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LYON PLAYFAIR'S LIFE.

Memoirs and Correspondence of Lyon Playfair, First Lord Playfair of St. Andrews, P.C., G.C.B., LL.D., F.R.S. By Wemyss Reid. Pp. xii + 487. (London: Cassell and Co., Ltd., 1899.)

IN writing the life of Lyon Playfair, and editing his autobiography and correspondence, Sir Wemyss Reid has had a congenial task, and this he has accomplished with his usual tact and success. The result is a volume full of interest both for the scientific and for the layman, for Playfair himself truly defines his position as half man of science and half politician, and his biographer has rightly appreciated the remarkable dual part which he played, and the work which in each direction he accomplished:

"The man the story of whose life is to be told in these pages, never rose to that dazzling eminence which justifies the world in describing a human being as supremely 'great.' He did not pretend to the genius which lifts a few men high above their fellows. It cannot be affirmed that he was one of the great figures of his generation. Yet his life, though it was lived without ostentation and without parade, was undoubtedly one of the fullest and most useful lives of his time. It was emphatically a life of work, and of work not for the accumulation of wealth, or for the achievement of fame, but for the acquiring of truth, and for the service of his fellow men."

The most interesting portions of the volume are doubtless those containing Playfair's own description of his life and labours. These, although fragmentary, give a truer picture of the man and his doings than can be attained even by so skilled a biographer as Wemyss Reid. Playfair did not write them with a view to publication, and begins by remarking that if they are ever made public,

"My only apology is that they may form some encouragement to others, who, like myself, have had in early life few friends and no influence, to believe that their future position depends upon themselves and not upon their surroundings."

This is indeed the keynote of the life. The story, told by Playfair in his own way, is one not of adventure but of work. Many a poor Scots lad has done as great things, and risen in the social scale as high as, or higher than, Lyon Playfair, but no one carried out his life's work more devotedly than he.

"To Lyon Playfair the good of his country," truly says his biographer, "was a thing to be pursued not merely in the Senate or on contested fields, but in the laboratory and the council room, in social intercourse and in the humdrum round of daily life. It was something calling not so much for isolated deeds of heroism as for a prudent and unremitting care extending even to the most trivial tasks and incidents."

And he was fortunate in the period over which his life's work extended. In early days he showed his partiality for scientific studies, and especially for chemistry. In 1835 he left the Glasgow University, where Thomas Thomson was the professor, for the Andersonian College, where a younger and more active man—Thomas Graham—occupied the chair. This was a fortunate step, for Graham, himself actively engaged in research, fired Playfair with a desire to do likewise, and sent him to Giessen.

"On presenting myself to Liebig," he says, "I was much struck by his handsome appearance and classically cut face. I mentioned my name and told him that I was a pupil of Graham's, and he laughingly said, 'You might have said that you are the discoverer of iodo-sulphuric acid,' which I had recently described in short papers,"

the titles of which are not, however, to be found in the Royal Society's Catalogue. This introduction and the friendship which followed were the most important events in Playfair's early life. He translated the "Agricultur Chemie," though "my knowledge of German was not good." This candid admission is amusingly borne out in a letter written many years later to his wife, in which he says of a German girl that she speaks English "*schlecht*," but French "*vorläufig*," instead of "geläufig"!

Notwithstanding the above opinion, there is no doubt that Playfair's English translations of Liebig were well done, and that they were the means of introducing him to many men of position and influence in this country, by whom his talents were soon appreciated and whose friendship formed a starting-point in his career.

The story of his introduction to the great Sir Robert Peel is well told, and the results were as unexpected as they were gratifying. The question of sanitary reform then arose, and Playfair was fortunate in being one of the first to be employed in carrying out the battle against dirt and disease, and to his last days he remained what he was in his youth, the most energetic of sanitary reformers.

Then, again, he was fortunate in being a forerunner of the great educational movement which has been one of the chief glories of the nineteenth century. That he was well fitted to be the pioneer of technical instruction was due to his true appreciation not only of the value of pure science as a means of culture, but of the importance of the application of scientific principles to the arts and manufactures.

"Not to teach trades or manufacturing, but the principles, scientific and artistic, which underlie those trades and manufactures,"

was his definition; and that he lived to see these principles carried into effect must have been to him a source of keen satisfaction.

"In the chapter which history devotes to the social progress of our century, Playfair's name must always hold a place of honour."

Early in the year 1851 he was brought into personal and intimate contact with Prince Albert, and soon the confidence of the Prince was gained, so that Playfair from that time forward became his trusted adviser and friend. Although Playfair acted as Gentleman Usher to the Prince Consort, and was afterwards a Lord-in-Waiting upon the Queen, he, as he tells us, was not a courtier in the sense often ascribed to the word. He spoke his mind fully and frankly both when his views were in agreement with, and also when they were opposed to those held by "exalted persons." Of the Prince Consort's character and abilities he had the highest opinion.

"The attachment to his service," he says, "gave me the privilege of being associated with the illustrious

Prince in many of the works which he undertook to promote education, science, and art. . . . In all my future intercourse with the Prince, I never on any occasion saw him animated by a single desire that was not connected with the public weal. . . . Only those who had the honour of his confidence can fully know the purity, ability, and simplicity of his character."

The history of the Great Exhibition of 1851, of the many difficulties satisfactorily surmounted, and of the grand final success, are all graphically told, including the celebrated story of the "Junk Chinaman" dressed up to represent a "yellow jacket" mandarin, and placed in the procession between the Archbishop of Canterbury and the Duke of Wellington! Greater than his services to the Exhibition were those which he bestowed on the appropriation and consolidation of the large funds placed at the disposal of the Royal Commissioners. Without the advice and the business capacity of Playfair this fund, now large and altogether devoted to purposes of science and art, would have been in danger of being frittered away, if not lost. "Nobody but yourself," writes the Prince of Wales to Playfair in 1889, "could have got us out of the serious pecuniary embarrassments in which we found ourselves placed."

"So long as South Kensington continues to exist in its present state, there will be no need to raise any monument to the memory of Lyon Playfair."

The letters and memoir contain interesting descriptions of professorial life at Edinburgh. He does not scruple to dilate on some amusing but not very creditable University squabbles in which he was often called upon to act as arbitrator. Then comes his Parliamentary career in both Houses, the details of which are both interesting and entertaining. How he represented the Universities of Edinburgh and St. Andrews. How he retired from this constituency in consequence of the Government putting Scotch education under a Scotch Secretary. How he was elected for South Leeds, "a working-man's constituency, where he received an almost enthusiastic appreciation, which quickly developed into a feeling of warm confidenec and affection."

As Chairman of Committees in the Commons, he had hard times in consequence of Irish insubordination. But he did yeoman service in speaking out strongly and fearlessly about the follies and the crimes of the Anti-vivisectionists and the Anti-vaccinators. The correspondence which occurs throughout the volume with persons of all ranks is full of interesting matter. The letters to his wife and children, and to the members of the Russell family, show the depth of his feelings, although, as one of his children writes:

"No letter he ever wrote could give an idea of his deep and intense sympathy, of his loving help in any trouble to those dear to him, and even to strangers. I never in the whole of my life have seen him cross or impatient, or known him speak a harsh word to any one."

Then his sense of humour was keen, and his powers as a *raconteur* were of the first order, and not the least interesting portion of the memoirs is that in which these powers are shown by the numerous anecdotes with which the volume abounds. Altogether the book is one which will be found full of interest, as giving a striking picture of a wonderfully full and varied life. H. E. R.

THE GOLD-FIELDS OF ALASKA.

Alaska and the Klondike: a Journey to the New Eldorado, with Hints to the Traveller, and Observations on the Physical History and Geology of the Gold Regions, the Conditions of Working the Klondike Placers, and the Laws governing and regulating Mining in the North-west Territory of Canada. By Angelo Heilprin, F.R.G.S., F.G.S.A. Pp. 315; with 35 plates from photographs, and 3 maps. (New York: D. Appleton and Co. London: C. A. Pearson, 1899.)

THE search for gold still holds something of the romantic glamour which has surrounded it from the earliest days of our civilisation. It is true that modern conditions have enmeshed the winning of gold from vein and banket, reducing it, like diamond-mining, to a systematised industry scarcely more inspiriting to the labourer himself than the mining of coal or ironstone. But placer-deposits still offer a possible chance of sudden riches to the man possessed only of bodily vigour and a few simple uncostly implements, and men's imaginations still take fire whenever the rumour reaches them that the old conventional symbol of wealth is to be had for the digging. And still, as in the ancient days, the greater the difficulties to be overcome, the stronger to the adventurous spirit seems the probability of success. So when, in 1896-7, through an ever-widening circle, was spread the news of rich discoveries of the precious metal in a remote and barely accessible corner of north-western America, thousands were found ready to cast aside their everyday pursuits and make, in the words of the wise Camillo,

"a wild dedication of themselves
To unpathed waters, undream'd shores, most certain
To miseries enough."

To any one knowing anything of the land, the newspaper information which led to the rush seemed strangely inadequate and misleading—a characteristic compound of half-truths, whole truths and untruths, out of which stood the bare fact that placers of unusual richness had been found. What was heedlessly lost sight of in the excitement was that this discovery was not the sudden outcome of a single traverse of a previously unknown Golden Land, but had been attained only at the end of twenty years of persistent exploration, during which, though in the aggregate much gold had been won, the average net individual gain had been rarely more and often less than "day-wages."

As usual, these initial stages (unmentioned in the volume before us) attracted little or no attention from the outside world, for the restless spirits who undertake the hardships of pioneer life in the unbroken wilderness, though perhaps *too* fluent in speech, write no descriptions of their journeyings. Almost everywhere these men penetrate in advance of the "original explorer," who often in his own narrative forgets to mention their presence; but unless some unusual happening brings their doings into prominence, their traces in the land they have traversed are slight. In this instance it was surely a matter for prime consideration that a body of more or less experienced men—in numbers, according to a table published recently in the eighteenth Annual Report of the U.S. Geological Survey (p. 132),

rising from 50 in 1882 to 1000 in 1894, and to 1700 in 1896—should for many years have been prospecting up and down the Yukon from its mouth nearly to its sources with only moderate success. This in itself was sufficient to show that the riches of the land were neither unlimited nor easily attained, and that most of the tyros in gold-hunting who made their laborious march in the wake of these men must do so in vain. According to Prof. Heilprin, "probably not less than thirty-five thousand to forty thousand people, possibly even considerably more, have in the short period following the discovery of gold in the Klondike region already passed to or beyond the portals of what has not inaptly been designated the New Eldorado. To some of these a fortune has been born; to many more a hope has been shattered in disappointment."—And how could it be otherwise?

The sudden movement of this great army, made up of units marching independently and without organisation, with self-interest as the only motive, into the heart of a wild land incapable of furnishing more than a very small number with the barest elements of sustenance, dependent therefore for their very existence upon supplies from a base many hundreds of miles away, possesses extreme interest to the student of economics and sociology; and perhaps the chief value of Prof. Heilprin's book is that it contains the record of a certain stage in the transient and unstable conditions which arose under these circumstances. That within the space of a few months this transplanted social mass should with scarcely any disorder have struck root amid novel and arduous surroundings, and by the play of individual interest alone should have found itself provided with all the actual necessaries, and many—indeed, too many—of the luxuries of life (brooms and window-glass being, according to Prof. Heilprin, the chief things lacking) is, in its way, as remarkable an object-lesson as the century has afforded. At no previous period in human history could this have happened, and it is all the more deserving of careful record. The flood of hazily inaccurate or wilfully misleading information from the newspaper press is past; we have reached the second stage at which, as in the volume before us, the underlying facts emerge; and there will follow, no doubt, in the fulness of time, the brightly coloured growth of fiction which imaginative writers will cultivate for our entertainment around the picturesque elements of the movement when its sordid details are forgotten.

As for the actual contents of Prof. Heilprin's book, it aims to place before its reader the impressions of one accustomed to examine critically and record accurately, during a tour to the Klondike by the Upper Yukon route, made under favourable circumstances between the end of July and the middle of October of last year. Prof. Heilprin went in from tide-water at Skaguay by the White Pass to the head of inland navigation on Lake Bennett in a day and a half, and came out, late in the season, by the Chilkoot Pass in one day with comparative ease, and concludes that the difficulties of both trails have been greatly exaggerated.

"To a mountaineer or traveller of ordinary resource neither the White Pass nor Chilkoot Pass will appear other than it actually is—*i.e.* a mountain pass, sufficiently rough and precipitous in places, and presenting no serious obstacle to the passage of man, woman, or child" (pp. 15–16).

But he justly observes that what to a person in his own circumstances seemed easy enough, both in these passes and on the trails of the interior, might wear a very different aspect to the man struggling onward with a load of 60 or 80 lbs. on his back In fact, all through the book we realise that the impressions are those of one travelling in ordinary tourist fashion, light and with sufficiency of means, and that the prospector mentioned on p. 177, "who was moving by slow stages, and without assistance of any kind, an equipment weighing somewhat over 400 lbs." would have another tale to tell.

However, with the completion of the railway in course of construction on the White Pass route, the journey to Dawson City becomes simply a matter of the payment of fares. Already, we learn from the newspapers, the journey from Vancouver to Dawson has been made in so short a time as six days, while from eight to twelve days is now ordinarily the length of the through trip.

From Lake Bennett Prof. Heilprin went by river-boats down the lakes and the Lewes or Upper Yukon River to Dawson in 4½ days, reaching the last-mentioned place on August 6. Here he took quarters in the recently opened "foremost hotel of the land," paying 35 dollars per week for his scantily furnished room, and 25 to 35 dollars per week more for board. He estimated the number of inhabitants of the two-year old city at 16,000, and this sudden concentration of humanity ahead of the resources of the country had, necessarily, curious consequences upon the relative values of merchandise. Thus we read (p. 101), that chickens "earlier in the season had sold for 100 dollars for three," but later "were obtainable at 10 dollars apiece"; eggs were 2½ dollars per dozen; radishes 75 cents a bunch of five pieces, and so on; while at the same time at the auction rooms many articles could be bought for less than the original outside cost (p. 104). But with regard to the enhanced value of food-stuffs, it may be well to mention that the Canadian Geological Surveyors, who were in Dawson during the same summer, state in their report that "it was found quite possible to purchase provisions at retail prices at the stores, for the maintenance of a party, at less than a dollar a day per man (Rep. Geol. Survey of Canada for 1898, p. 62).

That the conditions were peculiarly evanescent, and with the establishment of Dawson City as a distributing centre are not likely to be repeated in the district, should make the fluctuations of the Dawson markets during the last three years an instructive chapter in economics.

One notices at times in Prof. Heilprin's book an unpleasant oblique mode of expression, not uncommon in the literature of forty years ago, but now happily rare. This is especially pronounced in the chapter on the inhabitants of Dawson, as, for example, in the passages describing "Sir ——," "Count C——," the "professor-doctor" and the "Gold Commissioner" (pp. 110—112).

The author notes that the number of blacklegs was surprisingly small, and remarks on "the feeling of security which every one seems to experience and enjoy." This he ascribes in great measure to the efficiency of

the Canadian military police, and comments on "a condition so wholly different from that which but a few weeks before dominated the atmosphere of Skaguay and the American side of the trails" (p. 119).

In praising the summer climate of the Klondike Prof. Heilprin waxes enthusiastic—

"From August 6th to September 20th, barring three days of partial rain, and perhaps a fourth of cloudiness and mist, the weather was simply perfection—a genial, steady, mild summer with a temperature rising at its highest to about 80° or 82° F. in the shade. . . . In August . . . the evenings were but little less pleasant than the days, the balmy night air rarely necessitating clothing warmer than that ordinarily worn" (p. 70).

Neither did he personally experience any trouble from mosquitoes. He also thinks that the rigour of the winters has been exaggerated, as "most of the Dawsonites are inclined to make light of the winter's cold, and assure you that, except for head and foot wear, they take little stock in that over-burdening with heavy clothing which outfitters so delight in foisting, as 'absolute necessities,' upon the too credulous tenderfoot" (p. 73).

In short, there appears to be nothing in the region inimical to the permanent residence of civilised man the year round in comparative comfort. Even the agricultural possibilities of the country are spoken of hopefully (p. 83), and Dr. Dawson's previous favourable estimate in this direction is quoted with approval (p. 85).

As to that which to most people constitutes the sole interest of the region—its future possibilities for gold-production—Prof. Heilprin, while writing with somewhat oracular caution, takes on the whole a sanguine view. After describing the conditions and methods of working the placers which differ, in the frozen state of the subsoil and in some other particulars, from any placers hitherto worked on the continent except those of Cassiar in the northern part of British Columbia, and after pointing out that some of the best claims, viz. those of the hillsides and high benches, were located in the early part of 1898, at the time when the incomers had been warned that the region for a hundred miles or so about Dawson had been fully staked and occupied, the author concludes that "many good locations in the Klondike territory are still open, although it may not be easy or possible to say just which they are" (p. 207). This, we fear, will seem rather "thin" guidance to the anxious gold-seeker! The output of the past year Prof. Heilprin estimates to have been "in the neighbourhood of nine or ten million dollars, perhaps more; but that it will be vastly greater in the current year (1899) is certain" (p. 204). Like other investigators of the district, he thinks that capital judiciously expended in hydraulic-mining should yield profitable returns.

A summary of the Canadian laws regulating mining in the Yukon region forms one of the most useful chapters in the book.

The longest chapter is that which deals with the physical history and geology of the Klondike gold-fields (Chapter xi. pp. 212–280), and this is, perhaps, the least satisfactory part of the volume. To the general reader it may indeed be of some service; but to the student of geology or of physiography more adequate sources of information are available, and the chapter contains little that need detain him, especially since though passing mention is made of previous investigators exact references to their works are rarely given. Besides the early scientific descriptions of the Yukon country by Dawson, McConnell, Russell and others, the recently issued report of the Canadian Geological Survey for 1898 includes (pp. 55–62) a concise and practical summary of the geology and conditions of the Klondike gold district by those excellent observers Messrs. R. G. McConnell and J. B. Tyrrell, which gives a clearer view of the structure of the country than the volume before us; and the eighteenth Annual Report of the U.S. Geological Survey (Part iii. pp. 101–391) contains an elaborate memoir on "the Geology of the Yukon Gold District" by Mr. J. E. Spurr, with a particularly interesting preliminary chapter, previously referred to, on "the history and condition of the district to 1897," and a discussion of the drainage peculiarities, by Mr. H. B. Goodrich. To these works, then, rather than to Prof. Heilprin's book, the scientific student should turn for information.

Prof. Heilprin, after much discussion of the subject, comes to the conclusion that "the known facts of the Klondike region, so far as they relate to the primal origin of the gold in the placers, favour the theory of chemical solution and precipitation, as opposed to the generally accepted view of accumulation from disintegrated reefs, bodies or veins" (p. 280).

But his arguments are unconvincing, and his views are neither shared by Spurr for the placers on the American side of the frontier, nor by McConnell and Tyrrell, the latter investigators stating that "the gold in the Klondike has certainly been derived from the rocks of the immediate vicinity" (Rep. Can. Survey, *op. cit.*, p. 60). It is of course evident that during whatever time the rich ground may have remained permanently frozen, no percolation of the supposed solutions can have taken place.

With regard to the auriferous high-level deposits, Prof. Heilprin adopts a view similar to that held by Spurr to account for the high benches of the American side, viz. that they are "evidences of the past existence of large lake-like bodies of water, perhaps even of a vast inland sea" (p. 226). On this supposition he builds various speculations, and thinks that the old shores have formerly been of far greater extent and have yielded by condensation much of the gold of the valley placers. But Messrs. McConnell and Tyrrell offer a more simple and adequate explanation of the phenomena in question, as follows:—

"On Bonanza and Eldorado creeks, and doubtless also on a number of the other creeks that rise in the high land near the Dome, the work of concentration has been greatly expedited by small local glaciers, which, at a period not very remote, have originated at the heads of these creeks, and have filled the bottoms of their valleys through parts at least of their lengths. Thus the Eldorado glacier would appear to have had a greatest thickness of about 200 feet at French Gulch, and to have joined the Bonanza glacier at the Forks, below which both continued on some distance together. The gravel that fills the bottom of the valley from side to side is a typical glacier-wash, having been deposited by the stream which flowed from the face of the glacier. The lower benches on Bonanza Creek were also deposited in a similar way, but the higher so-called benches have been formed either as lateral moraines along the sides of the glacier, or by

streams which flowed between the side of the glacier and the bounding slope of the valley" (Rep. Can. Survey, 1898, p. 61).

There are no existing glaciers in the Klondike region, and while the former presence of small local valley-glaciers has been recognised, all the observers are agreed as to the absence of any trace of widespread glaciation. This probably implies that, as in Siberia, the climate throughout the Glacial Period was dry, and that then, as now, heavy precipitation was confined to the vicinity of the coast.

To sum up our impressions of this book, Prof. Heilprin may be complimented on having given us a vivid picture of transient conditions in the Klondike; but, from a physical standpoint, his work can scarcely be taken as a solid contribution to our knowledge of the district.

The numerous excellent reproductions of photographs with which the book is illustrated are for the most part well adapted to show the general character of the scenery and conditions, though now and again a picture is introduced for effect rather than for instruction. The deep yellow binding with its pictured dog-trains, reminiscent of the "yellow press," is not particularly happy. G. W. L.

A NEW TEXT-BOOK ON CHEMISTRY.

Inorganic Chemistry for Advanced Students. By Sir Henry E. Roscoe, F.R.S., and Arthur Harden, Ph.D. Pp. 432. (London: Macmillan and Co., Ltd., 1899.)

THIS book is intended to supplement "Chemistry for Beginners," which was published about six years ago by Sir Henry Roscoe, with the assistance of Mr. J. Lunt. It is not a complete treatise on the elements of inorganic chemistry, but part of a complete treatise. It is intended for students who have already gained a little knowledge of the subject, and those who would use it must first learn something about oxygen, hydrogen, chlorine, carbon, and their simpler compounds, and about many other matters, either from "Chemistry for Beginners" or from some other suitable elementary work.

We suppose that a small text-book is put into the hands of most beginners when they reach the stage at which they need such a book, and that presently, when they are older and more advanced, this small book is changed for one of the larger treatises. Now, at this latter stage a certain amount of confusion and some loss of time are very apt to occur owing to the overlapping of the contents of most elementary and advanced works on chemistry, and to the fact that the majority of young students are not able to skip with discretion. It is evident that this confusion and loss of time might be avoided by the use of two books, such as those which have now been provided by Sir Henry Roscoe and his colleagues, Dr. Harden and Mr. Lunt; and we believe that those who have had much experience in teaching chemistry under school conditions will at once recognise the merits of their method of dealing with the subject in two volumes, one quite elementary, one more advanced, and each the complement of the other.

The present volume, like its predecessor, follows in the main the lines laid down so successfully a generation ago in the familiar "Roscoe's Chemistry." That is to say, the book is intended for students who want to learn the fundamental principles of chemistry, and something about its methods and its data, rather than for those who desire to use the subject as part of a system of mental gymnastics. But though the new book follows lines which have so long been made familiar to us by the previous work of its eminent senior author, it differs from that earlier work in several respects, notably in its somewhat more limited scope, for organic chemistry finds no place between its covers, in the greater attention given to chemical theory, and in the fact that a great number of experiments for the student are described in the text.

The subject-matter of the volume is divided into thirty-nine lessons, the elements treated of being grouped in such a manner that from the beginning the student may be said to be preparing the way for his subsequent study of the periodic system of classification. The chapters on chemical theory are dispersed among the rest. This arrangement may, perhaps, seem open to the objection that the student's reading in certain subjects may be somewhat broken up; but the authors have adopted it, as they tell us in their preface, with the object of relieving him of the tedious task of working without a break through a long series of metals and their compounds. The parts of chemical theory chiefly discussed in these lessons are atomic and molecular weights, equivalents, specific and atomic heats, crystals and isomorphism, valency, the constitution of hydroxides and oxyacids, dissociation, thermochemistry, electrochemistry, the periodic law and spectrum analysis. There are questions to be worked out, and numerous summaries. We are not quite convinced that so many of these latter make for sound learning. Should not every student prepare a good many of his own abstracts after he has read a few chapters and compared them with some summaries provided as examples? This, however, is a small matter, as it is obvious that the existence of summaries in the text need not prevent any student from constructing his own abstracts during his reading. We feel sure that the new book will be welcomed by those who are familiar with its predecessor, and by many others, and we wish it and its companion volume all success. W. A. S.

OUR BOOK SHELF.

Elements of Natural Philosophy. By Alfred Earl, M.A. Pp. viii + 320. (London: Edward Arnold, 1899.)

MR. EARL is already well-known as the author of the admirable "Practical Lessons in Physical Measurement," and one naturally examines a new book of his with great expectations. The preface states that the present volume is "intended as a handbook for the laboratory," and "has been written for the use of beginners." The book does not, in our opinion, exactly fulfil these conditions; yet it may still prove of use, though rather to teachers than taught. A laboratory manual should give clear, precise instructions as to what the student has to do—guidance of a sufficiently explicit nature for the pupil to work from without unduly bothering the teacher, who, very often, has too large a number working at the same time for purely individual instruction. Yet, in dealing with the measurement of simple quantities, for example, Mr. Earl gives some nineteen pages of general descrip-

tion, with little or no practical work, contenting himself by adding thirty-eight exercises at the end of the chapter. These exercises leave little to be desired, but a beginner will not always be clear about the several steps by which he is to arrive at the required result. The divisions adopted by the author lead to some very miscellaneous chapters; thus Chapter vi., entitled "Changes Belong to Several Classes," runs to thirty-two pages, and includes a brief treatment of inertia, the electrophorus, voltaic cells, the thermopile, gravitation, expansion, the Gulf Stream, Trade winds and several other subjects. Chapters viii. and ix. take the pupil "along the well-beaten track of chemical rudiments," and were written by Mr. F. Collins. Too much is attempted in this section, and things are often taken for granted of which a beginner has no knowledge whatever. Thus, on p. 185, the modes of chemical action are partly explained by chemical equations, though the only guidance towards understanding them which has been given to the pupil is the table of elements, with their symbols and atomic weights, on p. 181. The value of the book would have been much increased by using simpler language, and adding more illustrations.

Elementary Practical Chemistry. By A. J. Cooper, B.A., B.Sc. Pp. viii + 86. (London: Whittaker and Co., 1899.)

SOME idea of the profound changes which have occurred in the teaching of elementary chemistry during the last decade can be obtained from the large number of books recently published, all of which claim to supply a long-felt want. Mr. Cooper's book covers familiar ground in a more or less familiar way. He starts with a brief account of the metric system (which, however, is too short to be of much use), describes the balance, how to determine relative densities, and to measure liquids and fit up apparatus. No wonder the student often asks why these subjects must be studied both in the chemical and physical laboratories. But like many another recent writer of an elementary course of chemistry, Mr. Cooper rightly avoids the thaumaturgic art of test-tubing, and it is in this connection we are able to perceive an advance has been made in the way of studying science. Though the "Heuristic" method, of which so much is heard nowadays, is not suitable throughout a complete course of chemistry, it is unfortunate that so many statements occur like "note the white powder of metastannic acid that is formed"; "the name of the gas which you have just prepared is nitrous oxide"—which have no significance to a beginner.

The Teaching of Geography in Switzerland and North Italy. By Joan Berenice Reynolds. Pp. xii + 112. (London: C. J. Clay and Sons, 1899.)

NO more hopeful indication of the growing desire on the part of British teachers to improve the methods of instruction in our schools could be desired than this little volume provides. It is particularly gratifying to find that the old insular prejudice is giving place to an intelligent study of foreign educational systems, and that it is at last becoming recognised there is much to be learnt from Continental pedagogic authorities. Miss Reynolds was, in 1897, awarded the Travelling Studentship for Teachers in connection with the University of Wales, and her report, which she presented in 1898 to the Court of this newest of our Universities, demonstrates conclusively that she made the best use of her opportunities. Equipped with the information provided by a wide course of reading in the geographical literature of the countries she intended to visit, Miss Reynolds was able to intelligently note all the features of Swiss and Italian teaching practice which would prove of assistance to our own teachers, and she has here set them down in a clear and interesting manner. Her book should be read by every teacher of geography.

Liverpool Marine Biology Committee's Memoirs. I. Ascidia. By Prof. W. A. Herdman, D.Sc., F.R.S. Pp. v + 52; with five plates. (Liverpool: T. Dobb and Co., 1899.)

THIS is the first of a series of memoirs which is being prepared by the Liverpool Marine Biology Committee under the editorship of Prof. Herdman, to supply a want which "has been constantly felt of a series of detailed descriptions of the structure of certain common typical animals and plants, chosen as representatives of their groups, and dealt with by specialists." The expense of preparing the plates in illustration of the first few memoirs is being met by a donation of Mr. F. H. Gossage, of Woolton. Prof. Herdman has omitted detailed references to original memoirs, the object of his manual being more to provide students of marine biology with a concise and accurate description of the appearance, structure, and life-history of the Ascidian than to publish a bibliography.

In an appendix a statement is given of the classification and characters of the Tunicata, in order to indicate the position of *Ascidia* as a type of the group and its relations to the other British Ascidians.

The Story of the Wanderings of Atoms, especially those of Carbon. By M. M. Pattison Muir, M.A.. Pp. 192. (London: George Newnes, Ltd., 1899.)

AN attractive title does not by itself make an attractive book. Assuming that "The Library of Useful Stories" is intended for the general reader, we are afraid that this short account of the compounds of carbon is largely beyond his comprehension. There is an abundance of information, but the repeated references to Mr. Muir's "Story of the Chemical Elements" will tantalise the man who expects to get knowledge and recreation by the same process. A sound knowledge of organic chemistry is only obtained by experimental methods based upon a thorough grounding in the elements of chemistry, and this end is most satisfactorily obtained by studying simple inorganic substances first. The author has adopted a style more suited for the class-room than the platform of the popular lecturer, and the ordinary person who takes up this little volume will, after reading very few pages, find himself completely out of his depth.

General Index, by Robert Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, to Annual Reports of Observations of Injurious Insects, 1877-1898. By Eleanor A. Ormerod, F.R. Met. Soc., &c. With Preface by the author. Pp. xii + 58. (Simpkin, 1899.)

THE twenty-two annual volumes of Miss Ormerod's Reports are known to all students of agricultural entomology, and their usefulness as indispensable works of reference will be largely increased by the present compendium, which includes, in addition to the general index, separate indices of plants, animals and unclassified "hosts." Miss Ormerod's preface contains remarks on the origin and method of the reports, notices of a few of the more important insects which have been dealt with, and miscellaneous observations. It is worthy of special note that she considers all birds which are even moderately insectivorous as beneficial to such an extent as to overbalance any mischief they may do in other ways, unless they are present in overwhelming numbers; but she especially excludes the house sparrow, which she denounces as a national evil. W. F. K.

A Hand-List of the Genera and Species of Birds. By R. Bowdler Sharpe, LL.D. Vol. I. Pp. xxi + 303. (London: Printed by order of the Trustees of the British Museum, 1899.)

THE system of classification adopted in this new "hand-list" is that proposed by Dr. Bowdler Sharpe in 1891. The book is founded upon the "Catalogue of the Birds

in the British Museum," a large part of which was written by Dr. Sharpe, but the new species described since the publication of the twenty-seven volumes which comprise the "catalogue" are here included. Proofs of the work have been read and corrected by a number of leading ornithologists throughout the world, assistance sufficient, as Dr. Sharpe says, to give the work "the importance of an international publication."

Human Nature: its Principles and the Principles of Physiognomy. By Physicist. Part ii. Pp. viii + 175. (London: J. and A. Churchill, 1899.)

THE nature of the volume can be indicated by stating one of the propositions of the author's theory of colour: "That exhausted viable matter absorbs the luminous rays, and reflects the invisible (potential) rays, therefore it is dark or nearly colourless, sometimes violet or purple being perceptible; and that viable matter stored with energy reflects the luminous rays, therefore it is yellow or some colour containing excess of yellow, as brown, or cream colour, &c., and absorbs the invisible or potential rays."

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.*]

The Cause of the Darjeeling Landslips.

PROF. JOHN MILNE'S prompt contradiction in the *Times* of October 3, and in NATURE (5th) of the telegraphic statement concerning the cause of the recent Darjeeling landslips is a distinct "score" for the seismograph. With the Committee appointed by the Bengal Government to investigate the causes of the recent disaster, and to formulate measures for anticipating its possible recurrence, I made special inquiries into the alleged occurrence of earthquakes at Darjeeling on the night of September 24–25, and we all agreed that there was no evidence to show that any seismic phenomena whatever occurred. No movements were felt in well-built houses, and those that were noticed, as well as the sounds which were heard during the violent cyclone, were only of a kind that might be expected in the ill-built, rickety structures which, for the shelter of those who temporarily reside in our hill stations, are known to their owners as "houses." Local earth-tremors may have resulted from the slips, but they were the effects, not the cause, of the latter.

The unprecedented rain which accompanied the September cyclone was a sufficient and satisfactory immediate cause for the numerous landslips near and in Darjeeling. Up to the morning of the 23rd, the monsoon rains measured some 17 inches in excess of the average for previous years, and the thick soil-cap was consequently already saturated. The cyclonic depression first reported by the Meteorological Department to be formed to the south-east of False Point in the Bay of Bengal moved northwards until its centre, on the 24th, had reached lat. 25°, causing heavy rain over most of the province. During the twenty-four hours ending at 8 a.m. on the 23rd, 5·31 inches of rain fell at Darjeeling, followed by 19·40 inches during the next twenty-four hours. Of the latter amount 14·32 inches fell between 4 p.m. on the 23rd and 4 a.m. on the 24th, being thus over an inch an hour for a stretch of twelve hours. It was during this last period, when the rainfall was at its heaviest, that the disastrous slips occurred.

The hill-sides in the neighbourhood of Darjeeling are by natural means already at or near their angle of repose for earth-slopes, and the reduction of frictional stability, due to the thorough saturation by the heavy rainfall of September 23–24, was sufficient to permit slipping of the less stable portions of the soil-cap. The biotite-gneiss massif below is undisturbed and perfectly stable: there is nothing here comparable to Naini Tal, where the slates, by differential movement along their bedding planes, have caused cracks in the masonry structures built upon them. In Darjeeling the slips were confined entirely to the soil-cap, which ran down the steep hill-sides as rivers of mud, and, with occasional included boulders, bombarded the back quarters of some of the houses. A more interesting example on the eastern side of the Jalapahar ridge shows movement on a comparatively large scale now in progress. The sides of the moving mass are defined by longitudinal shear cracks, whilst its upper region—the *Abrissgebiet* of Heim—shows gaping fissures with, in the uppermost ones, a vertical displacement of about 8 feet. A description of this interesting landslip, with map and photographs, will be issued at a later date by the Geological Survey Department. T. H. HOLLAND.

Geological Survey of India, Calcutta, November 8.

Barisal Guns.

I MUST first state how I came to notice this phenomenon so well known in Bengal. Early in February, 1890, I was posted to Backergunge, as District Superintendent of Police, and remained there till December, 1891, a period of twenty-two months. In order to travel quickly over the district a steam launch was always at my service, and as I had to visit each of the numerous police stations scattered all over the district at least twice every year, there are few places in Backergunge I have not visited repeatedly.

Shortly after my arrival I received a letter from my friend, Mr. G. A. J. Rothney, of the firm of Messrs. John Dickinson and Co., 65, Old Bailey, who has a very wide experience of India, and takes a keen interest in natural phenomena, asking me to try and elucidate this phenomenon of the Barisal Guns; to make careful observations and record them on the spot. This I did, and I now forward a copy of the note I sent him.

The causes usually assigned for this phenomenon are three in number, viz.:—

(1) High banks of rivers falling in;
(2) Surf breaking on the shore, and
(3) Subterranean explosions.

The first of these theories cannot stand in face of the undisputed fact that any such sound would be purely local and could be heard only at very short distances, whereas it is admitted these guns are heard at places a hundred miles apart. The second is equally untenable when we remember the whole delta is composed of alluvial deposit, without a rock for hundreds of miles. And, thirdly, this alluvial deposit entirely does away with the possibility of subterranean explosions.

It is well known to all navigators of these waters there is a peculiarly deep depression to the south of this delta, which either has never been sounded, or, if sounded, has shown a most unaccountable depth, and it is assumed these reports emanate from this depression. But I am not inclined to accept this as a sufficient explanation, as the sounds are so very irregular in their frequency. We all know that Geysers in various quarters of the globe are celebrated for shooting out great masses of water from time to time; but these usually have some periodicity, and their times for discharge have been, more or less, tested and reduced to some well-known law or theory. Now the very irregularity of the Barisal Guns proves they can be subject to no such law, for, if they were, the phenomenon should be heard with some regularity, whereas, as I have shown in my note to my friend, their irregularity is one of their most noticeable features.

There are two special occasions to which I would draw attention: the first in February, 1891, when from the southernmost outpost, Chaltabuni, I followed the reports for some forty miles out to sea; the second, mentioned in my letter to the Surveyor-General of Bengal, when, in August, 1891, for more than six hours, I followed the reports without getting any appreciably nearer, and also never hearing them to the north of me. HENRY S. SCHURR.

34, Bloomsbury Street, W.C., November 28.

(*Report.*)

BARISAL GUNS are heard over a wide range extending from the Twenty-four Pergunnahs through Khulna, Backergunge and Noakhali, and along the banks of the Megna to Naraingunge and Dacca. They are heard most clearly and frequently in the Backergunge district, from whose headquarters they take their name.

These Guns are heard most frequently from February to October, and seldom in November, December or January. One very noticeable feature is their absence during fine weather, and they are only heard just before, during, or immediately after heavy rain.

The direction from which they are heard is constant, and that is the south or south-east. I have heard them west of me when down in the extreme south of the district, but never north of me. On the other hand, I have been told by captains of river-going steamers that they have heard these reports to their north. These gentlemen, however, ply along waters outside the range of my observations, which lie on the mainland and its adjacent waters.

These Guns are always heard in triplets, *i.e.* three guns are always heard, one after the other, at regular intervals, and though several guns may be heard the number is always three or a multiple of three. Then the interval between the three is always constant, *i.e.* the interval between the first and the second is the same as the interval between the second and the third, and this interval is usually three seconds, though I have timed it up to ten seconds. The interval, however, between the triplets varies, and varies largely, from a few seconds up to hours and days. Sometimes only one series of triplets is heard in a day; at others, the triplets follow with great regularity, and I have counted as many as forty-five of them, one after the other, without a pause.

The report is exactly like the firing of big guns heard from a distance with this peculiar difference, that the report is always double, *i.e.* the report has (as it were) an echo. This echo is so immediate that I can best describe its interval by an illustration. Suppose a person standing near the Eden Gardens heard the 9 o'clock gun fired from Fort William, he would first hear the report of the gun and its immediate echo from the walls of the High Court. The Barisal Guns sound exactly like this, only as if heard from a distance of several miles, very much the same as the sound of the Fort gun heard at Barrackpore on a clear night in the cold weather.

The report varies little in intensity, and I cannot recollect that there was much difference in the sound, whether heard at Barisal itself or some 70 or 80 miles to the south at the extreme end of the district. The state of the atmosphere may affect it, but to no appreciable extent.

The Backergonian peasant is celebrated for the bombs he is in the habit of firing at his weddings and festivals, and many residents have asserted they can distinguish no difference between the reports of these festive bombs and the so-called "guns"; but to any one with a fairly acute sense of hearing, who listens attentively, the difference is very marked, and their assertions are completely refuted by the facts—

(1) that wedding bombs vary very noticeably in the intensity of their sound;

(2) are wanting in the very marked feature of the triplets, and

(3) are naturally confined to the wedding season, a very short season in each year, whilst the Barisal Guns are heard almost throughout the year, and very noticeably during the annual fast—the Roza—when, of course, there can be no festivals of any kind.

Letter from Geological Surveyor-General, Bengal.

I HAVE to thank you for your most interesting report on the Barisal Guns. What you say about following the sounds in a launch is very interesting, and points to a Seismic origin, that is to say, that wherever the sounds came from they really originated locally, wherever you were at the time. In this case, following them would be like trying to reach the foot of a rainbow, whereas if they originated in surf on the sea-shore, or the falling-in of river-banks, they should be traceable to their source. R. D. OLDHAM.

Butterfly Shadows.

WHILE photographing insects lately in the hills above Pegli (Italy), I was much struck by the curious way in which many of the butterflies turned and shifted their position after they had settled, their apparently eccentric behaviour making it difficult to obtain a good picture. It suddenly struck me that this turning and shifting was the result of an endeavour to settle in such a position as would cast no shadow, thereby ensuring to themselves less risk of detection. This seemed to be a motive particularly with such butterflies as Circe, Semele and Janira; and its success as a method of concealment was very striking in the case of Circe, which constantly settles on the bark of trees or on the rocky ground.

I submit this observation with the hope that it may attract the notice of others who are able to give more attention to the matter; it may, too, be of interest in connection with the recent letters which have appeared dealing with the capture of butterflies by birds.

Continental butterflies appear to be remarkably tame. I was constantly able to catch Podaliarius and other kinds with the hand. D. WILSON-BARKER.

Greenhithe, November 27.

A Canadian Lake of Subterranean Inflow.

IMAGINE a cliff about 180 feet in height, rising almost perpendicularly from the steamboat landing at Glenora on the south side of the Bay of Quinte, a great arm of Lake Ontario, and perched immediately on the top of the cliff, within 300 feet from the edge, a lake of clear fresh water about one a half miles long, with a width of about three-quarters of a mile, its waters continually flowing out to give the power which operates the Glenora mills, but its inflow invisible, and yet steadily maintained from month to month and from year to year. This is the Lake-on-the-Mountain.

Various origins have been suggested in accounting for the inflow. That its source is not attributable to springs from any possibly higher grounds in the same county seems established by the fact that during the long drought in the months of August and September of this year the level of the lake was well maintained. The source is, I think, rather to be sought in the Trenton limestone area twenty-five or thirty miles to the north-eastward of the Bay of Quinte. The dip of the rocks is favourable, and for the whole distance and into the Laurentian area beyond there is a steady rise until at about fifty miles away a height of nearly 400 feet above Lake Ontario is reached. A fair amount of rain fell in this higher country during the drought elsewhere.

To ascertain their bearing on the origin of the inflow, I this past summer took a series of depths and temperatures in the lake. Whilst a considerable part of its area was shallow, not exceeding a few feet, the lake was found to have, close alongside its southern boundary, a great rent, as it were, in its bottom, of towards a mile long, one-third of a mile or more wide, and varying from 75 to 100 feet deep. That this rent is due to a widened fault in the Trenton limestone here is very probable, and the same forces which gave rise to this fault may also account for a subterranean connection with higher ground many miles away. The temperature readings were equally interesting. In Lake Ontario, at its outlet opposite Kingston, during August, the surface of the water ranged in temperature around 72° F., and at a depth of 78 feet (the bottom) it was 56½° F., which latter was very much colder than during last and some previous years. At the Lake-on-the-Mountain, whilst the temperature of the surface was 74¼° F., at 30 feet depth it was 69½° F., at 45 feet 47° F., at 60 feet 43° F., and at 99 feet 42° F. Thus, whilst during the first thirty feet there was not very much change in the temperature, between thirty feet and forty-five feet there was a rapid fall of twenty-two and a half degrees, and between the latter depth and the bottom at ninety-nine feet a further fall of only five degrees.

ANDREW T. DRUMMOND.

Cause of Recent Sunset Colours.

MAY I suggest to your readers that the striking colours of the recent sunsets are possibly due to the dust in the air from the Leonid meteors?

They certainly remind one of the sunsets after the Krakatoa eruption. HORACE DARWIN.

The Orchard, Huntingdon-road, Cambridge,
December 4.

Substitute for Gas in Laboratories.

IT is proposed to extend the modern side of a large secondary school by the erection of chemical and physical laboratories and lecture-rooms. The school, however, is some miles distant from any town which has a gas supply, so that it is necessary to consider what is the best substitute. I am interested in the arrangements, and shall be thankful if any of your readers will give me their experience on this point. It is proposed that the laboratories will accommodate forty boys working at one time. WILLIAM GANNON.

County Technical School, Stafford, December 4.

THE METHODS OF INORGANIC EVOLUTION.

IN the study of the facts of inorganic evolution presented to us by stellar spectra, there is one point of paramount importance to be inquired into. In the problems of inorganic evolution which we have now to face, it is sufficiently obvious that we have to deal with a continuously increasing complexity of chemical forms, precisely as in organic evolution the biologist has had to deal, and has dealt successfully with, a like increase of complexity of organic forms.

How has this inorganic complexity been brought about? In the case of known compound bodies an easy answer is given by analysis. Chloride of sodium, for instance, is formed by the combination of chlorine and sodium. But when we wish to deal with the formation of the so-called "elements" themselves, no such easy solution of the problem is open to us.

If in order to investigate this problem we take the analogy furnished by compound bodies as our guide, we should say that the molecules of the elements themselves were produced by the combination of unlike forms.

But as a matter of fact, this method of producing complexity is not the only one known to chemists. There are bodies of the same percentage composition which differ in molecular weight; the methane series of hydrocarbons is a case in point; the higher molecular weights or greater complexes are produced by additions of the unit $C.H_2$, so that these higher complexes are produced by the combination of similar lower complexes. This process is termed polymerisation.

We are then familiar with two methods of increasing complexity, which we may represent by $a + a$ (polymerisation) and $x + y$ (combination), producing a form A.

This, then, is the problem from the purely chemical side. On which of these methods have the elements themselves been formed, now that we are justified in considering them as compound bodies? I suppose that chemists when hypothetically considering the possible dissociation of the chemical elements would favour the view of depolymerisation; that is, the breaking up of a substance A into finer forms (a) weighed by A/2 (or A/3), rather than a simplification of A into x and y.

The method of attacking this problem from the chemical point of view in the first instance, must be a somewhat indirect one.

The Stars and the Periodic Law.

In a recent lecture I referred to the hypothesis put forward by Newlands, Mendeléef and others in relation to the so-called "periodic law," which law indicates that certain chemical characteristics of the elements are related to their atomic weights. I further showed that the order of the appearance of the various chemical substances in the stars of decreasing temperatures did not appear to be on all-fours with the requirements of the periodic law.

It will be well to study this question with a view of discussing it more fully in the light of all the facts known to us, among which the stellar evidence and that afforded by the study of series are, I think, of especial importance, since it may be said that we are now absolutely justified in holding the view that of the lines which make their appearance in the spectra of chemical substances when exposed to relatively high temperatures, a varying proportion is produced *by the constituents of the substance*, whether it be a compound like the chloride of magnesium, to take an instance, or of magnesium itself.

Now the periodic law based upon atomic weights deals with each "element" as it exists at a temperature at which the chemist can handle it; that is, if it be a question, say of magnesium, the chloride or some other compound of the metal must have been broken up, and the chlorine entirely got rid of before the pure magnesium is there to handle, and of this pure magnesium the atomic weight is found and, having also regard to its chemical characteristics, its position in the periodic system determined.

But if the magnesium be itself compound, the position thus assigned for the element is certain not to tally with the stellar evidence if the temperature of the star from which information relating to it is obtained is high enough to continue the work of dissociation; that is to break up magnesium itself into its constituents as certainly as the chloride of magnesium was broken up in the laboratory in the first instance.

It is now known that dealing with this very substance magnesium, high electric tension brings us in presence of a spectrum which consists of at least two sets of lines, numerous ones seen also at the temperature of the arc, and a very restricted number which make their appearance in the spark.

If this be the work of dissociation—and, as I have shown elsewhere, the proofs are overwhelming—the "atomic weight" of the particle, molecule or mass, call it what you will, which produces the restricted number of lines—the enhanced lines—must be less than that of the magnesium by the breaking up of which it is brought into a separate existence.

And now comes the chief point in relation to the periodic law. *Seeing that the smaller masses which produce the enhanced lines have not been yet isolated, their "atomic" weights and their chemical characteristics have not been determined, and so of course their places in the periodic table cannot be indicated as it at present exists.*

My contention, therefore, is that some, at all events, of the apparent discrepancies between the stellar evidence and the "periodic" hypothesis arise from this cause.

The magnesium, and I will now add calcium, which the chemist studies at relatively low temperatures have atomic weights of 24 and 40 respectively, and the stellar evidence would be in harmony with the periodic law if magnesium (24) made its appearance after sodium (23), and calcium (40) after chlorine (39), and generally each substance should make its appearance after all other substances of lower atomic weight than itself.

But, and again for the sake of simplicity I shall confine myself to magnesium and calcium for the moment, in the stars we find lines in the high temperature spectrum of magnesium and calcium appearing before known lines in the spectrum of oxygen which has an atomic weight of 16.

How are these results to be reconciled? I suggest that the explanation is that the substances revealed by the enhanced lines of magnesium and calcium and noted in the hottest stars have lower atomic weights (smaller masses) than the oxygen of the periodic table.

Let us next, then, see what these atomic weights may possibly be. Assuming A/2 the atomic weight of proto-magnesium would be $24/2 = 12$; of proto-calcium $40/2 = 20$, supposing only one depolymerisation has taken place. If we assume two, we get 6 and 10 as the "atomic" weights of the simpler forms of magnesium and calcium which make their appearance in the hottest stars.

In this way we can explain the appearance of those finer forms of magnesium and calcium before oxygen, with a small number of depolymerisations, and the stellar record of the order of atomic weights would be the same:

Hydrogen	1
Proto-calcium	10
Proto-magnesium	12
Oxygen	16

So much, then, for a possible reconciliation. The next point to be considered is, is depolymerisation on such a small scale sufficient?

To do this we have to see the basis of the atomic weight of oxygen 16, and consider the series question in relation to oxygen. This necessitates a digression.

The simplest case presented in series phenomena is that placed before us by sodium and other elements which run through all their known spectral changes at a low temperature. Dealing with the line spectrum stage we have three "series," one principal and two subordinate (first and second). The former contains the orange line D, constantly seen at all temperatures, the first subordinate the red line, the second subordinate the green line, representatives of two series of lines which are best seen both in the flame and arc.

The two subordinate series of sodium, like those of all other elements so far examined, have the peculiarity that they end at nearly the same wave-length, while the end of the principal series occurs at a different, sometimes widely different, wave-length. This is a touchstone of the highest importance, as we shall see; it points to a solidarity of the two subordinate series, and to a difference between them and the principal series.

Although the original idea was that all three series were produced by the vibrations of the same molecule, observations of the sodium phenomena alone are simply and sufficiently explained by supposing that we have three different masses vibrating, and that two of them, producing the subordinate series, can be broken up by heat, while that producing the principal series cannot. The series represented by the red and green lines seen best at the lower temperatures have been seen alone, and it is a matter of common experience that the orange line representing the principal series is generally seen alone: it is not abolished at high temperature as the others are. Because the mass the vibrations of which give us the orange line is produced by the breaking up of more complex forms at a low stage of heat, and it cannot be destroyed by the means at our command, it is the common representative of the element sodium. Because the masses the vibrations of which produce the two subordinate series represented by the red and green lines are easily destroyed by heat, they are more rarely seen, scarcely ever at high temperatures when the quantity is small, since, as I pointed out years ago, "the more there is to dissociate, the more time is required to run through the series, and the better the first stages are seen."

This view is greatly strengthened by considering another substance which, if we accept Pickering's and Rydberg's results, has, like sodium, three series, one principal and two subordinates in quite orthodox fashion. I refer to hydrogen.

Till a short time ago we only knew of one "series" of hydrogen, and on this ground Rydberg assumed it to represent the finest form of matter known, regarding the other substances which give three normal series as more complex. This idea is in harmony with the view expressed above.

Pickering in 1897 announced the discovery in the stars of another series, and seeing that this ends in the same part of the spectrum as the other, we can provisionally regard the terrestrial and stellar hydrogen as representing the first and second subordinate series.

Rydberg in the same year gave reasons for supposing that one line seen chiefly in the bright-line stars may represent still another series of hydrogen which we may take as the principal series. The other lines in this series he calculated to be out of range.

If we accept all these conclusions we must regard hydrogen as identical with sodium in its series conditions. But there is this tremendous difference. In sodium we easily at low temperatures—the bunsen is sufficient—see all three series, while in the case of hydrogen even the Spottiswoode coil can show us nothing more than one of the subordinate series. At the same time, the other subordinate and the principal series are visible in stars which we have many reasons for believing to be hotter than the spark produced by the Spottiswoode coil.

The argument for the existence of three different masses producing the three different series derived from the sodium observations is therefore greatly strengthened by what we now know of hydrogen.

I shall therefore assume it in what follows, and now return from the digression.

Oxygen, instead of having three series like metals of low melting point such as sodium, and the gas hydrogen, has *six*. These six have been divided by Runge and Paschen into two normal sets of three, each set possessing one principal and two subordinate series.

There is evidently a new problem before us; we require to add the series of hydrogen to the series of sodium to get a "series" result similar to that obtained from oxygen.

Before we go further it will be well to consider the possible order of simplifications. Let us take the simplest case represented by sodium and hydrogen in the first instance. The facts are shown in the following table:—

High temperature.

Sodium.		*Hydrogen.*	
Line stage: Principal	Celestial and terrestrial vapour.	Line stage: Principal, Subordinate, Subordinate	Celestial gas.
Line stage: Subordinate, Subordinate	Terrestrial vapour.		
Flutings		Structure spectrum ...	Terrestrial gas.
Continuous	Solid and liquid.	Continuous	

Low temperature.

We may now bring these results to bear upon oxygen. We learned first from Egeroff that this gas at ordinary temperature and pressure is so molecularly constituted that it produces a fluted absorption in the red part of the spectrum. On account of the constancy of the results obtained by chemists we cannot be dealing with a mixture of molecules, the fluting absorption therefore must be produced by molecules of one complexity having an "atomic weight" of 16.

If we subject it to an induced current at low pressure (at which the action of such a current is feeblest), it at once breaks up into two normal sets of three series, that is six series altogether; it is almost impossible to consider this state of things in the light of what happens in the case of sodium and hydrogen without assuming on the ordinary chemical view that the "molecule" with the fluted spectrum is broken up into two, until finally we get—

High Temperature.

	Set A.	Set B.
Line spectrum ...	Principal series	Principal series.
	Subordinate	Subordinate.
	Subordinate	Subordinate.

Fluted spectrum.

Low temperature.

But if we accept this, we give up depolymerisation, for the molecules of the subordinate series of sets A and B thus produced cannot be identical because their spectra are not identical.

If we hold to depolymerisation we must arrange matters thus—

Set B or A ... ... { Principal | Subordinate | Subordinate

Set A or B ... ... { Principal | Subordinate | Subordinate

Fluted spectra

and we get six depolymerisations.

The number of lines measured by Runge and Paschen in the spectrum of oxygen at low temperature was 76; of these the six series referred to contain 56, leaving 20 residual lines. Now if we employ a strong induced current at atmospheric pressure, we practically extinguish these six series of lines and produce a new spectrum altogether, containing a still greater number of lines: 114, according to Neovius. Only one line is common to his table and that of Runge and Paschen. About the series conditioning of these new lines we are at present profoundly ignorant.

Let us take the simplest course in harmony with the principle of continuity, and suppose that the great number of new lines is due to the breaking up of the molecules of the upper principal series given in the previous table into representatives of a still finer form, as hydrogen, as we know it, is broken up into a finer form at the highest stellar temperatures.

Have we, on the line of reasoning we are pursuing, any means of estimating the number of finer forms which may be at work to produce the 113 new lines?

One possible way—a statistical way—seems open to us. Taking the number of lines already recorded in the spectra roughly between λ 7000 and λ 2600 of the following substances, which give us three series—lithium, sodium, potassium, helium, asterium, hydrogen—we find that the number of lines in each series and the total numbers are as follows:—

	Maximum number.	Minimum number.	Average number.
Principal series ...	10 Ast ...	1 H ...	7
First subordinate ...	17 He ...	6 Na ...	9
Second subordinate...	12 He ...	4 Li ...	8
Totals	39	11	24

This indicates that in oxygen we are slightly above the average with $\frac{56}{2} = 28$ lines per set. If we take the facts for oxygen itself, which give us 56 lines for two sets of three, the 113 lines will give almost exactly four additional sets of three series, and therefore the possibility of twelve more depolymerisations if this method of simplification is considered.

Of course we can halve the number of depolymerisations by assuming that the fluting molecule instead of being depolymerised is broken up into x and y, the bases of the two systems of series.

Now it is this last crop of new lines alone which are represented in the hottest stars, and no one, I think, will now urge that some kind of simplification which may include depolymerisation has not taken place before they were brought into evidence.

Our base of 16 then vanishes, and with it the previously considered possible atomic weights of the forms of magnesium and calcium which precede the appearance of oxygen in the hottest stars. We must therefore assume further depolymerisations in the case of these metals beyond those considered in the first instance.

I now come to another point. How do the above considerations bear upon hydrogen with its atomic weight of 1? Of this hydrogen we know nothing spectroscopically. There is evidence that it is broken up into something which gives the complicated structure spectrum with hundreds of lines not yet sorted into series, again into the one series seen in our laboratories and in the cooler stars, still again into two other forms we cannot get here.

Let us apply the statistical method we employed in the case of oxygen.

In the region included in these inquiries the number of hydrogen lines in the three series referred to is 17. Hasselberg has measured 454 lines in the structure spectrum between λλ 642 and 441. Now if this spectrum is built up of series similar to those observed at the highest temperatures, we must have more (seeing that Hasselberg's work was limited) than $\frac{454}{17} = \pm 27$ series or 9 sets of 3 each. We deal then altogether with 12 depolymerisations.

But to be on the safe side, let us assume 6 on the ground that the lines in the series may be more numerous, and that some of Hasselberg's lines may be due to flutings. It will be clear that the masses or "atomic weights" we arrive at must be very small. Here is the story:—

Spectrum.	Where existent.	Series, &c.	Mass.
Line spectrum ...	Celestial	Principal ...	·0019
		Subordinate ...	·0039
	Terrestrial	Subordinate ...	·0078
Fluted spectrum	Set B Terrestrial	Principal ...	·0156
		Subordinate ...	·0312
		Subordinate ...	·0625
	Set A Terrestrial	Principal ...	·125
		Subordinate ...	·25
		Subordinate ...	·5
Continuous spectrum... ...		Hydrogen weighed in the cold ...	1·

Such a conclusion as this, and therefore the reasoning which has led up to it, must stand or fall according as science knows anything of such masses.

I shall show subsequently that, thanks to the investigations of Prof. J. J. Thomson, science is beginning to know a great deal of such masses, and the result of this work may therefore favour the view that polymerisation is a *vera causa* for molecular complexity, at all events in the cases of elements of low atomic weight.

Let us then consider the case of those elements the atomic weight of which is greater. In the first stages of evolution, in which we deal with substances of relatively low atomic weight, the stellar evidence supplies us with definite landmarks, and these are definite because the spectra of the hottest stars are not overcrowded with lines. After we have passed the gaseous and proto-metallic stages, however, we find the spectra full of lines which we see at the temperature of the arc, and metals of relatively high atomic weight and melting point are involved; the exact sequences are naturally more difficult to follow, and therefore the *method* of evolution may escape us.

Kayser and Runge have shown that the melting point has a profound influence on the "series" conditions. Those with the highest melting-points, such as barium and gold, present us with no series. There is generally such a flood of lines that it has been so far impossible to disentangle them; we have the "structure spectrum" of hydrogen repeated in these metals at arc temperatures in the so-called "arc spectrum."

NORMAN LOCKYER.

(*To be continued.*)

TESTIMONIAL TO MAJOR-GENERAL SIR J. F. D. DONNELLY, K.C.B.

AT a meeting in the Lecture Theatre of the Victoria and Albert Museum on Wednesday, November 29, which was very numerously attended by members of the present and past staff of the Department, and by men of science and artists who have been connected with it, Sir John Gorst presented, on the behalf of some five hundred subscribers, the testimonial to Sir John Donnelly.

This consisted of a silver salver, a set of library furniture, a collection of books of reference, a Zeiss binocular, and a diamond brooch for Lady Donnelly, and the inscription on the salver stated that it was in recognition of their high regard and in remembrance of their cordial relations of more than forty years.

Sir John Gorst, in presenting the testimonial, said: Ladies and gentlemen—I have been invited this afternoon to perform one of the most pleasant duties that has fallen to my lot since I have had the honour of being Vice-President of the Committee of Council on Education. It is to present, in the name of the gentlemen who have been employed at South Kensington as colleagues of Sir John Donnelly, a memento of the long period of public service which he has performed in this place, and a testimonial of the affection and sympathy with which he is regarded by the gentlemen who have been his colleagues.

I have myself been a colleague of Sir John Donnelly for about four years, and speaking of my own personal experience, I can only say that I have received from him, upon all occasions, the most loyal co-operation, which has been enhanced by a very strong personal friendship.

I had an opportunity about three years ago of seeing an attack, made ostensibly on the department of which he was the head, but which really had a considerable amount of personal animus in it.

There was an inquiry by a Committee of the House of Commons, in which Sir John Donnelly was virtually put upon his trial, and I can only say that, in the opinion of his official chiefs—the Duke of Devonshire's opinion was the same as my own—from that inquiry Sir John Donnelly emerged with the conclusion, in the minds of those who have read the evidence, that he had been a most loyal servant of the Department, that there were no allegations made against him which could be substantiated, that his administration of the Department had deserved the approbation of the country, and that the insinuations made against him were absolutely baseless.

Sir John Donnelly had served the department for upwards of forty years, and the testimonial, of which you have been good enough to ask through me his acceptance, is before you on the table. There is one point about it which deserves special allusion on my part. Among the objects which Sir John Donnelly has been asked to accept is a binocular, and, I think, you will be interested to know that that binocular is entirely the gift of the junior staff of the Department. It has been subscribed for by 150 persons, comprising stokers, ex-policemen, labourers, boys, and those who form quite the bottom of this great Department. I think the value of this gift—which shows the estimation in which he was held by this very important but not very wealthy class of the public service—will be to him as much as any of the more costly gifts. I am also asked, at the same time, to present a diamond brooch to Lady Donnelly, and I am sure that it will be extremely gratifying to Sir John Donnelly to know that the estimation in which he has been held by this Department has been shared by Lady Donnelly. In the name of the employés of the Department of Science and Art I beg your acceptance, and Lady Donnelly's acceptance, of these testimonials.

Sir John Donnelly and Lady Donnelly made suitable replies.

It has been arranged to entertain Sir John Donnelly at dinner at the Victoria Room, Criterion, on Tuesday next, December 12. Many representatives of science and art, who are or have been connected with the Department and its affiliated Institutions, will be present as a recognition of the valuable services he has rendered.

THE NOVEMBER METEORS.

IN nearly all the accounts of the observations of the Leonids the same result is recorded, namely, the apparent dearth of these bodies. It is true that unfavourable weather conditions were experienced in many localities; but even taking this fact into account, it may be safely said that the expected shower did not arrive in anything like the density it was expected, at any rate during the nights in which watches were kept.

In a previous number of this journal (vol. lxi. p. 81) many communications were published describing, for the main part, observations made in the British Isles. Several accounts of other observations have recently come to hand, and the following brief summary shows that the result of these watches did not differ very much from that mentioned above.

Paris was evidently blessed with more favourable weather conditions than London. In the first balloon ascent, on the morning of November 14–15, the following number of Leonids was seen:—

	h. m.		h.			
From	1 45	to	2	...	2	Leonids.
,,	2	,,	3	...	13	,,
,,	3	,,	4	...	10	,,
,,	4	,,	5	...	26	,,
,,	5	,,	6	...	40	,,

Of these 19 were of the first magnitude, 43 of the second, 29 of the third, and 9 of the fourth. It is further stated that this number would probably have been considerably increased if the moon had been absent.

At the second ascent, on the night of November 15–16, in a watch from 1h. 20m. a.m. to 6 a.m., only 8 Leonids were observed. M. Bailland, at the Observatory of Toulouse, observed from 1–6 a.m., on the morning of the 16th, and only saw 43 Leonids in that long watch. M. Deslandres, at Paris, who had made great photographic preparations, was no more fortunate than the British observers.

From Strasbourg we learn that on the morning of the 15th many Leonids were seen; the maximum number occurred about six o'clock, when the rate reached sixty per hour. This seems to be the greatest number per hour this year recorded, and is in harmony with the observations made at the first balloon ascent referred to above.

The above accounts corroborate the statement that night observations made in different parts of the world have failed to record a *great* shower. If the earth did not actually pass through the dense part of the swarm in the daytime at some place, then we must conclude that the actions of some of the planets have so perturbed the orbit of the meteors that this year we have only skirted the outlying portion of the stream.

Two accounts of "daylight" observations of the Leonids have come to hand, and for one of these we must thank Prof. N. Story Maskelyne, who, when he heard of them, requested a written statement of the display from each of the spectators, asking them to describe in simple words what they were quite certain they saw.

The place of observation was Little Hinton, Wanborough, Swindon, Wilts, a village about 400 feet above sea-level, and a mile or so from the old Roman road from

Cricklade to Newbury; to the east of that road where it traverses Wanborough (a few miles east of Swindon).

The observers, whose descriptions are given below, were Miss May Jeans, aged eighteen; Mr. Purcell Jeans, aged sixteen; and Miss Emily Swayne.

Miss Jeans' description is as follows:—

"*November* 22.—Last Wednesday afternoon, November 15, as I was lying down in an easy chair, looking out of a window facing north, and was not thinking of seeing the meteors, but suddenly I noticed them. Immediately I called Miss Swayne to come and look and see if she could also see them. We then went out of doors to look at them; the air seemed full of them, both large and small meteors. There was a thick mist at the time, which cleared off after the shower was over. The element seemed alive with them; small ones were on the background, and larger ones suddenly appearing and shooting across the sky. The shower lasted about an hour. It was half-past one o'clock when first I noticed them. Just before half-past two, my brother, Purcell Jeans, came in from a walk, and I called him to see them. They were nearly over then. We also called Mrs. Prismall of this village, our washerwoman. They were like silver balls shooting about everywhere, shining brightly, more like a very starlight night; only the stars, instead of being a gold colour, were silver, and every star shooting in all directions. It is so difficult to describe, as I have never seen anything like it before."

Mr. Purcell Jeans writes:—

"When I came back from a walk, on Wednesday, about a quarter-past two o'clock, Miss Swayne told me to come and look at the Leonids, which I did. They were nearly over then, but the elements seemed full of them. I went indoors for a few minutes, and when I came out there was nothing more to be seen of them. There was a mist prevailing at the time, which we thought must have been the cause of our being able to see them. I was very much surprised at the sight, as I never thought it possible to see stars in the daylight. They looked like a lot of little silver balls floating about, and apparently falling to the earth."

Miss Emily Swayne's description of the shower is as follows:—

"I had just come indoors, on Wednesday last, November 15, at half-past one o'clock, and remarked to the washerwoman what a peculiar feeling there was in the air, as if we should have snow, and yet it did not feel cold enough. Almost as I finished speaking Miss Jeans called me. I found her sitting in an armchair quite close to the window. She exclaimed, 'Come and see. I believe I can see stars.'

"I thought it impossible, and would not believe it, but I looked, and certainly saw what appeared to be stars. We then went out, calling the washerwoman to come with us.

"I was facing the north. The air seemed filled all round me with little floating silver balls, which apparently fell from the sky, and on looking right up I saw what seemed to be large shooting stars, all starting from one point, some going east and others west; some leaving longer lines of light behind them than others. I thought it a very wonderful sight, and have never seen anything at all like it before."

The above descriptions give a fairly good account of a meteor shower seen during the daytime, and it will be interesting to hear if any other people in that neighbourhood noticed anything on that date.

The second communication hails from Aveley, in Essex, and the correspondent, Mr. E. Shaw, writes as follows:—

"We observed what appeared to be the meteor shower yesterday (Wednesday, November 15) afternoon between the hours of three and half-past four, resembling a shower of snow, only they were stars, working in and out and round about. We are not mistaken, for two persons in my house saw them."

Considering the accounts of these "daylight" observations in conjunction with those made at Paris and Strasbourg, there seems to be a certain amount of continuity between them.

At both the latter places the shower had every appearance, judging by the numbers of meteors observed, of increasing in intensity as the morning of the Wednesday wore on, and there seems no reason why the actual maximum should not have occurred about mid-day on the same day, and thus escaped more general notice. At the time of the observations made at Little Hinton, the constellation of Leo was already well below the horizon, so that the shower should also have been seen from some place during the night time. As no news of any such display having been seen has come to hand, these observations therefore receive no corroboration. Miss Swayne's statement that the shooting stars were "all starting from one point, some going east and others west," shows that they could not have been Leonids in any case. The observations are, however, worth recording, but that they refer to the Leonids is very much open to doubt.

The Andromedes.—This swarm of meteors, which follows the Leonids somewhat closely as regards the time of year, seems to have been seen by several observers.

From America we learn that Prof. Young, at Princeton, on the night of November 24, saw forty-two Andromedes and secured several photographs, but the period of observation is not stated. Mr. E. C. Willis, of Norwich, made many observations on the same night, and these are given below:—

November 24.

Time.	Meteors seen.		Remarks.
	Andromedes.	Others.	
10.0 –10.15	20	1	Fine.
10.15–10.30	9	2	Fine, but some cloud.
10.30–10 45	4	2	Fine.
10.45–11.0	6	2	Fine.
11.0 –11.15	9	2	Fine.
11.15–11.25	4	1	Partly clouded, moon just risen.

Before 10h. no systematic watch was made, but if the meteors had been exceptionally abundant, they would have been noticed.

11h. 30m.–16h. 45m. Sky entirely overcast.

16h. 45m.–17h. 15m. Slight breaks in the cloud, but no meteors seen.

W. J. S. LOCKYER.

FERDINAND TIEMANN.

CHEMISTS will learn with regret of the death of Prof. Ferdinand Tiemann, which occurred at Meran, of heart disease, on November 17.

Johann Carl Wilhelm Ferdinand Tiemann was born at Rübeland in 1848. He graduated as Ph.D. at Göttingen in 1870, and afterwards held the post of demonstrator under Hofmann in Berlin, in whose laboratory most of his researches were carried out, frequently in collaboration with students and pupils. In 1882 he was appointed professor of chemistry in the University of Berlin, and in the following year he succeeded Wichelhaus as editor of the Reports of the German Chemical Society, a post which he resigned in 1897.

Tiemann's best known researches deal with the constitution of odoriferous principles. In 1874 he showed that the glucoside coniferin, which occurs in the sap of coniferous trees, could be hydrolysed by emulsin into glucose and coniferylic alcohol, and that the latter compound, when oxidised, yielded vanillin, identical with the odoriferous principle of vanilla. A manufactory was established at Holzminden under the direction of his pupils, Haarmann and Reimer, both of whom had been associated with him in his researches on vanillin, and the commercial

production of this substance from the cambium of the larch became an accomplished fact. But Tiemann was not content with this merely material success; in a masterly series of researches, the constitution of vanillin and various allied naturally-occurring compounds — the protocatechuic series—was established. Fresh syntheses of vanillin—from eugenol and from guaiacol—were also discovered.

In 1893 he published, along with Krüger, his well-known paper "On the Aroma of the Violet." It was, however, the aroma rather of the iris root or orris root (with which that of the violet may or may not be identical) that he investigated. The quantity of the odoriferous principle contained in iris root is so infinitesimal, and that of the root to be extracted, consequently, so large, that, as he states, the resources of a mere scientific laboratory proved unequal to the task, and this preliminary part of the investigation had to be carried out in the works at Holzminden. The substance thus isolated was thoroughly investigated and its constitution established. In order to indicate its origin and, at the same time, its ketonic constitution, he termed it *irone*. His attempt to synthesise it was not, from the point of view of the pure chemist, successful, although for the manufacturing chemist it was of the utmost value. Starting with citral, obtained from oil of lemons or from lemon-grass oil, he condensed this substance with acetone, converting it into a compound which he termed pseudo-ionone; this, when treated with dilute sulphuric acid, yielded ionone, isomeric—not identical—with irone, but so closely resembling it in smell that very few people can detect the difference. For the purposes of the perfumer, therefore, ionone is every whit as good as irone. It is now manufactured, and the value of the process to the patentees may be judged of from the attempts that have been made to evade or to invalidate the patent—attempts that have been foiled in courts of law both in this country and in Germany.

Amongst Tiemann's numerous other researches may be mentioned his work on the terpenes, on camphor, and on the synthesis of amido-acids.

He was a brother-in-law of the late A. W. von Hofmann.

NOTES.

AT a general monthly meeting of the members of the Royal Institution, held on Monday, the following letter from the Clerk of the Goldsmiths' Company, Sir Walter S. Prideaux, was read:—"I am directed to inform you that the attention of the Court of the Goldsmiths' Company having been drawn to the fact that the Royal Institution of Great Britain has lately celebrated its centenary, they have, in order to mark their sense of the importance of that event, been pleased to make to the Institution the further grant of 1000*l.*, for the continuation and development of original research, and especially for the prosecution of further investigations of the properties of matter at temperatures approaching that of the absolute zero of temperature. I enclose a cheque for this amount, and I shall feel obliged to you to acknowledge the receipt." The following resolution, proposed by the Lord Chancellor, and seconded by Sir A. Noble, was then passed:—"That the members of the Royal Institution of Great Britain, in general meeting assembled, having been informed that the Court of the Goldsmiths' Company have made a donation of 1000*l.* to the funds of the Royal Institution in commemoration of its centenary, and in aid of the investigations which are being carried on in its laboratories into the properties of matter at low temperatures, desire to express to the Court their profound and grateful appreciation of this second munificent manifestation of their practical interest in the work of the Institution—a manifestation which has been made on this occasion at once reminiscent of past services to science and prescient of services yet to come."

THE Dover Town Council has received a letter from the President of the French Association for the Advancement of Science, enclosing a handsome silver medal, presented to the municipality in commemoration of the Association's visit to the town in September last. The Mayor, Sir William Crundall, said the medal would be placed with the corporation plate. It was decided to make a grateful acknowledgment of the gift.

DR. T. E. THORPE, F.R.S., has been appointed to succeed the late Sir Edward Frankland in the work of analysing the water supplied by the London water companies.

THE death is announced of Dr. Birch-Hirschfeld, professor of pathology in the University of Leipzig, at the age of fifty-seven. Prof. Birch-Hirschfeld was one of the most distinguished pathologists in Germany.

THE *British Medical Journal* states that a State Institute of Serumtherapy, Vaccination, and Bacteriology, to bear the name of Alfonso XIII., has been created in Madrid. The new institute is organised on the lines of the Institut Pasteur.

AN International Congress of Mining and Metallurgy will be held in Paris on June 18–23 next year. The congress, like that of 1889, will be under the direct patronage of the French Government. In the provisional programme the following subjects are down for discussion:—Mining: use of explosives in mines; use of electricity in mines; mining at great depths; labour-saving methods as applied to mining. Metallurgy: progress in the metallurgy of iron and steel since 1889; application of electricity to metallurgy—(*a*) chemical, and (*b*) mechanical; progress in the metallurgy of gold; recent improvements in the dressing of minerals. The general secretary is M. Gruner, rue de Châteaudun, 55 Paris.

A COURSE of twelve demonstrations will be given in the psychological laboratory of University College during the Lent Term, commencing on January 19, 1900, by Mr. W. McDougall, Fellow of St. John's College, Cambridge. The Class will meet once a week on the day and at the hour that are found to be most convenient to the majority of the students. The methods of investigating experimentally all the chief types of elementary mental process will be demonstrated, and the students will be afforded opportunities to practise the methods. The subjects will include the several aspects of skin-sensibility and the "muscular sense"; the colour sense, visual distance and optical illusions; appreciation of tone-intervals and localisation of sound; sensibility to pain; simple measurements of memory; estimation of periods of time, &c. Students should send in their names to Mr. McDougall, St. John's College, Cambridge, before Tuesday, January 16, 1900, when the Term begins.

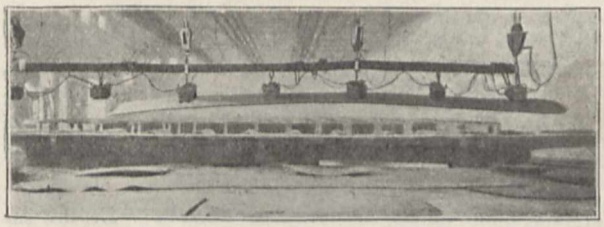
IN the early part of last week a "Bottlenose" whale was reported to have stranded on the river-bank at North Woolwich. The animal was a female, and on Wednesday, November 29, it was delivered, some time after death, of two young. On Friday a visit was made to Woolwich to see if either of the specimens were required for the Natural History Museum. That morning the carcase of the mother had, however, been towed out to sea by the sanitary authorities; but the body of a young one (which measured sixteen feet in length) was on view in front of the station, where it had attracted crowds the previous day. A glance showed that, instead of being a "Bottlenose," it was a "Finner" or Rorqual; and, since the mother was stated to have measured over sixty feet in length, there could be no doubt that it was the common species (*Balaenoptera musculus*), of which there is now a life-sized half-model in the Natural

History Museum. The young one differed from the adult in that the under-surface of the body was flesh-coloured instead of white.

WE learn from a German contemporary that a complete horn —that is to say, both the horn-core and its sheath—of the Avrochs or extinct European Wild Ox (*Bos taurus primigenius*) was disinterred some years since from a peat-bog at Treten, in Pomerania, and is now preserved in the zoological museum of the high school. The specimen has been examined by Dr. A. Nehring, of Berlin, who pronounces it to be about 300 years old; it is only in peat, or in an extremely dry cave, that the conservation of horn would be possible for such a lengthened period.

OWING to the frequent settlement of the land in the salt districts it has always been found a difficult matter to maintain in proper order bridges and other similar structures. To meet this difficulty the engineer of the Weaver Navigation, in constructing two new swing bridges over the river at Northwich, has so designed these that, instead of resting on the land, the weight of the bridges is carried on steel pontoons floating in the water, and the bridges are therefore independent of any settlement of the land so far as their foundations are concerned, and they are so built as to be easily adjusted to any settlement of the ground at the two ends. These bridges also are opened and closed by electric power, being the first to be so operated in this country. The two bridges have cost 25,000*l*.

AN interesting use of electro-magnets in steel works is referred to in the *Electrical Review*. It appears that in the works of the Illinois Steel Company, which makes very exten-



Electro-magnets carrying a steel plate.

sive use of electric power for all the purposes of steel manufacture, electro-magnetic cranes are used to carry plates from the rolls to the shears. A long plate being conveyed in this manner is shown in the accompanying illustration.

MONSIEUR CHARLES JANET, President of the Zoological Society of France, has for some years been engaged in investigating the minute anatomical structure of ants, wasps, and bees. The results of his investigations are published at intervals under the title of "Études sur les Formis, les Guêpes, et les Abeilles"; and of these we have just received Nos. 17, 18, and 19, the last published in the *Mémoires* of the French Zoological Society for 1898. All these treat of the anatomy of different portions of the body of the Red Ant (*Myrmica rufa*). Another memoir, on the cephalic nerves of the latter insect, appears in the journal last mentioned for 1899, although not under the same general title. The work being of an extremely technical nature, its details cannot be described in a note; but we may observe that these are worth the best attention of all students of insect morphology. The illustrations alone serve to indicate the extreme care and labour that the author has devoted to his subject, the elaboration of detail being little short of marvellous.

WE learn from the *Scientific American* that the Naval Board appointed to inspect and report on the performance of the *Holland* submarine boat has reported that in the recent tests, held on November 6, in New York Harbour, she fulfilled all the requirements laid down by the Department. These requirements were that she should have three torpedoes in place in the boat, she should have all arrangements for charging torpedoes without delay, and that she should be prepared to fire a torpedo at full speed both when submerged and at the surface. Lastly, the *Holland* was to make a run for two miles under water, starting from one buoy, running submerged for a mile to a second buoy, rising to discharge a torpedo at a mark near the second buoy, and then, after diving again return submerged to the starting point. In his report Chief Engineer John Lowe, U.S.N., who was specially ordered to observe and report the preliminary trial, says: "I report my belief, after full examination, that the *Holland* is a successful and veritable submarine torpedo boat, capable of making a veritable attack upon the enemy unseen and undetectable, and that therefore she is an engine of warfare of terrible potency which the Government must necessarily adopt into its service."

THE November number of the *Journal* of the Franklin Institute contains several of the addresses delivered on the occasion of the recent celebration of the seventy-fifth anniversary of the Institute. Dr. J. W. Richards, president of the chemical section, which is the oldest of the sections, inaugurated the proceedings of the commemorative week with an address in which he showed that the Institute has always stood for the happy combination of theory and practice—the union of pure and applied science. Mr. H. W. Wiley gave an address on the relation of chemistry to the advancement of the arts. The following remark illustrates the dominant influence of chemical science in one direction: "The agricultural experiment stations of the United States which have been directed by chemists, have taken such a leading position in the development of agricultural science as to practically monopolise all those investigations which have been most useful to agriculture throughout the country." Dr. E. J. Houston gave an account of the position of electrical science at the time of the birth of the Institute, in 1824, and showed that the Institute has exerted a marked influence on the extension and application of electricity by its great international exhibition of 1824, and through other means. Mr. R. W. Pope gave an address on a similar theme, namely, the influence of technical societies in promoting the progress of the arts. All the addresses in the *Journal* are of interest in connection with the subject of the bearing of science upon industry.

THE current number of the *Lancet* contains an article of particular interest dealing with the effects upon the wounded of the Mark II., the Mauser, the Dum-dum, and the Mark IV. bullets. The article, which has been written by Dr. Arthur Keith and Mr. Hugh Rigby, gives a clear idea of the relative amount of destruction caused by each of these modern military bullets, and the experiments upon which the writers' views are founded, confirm fully the experiences which have already been reported from the seat of war in South Africa. A glance at the illustrations shows the terrible havoc wrought by the Mark IV. and Dum-dum bullets and shows also that the old Martini-Henry bullet made an enormous and jagged wound compared with the neat little track that is left behind the Mark II., which our forces are using in South Africa, or the Mauser which is being used by the Boers. Dr. Keith and Mr. Rigby have not, however, been able to obtain results in their experiments with Dum-dum bullets that endorse Prof. von Bruns's statement of the case against the English open-nosed bullet. All open-nosed bullets cause fearful injuries, but it is contended that Prof. von Bruns must have used Dum-dum bullets of an exceptional nature to get the results which he recorded.

DR. F. A. COOK, who recently returned with the *Belgica* expedition, contributes to the December number of *Scribner's Magazine* an interesting article, accompanied by a number of illustrations reproduced from photographs, on the possibilities of Antarctic exploration. He shows that important results of immediate practical use to both science and commerce are likely to be obtained by Antarctic exploration. Referring to the need for exploration merely from a geographical point of view, Dr. Cook remarks:—"The actual existence of a land corresponding to what is charted as Graham Land is a matter of considerable doubt. On the map it extends from the sixty-ninth parallel of latitude, northward four hundred miles. But Alexander I. Land, the southern termination, is an island, and we saw no land eastward. The character of the land which may or may not exist between this and the newly-discovered Belgica Strait is in doubt. It offers scientific and commercial prospects promised by no other new polar region. At the one hundredth degree of east longitude, close to the circle, there is another interruption in the unknown. This is the much disputed Wilkes Land. It is by far the largest land mass in the entire Antarctic area. Including Victoria Land, its better known eastern border, it covers more than one-sixth of the circumference of the globe. In a territory of this extent, even under the most hopeless spread of snow, would it not be strange if something of value and much of interest were not found? Enderby Land and Kemp Land furnish other problems. They are probably not fixed to the continent, for the American, Morrell, found open sea below them; but whether they are isolated islands or parts of an archipelago remains to be ascertained. Does Peter Island exist? The *Belgica* drifted close to the position assigned to it by Bellingshausen, but saw no land. These are but a few examples of the many geographical problems to be solved in the Far South."

IN the *Journal de Physique* for November, M. A.-B. Chauveau discusses the diurnal variations of atmospheric electricity, to explain which no less than about thirty different theories have been proposed, of which four appeared in a single year (1884). M. Chauveau's principal conclusions, based on a comparison of curves from the Bureau central, Batavia, Sodankylä (Finland) Trappes, the College de France, and Greenwich, are as follows:—(1) That the influence of the soil which is greatest in summer (and of which the principal factor probably is the evaporation of negatively electrified water from the surface of the earth) intervenes as a disturbing cause in the diurnal variation. (2) That the general law of variation is represented by a simple oscillation having a maximum in the day, and a minimum (moreover, remarkably constant) between 3.30 and 4.30 a.m.

FROM the *Bulletin* of the French Physical Society we learn that M. Sagnac has given a theory of the propagation of light through matter which supposes that the light waves are transmitted by the same ether as *in vacuo* without the properties of this medium being in any way altered by the presence of material particles; the only effect of these is to scatter the vibrations in the same manner as small conductors, each of which reflects and diffracts all vibrations of sufficiently great wave-length. The author shows that, without introducing any electromagnetical or dynamical considerations, it is possible to give a *purely kinematical* explanation of the laws of reflection and refraction, the existence of the optic layer, and the existence of refractive indices greater than unity. M. Sagnac shows how the optic phenomena of entrainment of ether by matter can be explained by his hypothesis without the assumption of either an ether denser than the ether of a vacuum or any mechanical reaction between the ether and matter. This kinematical theory of the entrainment of the ether presents no difficulties or complications in accounting for the existence of dispersion or double refraction; and M. Sagnac has extended the theory to the explanation of anomalous dispersion and to the investigation of certain new optic phenomena.

IN the year 1891 the Hydrographic Office of Vienna established an elaborate service of rainfall and river observations in all the principal river systems. The volumes for the year 1897 have just been published and contain results of rainfall observations for no less than 2615 stations, together with tables showing the general distribution of temperature in the Austrian Empire. The depth of snow is also regularly gauged at over 40 stations. The work is accompanied by numerous diagrams and by a general discussion of the results for each of the 14 districts into which the service is subdivided.

WE have received the *Boletin Mensual* of the Manila Observatory for the first quarter of the year 1898. It is satisfactory to note that observations have been regularly recorded at this important observatory, under the direction of the Jesuit Fathers, for the last thirty-three years. The present volume contains hourly and daily means of the principal meteorological and magnetical elements, together with maximum and minimum values for Manila, from self-recording instruments and eye observations made twice daily at a number of secondary stations in the Philippine Islands. It also contains a monthly discussion of the observations and of earthquake phenomena, with curves of the meterological and magnetical elements.

MESSRS. BAILLIÈRE, TINDALL AND CO. have published the fourth edition of "A Synopsis of the British Pharmacopœia," compiled by Mr. H. Wippell Gadd, with analytical notes and suggested standards by Mr. C. G. Moor.

MR. A. C. SEWARD reprints from the *Proceedings* of the Cambridge Philosophical Society a paper on the Binney collection of Coal-Measure plants, in which a new genus, *Megaloxylon*, is described, belonging to the Cyadofilices, and considered by the author as furnishing an additional link between the Palæozoic representatives of this family and recent ferns. The paper is copiously illustrated.

THE sixth edition of M. Eric Gerard's "Leçons sur l'Électricité" has been published in two volumes by MM. Gauthier-Villars, Paris. The first volume deals with the general principles of electricity and magnetism, and the theory and construction of dynamo-electric machinery. The second volume is concerned with the most important industrial applications of electricity. The work has increased in size, and many new illustrations have been added.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*, ♀) from India, presented by Mr. J. A. Ewen, J.P.; a Brown Capuchin (*Cebus fatuellus*) from Guiana, presented by Mr. Douglas Mason; a Badger (*Meles taxus*), British, presented by Mr. G. A. Bronson; two Golden Agoutis (*Dasyprocta aguti*) from Central America, presented by Mr. C. Bevan; a White-bellied Sea Eagle (*Haliaëtus leucogaster*) from Tasmania, presented by Captain Francis Mayor; a Common Trout (*Salmo fario*), British fresh waters, presented by Mr. Arthur Irving; a Rufous Rat Kangaroo (*Æpyprymnus rufescens*, ♂) from New South Wales, two Ornamental Lorikeets (*Trichoglossus ornatus*) from Moluccas, a Banded Parrakeet (*Palaeornis fasciata*), four Starred Tortoises (*Testudo elegans*) from India, two Undulated Grass Parrakeets (*Melopsittacus undulatus*) from Australia, a Lapwing (*Vanellus vulgaris*, var.), four Bewick's Swans (*Cygnus bewicki*), European; two Wrinkled Terrapins (*Chrysemys scripta rugosa*) from the West Indies, two Emperor Boas (*Boa imperator*) from Central America, deposited.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN DECEMBER:—

December 9. 12h. 14m. Minimum of Algol (β Persei).
10–12. Epoch of Geminid meteoric shower (radiant 106°+33°).
12. 9h. 3m. Minimum of Algol (β Persei).
15. 2h. 48m. to 3h. 34m. Occultation of the star κ^2 Tauri (mag. 5·5) by the moon.
15. 2h. 55m. to 3h. 27m. Occultation of the star κ^1 Tauri (mag. 4·6) by the moon.
15. 5h. 52m. Minimum of Algol (β Persei).
15. Venus. Illuminated portion of disc = 0·928.
15. Mars. Illuminated portion of disc = 0·998.
16. Partial eclipse of the moon.
11h. 45m. First contact with shadow.
13h. 26h. Middle of the eclipse.
15h. 7m. Last contact with shadow.
Magnitude of the eclipse = 0·995.
16. 15h. 36m. to 16h. 11m. Occultation of Neptune by the moon.
17. 5h. Neptune in opposition to the sun.
18. 18h. 31m. to 19h. 9m. Occultation of *f* Geminorum (mag. 5·2) by the moon.
20. Jupiter 9° W. of Mercury, on Dec. 24, 11°, and on Dec. 27, 14°.
21. Saturn. Outer minor axis outer ring = 15″·76.
21. 18h. 4m. Transit of Jupiter's Sat. III. Egress.
22. 17h. Mercury in conjunction with Uranus (Mercury 2° 17′ N.).
25. 1h. Mercury at greatest elongation (22° 5′ W.).
25. 14h. 39m. to 15h. 47m. Occultation of the star D.M. − 10°, 3570 (mag. 6) by the moon.
26. 16h. 22m. to 17h. 3m. Occultation of the star 83 Virginis (mag. 5·8) by the moon.
29. 7 a.m. Jupiter, 6° E. of the moon.
30. ,, ,, 8° W.N.W. of the moon.
31. ,, Mercury, 5° W.N.W. of the moon.

The red spot on Jupiter will be about central on Dec. 21, 7.44 a.m.; Dec. 26, 6.54 a.m., and Dec. 28, 8.33 a.m.

MERCURY AND JUPITER AS MORNING STARS.—In the dark mornings of December it is almost as convenient for amateurs to effect observations of celestial objects as it is in the evening hours. It may therefore be of interest to mention that at about Christmas time Mercury and Jupiter will be favourably visible above the S.E. horizon just before sunrise, and that the crescent of the moon will be placed near these planets on the last three mornings of 1899. The following are the times of rising of Jupiter, Mercury and the sun on thirteen days:—

	♃ rises. h. m.	☿ rises. h. m.	☉ rises. h. m.
Dec. 18	5 36 a.m.	6 7 a.m.	8 3 a.m.
19	5 33	6 6	8 4
20	5 30	6 5	8 4
21	5 27	6 5	8 5
22	5 24	6 6	8 5
23	5 21	6 8	8 6
24	5 19	6 9	8 6
25	5 16	6 11	8 7
26	5 13	6 12	8 7
27	5 10	6 14	8 7
28	5 8	6 17	8 8
29	5 5	6 20	8 8
30	5 2	6 24	8 8

HOLMES' COMET (1899 *d*).

Ephemeris for 12h. Greenwich Mean Time.

1899.	R.A. h. m. s.	Decl. ° ′ ″
Dec. 7	2 5 48·62	+45 44 16·0
8	5 30·45	35 24·2
9	5 14·52	26 31·2
10	5 0·82	17 37·6
11	4 49·35	45 8 43·8
12	4 40·08	44 59 50·6
13	4 32·99	44 50 58·3
14	4 28·08	+44 42 7·4

COMET GIACOBINI (1899 *e*).

Ephemeris for 12h. Berlin Mean Time.

1899.	R.A. h. m. s.	Decl. ° ′	Br.
Dec. 7	18 16 7	+14 13·0	
8	17 50	14 30·4	0·42
9	19 33	14 47·8	
10	21 17	15 5 4	0·41
11	23 0	15 23·0	
12	24 44	15 40·7	0·40
13	26 29	15 58·5	
14	18 28 13	+16 16·4	

SPECTRUM OF P. CYGNI.—Herr A. Belopolsky has recently obtained several photographs of the spectrum of the variable star P Cygni (mag. 5), and states the results of his measurements in the *Astronomische Nachrichten* (Bd. 150, No. 3603). The instrument used was the two-prism spectrograph (camera 25 cm. long) attached to the 30-inch refractor of the Pulkowa Observatory. Both bright and dark lines are given, and it is noted that while the *bright* lines generally occupy a normal position, the *dark* lines are displaced towards the violet or more refrangible end of the spectrum. It is also interesting to note that several of the lines found are ascribed to nitrogen. The following table gives the wave-lengths of the lines in the star's spectrum with their probable origins:—

Bright Lines.	Dark Lines.	Wave Length Rowland, Runge, Neovius.	Origin.
4861·6	4858·2	4861·5	Hβ
4713·5	4711·0	4713·3	Helium
—	4648·3	4651·0	N
—	4640·8	4643·4 / 4640·5	N
4631·5	4629·2	4630·9	N
—	4620·3	4622·0	N
—	4606·2	4607·2	N
4601·9	—	4601·3	N
—	4561·7	—	?
—	4551·7	—	?
4472·1	4469·6	4471·8	Helium
4420·1	—	—	?
4396·1	—	—	?
—	4386·7	4388·1	Helium
4345·7	4344·8	—	?
4340·8	4338·1	4340·7	Hγ

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

FOLLOWING the usual custom, the anniversary meeting of the Royal Society was held in the apartments of the Society at Burlington House on St. Andrew's Day, November 30. The auditors of the Treasurer's accounts read their report, and the Secretary read the list of Fellows elected and deceased since the last anniversary. The President, in his anniversary address, referred to M. Haffkine's experience and views regarding preventive inoculation, and then proceeded to the award of the medals.

COPLEY MEDAL.

The Copley Medal is conferred upon Lord Rayleigh for his splendid services to Physics.

Lord Rayleigh's investigations have increased our knowledge of almost every department of physical science, covering the experimental as well as the mathematical parts of the subject. Acoustics, optics, electricity, and magnetism, the molecular theory of the constitution of bodies, the theory of elasticity, the composition of the atmosphere, are but a selection from the subjects of his investigations. In acoustics he has added to our knowledge of resonance (the subject of his first paper in the *Philosophical Transactions*), the behaviour of singing flames, the vibrations of jets, the general theory of the vibrations of dynamical systems, while his masterly "Theory of Sound" has thrown light on and given unity to the whole of the subject. In optics, his researches include the theory of the scattering of light by small particles, with its application to the explanation of the blue of the sky, anomalous dispersion, the nature of white light, reflection from crystals, and the general theory of optical instruments. In electricity and magnetism, in addition to theoretical investigations of great importance on the distribution

of alternating currents in conductors, he has made, in co-operation with Mrs. Sidgwick, those classical investigations of the value of the ohm in absolute measure, the electromotive force of the Clark cell, the electrochemical equivalent of silver, and the specific resistance of mercury. His researches on the theory of elasticity are valued by all students of mathematical physics. In his researches on the density of gases he met with small discrepancies between the density of nitrogen derived from the air and that derived from chemical compounds. Investigations into the cause of this discrepancy, followed up with wonderful skill and perseverance, led to the discovery of a new element (argon) existing in large quantities in the atmosphere, and possessing qualities of a very novel and remarkable kind. Lord Rayleigh's researches, from the range of subjects they cover, their abundance and their importance, have rarely been paralleled in the history of physical science.

ROYAL MEDALS.

One of the Royal Medals is conferred upon Prof. G. F. Fitzgerald, for his brilliant contributions to Physics.

A foremost position has been occupied by Prof. G. F. Fitzgerald during the last twenty years in the domain of Radiation and Electrical Theory. At the time when very few people had definite notions of the changed aspects which these subjects had assumed after Maxwell's theoretical advances, he was prominent as an expositor and developer of the new views. Thus his paper on "Electromagnetic Effects due to the Motion of the Earth" (*Trans. Roy. Dub. Soc.*, May 1882) was, perhaps, the earliest explicit effort to bring the facts regarding the astronomical aberration of light and general optical knowledge as to the relation of the æther to moving matter, into relation to electrical theory. Enough was there established, in both the optical and the purely electrodynamic domain, to show that no fundamental discrepancy was to be anticipated in the new point of view. Again, his paper "On the Quantity of Energy transferred to the Æther by a Variable Current" (*loc. cit.* November 1883), forms probably the earliest investigation of the field of an electric radiator. The case explored is that of a uniform current of periodically varying intensity; but the historical significance of the investigation is not impaired by the circumstance that subsequent research has transferred the source of actual radiation to the oscillations of the ions in the molecule. Already, in the preceding year, reflecting that crucial evidence with regard to the new standpoint of Maxwell was probably to be sought only in the domain of radiation, he had pointed to the oscillatory electric discharge in a condenser as a means of obtaining actual electric radiation, if only the period of the oscillations could be sufficiently reduced. Reference may also be made to the paper "On a Model illustrating the Properties of the Æther" (*Proc. Roy. Dub. Soc.*, January 1885), which has been widely useful, owing to the very simple manner in which the model—which is on the principle of Maxwell's own idle-wheel representation—visualises a large range of relations of the æther that had previously been amenable only to abstruse mathematical representation.

At an earlier period, Prof. Fitzgerald was occupied with magneto-optic phenomena, particularly with the theoretical bearing of Dr. Kerr's then recent discovery of the peculiarity in the reflection of light from a magnetised substance. That subject is considered at length, with restrictions, however, to transparent media in the analysis, in the latter half of the memoir, "On the Electromagnetic Theory of the Reflection and Refraction of Light" (*Phil. Trans.*, 1879). But the main interest of this memoir consists, perhaps, in the dynamical formulation of the electric theory of light on the basis of the Principle of Least Action, and in the comparison of that theory with the optical work of the author's countryman, MacCullagh. He has thereby contributed to a broader appreciation of that writer's position, and has shown that his theory of light, which was reached inductively along purely optical lines, runs parallel, and is, in fact, identical with the theory of Maxwell which presented itself in the course of a far wider induction originating in the domain of electrodynamics. The remark with which this memoir concludes, as to the advantage of "emancipating our minds from the thraldom of a material æther," has not, perhaps, yet lost all its force.

Not the least of Prof. Fitzgerald's services has been his success in guiding and energising an Irish School of Natural Philosophy. His efforts, and those of his pupils, have had a prominent share in the development and illustration in this country of the phenomena of electric radiation. Thus, in 1889, he was engaged, with Mr. F. T. Trouton, in verifying the laws of polarisation, by reflection, for Hertzian radiation; in 1890, he brought forward a new means of detecting such radiation by a galvanometer inserted across the spark-gap; in 1892 he returns to the problem of practical electric vibrators by a series of suggestions as to ways in which a continuous vibration of the requisite high frequency might possibly be established. He has experimented, with Dr. Trouton, in 1896, on the scattering of Röntgen radiation in passing through paraffin; and, along with Mr. W. E. Wilson, he has conducted a research on the effect of the pressure of the surrounding atmosphere on the temperature of the electric arc, which must have important bearings on the theory of radiation from solid bodies. He has also completed the work of Maxwell and Chrystal on Ohm's law of conduction by minutely testing its validity for the case of electrolytes.

More recently his efforts have contributed to the elucidation of the modifications impressed on the lines of a radiant spectrum, by change of pressure of the atmosphere surrounding the radiator, and by a field of magnetic force.

His critical activity pervades an unbounded field, enlivened and enriched throughout by the fruits of a luxuriant imagination.

The other Royal Medal is given to Prof. William Carmichael McIntosh for his very important labours as a zoologist.

Prof. McIntosh may be regarded as one of a distinguished succession of monographers of the British Fauna who, beginning with Edward Forbes, have during the last fifty years done work highly creditable to British Zoology.

McIntosh's great monograph of the British Annelids, published by the Ray Society, is still in progress. Two folio volumes appeared more than twenty years ago, a third is now in the press, and a final volume is contemplated. As a result of this work, and of numerous papers on the subject, McIntosh is justly regarded as the European authority on this group of animals. But his work has by no means been wholly that of a systematist. He is the author of one of the large and important *Challenger* Reports (that on the Polychæta), and of several minor reports of the same and other Government expeditions. His other papers extend over a wide range of subjects, and deal with many structural points. His name, moreover, is associated with the discovery or the description of several of the more remarkable or problematical of marine animals—such as *Pelonaia*, *Phoronis*, and *Cephalodiscus*.

Some of Prof. McIntosh's earlier papers were on fishes and their life history, and during the last ten or twelve years he has returned to that subject, and has added to the knowledge of our sea fisheries to a remarkable extent—both by observations anatomical and embryological (published in the *Trans. Roy. Soc. Edin.*), and in his book on British marine fishes, and by experiments on a large scale calculated to yield results of industrial importance.

Finally, Prof. McIntosh has been a notable teacher in Scotland, and many of those he has trained now occupy zoological posts and have conducted important researches. He is himself still a very active worker, both in his own investigations and in directing the researches of others. He was the first to found a marine biological station in this country, and the establishment of the present well-known Gatty Marine Laboratory at St. Andrews is entirely the outcome of his energy and influence.

DAVY MEDAL.

The Davy Medal is bestowed upon Edward Schunck for researches of very high importance in Organic Chemistry.

Edward Schunck is the author of a remarkable series of contributions to the chemistry of vegetable colouring matters, dating from 1841 up to the present time, and it is noteworthy that his first English paper appeared in the first volume of memoirs issued by the Chemical Society of London.

His earlier work includes two investigations which are everywhere regarded as classical, the one relating to the Madder plant, the other to the Indigo plant, from which the two most important dye-stuffs known to us are derived. In these, besides establishing the fact that the colouring matters are not present as such in the plant, but as glucosides, he brought to light much other information of importance in relation both to alizarin and indigo, and to allied substances with which they are associated.

In 1871, by his discovery of anthroplavic acid in artificial alizarin, he gave an important impetus to the further study of

the dye products of the manufacture of this substance, and thus contributed to a development of the industry which soon became of the utmost consequence.

Of late years he has devoted himself to the study of the green colouring matter of plants, and has contributed a series of remarkable papers to the Royal Society on the "Chemistry of Chlorophyll." These deal with one of the most difficult and at the same time most interesting chapters in the whole range of organic chemistry; they are full of observations of fundamental importance, and will serve as a sure foundation for all future researches on the subject. For the first time Schunck has succeeded in obtaining well-defined crystal-like products bearing a close relationship to the natural substance. Nowhere is his remarkable skill as a manipulator, his extreme delicacy of touch, more apparent than in this his latest work.

The Society next proceeded to elect the officers and Council for the ensuing year. The list of Fellows recommended for election has already been given (p. 38), and the only change was the substitution of the name of the Right Hon. James Bryce, M.P., for that of Sir John Murray.

The following are some of the subjects dealt with in the Council's Report:—

ASSOCIATION OF ACADEMIES.

With reference to the proposal for an International Association of Scientific Academies, mentioned in the Council's last Report, letters have been received from the Académie des Sciences, the Lincei at Rome, and the Imperial Academy of Sciences at St. Petersburg, expressing their approval of the suggestion and their readiness to join such an organisation. A preliminary Conference was held at Wiesbaden on October 9, to which the two Secretaries, with Prof. Armstrong and Prof. Schuster, were appointed as delegates from the Royal Society (the Senior Secretary was, however, unable to attend). The Conference exhibited the most perfect accord in the desire to further the practical establishment of an Association for the purpose in view, and proposed a draft scheme for the organisation of the Association on the following lines:—

(1) The Association shall consist of a General Assembly and a Council.

(2) The General Assembly shall consist of delegates appointed by the constituent Academies, each Academy having the right to appoint as many delegates as it may think necessary. On matters of organisation, each Academy shall have but one vote. No Academy shall be bound to take part in enterprises approved by the Association.

(3) The Assembly shall meet once every three years, but under specified conditions the time of such meeting may be altered.

(4) The Assembly shall be divided into two sections, for Natural Science and for Literature and Philosophy respectively. These sections shall have the right of separate meeting. Decisions arrived at by them shall be reported to the General Assembly for information, and, in case the decisions affect both sections, for confirmation.

(5) In the interval between the meetings of the General Assembly, the affairs of the Association shall be managed by a Council, to which each Academy shall send one or two representatives according as it belongs to one or both sections. In either case each Academy will have but one vote. The Council will have a President and a Vice-President, who must belong to different sections.

INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE.

The Second International Conference, held in the Society's rooms in October, 1898, appointed a Provisional International Committee, which was to consider reports on various questions discussed at the Conference, to be obtained by the Delegates to the Conference from local committees in their several countries.

The Committee met in the Society's rooms on August 1–5, those present being Prof. Armstrong, Sir M. Foster, Prof. Klein, M. Köppen and Profs. Poincaré, Rücker, Schwalbe and Weiss.

At the close of a series of very arduous sittings, during which questions of great difficulty and delicacy were discussed, a Report was agreed to; and in accordance with the decision of the second Conference, this has been issued by the Royal Society to the various Governments concerned, and will in due course be considered by the Council of the Society.

It should be mentioned that it was agreed to recommend: "That an International Conference, to arrive at a final decision on all matters concerning the catalogue, be held at Eastertide, 1900."

NATIONAL PHYSICAL LABORATORY.

The questions of detail concerning the establishment of this Institution, mentioned in the Council's last Report, having been settled with H.M. Treasury, a scheme of organisation prepared by a Committee of the Council has been approved by the Lords Commissioners of the Treasury. Under this scheme the Kew Observatory Committee, as at present constituted, will cease to exist, and will be incorporated with the National Physical Laboratory, but six members of the Committee have been appointed to serve for a definite period on the Executive.

The ultimate control of the Laboratory will be placed in the hands of the President and Council of the Royal Society, and the income and all other property will be vested in the Royal Society. The Governing Body will consist of a General Board and an Executive Committee, the former composed of the Officers of the Royal Society, the Permanent Secretary of the Board of Trade, twenty-four nominees of the Council, and twelve members nominated by the Councils of the six leading technical Societies, viz. The Institution of Civil Engineers; the Institution of Mechanical Engineers; the Institution of Electrical Engineers; the Iron and Steel Institute; the Institution of Naval Architects; and the Society of Chemical Industry.

The Council, on the recommendation of the Executive Committee, have appointed Mr. R. T. Glazebrook, F.R.S., to the Directorship of the Laboratory, and he will assume the duties of that post on January 1, next year. In the meantime, a number of sub-committees have been appointed to advise the Executive with regard to important questions as to the nature of the work to be undertaken in the Laboratory. Upon their Reports must depend largely the decision which will be taken by the Executive with regard to the buildings for the Laboratory and their site, subjects which are engaging the earnest attention of the Committee.

PROTECTION OF ROYAL OBSERVATORIES.

The protection of Royal Observatories from the effects of magnetic influence, referred to in the Council's last Report, having received the attention of the Government, delegates were appointed at the invitation of the Treasury to represent the Council at a conference of the officers of that Department. After some discussion, a model clause has received the sanction of the Chairmen of the Committees of the Houses of Lords and Commons respectively, and has been introduced into the Bills which were passed during the last Session of Parliament, for electric railways or tramways in the neighbourhood of London.

Under this clause, any Government Department which desires protection against the electrical or magnetic disturbances produced by electric railways or tramways will be at liberty to appeal to the Board of Trade, which will have power to decide whether the return conductor shall be insulated, or what other precautions shall be adopted.

SCIENTIFIC ADVICE TO THE GOVERNMENT OF INDIA.

Early in the year a letter was received from the India Office relating to scientific inquiry in India, and stating that, when the question had arisen of devising a scheme of investigation, the responsibility of suggestions had usually fallen on officials who were not competent to give advice. The Government of India suggested that they should have the advantage of the advice of leading men of science in England, who would exercise a general control over researches instituted by the Government. Lord George Hamilton having inquired whether the Royal Society would be willing to meet the wishes of the Indian Government by assisting in this capacity, the Council decided to appoint a Standing Committee to give such advice as it can on matters connected with scientific inquiry in India. Since the researches on which such a Committee would be consulted would probably in most instances refer to biological matters, the Committee has been chosen chiefly from among the biological Fellows.

The Committee thus constituted has a parallel in the Indian Observatories Committee established at the request of the Government some time since, and mentioned in various Reports of the Council.

CHELSEA PHYSIC GARDEN.

Towards the end of last year the Council received from the Charity Commissioners a request for their views upon a scheme

which, at the request of the Society of Apothecaries, the Commissioners had drawn up for the future government of the Chelsea Physic Garden, in the ownership of which the Royal Society had by the deed of grant of Sir Hans Sloane, a reversionary interest. The Council appointed a Committee to consider the Charity Commissioners' scheme, and this Committee having reported to the Council in favour of the scheme, with certain amendments which the Charity Commissioners expressed their willingness to adopt, the Council have concurred in the scheme, which provides for the maintenance of the Garden, under the Charitable Trusts Acts, for the purposes of botanical study, and gives to the Royal Society, among other Institutions, a representation upon the Committee of Management.

"PRIVILEGED" CANDIDATES FOR FELLOWSHIP.

The attention of the Council having been drawn to the regulations governing the election of Fellows under privileged conditions, a Committee was appointed early in the year to consider whether any alteration in them would be desirable. The Committee have duly reported, and, in accordance with their report, the Council have under consideration a modification of the Statutes, enabling the Council to recommend to the Society for election persons who either are Members of Her Majesty's Privy Council, or have rendered signal service to the cause of science, provided that not more than three such persons shall be elected in any one year, the persons so recommended to be selected by the Council by ballot in accordance with a procedure to be established by Standing Orders of Council. The Standing Orders which the Council propose to make correspond in the main with the procedure for the adjudication of the medals, but are still more stringent in character.

In the evening the Fellows and their friends dined together at the Whitehall Rooms.

STEREOCHEMISTRY AND PHYSIOLOGY.

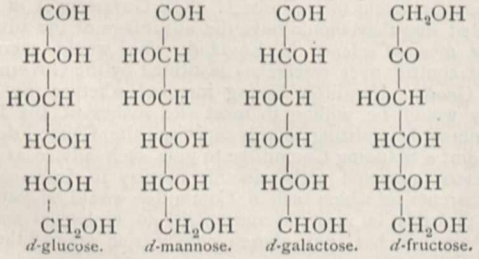
IN a recent number of the *Zeitschrift für physiologische Chemie*, Prof. Emil Fischer has reviewed the facts by which, in conjunction with Thierfelder, he has sought to explain the selective action exhibited by the enzymes either in effecting fermentation or in producing hydrolysis.

Pasteur was the first to show that a solution of racemic acid becomes lævo-rotatory in presence of penicillium, owing to the destruction of the dextro-tartaric acid by the fungus—an observation which has been frequently utilised in the attempt to isolate one of the optically active constituents of a racemic compound.

Configuration and Alcoholic Fermentation.—This selective action is exhibited in a very marked degree by the beer yeasts in producing fermentation of the carbohydrates. Of the eleven known aldohexoses (glucose type) only the three natural products are fermentable, viz. dextro-glucose, dextro-mannose and dextro-galactose, and of the ketohexoses only dextro-fructose is decomposed.

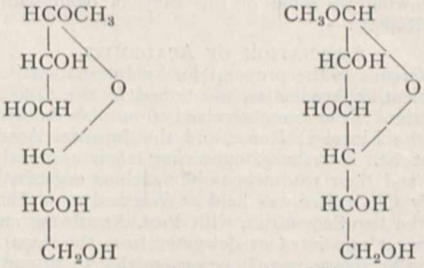
All the yeasts susceptible of inducing fermentation transform dextro-glucose, mannose and fructose with about equal velocity; but the action of yeast on dextro-galactose is slower, and certain species—*Saccharomyces apiculatus* and *productivus*—are totally without action upon it.

A comparison of the configuration of these four sugars will exhibit the differences in molecular grouping.



In glucose, mannose and fructose the grouping of the H and OH round the three lower asymmetric carbon atoms is the same, but differs from that of galactose, a fact which may account for the slower fermentive action of the latter. The other hexoses are not fermentable. The small difference in configuration which suffices to arrest the action is seen in the case of *d*-talose, which only differs from *d*-galactose by the position of one hydroxyl group.

Configuration and Zymolysis of the Glucosides.—By the combination of glucose with methyl alcohol, to form methyl glucoside, a new asymmetric carbon atom is created, and consequently two stereo-isomeric derivatives are possible. E. Fischer has obtained from *d*-glucose both modifications, which he terms α and β methyl *d*-glucosides, also the corresponding α and β methyl *l*-glucosides and similar products from the other aldoses. Fischer has allotted to the α and β methyl *d*-glucosides the following formulæ.



An aqueous solution of the emulsin of bitter almonds hydrolyses the β modification, but has not the least action on the α modification. Exactly the reverse happens with an aqueous extract of dry yeast. In this case the α compound is hydrolysed, whilst the β modification remains unchanged. The ethyl and phenyl glucosides, which are only known in one modification, behave like the α methyl compound, and probably belong to the same category. Neither emulsion nor yeast affect the two methyl *l*-glucosides.

D-galactose forms two methyl derivatives, one of which is attacked by emulsin and the other by the enzyme of yeast, but more slowly than the corresponding glucosides, the difference in rate corresponding with that observed in fermentation. Neither methyl *d*-mannoside nor methyl *l*-mannoside is attacked by emulsin or the enzyme of yeast. The second *d*-mannoside, which would probably be hydrolysed by one or the other ferment, is still unknown. The pentoses and heptoses are non-fermentable, and their methyl glucosides are likewise indifferent to both enzymes.

The following is a list of natural and artificial glucosides. The action of the enzyme is denoted by a + when it produces hydrolysis and by a − when it is without action.

		Artificial glucosides.	Emulsin.	Enzyme of yeast.
Aldosides.	Hexosides.	α methyl *d*-glucoside ...	−	+
		β methyl *d*-glucoside ...	+	−
		α methyl *l*-glucoside ..	−	−
		β methyl *l*-glucoside ...	−	−
		α ethyl *d*-glucoside ...	−	−
		phenyl *d*-glucoside ...	+	−
		α methyl *d*-galactoside ...	−	+
		β methyl *d*-galactoside ...	+	−
		methyl *d*-mannoside ...	−	−
		methyl *l*-mannoside ...	−	−
		methyl arabinoside ...	−	−
		α methyl xyloside	−	−
		β methyl xyloside	−	−
		methyl rhamnoside ...	−	−
		methyl gluco-heptoside ...	−	−
	Ketosides.	methyl sorboside ...	−	−
		methyl fructoside (not crystallised)	−	+

	Natural glucosides.	Emulsin.	Enzyme of yeast.
Simple derivatives of glucose.	Salicin	+	−
	Helicin	+	−
	Æsculin	+	−
	Arbutin	+	−
	Coniferin	+	−
	Phylbyrin	−	−
	Aprin	−	−
	Syringin	+	−
	Saponin	−	−
	Phloridzin	−	−
	Glucoside of mandelic nitrile	+	−
	Amygdalin	+	−
	Quercitrin	−	+

It would appear that the natural glucosides, which are for the most part phenol derivatives, probably belong to the group of β-glucosides. The indifference of some of these glucose derivatives to both enzymes is at present unexplained.

Configuration and Zymolysis of the Polysaccharoses.—The recent researches of E. Fischer on the hydrolysis of the polysaccharoses point to the fact that none of these carbohydrates is directly fermentable by the enzyme of yeast, but that without exception they first undergo hydrolysis by a hydrolytic enzyme associated with the ferment. The di-saccharoses—cane sugar, maltose, milk sugar, melibiose, trehalose, &c.—are anhydrides formed by the union of two hexoses. The structural formulæ of maltose and lactose are probably identical, seeing that each splits up on hydrolysis into two molecules of aldohexose, but since maltose yields only glucose, whereas lactose forms an equal number of molecules of glucose and galactose, the two compounds must be regarded as stereoisomeric. They probably correspond, too, with the α-methyl- and β-methyl-dextroglucoside, for emulsin hydrolyses lactose, but not maltose; whereas the enzyme of yeast produces the reverse effect.

Without discussing in detail the ingenious methods by which Prof. Fischer has successfully attacked the problem of the hydrolysis of the polysaccharoses, the following results may be briefly recorded.

The action of invertase, an enzyme which accompanies beer yeast, in hydrolysing cane sugar into glucose and fructose previous to fermentation, was first observed by O'Sullivan, and although Bourquelot and Lintner recorded a similar decomposition in the case of maltose, the experiments were not decisive. Fischer, however, extracted with water from dry yeast an enzyme which, unlike invertase, hydrolyses maltose, and which he has therefore named maltase of yeast. Instead of the aqueous extract, the dry yeast itself may be employed; in which case a little toluene must be added to the maltose solution to arrest the alcoholic fermentation.

The conclusion may be drawn that yeasts incapable of inducing alcoholic fermentation of cane sugar and maltose are destitute of invertase and maltase. This conclusion has been fully corroborated by subsequent experience.

Kephir grains and the yeast which ferments milk sugar do not ferment maltose, and are also without hydrolytic action upon it.

Saccharomyces martianus, which according to Hansen does not ferment maltose, does not hydrolyse it, and is therefore free from maltase. Beyerinck's *Schizosaccharomyces octosporus*, which acts on maltose but is indifferent to cane sugar, contains maltase but no invertase. *Monilia candida* is a particularly interesting case, since it contains neither invertase nor maltase, but nevertheless produces fermentation of both cane sugar and maltose. No aqueous extract which hydrolyses these two sugars could be obtained from it, but if the dried yeast is added to a solution of cane sugar in presence of toluene a vigorous hydrolysis is produced. The hydrolytic enzyme is present, but in this case it is insoluble in water.

Milk sugar, which is not attacked by beer yeast, is fermented by kephir grains and milk sugar yeast, which Beyerinck suspected to contain the hydrolytic enzyme lactase. The existence of this enzyme has been placed beyond question by Fischer, who has prepared the enzyme from kephir grains and milk sugar yeast in the dry state. It is accompanied by invertase, but maltase is entirely absent, and indeed no substance is yet known in which maltase and lactase are associated.

The hydrolysis of trehalose by an enzyme contained in *Aspergillus niger* and in green malt was observed by Bourquelot, and has since been confirmed by Fischer, who found also that a Frohberg dry yeast affected a similar but much more feeble decomposition.

Melibiose, which is a disaccharose, is obtained from raffinose. It is fermented by a low fermentation brewer's yeast. Fischer and Lindner have now been able to prove the existence in this yeast of a hydrolytic enzyme which they call melibiase.

In regard to the action of different yeasts on α-methylglucoside and its congeners, Fischer has shown that all yeasts which ferment maltose attack the α-methyl glucoside. The question then arises, has each glucoside or polysaccharose its special enzyme and each fermentable sugar its special ferment or zymase? Fischer considers such a proposition untenable, but inclines to the view that one and the same enzyme of yeast, maltase, attacks α-methyl glucoside as well as melibiose and the complex carbohydrates known as dextrins.

Theoretical considerations.—All these facts indicate that the chemical action of enzymes, in which may be included the zymase of yeast, is of quite a special character and distinct from that of the more simple organic and inorganic compounds. The cause of this selective action probably resides in the asymmetrical structure of the enzyme molecule. Although these substances are not yet known in the pure state, their relation to the proteids is so close and their derivation from the latter so probable, that they may be regarded as optically active molecular aggregates, and consequently asymmetrical. Fischer and Thierfelder have based upon this the hypothesis that between the enzymes and those substances which they attack, there must exist a correspondence in molecular configuration, which they compare to a lock and key. The observations of G. Bertrand on the relation of the polyvalent alcohols to their oxidisability by the sorbose bacteria, shows clearly that stereochemical considerations may be applied to other fermentive processes. Fischer applies the same idea to the chemical changes occurring in the bodies of higher organisms, which lead to the conclusion that in the chemical changes in which the proteid substances take a part as active masses, undoubtedly the case with protoplasm, the configuration of the molecule (*i.e.* space arrangement of the atoms) plays a part fully as important as its structure (*i.e.* plane, or relative arrangement of the atoms). It is easy to conceive on this hypothesis that the three isomeric tartaric acids should be assimilated at an unequal rate in the organism of the dog, and that of two sugars so closely allied as glucose and xylose, it is only the former which is oxidised or converted into glycogen, whereas xylose passes unaltered through the system.

The results of stereochemistry may also throw some light on chemical transformations occurring in the organism. The four sugars, *d*-glucose, *d*-mannose, *d*-fructose and *d*-galactose are not only those that are exclusively attacked by yeast, but those which in the animal system are assimilated as glycogen. The conversion of glucose, mannose and fructose into one another was first achieved by Fischer by a process of alternate reduction and oxidation, since when Lobry de Bruyn and van Ekenstein have arrived at the same result by simply warming with alkalis.

As von Baeyer pointed out twenty-eight years ago, all these phenomena may be explained by the intramolecular migration of an oxygen atom from one carbon atom to the other. The intermediate phases of this process are unknown; but alcoholic fermentation is an example of the facility with which the operation is effected. In regard to the assimilation of carbon dioxide by plants, which gives rise to exclusively active sugars, a similar explanation may be found, seeing that the carbon dioxide in process of assimilation is associated with the optically active chlorophyll bodies.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. F. C. Kempson, of Caius College, has been reappointed a Demonstrator of Anatomy for one year; and Dr. Elliot-Smith, Fellow of St. John's College, a Demonstrator of Anatomy for five years.

The work of Mr. W. Rosenhain, advanced student of St. John's College, which includes the joint Bakerian Lectures, with Prof. Ewing, delivered this year, has been approved for the University certificate of research.

Dr. Hill, Dr. Allbutt, Dr. Sladen, and Prof. Woodhead have

been appointed representatives of the University for the organisation of a Congress on Tuberculosis to be held in London in 1901.

AT the annual prize distribution of the Merchant Venturers' Technical College, Bristol, on December 20, an address will be given by Sir W. H. White, K.C.B., F.R.S., Director of Naval Construction to the Admiralty.

WE learn from the *British Journal of Photography* (December 1) that Dr. Hans Harting, formerly of Messrs. Zeiss, of Jena, has joined the Board of Management of Messrs. Voigtlander and Sohn. He succeeds Dr. Miethe, who was recently appointed Professor of Chemistry and Spectrum Analysis at the Technical High School, Berlin.

THE annual prize distribution and conversazione of the Northampton Institute, Clerkenwell, will be held to-morrow evening, December 8. Sir Henry Roscoe will distribute the prizes. A comprehensive programme of exhibits and short lectures referring to the various sides of the Institute's work has been prepared. Dr. Walmsley will describe alternating currents; Mr. John Ashford, flying machines in fiction and fact; and Mr. A. W. Martin, high speed telegraphy. There will also be special demonstrations of liquefaction of air, alternate currents, ice-making, mortising by machinery, colour photography, rapid stereotyping, and other subjects.

THE *Pioneer Mail* announces that the Government of India have given their cordial approval to the Tata scheme for an India University of Research, recently formulated by a conference at Simla, and already referred to in these columns. As soon as all the details have been worked out, the necessary legislation for the incorporation of the new University will be undertaken. Meanwhile the Government of India commend the scheme to the liberality of the public, and wish it every success, while they acknowledge in the most cordial manner the public spirit shown in Mr. Tata's munificent endowment. The Government of Bombay will be asked to appoint an officer to arrange with Mr. Tata for the transfer of the property which is to constitute the endowment.

THE Calendars of University College, London, and the University College of Sheffield, for the session 1899-1900, have been received. In the former, the Dean of the Faculty of Science, Prof. T. Hudson Beare, refers to the part taken by the College in connection with the reorganisation of the University of London, and expresses pleasure that in the new University engineering is to be put on an equal with the sister professions, law and medicine, and that (if the draft statutes are adopted) it is to have its own Faculty and its own representatives on the Academic Council. A noteworthy addition to the Dean's report is a complete list, covering nine pages, of the original memoirs and writings which have emanated from the different scientific departments of the College during the past two years. In the Calendar of the University College of Sheffield it is announced that a bacteriological laboratory has been established, with a special demonstrator to devote the whole of his time to bacteriological investigations.

SOME interesting particulars with reference to the relative attention given to science in our secondary schools, as judged by the number of candidates who present themselves in scientific subjects in the public examinations usually taken by the pupils, is given in the December number of *The School World*. It appears that in January of this year, of 1250 candidates examined for matriculation in London University, 842 selected a language as their optional subject, and 408 a branch of science. The total number of candidates who were examined in the five optional science subjects was little more than half the number that selected French as the optional subject. At the last Oxford Senior Local Examinations, the number of papers worked in English subjects was 6977, in languages 2418, in science subjects 796; in addition to which 969 candidates took mathematics. In the Senior Cambridge Local Examinations in 1898, the number of papers in English subjects was 10,327, in languages 3391, in mathematics 1590, and in science 1838. Similar proportions are shown to exist among candidates who present themselves for other general examinations. The numbers show clearly that in most of our secondary schools science still occupies but a minor place in the curricula.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Microscopical Society, November 15.—Mr. E. M. Nelson, the President, in the chair.—Mr. C. L. Curties exhibited a new form of portable microscope by Leitz. It had a folding foot and a movable stage, to enable the instrument to be packed in a small compass. The body was not made to incline, but was furnished with coarse and fine adjustment, and the stage was fitted with a modified form of Abbé condenser, with iris diaphragm. The President thought the instrument would be useful to those requiring a very portable one; its great compactness was effected in an ingenious manner, while the working parts were well made and finished.—The President read a short note descriptive of a set of three simple hand microscopes on the Coddington principle sent for exhibition by Mr. Edward Swan. They were apparently made for a medical man, and could not be very old. Dr. Hebb said Prof. Groves had made some modification in the form of a hand microtome, and had sent it for exhibition. The President called attention to six photomicrographs of the larvæ of gnats, taken from life by Mr. J. T. Holder. The President exhibited an old Gillett condenser, dated July 20, 1849, which had a collar adjustment.—Dr. H. C. Sorby's paper on the preparation of marine worms as microscopical objects was read by the President in the unavoidable absence of the author. The subject was illustrated by beautifully mounted slides under microscopes.—The attention of the meeting was then directed to a fine exhibition of *Foraminifera* by Mr. A. Earland, shown under a large number of microscopes, with written descriptions explaining the points of interest in each slide.

Linnean Society, November 16.—Mr. G. R. Murray, F.R.S., in the chair.—Mr. J. E. Harting communicated particulars of several cases in which parrots had been poisoned by eating parsley. After commenting on instances in which plants that were innocuous to man had proved fatal to some of the lower animals, he mentioned in support of the converse case that the berries of the yew and privet, which are generally considered to be poisonous to man, were greedily eaten by blackbirds, thrushes, bullfinches, and other birds; while, on the other hand, several cases were on record of pheasants having been poisoned by eating yew leaves. The immunity of goats from yew poisoning was remarkable in view of the fact that deer and cattle died after eating the leaves of that tree, although it had been stated that the ill effects were due to the leaves having been eaten in a desiccated state, and not while growing on the tree.—Mr. W. C. Worsdell read a paper on the comparative anatomy of certain species of *Encephalartos*. The chief features of the anatomy were shown to be the presence of several vascular cylinders in the stem, a character found also in *Cycas* and *Macrozamia*; and the *medullary* system of vascular bundles, forming, as in *Macrozamia Fraseri*, Miq., a complex network, intimately united with a corresponding network of mucilage-canals. The system of mucilage-canals in the pith is continuous with that of the cortex, but the medullary bundles form an independent *primary* system. The mucilage-canal-system is probably of use as a storehouse of moisture during the dry season, when the roots and foliage die away.—Mr. W. T. Calman read a paper on a collection of *Brachyura* from Torres Straits. These Crustacea had been collected by Prof. Haddon on his first expedition to Torres Straits in 1888. It comprised about seventy-five species, three of which were described as new, namely, *Cryptocnemus Haddoni*, *Pilumnus cristipes*, and *Lambrus confragosus*. Among the species already known, concerning which some fresh details were given, was the minute parasitic *Hapalocarcinus marsupialis*. Although described forty years ago by Stimpson, it had escaped re-examination until now, notwithstanding that the curious gall-like growths to which it gives rise on corals are well known. The occurrence in this collection of the three known Indo-Pacific species of *Palicus* (*Cymopolia*), two of which have been recorded hitherto only from widely distant localities, afforded the author of this paper an opportunity for a detailed examination of their distinctive characters.

Geological Society, November 22.—W. Whitaker, F.R.S., President, in the chair.—On some remarkable calcisponges from the Eocene Tertiary Strata of Victoria (Australia), by Dr. George Jennings Hinde, F.R.S. The greater number of the sponges described were discovered by Mr. T. S. Hall, of Melbourne

University, in incoherent detrital beds of Eocene age, in the southern part of Victoria; a few were picked out of some washings of fragmental polyzoa from the same district and horizon, by Mr. B. W. Priest. Some of the specimens are in an extremely perfect condition, and their structural details are as distinctly shown as in recent sponges. They are also of more than local interest in that they are the first fossil forms described of a group of calcisponges, the Lithonina, characterized by the peculiar aberrant forms of some of the spicules, and the mode in which they are closely fitted and organically fused together to form the skeletal mesh. This structure has, so far, only been recognised in one recent species, *Petrostroma Schulzei*, Döderlein, from the Japanese sea. The sponges are small, unattached, with a glassy, firm resistant skeleton, calling to mind that of siliceous Lithistida. They are built up of a great variety of spicular forms, some are simple rods, with three and four-rayed spicules, similar to those in recent calcisponges; but the majority are aberrant four-rayed forms, with three of the rays curved and with obtuse or expanded ends which are clasped, and fused as well, to the surfaces of adjacent spicules. The connected spicules form continuous anastomosing or radial fibres resembling those in the fossil Pharetrones, to which they are in some other respects similar, and it is probable that the spicules in the fibres of some members of this family were likewise organically cemented together. The common *Porosphæræ* from the Upper Chalk, generally regarded as Hydrocorallines allied to the recent *Millepora*, are also closely related to the above sponges, and the author hopes shortly to publish the evidence for their affinity to this group. The Victorian sponges are placed in four new species, belonging to three genera: two of these are new, the other, *Bactronella*, Hinde, was founded on some peculiar calcisponges of Jurassic Age, now known to be Lithonine in character.—In the discussion which followed, Prof. Sollas referred to the importance of these sponges from an evolutionary point of view.—The Silurian Sequence of Rhayader, by Herbert Lapworth. The stratigraphical relations of the Silurian formations which occur in the country surrounding the town of Rhayader (Radnorshire) were described in detail. Typical and confirmatory sections were given, demonstrating the complete local sequence of the rocks of the Rhayader district. These were illustrated by lists of characteristic graptolites. These fossils were compared with those of Southern Scotland, Sweden, and North Wales, showing that the graptolite succession is everywhere similar, and fixing the age of the Rhayader series as representing the Lower Llandovery, Upper Llandovery, and Tarannon of other areas. Finally, several new species of *Climacograptus* and *Diplograptus* were described. Tables of fossils enabled the author to establish a complete comparison of the whole of the local zones of the Rhayader district with those of Southern Scotland, Wales, and Sweden. In the Rhayader area there is found, for the first time in Britain, the entire Valentian succession developed in one general sequence of rocks, with a more or less common lithological character and with a fauna composed throughout of similar palæontological types.

MANCHESTER.

Literary and Philosophical Society, November 28.—Prof. Horace Lamb, F.R.S., President, in the chair.—Prof. F. E. Weiss exhibited some specimens of *Melanospora parasitica* found by Mr. H. Murray at Flixton. This species is now known to be parasitic on another fungus, *Isaria farinosa*, which infests the larvæ and pupæ of various insects. The latter fungus (*Isaria*) is now recognised as being another stage of growth of *Cordiceps militaris*, which has been particularly common this autumn.—Report on the Marine Mollusca obtained during the Jackson-Harmsworth Expedition to Franz Josef Land 1896–97, by J. Cosmo Melvill and Robert Standen. The collection was formed by Mr. W. S. Bruce, naturalist to the expedition, mainly at Franz Josef Land, and at Kolguev, the results from the first-named locality being by far the most voluminous both in quantity and quality, and forming an important contribution to science as being the most northerly dredgings of Mollusca yet obtained in the Polar regions. Only one species—a *Buccinum* (*B. Brucei*) of peculiar form—is considered new to science, but a *Thracia*, of which only very imperfect valves were obtained, is also probably so; whilst a *Sipho* (*S. togatus*) is particularly interesting on account of its peculiar epidermis. Considering how fully the Arctic mollusca have been studied, especially during the past thirty years, the results of this expedition are very gratifying. The total number catalogued are Kolguev, 36; Franz Josef Land, 66. Naturally, the nearer the poles are attained, life—pelagic as well as terrestrial—is adversely affected; for instance, the total number of northern mollusca round the Norwegian coasts is, according to Sars, 460 species.

DUBLIN.

Royal Irish Academy, November 30.—The Lord Bishop of Canea, Vice-President, in the chair.—Mr. Trouton showed an apparatus with which he had determined the heat required to evaporate steam from saturated salt solutions. The plan adopted consisted of an inner vessel completely surrounded by a larger one. The same solution is placed in both. The outer one is kept boiling by the application of external heat; the inner by an electric heater. The steam from the inner vessel is collected and weighed. In this way by knowing the heat supplied electrically the latent heat is found. Determinations made with various salts were described. The connection was also considered between the latent heat of evaporation from salt solutions and the cooling which accompanies the solution of the salt in water. In addition an apparatus was shown by means of which the cooling can be observed, through bringing the salt and water together at a temperature higher than the boiling point. This consisted of two spherical vessels placed over each other and connected by a tube which passed through the upper to near the bottom of the lower one. By means of a stopcock connection is closed till required. The water is placed in the lower, the salt in the proper proportions in the upper one. The whole is heated in a thermostate to such a temperature that on mixing, the resultant solution falls to the boiling point. In the case of sodium nitrate this cooling was 40° C.

PARIS.

Academy of Sciences, November 27.—M. van Tieghem in the chair.—The Perpetual Secretary gave an account of the present state of the fund for the Lavoisier monument.—The propagation of a pencil of parallel light, limited laterally, in a heterogeneous transparent medium; integration of the equations of motion, by M. J. Boussinesq.—Experiments on the destruction of Phylloxera, by M. Lanfrey. An aqueous 1 per cent. solution of picric acid is applied during June, July or August. The same treatment may be advantageously applied to other fruit trees.—Observations on the Leonids made in 1899 at the Observatory of Lyons, by M. J. Guillaume. Fog prevented observation on the nights of November 14 and 15, but on November 12, 13 and 16, only twenty-six Leonids were noted.—Observations of the Leonids made at the Observatory of Algiers, by M. Ch. Trépied. The numbers observed were, on November 13, three; on the 14th, thirty-six; the 15th, thirty. Forty per cent. of the shooting stars observed did not belong to the Leonid swarm. The classification of the Leonids in order of magnitude showed that 10 were of the 1st magnitude, 22 of the 2nd, 19 of the 3rd, 9 of the 4th, and 6 of the 5th.—Observations of the Leonids at Algiers, by M. Harold Tarry. During the three nights 92 shooting stars were counted.—On the definition of the area of a surface, by M. H. Lebesgue.—On the number of roots of an algebraical equation comprised in the interior of a given circumference, by M. Michel Petrovitch.—On the generalisation of Lagrange's development in continued fraction of the function $(1 \times x)^m$, by M. H. Pade.—On the stability of equilibrium of floating bodies and particularly of a ship carrying a liquid cargo, by M. P. Duhem. Referring to a recent note of M. P. Appell on this subject, in which a paper by the author is quoted, it is here pointed out that this work was completed in a second paper, with results agreeing with those recently published by M. Appell.—Remark on the preceding communication, by M. Appell.—On the transmission of sound by electricity, by M. Dussand. A description of a microphone by which the spoken sounds can be transmitted with very slight loss of intensity.—On the chemical action of the X-rays, by M. P. Villard. The X-rays, freed from kathode rays by an aluminium screen, cause a violet coloration of the glass, apparently due to an oxidising action.—The action of dry hydrochloric acid upon silver and the reverse reaction, by M. Jouniaux. The interaction of hydrogen and silver chloride in sealed tubes was studied at various temperatures—350°, 440°, and 600°. A limiting value for the percentage of hydrochloric acid formed was found in each case, but the velocity with which this limit was attained differed greatly

with the temperature, requiring several months at 250°, five weeks at 350°, seventy hours at 440°, and only one hour at 600°. Starting with the system silver, hydrochloric acid, a limit was similarly obtained for each temperature; but the final state of equilibrium was not the same as in the first case for temperatures below 600°. It is an example of the false equilibrium of M. Duhem.—On camphenylone, by MM. E. E. Blaise and G. Blanc. Camphene is treated with nitrogen peroxide at 0°, and the nitrate converted into camphenylone by treatment with potash. This ketone is treated with hydroxylamine, and the oxime dehydrated with acetyl chloride. The nitrite thus obtained gives on reduction a base, which is not identical with dihydroaminocampholene or the aminocampholenes. Hence camphenylone and its derivatives do not contain the trimethylcyclopentanic ring which exists in bodies belonging to the camphor series.—The colouring matter of digitalis, by MM. Adrian and A. Trillat. The new substance forms yellow needles, and has the composition $C_{16}H_{12}O_4$. It is very stable towards chemical reagents.—On an experiment relating to submarine currents, by M. J. Thoulet.—The resistance of seeds to high temperatures, by M. Victor Jodin. If seeds are gradually dried they will resist a temperature of 100°. Thus some seeds heated directly to 98° for ten hours were all killed; but if heated for twenty-four hours at 60° and then ten hours at 98°, from 30 to 60 per cent. of the seeds germinated.—On the glacial period in the Central Carpathians, by M. E. de Martonne. A detailed topographical study confirmed the views of Lehmann, showing undoubted signs of glacial action in the Carpathians.—The negative variation is not an infallible sign of nervous activity, by M. A. Herzen.—Cellular embolism, by MM. Charrin and Levaditi.—On a case of endothelioma of bone, by M. Paul Berger.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 7.

ROYAL SOCIETY, at 4.30.—Vapour-density of Bromine at High Temperatures: Dr. E. P. Perman and G. A. S. Atkinson.—Polytremacis and the Ancestry of Helioporidæ: Dr. J. W. Gregory.—Gold Aluminium Alloys: C. T. Heycock, F.R.S., and F. H. Neville, F.R.S.—On the Association of Attributes in Statistics; with Examples from the Material of the Childhood Society, &c.: G. U. Yule.—Data for the Problem of Evolution in Man. III. On the Magnitude of certain Coefficients of Correlation in Man, &c.: Prof. Karl Pearson, F.R.S.

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

LINNEAN SOCIETY, at 8.—On some Vegetable Poisons used for the Capture of Fish by the Australian Aborigines: J. W. Fawcett.—On some New Zealand Schizopoda: G. M. Thomson.—On the Structure of Porites: H. M. Bernard.

CHEMICAL SOCIETY, at 8.—Ballot for the Election of Fellows.—The Oxidation of certain Organic Acids in presence of Iron: H. J. H. Fenton, F.R.S., and H. O. Jones.—The Determination of the Constitution of Fatty Acids, Part II.: Dr. A. W. Crossley and H. R. Le Sueur.—On Sulphates of the Form R'_2SO_4, $2M''SO_4$, especially those of Isometric Crystallisation: F. R. Mallet.

RÖNTGEN SOCIETY, at 8.—Observations on Practical X-Ray Work, with Exhibition of Apparatus and Stereoscopic Skiagrams: Mackenzie Davidson.—Bullet in the Brain: J. Moore.

FRIDAY, DECEMBER 8

PHYSICAL SOCIETY (City and Guilds' Technical College, Leonard Street, Finsbury), at 5.—Cylindrical Lenses: Prof. Silvanus Thompson, F.R.S.—Exact Formulæ for Lenses: T. H. Blakesley.—On an Organic Compound of Great Double-Refraction: Prof. Silvanus Thompson, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 8.—Note on the Values of the Coefficients of the Terms of the Third Order in the Lunar Theory: E. W. Brown.—Observations of the Leonids at the University Observatory, Oxford: H. H. Turner.—On the Proper Motions of Berlin B. 5072 and 5073: F. A. Bellamy.—New Nebulæ discovered Photographically with the Crossley Reflector of the Lick Observatory: J. E. Keeler.—Observations of the Leonids: Durham Observatory.—On the Relation between Magnetic Disturbance and the Period of Solar Spot Frequency: W. Ellis.—The Extra-Equatorial Currents of Jupiter in 1899: Rev. T. E. R. Phillips.

MALACOLOGICAL SOCIETY, at 8.—On the Anatomy of *Hemiplecta Flowerí*, Smith, from Perak, with Notes on some other Eastern Genera: Lieut.-Colonel H. H. Godwin-Austen.—(1) Note on *Ampullaria Brohardi*, Granger; (2) Description of a New Species of *Leptopoma* from Borneo: E. A. Smith.—Note on the Anatomy of *Zonites Rollei*, Kobelt: W. E. Collinge.—On some Recent Conchological Discoveries in Victoria: Mrs. A. F. Kenyon.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—A Continuous Mean-Pressure Indicator for Steam-Engines: Prof. William Ripper.

MONDAY, DECEMBER 11.

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

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A Journey through Abyssinia to the Nile: H. Weld Blundell.

TUESDAY, DECEMBER 12.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Combined Refuse-destructors and Power-plants: C. Newton Russell.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—Survival in Primitive Rites of the Disposal of the Dead, with special reference to India: Wm. Crooke.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—(1) Notes on the Use of the Dallmeyer Focometer; (2) The Origination of Printing Types by Photographic Methods: T. Bolas.

WEDNESDAY, DECEMBER 13.

SOCIETY OF ARTS, at 8.—Sea Angling and Legislation: F. G. Aflalo.

THURSDAY, DECEMBER 14.

ROYAL SOCIETY, at 4.30.

SOCIETY OF ARTS, at 4.30.—Round about the Andamans and Nicobars: Colonel R. C. Temple.

MATHEMATICAL SOCIETY, at 8.—Sums of Greatest Integers: G. B. Mathews, F.R.S.—Note on Circular Cubics: A. B. Basset, F.R.S.—Formulæ involving Central Differences; and their Application to the Calculation and Extension of Mathematical Tables: W. F. Sheppard.—On the Expression of Spherical Harmonics as Fractional Differential Coefficients: J. Rose-Innes.—The Genesis of the Double Gamma Functions: E. D. Barnes.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Discussion on Mr. Crompton's and Mr. John Holloway's Papers.—Electrical Time Service: F. Hope-Jones.

FRIDAY, DECEMBER 15.

EPIDEMIOLOGICAL SOCIETY, at 8.30.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On Sludge: Blamey Stevens.

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