanical sediments ; and (3) that they are of chemical origin. Under the third head, the chemical action may have been that of original precipitation, or that of replacement or segregation of chemical or clastic materials by the substitution of iron oxides. Mr. Winchell inclines to the theory of oceanic precipitation advanced by him in 1889. He considers, however, that there is no reason to suppose that all the iron-ore deposits were formed in the same way.

From an engineering point of view, the Lake Superior region is remarkable for the manner in which labour-saving appliances are adopted for extracting the iron ore and for loading it into railway waggons and vessels. The result being that at the present time the mining cost is much below that at any previous period. Thus in 1890, when the Iron and Steel Institute visited the Lake Superior iron mines, the average cost of mining was 5*s.* per ton. At the present time it is 2*s.* 6*d.* per ton. In most cases the methods of mining adopted are those usual in under-



Oliver Iron Mine, showing a face of ore 50 feet high.

[1] "The Lake Superior Iron-ore Region." By Horace V. Winchell. (Excerpt from the *Transactions* of the Federated Institution of Mining Engineers, 1897.)

ground mines. On the Mesabi range, however, some of the largest mines are worked as open quarries, the ore being obtained by steam shovels at a cost of 7½*d.* per ton. The accompanying illustration shows the steam-shovel method of mining at the Oliver Mine on the Mesabi range. The face of iron ore is 50 feet high, and the 90-ton steam-shovel with a 2¾ cubic yard digger shown, is capable of loading 500 tons of ore per hour. It is difficult to over-estimate the value to the United States of the discovery of ore in the Mesabi Range. A producer for only four seasons, this district has in sight to-day nearly 400,000,000 tons of better ore than the average used in the United States, and perhaps 200,000 tons of ore containing 60 per cent. of iron, 0·06 per cent. of phosphorus, and 10 per cent of moisture. Indeed, Mr. Winchell thinks that it is not unreasonable to assert that the range will produce 500,000,000 tons of ore before it is abandoned.

At the present time the cost of a ton of Mesabi ore laid down at a Lake Erie dock is made up of the following items :—

	s.	*d.*		*s.*	*d.*
Royalty	0	0	to	1	5½
Mining cost	0	7½	to	3	1½
Railway freight	1	4	to	4	2
Lake freight	2	6	to	3	4
Insurance, commission, and loss ...	0	2½	to	0	10
Totals	4	8		12	11

There is probably no mine which has all the minimum costs, and it is evident that prices may go still lower without shutting up enough mines to produce a scarcity of ore. Mr. Winchell appends to his valuable paper a carefully compiled bibliography, tables of analyses, and statistics of shipments for the past forty-one years. BENNETT H. BROUGH.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following is the speech delivered on March 10 by the Public Orator, Dr. Sandys, in presenting, for the honorary degree of Doctor in Science, Prof. Wilhelm Pfeffer of Leipzig, Croonian Lecturer of the Royal Society, 1898 :—

Veris adventu iam propinquo, dum terra gaudet, dum caelum avet nitescere, et arbores frondescere, nihil auspicatius ducimus quam veris quasi praenuntium quendam trans maria advectum verbis bene ominatis salutare. Salutamus praeceptorem insignem, qui rerum naturae pulcherrimam nactus provinciam, discipulos ex omni orbis terrarum parte affluentes docet, qua lege lilia crocique calyces suos explicent ; quo admonitu flores, alii solis calore, alii solis lumine adducti, se aperiant ; arte quali *mimosa* tactum etiam mollissimum reformidet frondesque teneras in sese contrahat ; artificio quam admirabili etiam vites, natura caducae, claviculis suis adminicula quaedam tamquam manibus complectantur, et quasi animantes a terra sese altius erigant. Quam dilucide demonstrat, quicquid terra gignit, secundum ea quorum in medio vivit, velut ipsos animantes, naturam suam sensim variare ac mutare. Idem neque per membranam tenuissimam aquae sorbendae rationem, quae *osmosis* dicitur, neque cellularum motum, qui *chemotaxis* nuncupatur, inexploratum reliquit. Etiam animalium minutissimorum quae *bacteria* nominantur motus varios quam subtiliter moderatur, et in ipsum exitium quam insidiose pellicit. Nuper a Societate Regia Londinensi in Britanniam vocatus, propediem (nisi fallor) ostendet, in eis rebus quas terra gignit, quinam sit ipse motus fons et origo ; quo potissimum modo sucus ipse quem e terra trahunt, spiritus ipse quem e caelo hauriunt, quasi vim quandam mittat liberam, unde motuum inter se diversorum varietas tam magna exoriatur. Quid est in his omnibus, Academici, (ut Ciceronis utar verbis) "quid est, in quo non naturae ratio intellegentis appareat"?

Praesento vobis scientiae botanicae praeceptorem illustrem, Professorem Lipsiensem, WILLELMUM PFEFFER.

MR. WILLIAM HOULDSWORTH, Rozelle, Ayr, has just intimated his intention of presenting to the University of Glasgow a sum of 5600*l.*, so invested as to yield an annual income of 150*l.*, in order to endow a research studentship in connection with the Faculty of Science. The sum of 120*l.* is to be paid annually to the research student on the foundation, the remainder to be used to defray laboratory expenses and materials in connection with his work, and the fees of such science classes as he may attend. To be eligible for appointment candidates must have studied at least two years in the University of Glasgow, and the appointment is to be made in the manner laid down by the ordinance regarding research students and fellows. The period of tenure is to be two years, during which the holder must prosecute research studies in the Natural Philosophy department with diligence and regularity. Mr. Houldsworth has taken this method of showing his interest in the welfare of the University and the advancement of science, and his recognition of the distinguished services rendered to scientific research by Lord Kelvin during a professorship of fifty years.

THE London University Commission Bill passed through Committee of the House of Lords on Thursday last. The Duke of Devonshire announced that the names of the Commissioners were the same as those in the Bill of last year with one exception, and were as follows :—Lord Davey (chairman), the Bishop of London, Sir William Roberts, Sir Owen Roberts, Prof. Jebb, M.P., Prof. Michael Foster, and Mr. E. H. Busk (chairman of Convocation). It was agreed that the powers of the Commissioners should continue till the end of 1899 instead of 1898. With the object of securing for the Agricultural College of Wye, established by the County Councils of Surrey and Kent, the advantages derivable under the Bill, Lord Stanhope moved an amendment to the clause referring to the powers and duties of the Commissioners, and he was supported by Lord Ashcombe and Lord Thring. The amendment was not pressed on a promise being given by the Duke of Devonshire that if it were found to be possible without injuriously disturbing the compromise embodied in the Bill he would endeavour on the report to insert words to meet the claims of Wye College.

REPLYING to a question asked by Lord Norton in the House of Lords on Thursday last, the Duke of Devonshire said he hoped the Bill of the Government relating to secondary education would be introduced after Easter. He added : "It is not, and never has been, the intention of the Government to do anything in the nature of what may be called establishing secondary education all over the country. Any measure which we propose will be solely for the purpose of organising in a better way that which already exists, and, possibly, for supplementing it to a certain extent. That what is being done by county authorities, or municipal bodies, or private individuals is something to be done by the Government, is not an idea which has ever been entertained by the Government. No doubt a certain amount of the 800,000*l.* which has been given to be principally expended on technical education may have been at the outset misapplied, and perhaps a certain portion of it has been wasted ; but, on the other hand, I believe that a very large portion of it is now being most usefully employed, and with very great advantage, to the various localities. It is not dependent entirely upon the will and pleasure of the County Councils. Almost every County Council has, for the purpose of administering this grant, established an educational committee, which does not usually consist solely of members of the County Council, or need not consist solely of members of County Councils. Those bodies are gradually acquiring a great deal of experience, and I believe that in a great many centres they are at present doing very valuable work."

SCIENTIFIC SERIALS.

IN the January number of the *Quarterly Journal of Microscopical Science*, Mr. E. A. Minchin gives a valuable addition to our knowledge of asconid sponge morphology in a paper on the origin and growth of the triradiate and quadriradiate spicules in the family Clathrinidæ. Mr. Minchin here produces full histological evidence of his discovery of the composite origin of these two kinds of spicules ; he shows that the triradiate spicules are formed by trios of dermal cells which immigrate from the epithelium to the interior ; by the division of each cell a sextet is formed, and the spicule appears with each of its rays corresponding to two sister cells of the sextet. With regard to the quadriradiate spicules the three basal rays develop exactly as do the triradiate spicules, but the fourth or gastral ray is secreted by a mother cell derived from a porocyte. The spicules are crystalline as a whole, but the rays are non-crystalline so long as they are distinct from one another, and may remain so for some little time after union has taken place ; the crystallisation appears

to start from the secondary deposit which unites the rays at the centre. Much skill and care have been bestowed on the beautiful drawings illustrating these researches, and they are admirably reproduced in an excellent series of plates.—Prof. MacBride, in a paper on the early development of Amphioxus, shows the similarity between the cœlomic chambers of Amphioxus and Balanoglossus, and homologises the metapleural lymph canals of the former with portions of the collar pouches of the latter; in consequence of this he revives Bateson's comparison of the atrial folds of Amphioxus with the posterior collar folds of Balanoglossus.—Mr. Shipley gives an account of a new Tapeworm from a bird in the Sandwich Islands.—Dr. Willey gives the diagnosis of a new genus of Enteropneusta.—Prof. Haswell describes a Turbellarian from deep wells in New Zealand.—Prof. Ray Lankester, in a note on the development of the atrial chamber of Amphioxus, corrects Prof. MacBride's statements with regard to the well-known researches by himself and Dr. Willey on the development of the atrial chamber.

Bulletin of the American Mathematical Society, February.—The number opens with an account of the fourth annual meeting of the Society on December 29, 1897. After the election of the new Council—Prof. S. Newcomb being re-elected President—eleven papers were presented; of some of these abstracts are given, and the journals in which they have appeared, or will appear, are named.—Prof. Woodward's paper on the differential equations defining the Laplacian distribution of density, pressure, and acceleration of gravity in the earth presents an improved mathematical method for the treatment of the problem, previous methods being deemed by the author to be lacking in elegance and compactness.—The following are to appear in the *American Journal of Mathematics*—viz. on some points of the theory of functions, by Prof. Chessin; and point-transformation in elliptic coordinates of circles having double contact with a conic, by Dr. Lovett. A second paper by Dr. Lovett, entitled "Certain invariants of a plane quadrangle by projective transformation," will be published in the *Annals of Mathematics*. It is a contribution to the theory of a system of 4-coplanar points, and shows among other things how the group theory may be made to yield the details of elementary geometry.—Prof. Newcomb's presidential address, given *in extenso*, treats of the philosophy of hyperspace. "There is a region of mathematical thought," he remarks, "which might be called the fairyland of geometry. The geometer here disports himself in a way which, to the non-mathematical thinker, suggests the wild flight of an unbridled imagination rather than the sober sequence of mathematical demonstration." He defines his hyperspace as being, in general, space in which the axioms of the Euclidean geometry are not true and complete. Curved space and space of four or more dimensions are completely distinct in their characteristics, and must therefore be treated separately. Prof. Newcomb's views have already been stated in our columns, and the present address is an interesting sequel to them up to date.—Another of the papers, viz. orthogonal group in a Galois field, by Dr. L. E. Dickson, is also given here. The term *orthogonal*, in the present connection, is defined, and a remark of Jordan's shown to be not exact (*Traité des Substitutions*, p. 169, *ll.* 18–21).—We can merely mention that the second meeting of the Chicago Section was held on December 30 and 31, 1897, at which twenty-one papers were read. Brief abstracts are given. From the *Notes* we learn that in the year 1897 the membership of the Society increased from 280 to 301, and the total number of papers read was 88!

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 27.—"On the Zoological Evidence for the Connection of Lake Tanganyika with the Sea." By J. E. S. Moore, A.R.C.S.

The results of the morphological examination of the animals obtained during the author's recent expedition to Lake Tanganyika have made it evident that the fauna of this lake must be regarded as a double series, each half of which is entirely distinct in origin and nature from the other. The remarkable Molluscan shells which were brought home by Burton and Speke, form but a small part of the Molluscan section of the more abnormal of these fresh-water stocks. Besides Molluscs, the lake was found to contain fishes, Crustacea, Cœlenterata, and Protozoa, all of which, like Speke's shells, present the most curious marine affinities, and for distinctive purposes the individual members of this unique assemblage of quasi-marine fresh-water organisms are described as members of the Halolimnic group.

The distribution of the aquatic faunas occurring in Lakes Shirwa, Nyanza, Kela and Tanganyika, all of which were visited and dredged during the expedition, shows (together with what is already known respecting the Victoria Nyanza and the more northern lakes) that the Halolimnic animals are exclusively restricted to Tanganyika. It is thus rendered inconceivable that the Halolimnic forms can have arisen through the effect of ordinary conditions operating upon the population which the lake originally possessed. For the same reasons, it becomes equally clear that the Halolimnic animals cannot be regarded as the survivors of an old fresh-water stock. Since, if we accept either of these suppositions, we are bound by the facts of distribution to believe, also, that the Halolimnic animals have been destroyed in every African lake but one; a supposition which may be ingenious, but which, when the number of lakes existing in the African interior is fully realised, becomes grotesque.

Apart from the physical difficulties which the present effluent of Tanganyika presents to the ingress of organisms from the sea, it is impossible to regard the Halolimnic forms as having recently transmigrated thither from the ocean, since none of these animals are exactly similar to any marine organisms at present known. They must, therefore, have been in Tanganyika long enough to modify into their present condition from the living oceanic species which we know, or they retain the characters of a sea-fauna that has elsewhere become extinct.

The delicate nature of the lake Medusæ, and the fact that most of the Halolimnic Molluscs are exclusively deep-water forms, renders it impossible that these organisms can have made their way into Tanganyika at any time under the physical conditions which now exist.

The facts of distribution and the general characters of these forms, as well as the geographical conditions of the lake in which they are now found, lead then to the conclusion that the Tanganyika region of Central Africa must have approximated to a deep arm of the sea in ancient times.

This view is finally confirmed by the details of the anatomy of the Halolimnic animals themselves. For some of the individual Molluscs of this group combine the characters of several of the most modern marine genera. The Halolimnic fauna of Tanganyika, therefore, cannot represent an extinct fresh-water stock, since the characteristic fresh-water organisms of the present day (which would in such a case have to be regarded as their linear descendants) possess the anatomy of vastly older types.

To the Halolimnic animals there thus attaches the unique interest that they themselves constitute the few surviving indications of an old sea which once extended far into the African interior, and which, judging from the characters of the animals it left behind, must have retained its connection with the ocean at least as late as Tertiary times.

These conclusions, it will be observed, are directly in opposition to the views which were originated by Murchison, and which depict the African interior as never having been below the sea at least since the New Red Sandstone age.

February 17.—"On the Magnetic Deformation of Nickel." By E. Taylor Jones, D.Sc.

The experiments were made with a view to further testing a result arrived at on a former occasion by the author, viz. that the magnetic contraction of a long nickel wire was approximately proportional, when allowance was made for the effects of Kirchhoff's system of stresses, to the fourth power of the magnetisation.

In order to vary, if possible, the conditions of the experiments some preliminary measurements were made to find out whether temperature had any marked influence on the magnetic contraction. The temperature of the specimen was raised by allowing warm water to flow through the water-jacket of the magnetising coil. It was found that at low field-strengths (up to about 90 C.G.S.) the magnetic contraction was greater at 56° C. than at 19° C.; at higher fields the contraction was greater at the lower temperature, the difference being about 6 per cent. at the field 330 C.G.S.

Repeated measurements showed that the contraction at any

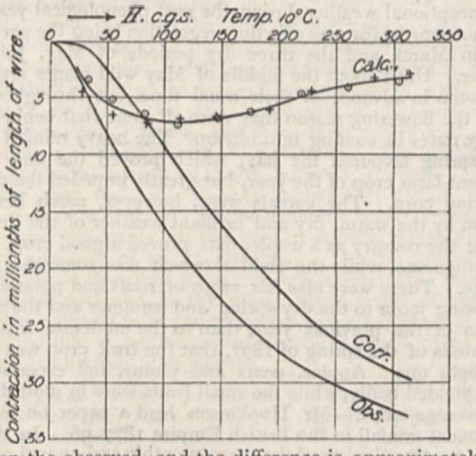
temperature and field was not constant, but diminished as time went on. In order to eliminate this effect as far as possible the subsequent measurements were made in the following order:—

(1) The change of magnetisation accompanying a certain increase of tension, and the magnetisation at the mean tension (at 10° C. and 55° C.).

(2) The magnetic contraction at the mean tension (at 10° C. and 55° C.).

(3) The measurements of (1) repeated.

(4) The magnetic contraction at 10° C. Values of the expression deduced from Kirchhoff's theory were calculated from (1) and (3) for both temperatures, and the mean compared with the observed contraction (2). The results are shown (for 10° C.) in the accompanying diagram. The calculated contraction is much



less than the observed, and the difference is approximately proportional to the *sixth* power of the magnetisation. A similar result was obtained by comparing the mean observed contraction at 10° C. (2) and (4), with the calculated value deduced from (3). All the quantities measured showed a diminution as time went on, especially the influence of tension on magnetisation at low fields. The calculated values of the contraction deduced from (1) are indicated in the diagram by the points + + + . . .; those deduced from (3) by the points ⊙ ⊙ ⊙ . . . At the field 275 C.G.S. the magnetic contraction was about 16 per cent. less than it was four months earlier.

Physical Society, March 11.—Mr. Shelford Bidwell, President, in the chair.—Prof. J. D. Everett gave a communication on dynamical illustrations of certain optical phenomena. The first part of the paper deals with the properties of a series of equal particles attached at equal intervals to an uniform stretched elastic weightless string. Their free simple-harmonic modes of wave-motion are first investigated. The highest frequency occurs when the wave-length is double that of the common distance a. As the wave-length increases from $2a$ to infinity, or diminishes from $2a$ to a, the frequency tends to zero. To every wave-length λ_1 between $2a$ and infinity, there corresponds a wave-length λ_2 between $2a$ and a, such that $a/\lambda_1 + a/\lambda_2 = 1$. The frequency is the same for λ_2 as for λ_1. Further examination shows that the difference of wave-length between these two solutions is only apparent, and that, so far as the movements of the particles are concerned, waves of length λ_1 travelling in one direction, are identical with waves of length λ_2 travelling in the opposite direction. The same is true if $a/\lambda_1 + a/\lambda_2$, instead of being unity, is equal to any integer. On the other hand, if the difference between a/λ_1 and a/λ_2 is an integer, the two sets of waves travel in the same direction. Any simple-harmonic wave-motion of the system of particles may thus be regarded as having any one of an infinite number of wave-lengths. When one particle of the system is constrained to a S.H. motion, of frequency not exceeding that which corresponds to $\lambda = 2a$, the whole system will ultimately vibrate in equal waves. When the frequency of the constrained particle exceeds that due to $\lambda = 2a$, the ultimate state will be S.H. motion with exact opposition of phase between successive particles. The simultaneous displacements of the particles at any instant, as we travel away from the constrained particle in either direction, form a diminishing geometrical progression with signs alternately plus and minus. Expressions are investigated for the constraining force and for the ratio of the energy of the system (consisting of an unlimited number of particles) to the energy of the constrained particle. The second part of the paper deals with pendulums. (1) Sympathetic pendulums, such as two equal pendulums suspended from the same support. (2) Double pendulums, *i.e.* one simple pendulum suspended from another. In each case the investigation consists in seeking a mode of vibration in which the two bobs have either identical or opposite phases, so that their displacements are in a constant ratio, positive or negative. In every case there are two such modes, one with a positive and the other with a negative ratio. As regards the sympathetic pendulums: when they are equal in mass and length, the periods for the two modes are approximately equal, and the displacement of each pendulum follows the law of a "curve of beats," the excursions are largest for one pendulum when they are smallest for the other. As regards the double pendulum: when the lower mass is much less than the upper, there exist, in like manner, motions following the law of beats, provided that, to start with, one bob is at rest in the zero position, and the other at rest in an extreme position. If the lengths of the two strings are decidedly unequal, one fundamental mode has approximately the period of the upper, and the other the period of the lower pendulum. In the former, the displacements of the two bobs are comparable; in the latter, the displacement of the upper is small compared with the lower. The bearing of these conclusions is pointed out, first, on Lord Kelvin's conclusions respecting a suspended clock; and, secondly, on Lord Rayleigh's assertion (frequently quoted in connection with anomalous dispersion) respecting the influence on a heavy pendulum of a much lighter one suspended from it. To obtain the phenomenon of beats in perfection, the upper string must be slightly longer than the lower, and the ratio of *difference* to *sum* of lengths must equal the ratio of lower mass to upper. The beats thus obtained explain the experiment described in the second edition of "Rayleigh on Sound," § 62. Sellmeier's application of the beats of double pendulums to explain fluorescence is briefly described. Stokes explains fluorescence by the analogy of the chain of equal particles discussed in the first part of the paper. Forced vibrations quicker than the critical frequency are produced by the action of the vibrating ether on the fluorescent body; and when the body is left to itself, its subsequent motion is made up of S.H. components, all of which are below the critical frequency.—Prof. R. A. Lehfeldt then read a paper on the properties of liquid mixtures. In a previous communication (*Phil. Mag.* 5, vol. xl. p. 398) the author followed out the consequences of a certain thermodynamic relation between the composition of a liquid mixture and that of the vapour in equilibrium with it, and the saturation-pressure of the system. More stable compounds are now chosen, viz. benzene and toluene mixed with carbon tetrachloride, as types of normal organic compounds; and benzene and toluene mixed with ethyl alcohol as types of a so-called "associated" liquid. These experiments have been carried out in the Davy-Faraday laboratory. The measurements come under two distinct groups: (1) vapour-pressure, (2) composition of vapour. They were made separately, on material from the same source, prepared identically. To measure the vapour-pressure of the mixtures, the "dynamic" method was adopted. An experiment consists in weighing out a mixture, taking its refractive-index by a Pulfrich refractometer, placing it in a boiling tube, and after adjusting temperature and pressure, taking observations at different temperatures on a rising scale, and then on a falling scale. The refractive-index of the residue is again measured; this is always used for checking the composition of the mixtures. For determining the composition of the vapour over liquid mixtures, the method used is to distil a little of the mixture and analyse the distillate. The apparatus is arranged so that the distillate can be drawn off by a tap, as required. The author criticises the results of Linebarger (*Jour. Amer. Chem. Soc.*, vol. xvii.), and also those of Margules (*Wien. Ber.*, vol. civ.). Linebarger states that the partial pressure of benzene and toluene in mixtures, is simply proportional to the molecular percentage present. This conclusion, the author considers, is only roughly true; the partial pressure of the hydro-carbon vapour is not necessarily linear in mixtures; hence, the rule proposed by Linebarger for determining the molecular weight is incorrect.—The President proposed votes of thanks to the authors, and the meeting was adjourned until March 25.

Chemical Society, March 3.—Prof. Dewar, President, in the chair.—The following papers were read :—Preparation of anhydrous hydrogen cyanide and carbon monoxide, by J. Wade and L. C. Panting. On dropping a mixture of equal volumes of sulphuric acid and water on to 98 per cent. potassium cyanide, hydrogen cyanide is evolved in nearly theoretical amount ; with concentrated sulphuric acid, nearly pure carbon monoxide is evolved in almost theoretical quantity.—Preparation of some nitro- and amido-oxylutidines, by J. N. Collie and T. Tickle. The authors have prepared mononitro- and monamido-derivatives of pseudolutidostyril and ethylic pseudolutidostyrilcarboxylate by the ordinary methods.—Production of some nitro- and amido-oxylutidines. Part ii., by Miss L. Hall and J. N. Collie. Nitrolutidone is obtained by nitrating lutidone with a mixture of nitric and sulphuric acids ; the platinichloride of amidolutidone, when warmed with hydrochloric acid, seems to yield a salt of propine diamine, $CMe(NH_2) : CH(NH_2)$.—On benzene hexabromide, by F. E. Matthews. The author was unable to prepare the second benzene hexabromide described by Orndorff and Howells, and could not prepare either the hexachloride or hexabromide of bromobenzene.—Note on the action of bromine on benzene, by J. N. Collie and C. C. Frye. The authors have succeeded in proving the presence of ortho-compounds in the product of the action of bromine on benzene in presence of sunlight.—Note on manganic salts, by C. E. Rice. The author shows that the decomposition of manganic chloride in solution into manganous chloride and chlorine is reversible.—Some chemical properties of concentrated solutions of certain salts. Part i. Potassium carbonate, by W. C. Reynolds. By crystallising a concentrated solution of potassium carbonate containing the chloride, nitrate, or acetate of various metals, the author has obtained crystalline double salts of the following compositions : $CuK_2(CO_3)_2$, $CuK_2(CO_3)_2,H_2O$, $CuK_2(CO_3)_2,4H_2O$, $MnK_2(CO_3)_2$, $4H_2O$, $FeK_2(CO_3)_2$, $4H_2O$, $CaK_2(CO_3)_2$, $Bi_2OK_4(CO_3)_4,H_2O$, $CoK_2(CO_3)_2,4H_2O$, $NiK_2(CO_3)_2,4H_2O$, $MgK_2(CO_3)_2,4H_2O$, and $AgKCO_3$.—The colouring matters of the Indian dye-stuff *Delphinium zalil*, by A. G. Perkin and J. A. Pilgrim. The dried flowers and stems of *Delphinium zalil* are used in India under the name of "asbarg" for producing a yellow colour on alum-mordanted fabrics. Three colouring matters exist as glucosides in the plant, namely isorhamnetin, quercetin, and a third which was not obtained pure.—Some metallic salts of natural yellow colouring matters, by A. G. Perkin and P. J. Wood. Quercetin, morin, fisetin and myricetin decompose potassium acetate in alcoholic solution with formation of sparingly soluble metallic derivatives ; luteolin, apigenin, chrysin and gentisin do not do so.—The interaction of magnesium and solution of copper sulphate, by E. Divers.

Royal Microscopical Society, February 16.—Mr. A. D. Michael, Vice-President, in the chair.—Mr. J. E. Barnard said that when he gave his demonstration at the November meeting, on the application of the electric arc to photomicography, Mr. Nelson suggested that it would be of interest if he would show some lantern slides taken in that way ; he had accordingly brought a few examples for exhibition on the screen. These included a series showing ringworm fungi, which he thought would have some interest apart from the method by which the photographs had been produced. A number of slides were then shown, illustrating the appearance of the fungi in various stages and under conditions in which the external portions, or internal structure of the hair of man and animals had been attacked, and their appearance when cultivated artificially. The photographs were from microscopical preparations lent by Dr. T. Colcott Fox. Other slides were shown of the bacilli of anthrax, tuberculosis, typhoid fever, bubonic plague, &c. Dr. Hebb concluded some remarks by saying that he did not know that he had ever seen these subjects so beautifully illustrated as he had that evening. Mr. T. Charters White said he could endorse all that fell from Dr. Hebb. For high amplification he did not know that he had seen anything so sharply defined, especially in the case of the Podura scale magnified 6000 diameters. The Chairman said no one could fail to be struck by the clear manner in which these minute objects had been shown. [Two of the pictures, with a short account of the light used in their production, have already appeared in these columns (p. 448). —Mr. T. Charters White read a paper on microcrystallography, which he illustrated by the exhibition on the screen of a number of slides of the crystals described. He had selected them to show how large a number of beautiful forms might be obtained from the same salt by causing it to crystallise under different conditions. Mr. White further illustrated the subject by exhibiting the formation of crystals under the microscope. The Chairman thought it quite possible that when they came to examine these crystals very carefully they would find that the ultimate form did, after all, agree with the typical form, but it was remarkable to see how other forces could modify these forms.—The Chairman said they had another paper on the agenda, on Foraminifera taken chiefly from shallow water in the Malay Archipelago, by Mr. Durrand.

Royal Meteorological Society, February 16.—Mr. F. Campbell Bayard, President, in the chair.—Mr. E. Mawley gave a report on the phenological observations for 1897, from which it appeared that there had been a marked absence of very exceptional weather during the past phenological year, the most noteworthy features affecting vegetation being the persistent rains in March and the three dry periods of May, July and October. Until about the middle of May wild plants appeared in blossom in advance of their usual time, but throughout the rest of the flowering season they were all somewhat behind their average dates in coming into bloom. The heavy rainfall in the early spring favoured the hay, which proved the only really abundant farm crop of the year, but greatly impeded the sowing of spring corn. The cereals were, however, much benefited later on by the warm, dry and brilliant weather of the summer. Taking the country as a whole, oats proved a good crop, barley an average one, while the yield of wheat was somewhat under average. There were also fair crops of roots and potatoes. It was owing more to the dry spring and summer and the sunless autumn of the previous year, than to the moderate frosts and cold winds of the spring of 1897, that the fruit crop was such a very light one. Apples, pears and plums, and especially the latter, yielded badly, while the small fruits were in most districts only average crops.—Mr. Hopkinson read a paper on monthly and annual rainfall in the British Empire 1877-96. In this the author gave particulars of the mean monthly and annual rainfall, and the number of rainy days, at the following twelve stations in the British Empire, viz. London, England ; Port Louis, Mauritius, Calcutta and Bombay, India ; Colombo, Ceylon ; Adelaide and Melbourne, Australia ; Wellington, New Zealand ; Toronto and Winnipeg, Canada ; Kingston, Jamaica ; and Malta.

Linnean Society, February 17.—Dr. A. C. L. Günther, F.R.S., President, in the chair.—Dr. Kakichi Mitsukuri, Professor of Zoology, Imperial University, Tokyo, was admitted a Foreign Member.—Prof. G. B. Howes, F.R.S., exhibited specimens of Dog-fishes : (1) *Scyllium canicula* from the egg-case, and (2) *Scyllium catulus* prematurely hatched, which he had received from Mr. C. W. L. Holt, of the Marine Biological Laboratory at Plymouth. The specimens showed the dorso-lateral and caudal placoids which led Filippi to propose the species *Scyllium acanthonotum*, shown by Dr. Günther to be based upon a developmental character, and had in recent years been the subject of some interesting speculations by Paul Meyer. For comparison he exhibited also an embryo from the purse of *Callorhynchus antarcticus*, showing a similar set of organs, and gave reasons for surmising that they are not merely transitory vestiges, but of service to the animal while encapsulated within its egg-case. Some additional remarks were made by the President.—Mr. J. E. Harting exhibited a nearly white variety of *Mus rattus* recently obtained in Carnarvonshire, and made some remarks on the difference of haunts and habits in the two species *M. rattus* and *M. decumanus*, and on their usual antagonism. In reply to Mr. H. J. Elwes on the question of occasional hybridism, he stated that no well-established case of the kind had been recorded, although some years ago Mr. Barrett Hamilton had described (*Zool.*, 1888, p. 141) a suspected hybrid which was partly brown in colour, partly black, and exhibited some other intermediate characters. He referred to the so-called Irish rat, *Mus hibernicus* of Thompson, which was now regarded as a permanent black variety of *Mus decumanus* not confined to Ireland.—Mr. F. N. Williams read a paper on *Arenaria*, one of the larger genera of Caryophyllaceæ, which now includes a considerable number of species. *Alsine* and others, usually included as sections of the genus, he thought should be regarded as distinct genera ; *Alsine* and *Arenaria* being distinguished by the same cardinal character which separates *Lychnis* from *Silene*.—Mr. G. S. West read a paper on the histology of the salivary, buccal, and Harderian glands of the *Colubridæ*, with notes on their tooth-succession and the relationship of the poison-duct.

Geological Society, February 23.—W. Whitaker, F.R.S., President, in the chair.—On some submerged rock-valleys in South Wales, Devon, and Cornwall, by T. Codrington. The author described various valleys in which the solid rock was reached at a considerable depth below sea-level, on the sides of Milford Haven and in the Haven itself; beneath the Tivy, Tawe, and Neath, the Wye, the Severn, the Bristol Avon, the Dart, the Laira, the Tavy, the Tamar, and other rivers. In the case of the Dart the rock-bottom had been found at one place at a depth of 110 feet below low-water level, and in the case of other rivers at varying depths less than this. The deposits showed that some of the infilling took place after the period of submerged forests, and much before this, for frequent cases of glacial deposits filling the bottoms of these submerged valleys were recorded. The fact that in the Solent and Thames the glacial deposits bordered the sides of the valleys, and did not occur at the bottom as in the case of the valleys described in the paper, indicated that the latter were older than the former, though they presented features similar to those of some of the valleys of the North-east and North-west of England.—Some new carboniferous plants, and how they contributed to the formation of coal-seams, by W. S. Gresley. The author, in a paper published in abstract in the Society's *Quarterly Journal* for May 1897 (vol. liii. p. 245), argued that certain brilliant black laminæ in coal, and similar materials found among some mechanical sediments of the coal measures, pointed to the former existence of an aquatic plant. In the present communication he described structures in the pitch-coal laminæ of bituminous coal and in the glossy black layers of anthracite which he believed to be indications of two other kinds of plants, and stated that he had examined structures which might be due to some other kinds of vegetation.

Zoological Society, March 1.—Dr. W. T. Blanford, F.R.S., in the chair.—Mr. G. A. Boulenger, F.R.S., exhibited, and made remarks upon, a living hybrid newt, the result of a cross between specimens of a hybrid *Molge cristata* × *M. marmorata* and the former species, which had been reared at Argenton-sur-Creux by M. R. Rollinat.—Mr. F. E. Beddard, F.R.S., read a paper on certain points in the anatomy of the cunning Bassarisc (*Bassariscus astutus*), as observed while dissecting a specimen which had died in the Society's menagerie, and called special attention to certain points in the viscera and in the form of the brain in which *Bassariscus* agreed with the arctoid carnivora.—Mr. G. A. Boulenger, F.R.S., read a paper entitled "a revision of the African and Syrian fishes of the family *Cichlidæ*, part I." The author had come to the conclusion that the African and Syrian fishes of this family were, so far as was known, represented by nine genera.—A communication was read from Prof. B. C. A. Windle and Mr. F. G. Parsons containing the second part of a memoir on the myology of the terrestrial carnivora. The present portion dealt with the muscles of the hind limb and the trunk in various species, which, in many cases, seemed to give good indications of their affinities.—A communication from Dr. A. G. Butler on the Lepidoptera collected by Mr. G. A. K. Marshall in Natal and Mashonaland in 1895 and 1897 was read.

PARIS.

Academy of Sciences, March 7.—M. Wolf in the chair.—Chemical actions exerted by the silent discharge. Aldehydes and nitrogen, by M. Berthelot. Mixtures of nitrogen with various substances of aldehyde function, including acetaldehyde, propionic aldehyde, acetone, methylal, aldol, paraldehyde, trioxymethylene, formaldehyde, camphor, benzaldehyde, salicylic aldehyde, and furfurol were submitted to the action of the silent discharge for periods varying from eight to twenty-four hours. The nitrogen absorbed was measured, and the gases produced analysed. The solid and liquid products were not obtained in quantities sufficient for analysis.—Chemical action of the silent discharge. Organic acids and nitrogen, by M. Berthelot. The acids studied were formic, acetic, propionic, crotonic, benzoic, succinic, maleic, fumaric, phthalic, camphoric, glycollic, lactic, malic, tartaric, oxybenzoic, pyruvic, levulic, and dehydracetic acids.—Observations relating to the chemical action of the silent discharge on dielectric liquids, by M. Berthelot. The liquids examined were alcohol, olive oil, and essence of turpentine. Alcohol gave a mixture of hydrogen and ethane.—Action of calcium sulphate upon some haloid salts of the alkalies, by M. A. Ditte. A study of the equilibrium produced in aqueous solutions containing calcium sulphate, and varying proportions of alkaline chlorides, bromides, and iodides.—On the number and symmetry of the fibro-vascular bundles of the petiole as a measure of the perfection of vegetable species, by M. A. Chatin.—On the results given by a seismograph installed at Grenoble, by M. M. Lévy. The slight earthquake shock noticed in the valley of the Po on March 4, was clearly shown on the seismographs (Kilian and Paulin, Angot) at Grenoble.—On the absorptive power of lampblack for radiant heat, by MM. Crova and Compan. It is usually assumed that for a given flux of radiant energy the absorptive power of a layer of lampblack is equal to unity. This, however, is not necessarily the case, the coefficient of absorption varying between narrow limits according to the nature of the deposit and its mode of application. A layer of black, applied in the ordinary way, may have an absorptive power as low as 0·9. The application of several layers, each washed with alcohol and then dried, gives a more complete absorption, the coefficient after some six deposits, rising to ·98. Fewer deposits of platinum black are required to reach the same limit.—Report on a memoir of M. Gonnessiat, entitled "Researches on the law of variations of latitude," by M. Radau.—On the "Histoire celeste du 17^{e} siècle" of Pingré, by M. G. Bigourdan.—Note on the ellipsoid of Jacobi, by M. P. Krüger.—On the determination of the group of rationality of linear differential equations of the fourth order, by M. F. Marotte.—On conjugated congruences of pencils C, by M. C. Guichard.—On the invariants of linear partial differential equations of two independent variables, by M. J. Le Roux.—On a problem of Riemann, by M. Ludwig Schlesinger.—On certain first integrals of some dynamical equations in two variables; application to a particular case of the problem of three bodies, by MM. J. Perchot and W. Ebert.—Researches of precision on the infra-red dispersion of quartz, by M. E. Carvallo. The dispersion was measured by means of a bolometer; the results differ appreciably from those of Mouton, but show a remarkably close agreement with figures calculated by means of an extrapolation formula of Mace de Lépinay, derived from observations in the visible spectrum and ultra-violet.—Influence of soft iron on the mean square of the difference of potential at the extremities of a bobbin traversed by a high-frequency current, by M. H. Pellat.—On the temperature of incandescent lamps, by M. P. Janet. The variation of the resistance of the lamp as a function of the difference of potential at the ends of the filament is measured, and also the variation in the resistance of a cooled lamp as a function of the time. From these, with the weight of the filament, the temperature can be deduced, assuming that the filament is composed of pure carbon. Four lamps gave concordant figures, namely 1610°, 1630°, 1620°, and 1720° C.—Some properties of kathodes placed in a powerful magnetic field, by M. André Broca. The experiments lead to the conclusion that there are two kinds of kathode rays, one of which rotates round the line of force of the magnetic field, and the other which follows this line of force.—Researches on nickel-steel. Variations of volume of irreversible alloys, by M. C. E. Guillaume.—Researches on the magnetic properties of nickel-steel, by M. Eugène Dumont. A determination, in absolute values, of the magnetic permeability of twelve samples of nickel steel containing from 26 to 44 per cent. of nickel, in fields varying from 14 to 50 C.G.S. units, and at temperatures between −78° and 250° C. The results are expressed graphically in three sets of curves.—Preparation of beryllium by electrolysis, by M. P. Lebeau. The pure metal is most conveniently obtained by the electrolysis of the fused double fluoride of sodium and beryllium by a current of six amperes, and potential difference of 35 to 40 volts.—Chemical estimation of carbon monoxide in the air, even in the smallest traces, by M. Maurice Nicloux. The method is based upon the fact that carbon monoxide is oxidised by iodic anhydride at 150°, giving carbonic acid and iodine, the latter, representing the carbonic oxide present, being measured by a colorimetric method.—On the dissociation of the carbides of barium and manganese, by MM. Gin and Leleux. These two carbides, at the highest temperatures of the electric furnace, behave similarly to calcium carbide; not being volatile, but dissociated into the metal and carbon.—Researches on the explosion of mixtures containing marsh gas by electric currents, by MM. H. Couriot and J. Meunier. There is no danger of explosion of mixtures of air and methane, by wires raised to incandescence by an electric current. It is only when the wire melts, and a spark passes, that an explosion is determined.—On the preparation and etherification of asymmetrical dimethylsuccinic acid, by M. E. E.

Blaise.—On the synthetical isoborneols, their identity with fenoilic alcohols, by MM. G. Bouchardat and J. Lafont.—On the partial decomposition of chloroform in the organism, by MM. A. Desgrez and M. Nicloux. A reply to the criticism of M. de Saint-Martin. Normal blood gives on analysis a small proportion of carbon monoxide. This amount is notably increased in the blood of animals under chloroform.—A true mucin produced by a fluorescent pathogenic bacillus, by M. Ch. Lepierre.—Action of the bacterium of sorbose upon polyhydric alcohols, by M. Gabriel Bertrand. Alcohols show very different behaviour when treated with the sorbose bacillus; some, such as glycol, xylite and dulcite, resisting the oxidising action completely; others, glycerine, sorbite, mannite, being readily oxidised to ketones.—Influence of the medium upon variations in the Protozoa, by M. J. Kunstler.—The larva of the sponges and homologation of the leaflets, by M. Yves Delage.—On a new type of Copepod, by M. Jules Bonnier. The new type, to which the name *Pionodesmotes phormosomæ* is given, was found by the Prince of Monaco in one of the scientific voyages of the *Princess Alice*.—On a cereal of the Soudan, by M. Dybowski.—A prehistoric station at Mount Huberville, near Valognes, by M. Le Nordez.

DIARY OF SOCIETIES.

THURSDAY, MARCH 17.

ROYAL SOCIETY, at 4.30.—The Croonian Lecture will be delivered by Prof. Wilhelm Pfeffer, For. Mem. R.S. On the Nature and Significance of Functional Metabolism (Betriebs-stoffwechsels) in the Plant.

ROYAL INSTITUTION, at 3.—Magnetism and Diamagnetism: Prof. J. A. Fleming, F.R.S.

LINNEAN SOCIETY, at 8.—Natural Selection the Cause of Mimetic Resemblance and Common Warning Colours: Prof. E. B. Poulton, F.R.S.—On the Brain of the Edentata, including Chlamydophorus: Dr. Elliott Smith.—On Limnocarpus, a New Genus of Fossil Plants from the Tertiary Deposits of Hampshire: Clement Reid.

CHEMICAL SOCIETY, at 8.—The Reduction of Bromic Acid and the Law of Mass Action: Winifred Judson and Dr. J. Wallace Walker.—The Action of Ferric Chloride on the Ethereal Salts of Ketone Acids:—Dr. R. S. Morell and Dr. J. M. Crofts.—Note on the Volatility of Sulphur: T. C. Porter.—Action of Ammonia and Substituted Ammonias on Acetylurethane: Dr. George Young and Ernest Clark.—Cannabinol: T. B. Wood, W. T. N. Spivey, and Dr T. H. Easterfield.—Formation of Oxytriazoles from Semicarbazides: Dr. G. Young, and B. M. Stockwell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Sixth "James Forrest" Lecture, Geology in Relation to Engineering: Prof. W. Boyd Dawkins, F.R.S.

CAMERA CLUB, at 8.15.—Some Recent Animal Photographs: Gambier Bolton.

FRIDAY, MARCH 18.

ROYAL INSTITUTION, at 9.—The Bringing of Water to Birmingham from the Welsh Mountains: J. Mansergh.

MONDAY, MARCH 21.

SOCIETY OF ARTS, at 8.—The Thermo-Chemistry of the Bessemer Process. Prof. W. N. Hartley, F.R.S.

VICTORIA INSTITUTE.—A New Babylonian Story of the Flood: Theo. G. Pinches.

CAMERA CLUB, at 5.30.—Annual General Meeting——At 8.30.—Travels in Kashmir and Little Tibet: Dr. Arthur Neve.

TUESDAY, MARCH 22.

ROYAL INSTITUTION, at 3.—The Simplest Living Things: Prof. E. Ray Lankester, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Calcium Carbide and Acetylene: Henry Fowler.—Extraordinary Floods in Southern India: their Causes, and Destructive Effects on Railway Works: E. W. Stoney.

ROYAL HORTICULTURAL SOCIETY.—Horticultural Soils.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—The Gum Bichromate Process: Robert Demachy.

WEDNESDAY, MARCH 23.

SOCIETY OF ARTS, at 8.—The Preparation of Meat Extracts: C. R. Valentine.

GEOLOGICAL SOCIETY, at 8.—The Eocene Deposits of Devon: Clement Reid.—On an Outlier of Cenomanian and Turonian near Honiton, with a Note on *Holaster altus*, Ag.: A. J. Jukes-Browne.—Cone-in-Cone: Additional Facts from various Countries: W. S. Gresley.

THURSDAY, MARCH 24.

ROYAL SOCIETY, at 4.30.—The Bakerian Lecture will be delivered by Dr. W. J. Russell, F.R.S. Subject: Further Experiments on the Action exerted by certain Metals and other Bodies on a Photographic Plate.

ROYAL INSTITUTION, at 3.—Recent Researches in Electricity and Magnetism: Prof. J. A. Fleming, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Cost of Generation and Distribution of Electrical Energy: R. Hammond.

CAMERA CLUB, at 8.15.—Photographic Engraving in Intaglio: Colonel Waterhouse.

FRIDAY, MARCH 25.

PHYSICAL SOCIETY, at 5.—On the Circulation of the Residual Gaseous Matter in a Crookes' Tube: A. A. Campbell Swinton.—On some Improvements in the Roberts-Austen Recording Pyrometer, and Notes on Thermo-electric Pyrometers: A. Stansfield.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Internal Governor Friction H. O. Eurich.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Évolution Individuelle et Hérédité: F. Le Dantec (Paris, Alcan).—Ethnological Studies among the North-West Central Queensland Aborigines: W. E. Roth (Brisbane, Gregory).—Exploration of the Air by means of Kites (Cambridge, Mass., Wilson).—Queen's College, Galway, Calendar for 1897-98 (Dublin, Ponsonby).—Prospecting for Minerals: S. H. Cox (Griffin).—Lehrbuch der Algebra: Prof. H. Weber, Zweite Auflage, Erster Band (Braunschweig, Vieweg).—The Collected Mathematical Papers of Arthur Cayley. Supplementary Volume containing Titles of Papers and Index (Cambridge University Press).—Araneae Hungariae: C. Chyzer and L. Kulczynski, Tome 1 and 2 (2 parts) (Budapestini).—Audubon and his Journals: M. R. Audubon, 2 Vols. (Nimmo).—The Smithsonian Institution, 1846-1896. The History of its First Half-Century: edited by G. Browne Goode (Washington).—Smithsonian Institution. Revision of the Orthopteran Group Melanopli (Acrididæ): S. H. Scudder (Washington).

PAMPHLETS.—Field Columbian Museum. Annual Report of the Director to the Board of Trustees for the Year 1896-97 (Chicago).—Ditto. List of Fishes and Reptiles obtained by Field Columbian Museum East African Expedition to Somali-Land in 1896: S. E. Meek and D. G. Elliot (Chicago).

SERIALS.—Knowledge, March (Holborn).—Botanische Jahrbücher, Fünfundzwanzigster Band, 1 and 2 Heft (Leipzig).—Strand Magazine, March (Newnes).——Engineering Magazine, March (222 Strand).—Rendiconto delle Sessioni della R. Accademia delle Scienze dell' Istituto di Bologna, 1895-96: Ditto, Nuova Serie, Vol. 1, Fasc. 1 to 4 (Bologna).—Katalog der Bibliothek der K. Leopoldinische-Carolinischen Deutschen Akademie der Naturforscher, Achte Liefg., Band ii. 5 (Halle).—Journal of the Institution of Electrical Engineers, March (Spon).—Science Abstracts, January (Taylor).—Bulletin of the Liverpool Museums, February (Liverpool).

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