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THE STORY OF THE SOIL.

The Story of the Soil: from the Basis of Absolute Science and Real Life. By C. G. Hopkins. Pp. 350. (London: T. Werner Laurie, n.d.) Price 6s. net.

WHEN Dr. Cyril Hopkins sets out to write a book we know that we are in for something unconventional, but this time he has excelled himself in unconventionality, and has essayed a task that no author has attempted for the last sixty years: to tell the story of the soil in the form of a chronicle that almost amounts to a novel.

When, in 1852, Hoskyns wrote "Talpa, or the Chronicle of a Clay Farm"—to-day one of the treasures of the agricultural bibliophile—he secured the cooperation of George Cruikshank. But Dr. Hopkins does without any extraneous help, and alone and unaided boldly enters into competition, as he tells us, with popular fiction. The result is remarkable; a clear account is given of the soil in relation to the crop, and the interest of the subject is broadened by skilfully weaving in the threads of a mild novel. It will be interesting to learn whether the farmer reads this book any more readily than he does the ordinary science book that is supposed to appeal to him.

An agricultural student from Illinois, full of facts and figures, travels about the States in search of a farm. He wants to put into practice some of the ideas he has formed during his college course, and so, instead of seeking for improved land, he looks for a worked-out derelict farm. He first goes southwards and strikes a Virginian farm where the produce had fallen during one lifetime from five or six thousand bushels of wheat to five or six hundred, in a district where all the land is at least as impoverished, excepting only a few dairy farms, on which fertility was maintained at the general expense of the locality by the consumption of hay or grain bought in from neighbouring farms. And this in spite of the fact that most of the farms were managed by their old owners, a superior type of people, whose chief characteristics were "culture, refinement, and poverty."

The system of management which had brought about this deplorable state of affairs consisted in ploughing up the run-out pasture land and planting maize, wheat, or oats, followed by a mixture of clover and timothy. The latter is cut for hay for two years, then left for pasture for six or eight years, by which time weeds have crowded out the useful plants; finally a dressing of farmyard manure is applied, and the land is once more ploughed up for maize. Wheat and cattle are the principal products sold. This system, we are informed, is in regular use, and leads always to a similar deterioration. Our agricultural student decided not to settle there, but gave some advice that turned out very useful; he tested the soil with litmus paper, and found that it was acid; hydrochloric acid also showed the absence of carbonates; it was clear therefore that the soil would produce neither clover nor lucerne until lime was added, although it could still grow wheat, maize, and timothy. The question whether burnt lime or the less expensive limestone would be the better had been investigated at the Pennsylvania Experiment Station for many years in what is perhaps the most complete set of experiments in the world on this particular problem, and the result shows that finely ground limestone is superior in every way. At most railway stations in Illinois it can be obtained for 1.50 dollars a ton, this low rate being quoted because it is realised that the general prosperity of railway companies and everyone else in Illinois is bound up with the maintenance of the fertility of the soil. In Virginia, however, no such plan is in operation, so that the cost of the improvement would be considerably higher. But the addition of limestone is only the beginning; the amount of nitrogen in the soil has also to be increased, and this can only be done profitably by growing leguminous crops. Since clover only grows with difficulty, and lucerne not at all, recourse was had to inoculation, not with a bacterial culture, but with soil that had grown lucerne well. Finally, the addition of rock phosphate and an improved rotation raised the fertility of the soil considerably.

A very different problem was presented by the swamp soils of Illinois, barren in spite of their high content of humus, nitrogen, and phosphorus compounds. The Illinois Experiment Station, knowing how to set about the problem, discovered that the supply of potassium constituted the limiting factor; as soon as potassic fertilisers were added the barren soils produced great crops at the cost of about three dollars per acre. A man who had been farming some of the same soil came to see the result, and brought with him his wife and children.

"As he stood looking first on the corn on the treated and untreated land, and then at his wife and children, he broke down and cried like a child. Later he explained to the superintendent who was showing him the experiments that he had put the best of his life into that kind of land. 'The land looked rich,' he said, 'as rich as any land I ever saw. I bought it and drained it and built my house on a sandy knoll. The first crops were fairly good, and we hoped for better crops, but instead they grew worse and worse. We raised what we could on a small patch of sandy land, and kept trying to find out what we could grow on this black bogus land. Sometimes I helped the neighbours and got a little money, but my wife and I and my older children have wasted twenty years on this land. Poverty, poverty, always! How was I to know that this single substance which you call potassium was all we needed to make this land productive and valuable?'"

Thus experience by itself counts for very little; indeed, "experience is a mighty dear teacher, and if we finally learn the lesson it may be too everlasting late for us to apply it." And so, when finally our student settles down in Heart-of-Egypt, Southern Illinois, he has his soil analysed, draws up a rotation and scheme of fertilisers on the most approved principles, sets them into operation, and—very nearly fails. The situation is saved by some advice given by an old farmer, who has learnt the secret of proper tillage. Moisture, in fact, had been lacking, and the fertiliser scheme, good as it was, had no chance to show its merits until moisture-conserving tillage was adopted. Thus the young man's science and the old man's experience finally solved the problem, and that particular tract of land was conquered.

But we have only been able to give a very brief account of this delightful book. The American agricultural student and farmer are admirably drawn, and the reader also learns Dr. Hopkins's views on soil fertility, and where he differs from the Bureau of Soils. Light reading the book certainly is, as the author intended, but it has depth and permanent value.

E. J. RUSSELL.

TWO IMPORTANT WORKS ON CLIMATOLOGY.

(1) *Handbuch der Klimatologie.* By Prof. J. Hann. iii. Band. Klimatographie. 2 Teil, Klima der gemäszigten Zonen und der Polarzonen. Dritte Auflage. Pp. ix+713. (Stuttgart: J. Engelhorn's Nachf., 1911.) Price 23 marks.

(2) *Das Klima der Schweiz auf Grundlage der 37-jährigen Beobachtungsperiode* 1864–1900. Bearbeitet von Jul. Maurer, Rob. Billwiller, jr., und Clem. Hess. Preisschrift herausgegeben durch die Stiftung von Schnyder von Wartensee mit Unterstützung der schweizerischen meteorologischen Zentralanstalt. In zwei Banden. Erster Band, Text, pp. viii+302. Price 12 marks. Zweiter Band, Tabellen, pp. v+217. Price 8 marks. (Frauenfeld: Huber and Co., 1909–1910.)

WITH the third volume of his "Handbuch der Klimatologie" (1) Prof. Hann has completed the third edition of that famous work. This last volume deals with the special climatology of the temperate and polar regions. It would be difficult to find in other 700 pages of printed matter a similar collection of well-arranged facts. Not that the book is a mere collection of facts. The author has succeeded in clothing the dry bones with flesh, and the discussions of the data and the bringing of them into relation, on one hand, with the general physics of the globe, and, on the other, with the various phases of human activity, make most interesting reading. The manner in which the works of other authors are drawn on in this connection is wholly admirable.

The arrangement of the book is similar to that adopted in the second volume, which dealt with the tropics. Each section commences with a general description of the main features of the region under review. Thus when considering the Mediterranean—the world of the ancients—twenty-five pages suffice to supply a framework into which we can fit the details of the later 140 pages of special description. They bring vividly before us the essential differences between the coastal and the inland regions, the distribution of rainfall with its typical winter maximum becoming gradually modified into a summer maximum at the foot of the Alps, the peculiar temperature conditions with the remarkable warmth of the autumn months, and the principal local winds. More detailed information for each country or other division follows. This is accompanied by much tabular matter, the scope of which has been considerably extended in this edition as compared with its predecessor. Data are now given, as a rule, for all twelve months, and not merely for four characteristic months. For regions which possess no organised meteorological services the work of bringing together data from scattered sources, comparing them and calculating average values, had to be gone through. Even for regions where an organised service exists Prof. Hann has not always been satisfied with mere selection and extraction. For instance, in the tables of mean temperature he has endeavoured to correct the values so as to give the best approximation to the true daily mean wherever it was possible and necessary to do so. Great stress is laid throughout on this element, and in some cases a laborious recalculation of means has been gone through in order to realise the object.

When dealing with regions of which the majority of his readers are likely to have no personal experience, Prof. Hann has added to the discussion of the data pregnant descriptions of the effects of the climate on man, taken from the accounts of travellers or residents. These serve to bring out the salient points in a way that tables of extreme and mean values fail to do. Thus the contrast between the generally calm condition of eastern Siberia with its intense winter cold and the violent blizzards of the steppes of the western Siberian region makes little impression on our imagination until we consider the effects of these climates on man. In the east the intense cold is borne without serious discomfort, but in the steppes the wind and drifting snow render the conditions almost unbearable, though the temperature may be considerably higher. Again, the accounts of the effect on man of the snowstorms of the steppes remind us in many ways of the sandstorms of the African desert. Against both, man and beast are powerless.

Since the appearance of the second edition in 1897 our knowledge of the main features of the climate of Europe and North America has altered little. Progress has been mainly in the direction of a more thorough discussion of the data. Most of the old-established meteorological services have published summaries of the whole or of a portion of their accumulated observations. Thus for Russia we have Rykatscheff's "Climatological Atlas for the Russian Empire," for Germany Hellmann's work on the rainfall of North Germany, for France Angot's temperature tables, and for Italy Eredia's temperature and rainfall tables. For Austria the results for each province are being issued separately; those for four regions have already appeared, and have been noticed from time to time in NATURE. For the American continent we have Henry's "Climatology of the United States" and Bigelow's "Report on the Temperatures and Vapour Tensions of the United States," which have been issued by the Weather Bureau. In Australia also the establishment of a Commonwealth Weather Meteorological Bureau has already given us a new rainfall map of the continent. In other parts of the world the primary survey has been pushed forward into what were in 1897 little-known regions. Especially in South Africa has there been a great improvement consequent upon the establishment of the Transvaal meteorological service. In no part of the world have the last few years seen a greater advance than in the Antarctic. In the second edition two pages sufficed to summarise our knowledge of its climate. In the present one twenty-two pages are assigned to it, in which we find, perhaps for the first time, a summary of all the data collected between the Ross expeditions of 1840 and Shackleton's dash for the pole.

Not the least valuable part of the book is provided by the very complete references to the sources from which information is taken or to works in which further details may be found. Many of these are to such recent publications that they can only have been added as the proof-sheets were going through the press. In such a complete work it seems almost ungrateful to ask for more, but we should have liked to see more maps included in the book. Ten diagrams seem a small allowance for 700 pages of letterpress in a subject which depends so largely on geographical distribution as climatology does. An atlas should always be at hand when the book is being consulted.

(2) It is instructive to turn from a book like the "Handbuch," which deals in the comparatively small space of 700 pages with the climate of the temperate and polar regions, to a work like that recently issued under the joint authorship of Maurer, R. Billwiller, jun., and C. Hess, on the climate of Switzerland. Two quarto volumes, together running to more than 500 pages, devoted to the climate of some 15,000 square miles of the earth's surface! We find ourselves asking what space would be required to deal equally fully with the whole area discussed by Hann. The authors have, however, had in view a totally different object. They have set themselves the task of summarising the observations which are available for their country in the year-books of the Swiss Meteorological Institute. They have followed to some extent the plan adopted in the somewhat similar publications for the provinces of Austria to which reference has been made above. Tables comprise a large part of the work. One set gives the average values for the meteorological elements usually observed at stations of the second order for ninety-five stations, based wherever possible on observations for the period 1864, the year of establishment of the Confederate meteorological service, to 1900. In the case of mean temperature normal values for the period 1864–1900 have been computed by extra-polation whenever the observations extended over a sufficiently long period to justify doing so. Another set of tables gives the monthly means for the principal elements for each year of the period for those stations which have been in operation throughout. There is thus plenty of material for the study of meteorological problems from the historical point of view. Average hourly values are also given for a few places for the most important elements. The whole forms a most valuable body of statistics.

The first volume of 300 pages is devoted to the discussion of the data. The plan adopted is a combination of that followed in France and Italy, where the distribution of one element over the whole country forms the subject of elaborate works, such as Angot's temperature tables, or Eredia's rainfall tables, and the Austrian method of considering the climate of each region as a whole. We have first a few chapters devoted to the consideration of the distribution of each element, and then a detailed discussion by regions. In the section on temperature, considerable space is devoted to the interdiurnal variability of temperature and to the frequency of changes of given magnitude. As at other places in Central Europe, the variability is smallest in September for most stations, but the mountain stations show a distinct minimum in April. The greatest variability occurs at moderate altitudes on the southern slopes of the Alps. In the section on rainfall we have a new map of the distribution of annual rainfall, based on observations at 400 stations, reduced to the forty-year period 1864–1903. The highest value is 251·4 cm. on the Säntis, at an altitude of 2500 m., the lowest 52·8 cm. at Grächen, in the Upper Rhone valley, at an altitude of 1629 m. We should have expected rather more information regarding the average depth of snow, but systematic observations thereon are of comparatively recent date. For a number of places it is possible to give the average earliest and latest dates on which snow remains lying. At stations at 1000 m. there are on the average 140 to 150 days in the year with snow lying, and during the winter months almost all days come into this category. Figures are also given for a selection of stations of the percentage of the total precipitation which falls as snow. The increase with height is approximately linear, being at the rate of 1 per cent. per 100 feet. Very interesting results are given for the records of bright sunshine on the mountain stations, for which the percentage of the possible shows a distinct maximum in winter. The Säntis records 49·3 per cent. of the possible during November, and 47·5 per cent. for December, the corresponding figure for June being 31·2 per cent. For Ben Nevis the percentages for these months are:—November, 11; December, 9; and June, 22. In an appendix Dr. Hess discusses the statistics of thunder and hailstorms, which have been collected systematically during the past twenty years.

We congratulate the authors and the Swiss Central Meteorological Institute on the completion of this most important contribution to the climatology of their country.

THE LAST VOLUME OF LORD KELVIN'S PAPERS.

Mathematical and Physical Papers. Vol vi., Voltaic Theory, Radio-activity, Electrons, Navigation and Tides, Miscellaneous. By the Right Hon. Sir William Thomson, Baron Kelvin, O.M., P.C., G.C.V.O. Arranged and revised, with brief annotations, by Sir Joseph Larmor, Sec.R.S. Pp. viii + 378. (Cambridge: University Press, 1911.) Price 10*s*.

A FEW months ago we reviewed the fourth and fifth volumes of Lord Kelvin's "Mathematical and Physical Papers," and now we have the sixth and concluding volume. Sir Joseph Larmor is to be congratulated on the conclusion of a task which, however congenial to him, must have caused him a good deal of labour and anxiety. And the work has been done in the best possible way. The short notes appended here and there are very helpful, but the personality of the editor is never obtruded; indeed, it might sometimes, with advantage perhaps, have been more in evidence. The error, if it be one, is on the right side, and it may be that in connection with the selection of letters which we understand it is proposed to publish, we may have more of the editor's views on the various scientific questions, still unsettled, which are raised in these volumes.

The present volume contains papers on the electrification of air, on contact electricity, on radio-activity, on navigational and tidal instruments, terrestrial magnetism and the correction of the compass, and one or two of Lord Kelvin's last popular addresses. These papers are for the most part too recent for discussion here; the continued progress of research on ionisation and radio-activity is a commentary on many of them, and in any case we have no space for even a descriptive account of their content.

A word may perhaps be said on the vexed question of contact electromotive force between metals. Surely the reality of any contact difference of potentials must depend on whether or not any perceptible energy change—evolution or absorption—takes place at the surface, or rather the locality, of contact. When a part of a circuit carrying a current is moved in a magnetic field work is done upon or by that part, and energy is there absorbed or evolved, while in all parts of the circuit there is energy converted into heat with a corresponding potential gradient. And when there is change of potential from metal to liquid or from liquid to metal, or from liquid to liquid, energy changes which correspond are concerned. The process is, if anything, still more evident in thermo-electric circuits, and leads to an absolute evaluation of electromotive force. Now there must at bottom be unity of cause of electromotive force, and the existence of a finite contact electromotive force between metal and metal, which seems to have been insisted on to the last by Lord Kelvin, is, from the point of view of the energetics of the circuit, a great difficulty to some at least of those who are earnestly striving to obtain a clear and consistent view of voltaic phenomena.

The papers on radio-activity are very interesting as heroic attempts to explain on dynamical grounds, without calling into play any process of atomic disintegration, the extraordinary energy changes which radium and its products have disclosed. The comparison (p. 209) of the permanent rise of temperature of a thermometer which has radium near its bulb with the excess of temperature of a vessel containing black cloth over that of a similar vessel containing white cloth, when both vessels are immersed in baths of water exposed to the sun's rays, seems only to make the difficulty of any such explanation more evident, at least to the mind of the ordinary student. What corresponds to the sun's radiation in the radium experiment? According to this hypothesis, the radium "somehow" picks up energy of ethereal waves in a very special and effective manner. Is it not simpler and more reasonable to put down in the ordinary way the energy evolved to the changes effected in the stuff, especially as such changes are chemically manifest? It would seem so; and yet the suggestion must be received with respect and tested as far as possible, even though it appear to involve the reconsideration of many other cases of physical and chemical change.

The navigational and tidal papers are less sensational, but are of great interest in connection with terrestrial physics. The tide-predicting machine, set from the results of the analysis of tide curves, makes the past disclose the future in a very remarkable manner, and if nothing else had directly or indirectly come out of the work of the British Association Committee on Tides, would have justified the whole expenditure on that subject. But much more has come; through Lord Kelvin's and Sir George Darwin's guidance and the work of the committee and its skilled calculators the book of the tides of long period has been opened, and its secrets are being read.

As a lesson on the theory and practice of mechanical integration the tidal analyser ought to be better known than it is. We have not seen, except in connection with the tidal application, any adequate popular account of it; and yet the machine, from the point of view of integration-theory, and even of differential equations, is of great interest and importance. The machine with two complete harmonic components in periods of the ratio 1 : 2 is, or was, used for variations of atmospheric pressure; but the large machine constructed for the tidal application and described in the volume of papers before us stands inactive at South Kensington.

The oration on James Watt and the inaugural address delivered as chancellor of the University of Glasgow are given as interesting memorials of Lord Kelvin's lifelong association with Glasgow. They were reported in NATURE at the time, but their reproduction here gives a fitting personal note with which to close the long and brilliant record of scientific work which these volumes contain, a record which is one of the most glorious scientific facts of the most scientific age of the world's history. A. G.

SEWAGE PURIFICATION.

Modern Methods of Sewage Purification: a Guide for the Designing and Maintenance of Sewage Purification Works. By G. Bertram Kershaw. Pp. xiii+356. (London: Charles Griffin and Company, Ltd., 1911.) Price 21*s*. net.

IN view of the numerous text-books dealing with the purification of sewage which have recently appeared it would seem difficult to justify the publication of a further work on the subject. During the long period in which the author has been associated with the Royal Commission on Sewage Disposal he has had exceptional opportunities of personally investigating the various methods which have been adopted for the solution of the difficult problem of the economic disposal of sewage, and consequently he is well qualified to undertake a treatise on the subject.

The book to a very large extent, however, owes its justification to the systematic and exhaustive manner in which the author quotes the various findings of the Commissioners, with whose work he is naturally thoroughly intimate. Considerable space is devoted in the opening chapters to a historical survey of the subject, together with a *résumé* of the various laws enacted to deal with questions of public health, river pollution, &c. Later, such questions as drainage area, water supply, sewerage system, rainfall, variation in rate of flow of sewage, &c., all of which influence in some degree the ultimate scheme of purification, are dealt with in a very complete manner.

Under the head of preliminary processes the author, of course, deals with the various methods of tank treatment. It is, however, unfortunate that in a work of this character passing reference only is made to the recent work in regard to the extension of the original idea of septic tank treatment. It would have been interesting, *e.g.* to have had the author's views on the Emscher tank of Imhoff, which at the present time is apparently creating a very favourable impression amongst Continental and American engineers.

Where difficulty is experienced in disposal of the tank sludge, it is obviously important to reduce the quantity produced to a minimum. The above tank is designed with this object, by allowing the accumulated sludge a maximum period for fermentation out of contact with the sewage passing through, and it is claimed that not only is there a considerable amount of actual destruction of the organic matter, but that the resultant sludge is of high density with consequent further diminution of volume to be dealt with. On the other hand, where the sludge can be readily disposed of without nuisance, it is very doubtful whether the increased expenditure on tank construction would be justified.

In connection with the question of tank treatment, the author's statement that nitrogen and oxygen are evolved in the septic tank requires correction. The conditions prevailing do not allow of the evolution of oxygen, and in the absence of nitrates in the sewage it is more than doubtful whether nitrogen is actually evolved. Nitrogen is usually found in septic tank gases, but in all probability it is derived from solution in the sewage and not as the result of any fermentative action. The chapter on sludge disposal is well written and comprehensive; reference, however, could with advantage have been made to the possibility of the recovery of grease from sludge, or of use in specially constructed gas producers.

The author's intimate acquaintance with the representative English sewage farms has enabled him to deal with the question of the purification of sewage on land in an excellent manner. Unfortunately the number of places where such treatment of sewage is possible in England is rapidly diminishing. When considering the question of treatment of sewage on contact beds and percolating filters, the author follows the lines laid down by the Royal Commission, and in the chapters dealing with this part of the subject elaborate quotations from the various reports of the Commission are given. It is to be observed that as regards the engineering side of the subject, the author doubtless has been to a large extent responsible for the conclusions arrived at by the Commissioners.

The importance of the remarks on p. 229, in regard to the construction of feed carriers, cannot be too strongly emphasised. The existence of channels which can only be emptied by extensive pumping operations is certainly to be avoided, on account of the trouble arising from the secondary decomposition of the sludge which periodically accumulates.

The value of the work is increased by the number of examples of works in operation, together with plans and results of treatment, although a more representative works illustrating contact-bed treatment might have been selected. The book can be recommended to sanitarians as affording a good general survey of the subject from the engineering point of view, and more particularly as being an admirable handbook to the voluminous reports of the Royal Commission on Sewage Disposal. EDWARD ARDERN.

VERTEBRATES OF TWEED.

A Fauna of the Tweed Area. By A. H. Evans. Pp. xxviii+262. (Edinburgh: David Douglas, 1911.) Price 30*s*.

THIS is the eleventh volume of Mr. J. A. Harvie-Brown's well-known "Vertebrate Fauna of Scotland," and brings the series within sight of completion, four areas (Forth and Clyde, Solway and Dee) remaining to be dealt with. Mr. A. H. Evans is to be congratulated on the success with which he has dealt with the fascinating area of "Tweed" and sustained the high traditions of the series. In his labour of love he has been loyally helped by Mr. George Bolam, Mr. William Evans (who is treating of the Forth area), Mr. George Muirhead, Mr. Abel Chapman, and other well-known observers, not forgetting the editor himself. The beautiful illustrations which adorn the text are mostly due to photographs by Mr. William Norrie, of Fraserburgh, whose work has enhanced the value of previous volumes. They bring the habitats depicted very vividly before the eye, most of all when pleasant memories are already there.

"Tweed" is a scientifically natural area, a vast amphitheatre, facing the German Ocean, surrounded on three sides by hills of considerable height, and watered by the river Tweed and its tributaries. It includes considerable variety of habitat—the hills, the sea-cliffs, the rivers, the moors, the woods, and the fertile plains, and the fauna is correspondingly diverse. In his "Introduction" Mr. Evans directs attention to some of the features of peculiar interest. Thus it is still the haunt of some of our scarcer mammals, such as the badger and the great grey seal; and as regards birds, its peculiar interest is in connection with extension of range northward or southward. The nightingale was once identified within the limits, the nuthatch has been known to nest, the wryneck and the green woodpecker have occasionally been seen—"these birds being here approximately at the northernmost point of their range in the United Kingdom." "Of equal interest are those birds which find in the Tweed area their extreme limits to the southward, or at least have not been known to extend far beyond it in recent times." Thus a golden eagle was shot in 1877 on one of the Cheviots, where in earlier days it used to have its eyrie; the wigeon has quite lately been proved to breed in Roxburghshire and Selkirkshire, having certainly arrived of recent years; and the eider-duck's breeding range has its southerly limit at the Farne Islands, which are included near the southern boundary of "Tweed." In short, there is a peculiar interest in the area treated of in this volume, since it occupies a distinctly intermediate faunal position between the north and the south of Great Britain.

The scope of the book needs no description. After an introduction, including a reference to previous workers, and a bibliography, the author gives a short but picturesque account of the physical features of the area, treating of the following subdivisions in order: St. Abb's Head and the Northern Hills, the Western Hills, the Southern Hills, the coast lands and islands, the Berwickshire valleys and the How of the Merse, the shires of Peebles and Selkirk, Teviotdale and Lower Tweedside, the Cheviot valleys and the English tributaries of "Tweed." Then follows the systematic part of the book—the account of the mammals and birds, reptiles, and amphibians. As the ichthyology of the district is so closely connected with that of "Forth," the fishes have been left to the volume on that area. The body of the book is rich in interesting notes, and the author has evidently spared no pains to make his faunistic records complete and accurate. This has demanded much personal verification, and a careful search among old records, many of which require that critical handling which only an experienced naturalist can give.

To give a sample of attractions which the area affords, we will quote a short paragraph in reference to north-western Northumberland:—

"In few localities in the kingdom does the naturalist find so many changing scenes within so short a distance of one another, or so easy of access. The highest hills rise to a considerable elevation, and though he can no longer visit an eagle's eyrie on Cheviot, or even hope to see the king of birds upon the summit, yet he has at least a chance of observing the peregrine falcon and the raven; the resident kites, buzzards, and hen-harriers have departed, as from most parts of England, but he may see the merlin on the moors, while sparrow-hawks, kestrels, and carrion-crows are still more common; the brown and long-eared owls are abundant, and the short-eared owl appears in the time of vole plagues; herons nest at Chillingham and other places; tufted ducks, pochards, shovellers, and teal breed within easy range; wheat-ears, ring-ousels, pied flycatchers, wood-wrens, and grasshopper-warblers occur here and there, with other of our less common passerine birds; black-headed gulls share the lakes with coots and dabchicks; and, finally, it is but a short and easy journey to the Farne Islands or the Fenham Flats."

OUR BOOK SHELF.

In and Out of Parliament: Reminiscences of a Varied Life. By the Right Hon. Robert Farquharson, P.C. Pp. xi+338. (London: Williams and Norgate, 1911.) Price 12*s*. 6*d*. net.

AFTER twenty-five years of Parliamentary life there are sure to be many interesting reminiscences in any man's experience, and when to those years are added many others spent in study and travel, the whole, summed up in easy, flowing language, forms a volume of delightful and pleasant reading. The most interesting part of the book to most people will be that devoted to "In Parliament."

Dr. Farquharson's description of his first entry into Parliament, and of the difficulties and embarrassments which surround anyone in a like position, will be recognised as very true to life by those who have gone through a like experience. Nothing probably strikes the new member, after a few first days of Parliamentary experience, as his apparent uselessness, and his utter inability to do anything "on his own." Later on perhaps things improve. The chase of that elusive object, the Speaker's eye, is interesting, if often disappointing; committee work, and the demands of his constituents, will help to occupy his time, but his first impression of Parliamentary life will not be flattering to his sense of self-importance.

To those who from time to time have raised complaints as to the ventilation of the House, Dr. Farquharson's experience as a medical man, and as a member of two committees under the chairmanship of Sir Henry Roscoe which investigated the questions of the drainage and ventilation, will be reassuring. The source from which the air is pumped and the process by which it is purified and rarefied are described, and should carry conviction to the grumblers.

Dr. Farquharson also assisted in the experiments devised by Sir Michael Foster to determine the number of micro-organisms in the air of the House during its sitting. He sat for two years on the committee which settled the constitution and building of the Science and Art Department, and supported Sir Michael Foster's opposition to the motion against vaccination. He spoke, in fact, on most questions connected with public health and the Army Medical Department.

The perusal of Dr. Farquharson's book will well repay anyone who takes an interest in the inner life of our legislators and the part which a man of science may play in the House of Commons.

Who's Who in Science (International), 1912. Edited by H. H. Stephenson. Pp. xvi+323. (London: J. A. Churchill.) Price 6*s*. net.

THE man of science will find this new publication a very useful addition to the books of reference kept on his desk. The volume begins with lists of the heads and senior professors of the world's universities, and these are followed by short biographies of the more important workers in science in all countries. A classified index brings together conveniently under their various countries the names of the men of science prominently associated with each subject. The biographies provide information as to the academic career and the important contributions to science of each person whose name is included.

Prehistoric Parables. By Wilson Bell. Illustrated by Horace Taylor. Pp. viii+63. (Halifax: Milner and Co.) Price 1*s*. net.

THE seven short stories relating to prehistoric man included in this little book are dramatic and interesting. Civilisation is only superficial in comparison with the history of man, and a scratch will often reveal the elemental human nature beneath. Mr. Bell's parables may therefore represent humanity as faithfully as any efforts to project ourselves into the mind of the past can do. He realises that to place man, as he has done, in the Carboniferous period for artistic effect has no geological sanction—and we think he has gained nothing by such a departure from fact—but overlooking this point the stories are certainly of human interest.

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.*]

FitzRoy and Darwin, 1831-36.

DARWIN'S "Naturalist's Voyage" is the principal record of a period of the greatest importance to him personally and to the world at large. There is also much interesting matter in the accounts of the voyage given in "The Life and Letters"[1] and in "More Letters." In his "Autobiography"[2] Darwin gives his impressions of FitzRoy; thus, he wrote:—

"FitzRoy's character was a singular one, with very many noble features: he was devoted to his duty, generous to a fault, bold, determined, and indomitably energetic, and an ardent friend to all under his sway." After going on to say something of FitzRoy's unfortunate temper and of one of the rare quarrels that occurred between them, he goes on:—"But after a few hours FitzRoy showed his usual magnanimity by sending an officer to me with an apology and a request that I would continue to live with him. His character was in several respects one of the most noble which I have ever known."

The interest of the following extracts is that they give the other side of the picture—that is, they supply us with FitzRoy's impressions of Darwin written in 1831–6. I am much indebted to the Hydrographer, Admiral Purey-Cust, for directing my attention to the existence of the references to my father in the correspondence of FitzRoy with the hydrographer of his day, and for allowing me to see copies of them. These the Lords of the Admiralty have been good enough to permit me to publish. In FitzRoy's "Voyages of the *Adventure* and *Beagle*," ii., p. 39, he states that he was directed to transmit reports from time to time, so that if "any disaster should happen to the *Beagle*, the fruits of the expedition should not be altogether lost." He was also directed to keep up a detailed correspondence with the hydrographer (Captain Beaufort), who, as it happens, was a personal friend.

No. 1. September 5, 1831.

"I have seen a good deal of Mr. Darwin, to-day having had nearly two hours' conversation in the morning and having since dined with him.

"I like what I see and hear of him, much, and I now request that you will apply for him to accompany me as a Naturalist. I can and will make him comfortable on board, more so perhaps than you or he would expect, and I will contrive to stow away his goods and chattels of all kinds and give him a place for a workshop.

"Upon consideration, I feel confident that he will have a much wider field for his exertions than I was inclined to anticipate on Friday last; and should we even be disappointed, by giving me the means of discharging him from the Books, he might at any time return to England or follow his own inclinations in South America or elsewhere."

On September 5, 1831, Darwin[3] had practically given up all hopes of the voyage, having seen an unfavourable letter from FitzRoy to Wood, who was a sort of intermediary between him and Darwin. It scarcely seemed worth his while to come to town, "but here I am . . . Captain FitzRoy is in town and I have seen him. It is no use attempting to praise him as much as I feel inclined to do, for you would not believe me." It appears from Darwin's letter[4] of September 9, 1831, that FitzRoy had confessed that the unfavourable letter to Wood was meant to throw cold water on Darwin's candidature; "he seems to have taken a sudden horror of the chances of having somebody he should not like on board the vessel." The more cheerful view as to a "wider field for his [C. D.'s] exertions" is presumably the official reflection of his favourable view of C. D. as a future shipmate. It is only fair to FitzRoy to remember that up to September 5 he was hampered by a friend who proposed to accompany him,[5] and that it was only on that day that FitzRoy heard that the friend could not come.

No. 2. September 12 [Monday], 1831. Spithead.

"I like what I see of Mr. Darwin very much. He will do well, I think—you are aware, I believe, that he is now with me on his way to see the *Beagle* and get an idea of the square inches he will be allowed."

In "Life and Letters," i., p. 211, Darwin says:—"I shall go on Sunday [September 11] per packet to Plymouth."

With regard to the "square inches," Darwin wrote,[6] September 19, 1831:—"My objection to the vessel is its smallness, which cramps one so for room for packing my own body and all my cases, &c., &c"

No. 3. September 15, 1831.

"He [Darwin], Captain King and I *now* think that it would be better in many respects, that he should *not* be on the *Books*, but that he should go out in a strictly *private* capacity. I am, however, *equally* ready to receive him in *either* manner, and I have recommended his asking which plan meets *your* approbation.

"P.S.—He has seen his future dwelling and is satisfied with it."

At this date Darwin certainly believed himself to be on the books, as he wrote[7] (September 9, 1831):—"Captain Beaufort says I am on the Books for victuals"; and this arrangement was adhered to.

FitzRoy[8] speaks of obtaining the services as naturalist of "Mr. Charles Darwin, a grandson of Dr. Darwin the poet, a young man of promising ability, extremely fond of geology, and indeed all branches of natural history." An order was "given by the Admiralty that he should be borne on the ship's books for provisions. The conditions asked by Mr. Darwin were that he should be at liberty to leave the *Beagle* and retire from the Expedition when he thought proper, and that he should pay a fair share of the expenses of my table."

No. 4. November 19, 1831.

"Messrs. Earle[9] and Darwin are the very men, of all others, for their employment, and I assure you that Darwin has not yet shown *one* trait which has made me feel other than glad when I reflect how much we shall be together." When this was written Darwin was expecting to sail[10] on November 30, but a series of gales prevented this, and it was not until the *Beagle* had twice been driven back to Plymouth that finally, in a dead calm, "we warped from our sheltered and picturesque retreat in Barn-pool"[11] and made a real start on December 27.

Darwin[12] had been living at Plymouth from October 24, and in a very low state of spirits, convinced that he had heart disease, but determined not to consult a doctor, lest he should be declared unfit for the voyage. It is to his credit that he was able to conceal his depressions from his leader, FitzRoy.

No. 5. March 5, 1832. Bahia.

"Darwin is a very sensible, hard-working man and a very pleasant messmate. I never saw a 'shore-going fellow' come into the ways of a ship so soon and so thoroughly as Darwin. I cannot give a stronger proof of his good sense and disposition than by saying 'Everyone respects and likes him.'" It is pleasant to find that what FitzRoy could say of Darwin after a few months' experience was substantially repeated by his other shipmates after five years' knowledge of his character. Thus, for instance, Admiral Mellersh, who was mate on board the *Beagle*, wrote:—"I think he was the only man I ever knew against whom I never heard a word said; and as people when shut up in a ship for five years are apt to get cross with each other, that is saying a good deal."[13]

1 In these footnotes the "Naturalist's Voyage" (edit. 1860) will be referred to as N. V., "The Life and Letters" as L. and L., "More Letters" as M. L., FitzRoy's "Voyages of the *Adventure* and *Beagle*," 1839, as V. A. and B.

2 L. and L., i., p. 60. 3 L. and L., i., p. 201. 4 L. and L., i., p. 208.

5 L. and L., i., p. 201. 6 L. and L., i., p. 212.

7 L. and L., i., p. 207. 8 V. A. and B., vol. ii., p. 18.

9 Mr. Augustus Earle was an artist privately engaged by FitzRoy. He was in bad health and resigned in the summer of 1832. (V. A. and. B., ii., p. 20.)

10 L. and L., i., p. 214. 11 V. A. and B., ii., p. 42.

12 L. and L., i., p. 64. 13 L. and L., i., p. 222.

No. 5, continued.

FitzRoy goes on:—"He was terribly sick until we passed Teneriffe, and I sometimes doubted his fortitude holding out against such a beginning of the campaign. However, he was no sooner on his legs than anxious to set to work, and a child with a new toy could not have been more delighted than he was with St. Jago. It was odd to hear him say, after we left Porto Praya, 'Well, I am *glad* we are *quietly* at *sea* again, for I shall be able to arrange my collections and set to work more methodically.' He was sadly disappointed by not landing at Teneriffe and not seeing Madeira, but there was no alternative."

Darwin had written to his sister[14]:—"I daresay you expect I shall turn back at Madeira; if I have a morsel of stomach left I won't give up." With regard to this part of his voyage, he wrote in 1846:—"Farewell, dear FitzRoy, I often think of your many acts of kindness to me, and not seldomest on the time, no doubt quite forgotten by you, when before making Madeira, you came and arranged my hammock with your own hands, and which, as I afterwards heard, brought tears into my father's eyes."[15]

It was at St. Jago, in the Cape de Verd Islands, that his career as a discoverer in geology began. He wrote in his "Autobiography"[16]:—"That was a memorable hour to me, and how distinctly I can call to mind the low cliff of lava beneath which I rested, with the sun glaring hot, and a few strange desert plants growing near, and with living corals in the tidal pools at my feet."

No. 6. March 4, 1832. Bahia.

(Official letter to the hydrographer, extract from.)

"Mr. Darwin has found abundant occupation already, both at sea and on shore; he has obtained numbers of curious though small inhabitants of the ocean, by means of a Net made of Bunting, which might be called a floating or surface Trawl, as well as by searching the shores and the Land. In Geology he has met with far much more interesting employment in Porto Praya than he had at all anticipated. From the manner in which he pursues his occupation, his good sense, inquiring disposition, and regular habits, I am certain that you will have good reason to feel much satisfaction in the reflection that such a person is on board the *Beagle*, and the certainty that he is taking the greatest pains to make the most of time and opportunity."

The *Beagle* reached Bahia on February 29, 1832. Darwin writes[17]:—"The day has passed delightfully. Delight itself, however, is a weak term to express the feelings of a naturalist who, for the first time, has wandered by himself in a Brazilian forest." At Bahia, too, he began his speculations on the geology of South America (*loc. cit.*, p. 12).

Porto Praya is in St. Jago, already referred to in No. 5.

No. 7. April 28, 1832. Rio de Janeiro.

"Darwin is a regular Trump." On May 18, 1832, Darwin wrote[18]:—"The Captain does everything in his power to assist me, and we get on very well"; and again, "I am very good friends with all the officers."

No. 8. August 15, 1832. Monte Video.

"Mr. Darwin is a very superior young man, and the very best (as far as I can judge) that could have been selected for the task. He has a mixture of necessary qualities which makes him feel at home, and happy, and makes everyone his friend.

"By this Packet, the *Emulous*, he sends his first collection to the care of Prof. Henslow, at Cambridge, there to await his return to England. I *fancy* that, though of small things, it is numerous and valuable, and will convince the Cantabrigians that their envoy is no Idler."

The letter with which he sent the first of his collection to Henslow is published in "More Letters of Charles Darwin," i., p. 10. Apparently it was not until July, 1834, that he received Henslow's encouraging remarks about his collections.[19]

[14] L. and L., i., p. 207.
[15] L. and L., i., p. 332.
[16] L. and L., i., p. 66.
[17] N. V., p. 11.
[18] L. and L., i., p. 237.
[19] M. L., i., p. 14.

No. 9. August 14, 1834. Valparaiso.

"My messmate Darwin is now roaming amongst the Andes—he left me a week ago, intending to wander until the end of September."

No. 10. November 3, 1834.

"Mr. Darwin has been ill, as well as myself, though from a different cause."

Darwin[20] started on a "riding excursion" on August 14, 1834. On his way back he fell ill (September 20), and reached Valparaiso "with great difficulty" on September 27. He was kindly nursed back to health in the house of an old schoolfellow, Mr. Corfield. His father (Dr. Darwin) was apparently puzzled by Charles Darwin's description of the illness, and was unable to identify it. In later life Darwin was sometimes inclined to attribute his own breakdown in health to this South American attack. But when we remember the ill-health of his brother Erasmus there is no need to seek for any cause beyond a hereditary taint.

No. 11. January 26, 1836. Port Jackson.

"My messmate Mr. Darwin is so much the worse for a long voyage that I am most anxious to hasten as much as possible. Others are ailing and much require that rest which can only be obtained at home."

The return home was nevertheless delayed by the necessity of clearing up "some singular disagreements in the longitudes." Darwin[21] wrote:—"This zigzag manner of proceeding is very grievous; it has put the finishing touch to my feelings. I loathe, I abhor the sea and all ships which sail on it."

The most interesting point about No. 11 is Captain FitzRoy's statement about the poor state of Darwin's health. I was quite unprepared for such a statement, and it seems probable that it was the beginning of the general breakdown in health which began so soon after his return to England.

No. 12. February 3, 1836. At sea.

"My messmate Mr. Darwin is *now* pretty well; but he is a martyr to confinement and sea-sickness when under way."

No. 13. May 3, 1836. Mauritius.

"I think you will allow, at a future day, that my messmate Darwin has *well* earned his *stowage* and provisions. Though still a martyr to sea-sickness, he recovers at the sight of land, and if the weather is not very bad, does a good deal at sea, in the thinking and writing way."

FitzRoy's statement as to the amount of suffering which Darwin went through from sea-sickness quite confirms the recollections of other officers.[22] In after life he seems to me to have forgotten how much he suffered.

When he was safe home and settled in London he wrote to FitzRoy[23]:—"I think it far the *most fortunate circumstance* in my *life* that the chance afforded by your offer of taking a Naturalist fell on me." In the preface to the "Naturalist's Voyage" he wrote:—"As I feel that the opportunities which I enjoyed of studying the Natural History of the different countries we visited have been wholly due to Captain FitzRoy, I hope I may here be permitted to repeat my expression of gratitude to him, and to add that during the five years we were together I received from him the most cordial friendship and steady assistance."

The children of Charles Darwin learned from his stories a friendly feeling for those unknown companions of his travels. And I think we also learned from him to respect sailors and to agree with Fielding that "in their own element, there are no persons, near the level of their degree, who live in the constant practice of half so many good qualities."

FRANCIS DARWIN.

February 18, 1912.

Osmotic and Liquid Membranes.

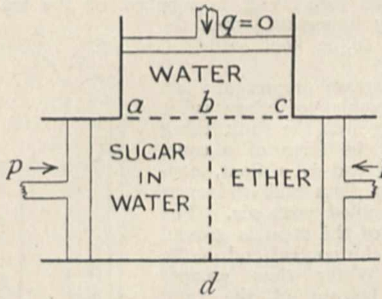
IN the Proceedings of the Royal Society (vol. lxxxvi., pp. 148–54) Prof. Trouton founds a new general method of determining osmotic pressures on experiments of the following character. He fills the closed limb of a **U**-tube with an aqueous solution of sugar, and places pure ether over the solution in the other limb; on applying to the

[20] N. V., pp. 254, 269.
[21] L. and L., i., 265.
[22] L. and L., i., 224.
[23] L. and L., i., 226.

contents of the tube a pressure equal to the osmotic pressure of the sugar solution, he finds that the ether takes up from the solution the same quantity of water that it would contain if it were in contact with water at atmospheric pressure.

I think it can readily be shown that these results can only be due to coincidence.

Consider the system in the figure, where *ab*, *bc*, and *bd* are membranes permeable to water only, and the left-hand compartment is filled with a solution of 600 grams of sugar to the litre—this is the solution that Prof. Trouton uses—bearing in mind that (on the assumption that the solubility of ether in the sugar solution may be neglected) the surface of separation between the sugar solution and the ether in the U-tube is a true semi-permeable membrane, then on closing *ab* and *bc*, and putting a pressure on the two pistons of $p=80$ atmos. (the osmotic pressure of the sugar solution), we have exactly Prof. Trouton's experiment.



The ether therefore takes up water from the solution until it is in osmotic equilibrium with it, but on opening the membrane *ab* the solution is in equilibrium with the water in the upper compartment, where the pressure is $q=0$; on opening the membrane *bc* the aqueous ether will also be in equilibrium with the water, for otherwise perpetual motion would ensue: in other words, p is also the osmotic pressure of the aqueous ether.

Now, if I understand Prof. Trouton's theory right, if any other solution of sugar had been placed in the sugar compartment under a pressure p', corresponding to the new concentration, the ether would have taken up the same quantity of water; therefore, by a similar process of reasoning as in the previous paragraph, the same solution of water in ether has two different osmotic pressures—which, of course, is impossible.

A general method of determining the osmotic pressures of substances not soluble in the liquid semi-permeable membrane can be deduced; it is, however, only a modification of De Vries's original isotonic method. As already pointed out, the ether takes up just such a quantity of water as to give it the same osmotic pressure as the solution; hence it is only necessary to obtain once and for all a series of determinations of the osmotic pressures of varying concentrations of water in ether (these could be derived by means of vapour-pressure measurements), and then place the sugar solution and ether in the U-tube and determine at what pressure the ether takes up enough water for it to have an osmotic pressure equal to the pressure actually upon it. It must not be forgotten that in actual work a correction will have to be applied for the varying solubility of the ether in the sugar solution. BERKELEY.

Foxcombe, February 13.

Microscope Stands.

MAY I be permitted, as having had a practical experience in both English and Continental factories in the actual manufacture and testing of microscopes, also in having made a study of microscopists' requirements in general, to pass a few comments on the subject of microscope construction lately dealt with in the letters appearing in your columns?

In respect to the question of tripod *versus* horseshoe base, certainly the tripod imparts stability to the instrument when in the horizontal position, but the same stability is also to be found in the horseshoe base as made by the more modern makers, who have extended the rear toe, or bearing point. The latest stands of a certain Continental firm greatly excel in this latter feature, which permits of inclination of the instrument to the horizontal with perfect rigidity and safety.

Moreover, the horseshoe base ensures portability to a greater extent than the tripod; and speaking from practical use, no matter which form of base is employed, in photomicrographic work clamping is absolutely necessary to ensure against vibration and the retention of perfect alignment.

The attachable mechanical stage, I have reason to know, was originally brought out in order to provide scientific workers with an accessory which could be utilised in certain branches of work only, and which it is desirable to be able to dispense with at will.

The mechanical stage built into the microscope stand is also made by Continental firms on a rotating principle, so that it can be fixed in any desired position and can be manipulated either from an angle or from the left or right side of the instrument, the cross motion moving independently from the plate on which the object-slide rests in order to avoid the fouling of the condenser, which is the trouble experienced in mechanical stages built into the stand and permitting of manipulation from one side only, as is mostly the case in English-made stands of the pattern referred to.

In the case of curtailed motions, which are adopted in order to avoid fouling, the motions become too short to be of practical use in serial work.

The use of mechanical stages is not advocated in certain branches of scientific study, and is only required at times, when the attachable form is most welcome.

The necessity of a centring device to a substage condenser in preference to the fixed form is a matter for the individual worker to determine. The question presents itself as to how many students in microscopy know how to centre a substage condenser. For all regular and ordinary classes of work, other than the highest scientific investigations, a fixed condenser is the best and an advantage, provided the objectives used are made to a strict standard throughout and are fitted to the identical instrument on which they are intended to be used.

The advanced worker who finds it necessary to employ a centring appliance would, from a practical point of view, do well to select the centring device provided for attachment to the objective and centre it to the condenser, this form being more convenient to adjust in its position at the end of the body-tube, than the centring screws fitted to the substage underneath the stage, this latter arrangement necessitating care being taken not to cut off the light received off the mirror.

If, however, the centring substage is preferred, the same is made by a Continental firm, and this also applies to the objective centring device for use on ordinary microscope stands.

Regarding the standardisation of substage fittings, it is a mechanical impossibility to make smooth sliding fittings interchangeable where tubes are employed, one of which is sprung in order to maintain a certain constant tension, unless by resorting to a pressure screw, which arrangement could, however, only be used when a centring appliance is employed. The standardisation of objectives is a totally different matter, as greater latitude is permissible in cutting the threads, the tension being obtained at the shoulder of the objective mount, *i.e.* when the objective is screwed right home.

In respect to sprung slide fittings *versus* ground-in slide bearings, it has been stated that the former are more easily adjusted by the microscopist, which dispenses with the necessity of returning the instrument to the maker as in the case of ground-in bearings; but it must be recognised that the constant adjustment necessary and ever attendant when sprung fittings are employed in vertical slides, *i.e.* coarse and fine adjustments and substage slides, immediately throws these bearings—responsible for the proper carrying of the above adjustments—and objectives and condenser, out of alignment with each other.

The adoption of slide fittings requiring to be sprung is, from a constructional point of view, totally wrong, and this is proved by the fact that even these slides are ground to fit in the first course of manufacture, and that the springs are cut and adjustment screws provided afterwards in order to take up the looseness and shake which has already developed before the instrument has left the workshop; this will be borne out by any person with practical experience.

The perfectly constructed and accurately machined slide bearings adopted on the Continental microscopes only require slight grinding in, and consequently last for a considerably greater length of time, and if returned to the maker for readjustment, the substage, condenser, and objectives are recentred by any house which has a reputation worth maintaining.

Objectives provided with correction collars are now almost a thing of the past, as cover-glasses of a near definite thickness are no longer difficult to obtain, and what slight correction may be necessary can be effected by an easy working draw-tube of the sliding type, which can be adjusted to a nicety by adopting a twisting motion when moving the tube either up or down.

London, February 19. F. R. BRAND.

On Martian Detail.

THE present seems to me a fitting time to publish the results of nearly three years' investigation of the above subject. In the pursuit of this investigation I have visited most of the principal observatories in the world and tested their seeing conditions, and I conclude categorically that the climate at Flagstaff is immeasurably superior to that of any other observatory with which I am acquainted. At Flagstaff—by the means which experience has proved to be the best—Mars is so well seen that it is difficult to believe it the same planet, the grotesque caricatures of which are apt elsewhere to mislead the observer.

No one elsewhere seems to have realised the fundamental postulates of visual work, the first of which is that small apertures always define better than big, and that if we set a minimum of 12 to 15 in. any increase on this causes a loss of defining power.

That this is not generally known is witnessed by the scepticism of the leading optician of the firm of Alvan Clark, which, however, vanished when he performed the experiment here a few years ago. It is therefore *a priori* impossible to corroborate with vast apertures of 30 to 60 in. the results to which the smaller ones have led us.

In the face of the postulate above stated, it is impossible to believe the work of great apertures. It would be difficult to see why so much confidence has been placed in them were it not for the fact that those who uphold them have up to now never tested the truth of our postulate.

I have even met observers who averred that dark glasses were unnecessary when the planet dazzled the eye.

Those who could overlook this necessity may easily be blind to all other refinements of instrument and observer. That reduction of aperture means improvement of definition may be tested by anyone at any time with any instrument, and none but the wilfully blind can fail to be convinced.

When the above precautions are duly taken the canals are seen with a geometric reality, fineness, and clearness that is amazing. When so seen, the very strangeness of the sight at once suggests and demands the explanation that they are not natural, but artificial, features of the planet—the work of reasoning beings, whose purpose we can divine. Those who discredit the immortal discoveries of Schiaparelli and Lowell have never learned how to observe them, being wilfully or accidentally without knowledge of the proper method of seeking them.

In pursuit of this investigation I have used all apertures from 2 in. to 60 in.

No doubt remains in my mind as to the objective reality of what I have seen, and therefore with entire confidence I endorse the discoveries of Schiaparelli and the further advances made by Lowell in the same investigation. The latter has also set forth what I deem the only rational explanation conceivable to account for this most amazing concatenation of observed phenomena.

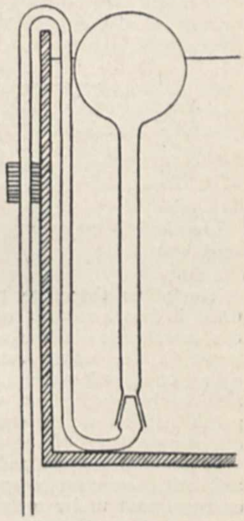
Further, I would point out to your readers that Lowell's explanation is the only complete and consistent one ever put forward, and that it can only be replaced by an equally complete one, and is not to be combated by the isolated and conflicting statements of biassed and partial judgment which up to now have been brought against it.

JAMES H. WORTHINGTON.

Lowell Observatory, Flagstaff, Arizona, January 22.

A Simple Automatic Syphon.

THE accompanying diagram illustrates a form of automatic syphon which has been found useful in cases where it is desirable to draw off water from the *bottom* of a tank at the same rate as it is supplied at the top. This is particularly important when the water has to be kept saturated with air.



The diagram represents an ordinary syphon of glass tube, the opening into the tank being ground to the form of a cone. Above this end is a float, consisting of a glass bulb and open glass stem filled with air. The lower end of the stem is ground to fit over the conical end of the syphon. Water thus escapes from the bottom of the tank through the annular space between the ground portions, and the float automatically adjusts itself so that the rate of flow of water through the syphon is exactly the same as the rate at which water enters the tank. Should the supply of water cease, the float sinks and closes the syphon.

The syphon is conveniently fixed by passing one limb through a cork cemented on to the outside of the tank. The weight of the tube maintains the float in a vertical position, while the ground end of the syphon tube keeps it stationary in the tank.

Charterhouse, Godalming. J. C. THOMSON.

Glazed Frost.

DURING the two winters that I lived in Massachusetts, glazed frosts, or "ice storms" as they were called there, were of comparatively frequent occurrence. I can recall three or four at least.

The ice storm always came after a period of very cold weather, when the temperature had been down to zero or below for some days. Suddenly the frost would break, and the thermometer rose to 32° or 33° F., the sky became overcast, and a heavy drizzle began to fall, driving before a slight wind, usually from the west. As the rain fell it froze in a clear layer upon everything exposed to its course. Trees, pavements, tram-lines, and overhead wires were covered in an hour or two to as much as 1 inch in thickness. The trams and trains had to stop running owing to the state of the rails, whilst even the thick trolley wires were unable to support the weight of the incrustation, and branches as much as 6 inches thick were broken from the trees everywhere.

The storms always came on in the morning. About noon the rain stopped, the clouds cleared away, and the sun came out. The diamond-coated branches, with showers of silvery drops falling from them, against the dark blue American sky made a scene the beauty of which can scarcely be imagined. W. ERMEN.

10 Marsden Street, Manchester, February 16.

THE INDUSTRIAL USES OF OZONE.

THE production of ozone by the discharge of a frictional electrical machine was originally noticed by Van Marum in 1785, but it was Schönbein in 1840 who first actually prepared it and gave it the name of "ozone," from the Greek ὄζων, meaning smell. He also showed that it was much more active as an oxidising agent than ordinary oxygen. As is well known, it is produced by the slow oxidation of phosphorus, and the peculiar odour of this element is really not the odour of phosphorus, but the odour of ozone, and this can be shown to be the case by adding small quantities of substances to phosphorus, which prevent its oxidation, when the odour is no longer perceptible. It also appears to be produced in small quantities by the burning of hydrocarbons. It is likewise formed in the open country, partly by evaporation, but probably most largely by the action of ultraviolet rays from the sun. This at any rate would account for its formation in the higher regions of the atmosphere. It is formed in considerable quantities when fluorine acts upon water. If a drop of water is introduced into a tube filled with fluorine, reaction immediately ensues, and the tube becomes filled with deep blue vapour. This is ozone which has a blue colour when concentrated.

Ozone is also produced at the anode when acid solutions of water are electrolysed, particularly if the electrode is a platinum tube through which cold water is passed. By this means Fischer and Massenez have obtained oxygen containing 25·27 per cent. of ozone in electrolytic oxygen by electrolysing at 0°. Such a process would not, however, be satisfactory on a large scale, owing to the cost of production. It is also produced by heating and suddenly cooling oxygen, and also by the action of the ultra-violet rays, produced by the mercury-vapour lamp. The only method employed commercially to prepare it is to subject oxygen to the action of the silent electric discharge, the oxygen thereby receiving electrical energy and becoming converted into ozone thus:—

$$3O_2 + \text{energy} = 2O_3.$$

As the formation of ozone is an endothermic reaction it follows that it is less stable than oxygen, and is in a condition in which it will readily part with the energy originally received electrically in the form of heat—*e.g.* when the pure gas explodes, or as chemical energy when it acts as an oxidising agent. The thermochemical equation accounts for its instability:—

$$O_2 + O = O_3 - 32{,}400 \text{ cal.}$$

It is only within the last decade that the employment of ozone for the purification of water has been practically worked out and actually employed commercially. Various processes have been suggested and employed for the sterilising of water, and it will perhaps be as well in the first place to refer to the different forms of construction of the apparatus. All the apparatus employed depends upon some method or other of obtaining a silent electric discharge; consequently very high electrical potential is necessary. In general the silent discharge takes place between conducting plates separated by means of a dielectric. The original ozoniser of this type was the invention of W. von Siemens, and consisted of two concentric tubes, which are coated on their outside surfaces with tinfoil, the glass of the tubes acting as the dielectric. Berthelot used glass as the dielectric and a liquid as the conducting material. Modifications of both these forms are used commercially. The "Ozonair" apparatus consists of wire gauze as the conductor, separated by mica as dielectric. The ozoniser is enclosed in an iron case when the ozone is to be produced for water sterilising or similar purposes. When it is required for the purification of the air or for ventilation it is open and the air is drawn through the apparatus and distributed by means of a fan. Fig. 1 shows a semi-enclosed type in which the grid can be entirely enclosed by completely boxing in. The electrical tension employed is about 7000 volts.

The Siemens-Halske type which is used for water sterilising is illustrated in Fig. 2. It consists of concentric pipes D and E placed one within the other; the inner one is of aluminium, and is connected with the leads carrying a high-tension current marked in the diagram as +, as this is the positive pole. The

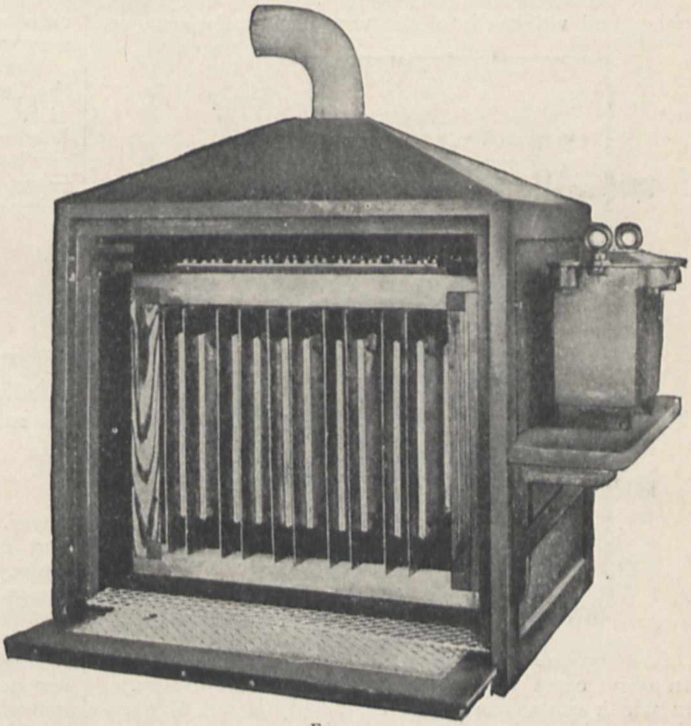


FIG. 1.

glass cylinder E is the other pole; it is surrounded with water which can be circulated for cooling purposes, and as this is "alive" it receives its charge from it. The water which surrounds the glass cylinder receives its electricity from the iron-containing box, which is earthed, and consequently forms the negative pole. The annular space between D and E is where the silent discharge takes place. The complete apparatus consists of a cast-iron box divided into three chambers, the lower chamber for receiving and conveying the air to the ozone tubes, an hermetically sealed middle compartment into which the ozone tubes are inserted by means of a stuffing-box-gland, and an upper compartment for collecting the ozonised air. An alternating current at 8000 volts is employed.

A very high tension apparatus is the Abraham Marmier, in which a potential of 40,000 volts is employed. It is made up of a number of hollow cylindrical electrodes, which are insulated by means of glass and contained in a box. For cooling purposes water is circulated through the electrodes.

The Otto ozoniser consists of a series of transverse plates, so arranged that a dielectric plate is placed between the electrodes. The air is drawn or blown between the plates, the silent discharge passing between the spaces of the plates and thus ozonising the air. Fig. 3 shows diagrammatically the manner in which the air passes through the apparatus. An alternating current at 6500 volts is employed. In another form of the Otto ozoniser there is a metal chamber, the walls of which make one electrode. Within this chamber a number of sheet steel rings are mounted on an axle, the edges of the rings being sharpened. When in operation this bunch of rings is rotated and forms the other electrode. No dielectric is used. Air is blown through the box, the rotation of the central electrode causing thorough mixing. If an arc is struck it is immediately extinguished, as the electrode rotates because each of the rings has a groove cut in it. The tension of the current employed is about 25,000 volts.

The providing of a pure water supply to our towns, cities, and villages is of the very highest importance.

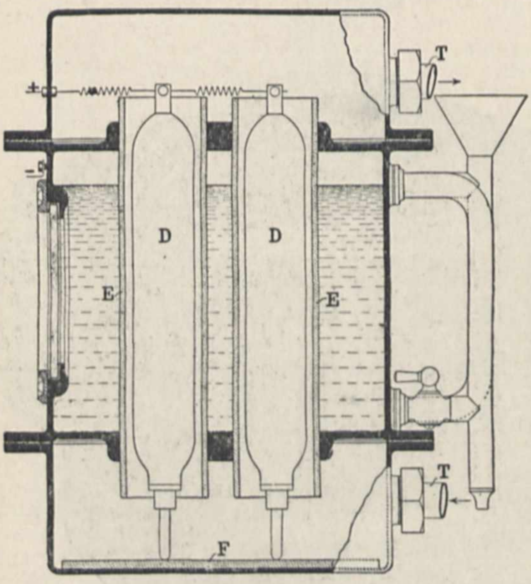


FIG. 2.

In some cases where the water comes from sources in which contamination of the supply is out of question, such as from mountain lakes or from deep springs, then no special purification is necessary. In other cases, however, where the source of water admits of, or even invites, contamination, purification in some way or other is a *sine qua non*. The method chiefly employed is mechanical filtration. Chemical methods, such as treatment with oxidising agents, can only be carried out on a small scale. The sand filtration method is partly bacterial and partly one of filtration. The surface of the sand becomes coated with a slimy deposit which is partly of bacterial formation; consequently the water first passes through the bacterial layer which exerts a beneficial effect in destroying harmful bacteria, and also makes a much finer filter than can be produced by the more or less coarse-grained sand, and then it percolates through the sand. Sometimes, however, owing to floods and special contamination, the filter-bed breaks down, and then it may be a very serious matter for the populace. Therefore where there is a possibility of water at any time being contaminated, purification by some other means is advisable.

In the Ozonair process, which is being used in this country, the ozonisation of water takes places in three stages—that is to say, the same water comes into contact with ozone three times. In the first place, the water is atomised in presence of ozonised air, and the minutely divided particles of water then fall upon the upper part of a pile of glass spheres, or other scrubbing arrangement, packed in a tower. As the water percolates down it meets an ascending stream of ozonised air. At the bottom of the tower it falls into a tank through which ozonised air is blown by means of nozzles beneath the surface of the water in the tank. The tank is in the shape of an inverted cone, and a syphon is carried to the bottom of the cone for carrying off the water. Owing to this arrangement, all the water gets equally acted upon before being carried away. The syphon discharges the water on to steps, so that it cascades down into the storage tank. As it cascades the water comes into contact with the atmosphere, and the excess of ozone is given up. Fig. 4, which is self-explanatory, shows diagrammatically the arrangement of the plant. Should the ozoniser get out of order or cease to work, the water supply is automatically cut off.

The Siemens-Halske system is largely employed on the Continent, the largest plant erected by them being at St. Petersburg. In this plant the method of sterilisation is slightly different from that previously employed. The water is conveyed into an emulsifying tower by means of special injectors, the ozonised air being used to force the water into the bottom of the

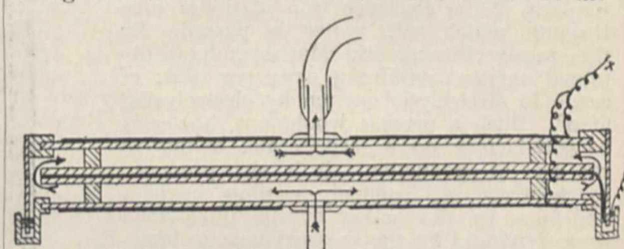


FIG. 3.

tower. The water and ozone therefore enter together, and consequently very complete emulsifying takes place. The water flows over from the top of the tower, and is cascaded down to the reservoir. In this particular case the water of the Neva is the source of supply. It is very turbid, and is therefore previously treated with 30 to 40 grams of aluminium sulphate per cubic metre of water, and after settling for two hours it is filtered. The water in the first place contains a large amount of pathogenic and harmful bacteria, but after ozonising these have all disappeared. In all probability a considerable number are removed by the precipitation treatment, because when water is softened by means of lime or other precipitant it is always found to contain less bacteria than before treatment. But, of course, precipitation could not entirely be depended upon for sterilising purposes. On the other hand, ozone can be depended upon to sterilise. The St. Petersburg plant is capable of dealing with 2000 cubic metres of water per hour. There are three 150-h.p. steam engines for motive power, one, however, being always held in reserve. The whole output of the engines is not required for working the ozonisers, as the power is also used to operate the pumping and filtering plant and all the other necessary mechanical appliances. The ozonisers are worked with a three-phase alternating current at 7000 volts and 500 periods.

Other places on the Continent where ozone is used for sterilising the public water supply are Paderborn, Wiesbaden, Paris, Hermannstadt, Florence, Nice, Chartres, Villefranche, Rovigo, and Chemnitz. Two new ozone plants are being installed in Paris with a daily output of 45,000 cubic meters of water.

In the United States ozone is employed at Philadelphia. The water ozonised is from the River Schuylkill in West Philadelphia. This is extremely impure, and is said to contain 2,500,000 bacteria per cubic centimetre. After treatment the number is reduced to 25 per cubic centimetre. The *Bacillus coli* which previously abounds is completely destroyed. The colour of the water is improved and its offensive odour removed.

It is obvious from the foregoing that the employment of ozone for sterilising water is now being carried out on a very considerable commercial scale, and it is found not only efficient but also very cheap. In this country to sterilise 1000 gallons of water the cost is from one halfpenny to one penny, depending upon the size of the plant and the cost of the electrical power. In connection with the sterilisation of water, it should be mentioned that it is an easy matter by means of petrol motors to use ozone for sterilising water during campaigns. Indeed, during the Russo-Japanese war a portable plant supplied by Messrs. Siemens and Halske was employed with great success. The apparatus consists of two small wagons, each of which is hauled by one horse. The small dynamo and all the pumping appliances, &c., are worked by means of a petrol motor.

Ozone apparatus have also been devised for fitting on to the ordinary water mains, the ozoniser only functioning when the water tap is turned on. The water passes through a special form of injector which causes a thorough admixture with the ozone. At the moment the water is drawn off it smells of ozone, but within a few minutes the odour has gone off, and the water is fit for drinking purposes. This form of ozoniser is very useful in hospitals and other public institutions.

A new method for production of ozone in large quantities has just been described by E. H. Archibald and H. von Wurtenberg. Dilute sulphuric acid is electrolysed with a direct and alternating current. The alternating current acts as a depolariser, and the production of ozone is 300 times greater than with a direct current only. The maximum yield was obtained with an alternating current of 6 amperes and a continuous current of 0·25 to 1 ampere. Increase in the frequency of the alternating current increases the ozone yield.

Before leaving the question of water sterilisation another method which is now being employed should be mentioned. It has been found that the ultra-violet rays are very efficient for sterilising water. The rays are produced by a mercury-vapour arc enclosed in a quartz tube. Under the influence of the rays from a mercury-vapour lamp of silica with a current of 3 amps. at 220 volts *B. coli* are killed in

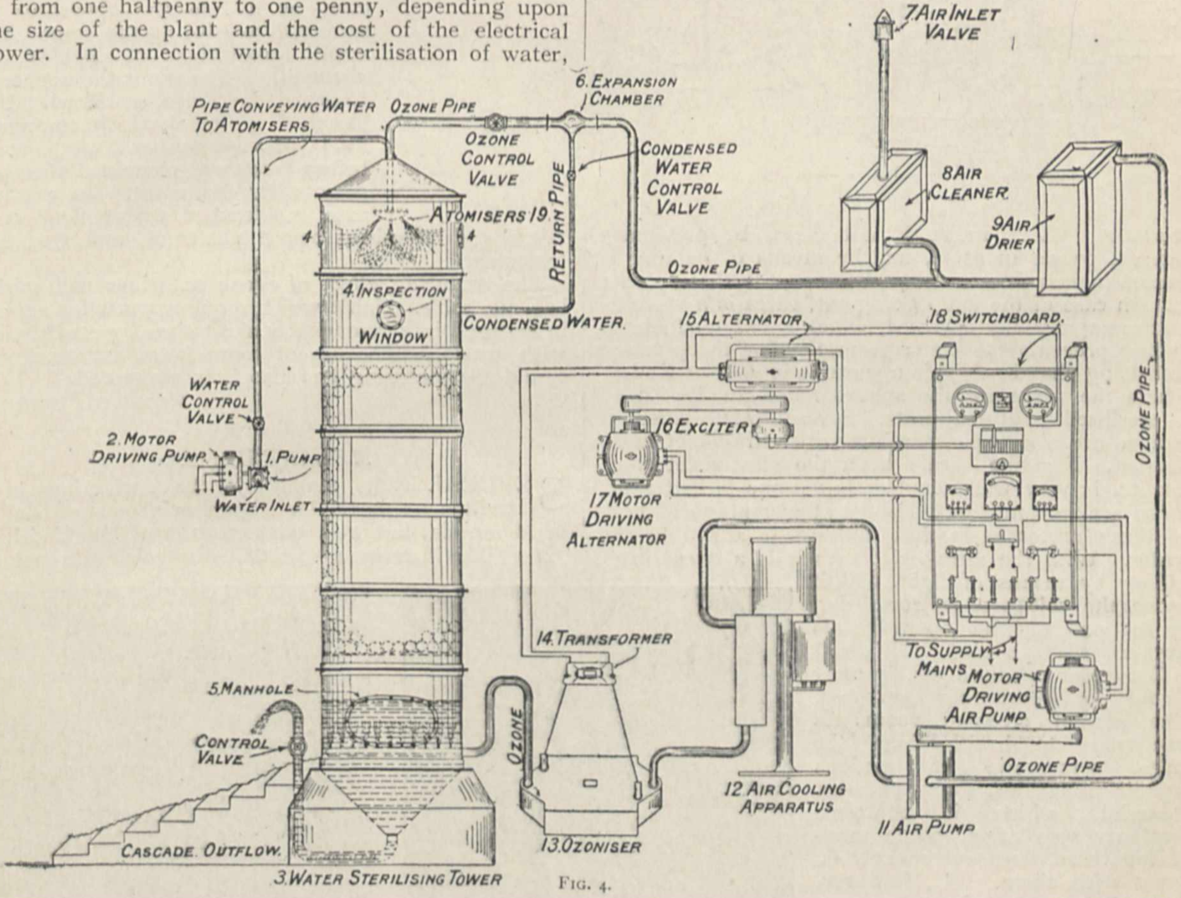


FIG. 4.

1 second	at a	distance of	10	centimetres
4 seconds	,,	,,	20	,,
15 ,,	,,	,,	40	,,
30 ,,	,,	,,	60	,,

Where water is to be sterilised it is necessary for it to be clear, because the ultra-violet rays are very rapidly absorbed. This is particularly the case if water contains colloids. The various classes of microbes are not equally sensitive; *e.g.* conditions which kill *staphylcoccus* in five seconds will kill cholera in from twenty to sixty seconds.

Lamps of glass are useless, because the glass absorbs a great portion of the rays. Fig. 5 shows the construction of the apparatus for water sterilisation brought out by the Cooper-Hewitt Westinghouse Co.

The apparatus is made to sterilise different units, the largest size being capable of dealing with 600 cubic metres in twenty-four hours. The diagram practically explains itself. L is the lamp, which is enclosed in a box with rock-crystal windows. The water to be

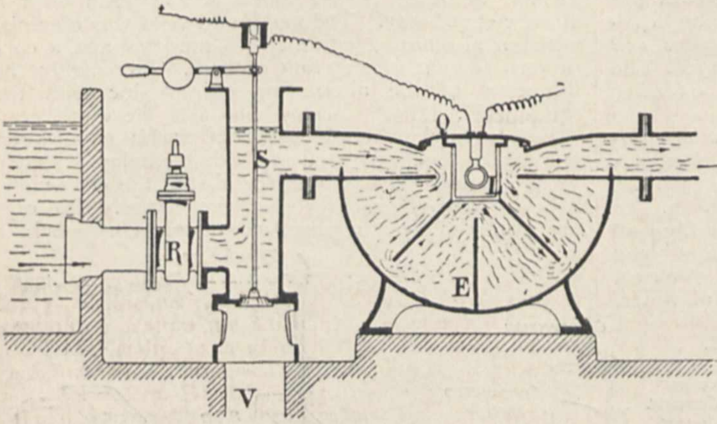


FIG. 5.

sterilised, which must, if not clear, be previously filtered, passes in at R, and by means of baffling is caused to pass three times past the rays in the steriliser E. In case of the lamp going out, there is a valve S, electromagnetically operated, which opens, and immediately prevents the water from flowing through the sterilising chamber. This apparatus is used at Rouen, where the water for the suburb Maromme-les-Rouen is sterilised by three units. Several other cities in France are also experimenting with ultra-violet sterilisation. For small scale work the ultra-violet sterilisation is very well adapted, but ozone is better for large scale operations. The great advantage of both of these processes is that nothing is added to the water. With the ultra-violet rays it is a question of killing by means of light. With ozone the sole product remaining at the end of the operation is oxygen.

Ozone, or ozonised air, is most useful for ventilating purposes. The air of crowded rooms is dangerous to health from the large percentage of noxious organic impurities, many of them bacterial, which it contains. Ordinary ventilation, while minimising these, does not entirely do away with them. If, however, the fresh air driven into the room for ventilation be previously ozonised, the organic impurities become oxidised. Ozonised air is, as a matter of fact, very largely employed in the ventilation of theatres and other large public buildings. Complaint is continually made as to the evil effect of the atmosphere of the House of Commons upon the members of Parliament, and this, in spite of strenuous efforts on the part of ventilation engineers. Probably the atmosphere would be greatly improved if the ventilating shaft which supplies fresh air to the House had an ozonising apparatus placed in it. At the Turin Exhibition the beneficial effects of ozone were forcibly brought before the notice of the writer. Ozone plant is now being employed in the ventilation of the Tube Railways with beneficial results.

Ozone is used in the manufacture of vanillin from isoeugenol. It has also been found advantageous in brewing. Weak yeast appears to be strengthened by ozone and to act more vigorously if the air of the fermenting house is kept fresh with ozonised air. Ozone is used for bleaching oils and fats, the results being very striking. It is also used for blowing oils such as linseed oil. The bleaching effect of ozone has been found useful in laundries and for bleaching delicate fabrics. Flour is bleached by means of ozone. In this case, however, as a rule the apparatus is arranged to give at the same time small quantities of oxides of nitrogen. The flour is not only bleached but also sterilised. Unbleached rye meal which contained 2400 micro-organisms per gram before treatment contained 1600 per gram after treatment. In another case, unbleached wheat flour contained 540 organisms before treatment, and 170 after treatment.

The maturing effect of ozone on wines and spirits is remarkable. Spirit which requires years for ageing is matured in a remarkably short time by emulsifying with ozone. The use of ozone in tobacco factories to aid the maturing has also been suggested.

F. MOLLWO PERKIN.

MELANESIANS.[1]

SEVERAL books, mainly by missionaries, have been written on particular islands or groups of islands in Melanesia, but with the exception of Dr. Codrington's "The Melanesians: Studies in their Anthropology and Folk-lore" (1891), there has been no general book on Melanesia, and even Dr. Codrington says very

FIG. 1.—The Rev. John Pengoni and his father. From "Islands of Enchantment."

[1] "Islands of Enchantment: Many-sided Melanesia." Seen through Many Eyes, and recorded by Florence Coombe. Pp. xxvii+382. (London: Macmillan and Co., Ltd., 1911.) 12s. net.

little about the Solomon Islands. This lack of a general survey has been supplied by Miss Florence Coombe, who has written a most admirable and interesting account of her voyaging among these fascinating islands on board the *Southern Cross*, the steam-yacht which does the business of the Melanesian Mission in great waters. And it is not as tourists and strangers that her passengers go to and fro among the groups, but rather as "friends of the family," knowing somewhat of each island's story, and having familiar acquaintances among the brown folk everywhere, so that they are received and made welcome in the homes of the people.

It is obvious that Miss Coombe could not have collected first hand all the information contained in her book; indeed, on the title-page she describes her account as "seen through many eyes, and recorded" by herself. Her indebtedness to Codrington's classical work is manifest; her acknowledgments to certain other helpers are also mentioned; but, like all travellers, she must have gained a considerable amount of casual information from missionaries. All this, combined with that gained by her own keen powers of observation, she has weaved into a bright narrative that carries the reader along without a hitch. The personal element is unobtrusive but sufficient to give continuity and unity to the narrative, and when the reader has finished the book, which he assuredly will do when he once begins it, he will find himself in possession of a general impression of Melanesia and of a large amount of detailed knowledge which cannot be gained from any single source.

Though dealing with the sphere of influence of the Melanesian Mission, the missionary element is not obtruded, and where brought in merely serves to illustrate the ameliorating influences of the "'new teaching,' or 'the way of peace,' as Christianity is called by the Melanesians." The popular treatment should give the book a large sale; on the other hand, it is a book which the ethnologist must read, as it is crowded with facts and observations, some of which are new. The very numerous and beautiful photographs, by J. W. Beattie, not only embellish the book, but afford to the student a mine of ethnographical details. Various folk-tales are interspersed throughout the book; some inevitably record the prowess of Qat, the hero of the Banks Group, one or two of which are variants of those narrated by Codrington. An interesting account is given of a visit to the little-known island of Tikopia, and the author emphasises the contrast of the natives—a Polynesian outlier in Melanesia—with those of neighbouring islands.

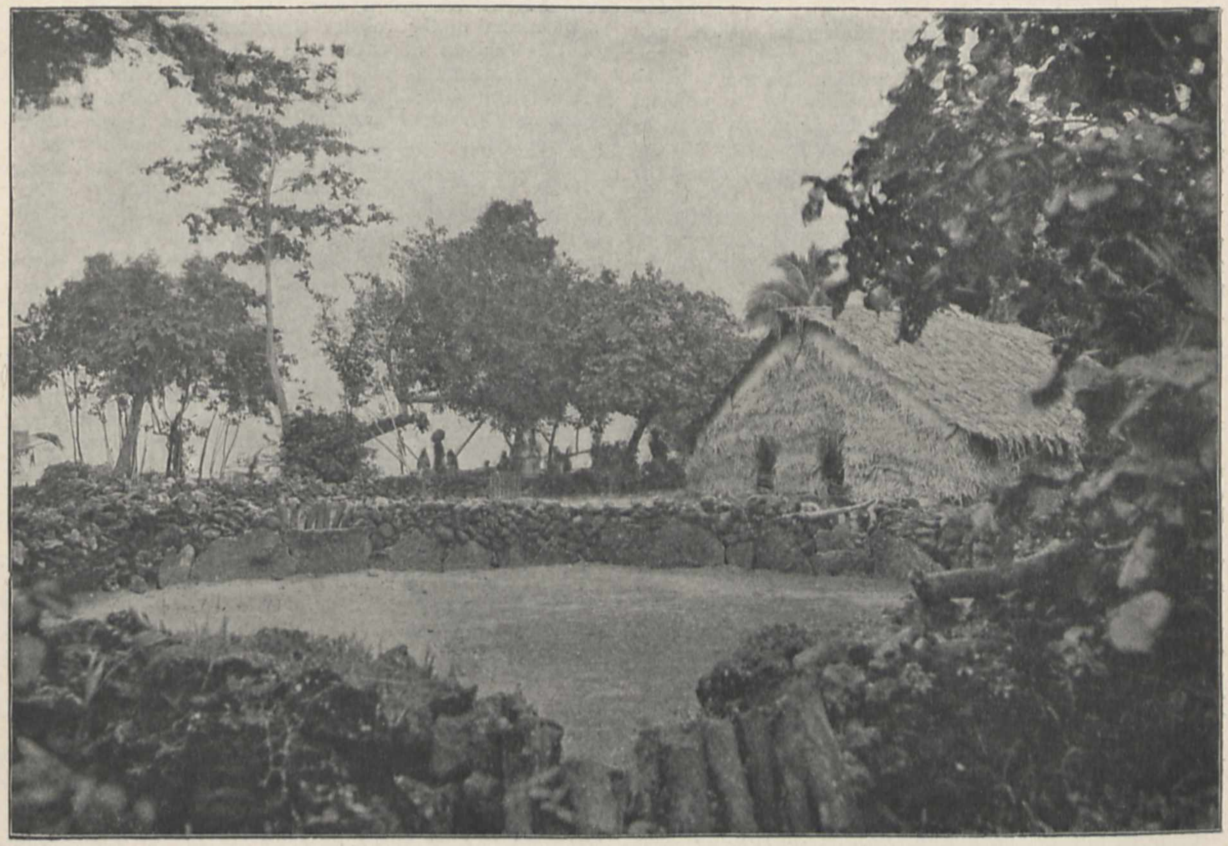


FIG. 2.—*Gamal* and dancing-grounds. From "Islands of Enchantment."

THE ETIOLOGY OF KALA-AZAR.

A TELEGRAM from Surgeon-General Bannerman to Sir Ronald Ross, published in *The Times* and other daily papers of February 15, announces that Captain W. S. Patton, I.M.S., "has discovered the complete development of the parasite of Kala-azar in Indian and European bed-bugs." The news, as it stands, is not quite intelligible, since Captain Patton proved in 1907 that the parasite *Leishmania donovani* went through the same development in the Indian bed-bug, *Cimex rotundatus*, that it had been discovered by Major Leonard Rogers to undergo in artificial cultures. On epidemiological grounds the bed-bug had been indicated by Major Rogers as the probable agent in the transmission of the disease, while Major Donovan considered it more probable that another bug, *Conorhinus rubrofasciatus*, was the means of disseminating the parasite. The bare fact that the parasite developed in the bed-bug so far as its flagellated, herpetomonad stage was not in itself a decisive proof that the bed-bug was responsible for its transmission; and from the telegram received it can only be supposed that Captain Patton has completed his former investigations on the development of the parasite, and has obtained definite experimental proof of its transmission by the agency of the bed-bug.

The recent investigations of Dr. Wenyon on the allied parasite, *Leishmania tropica*, the cause of Oriental sore, make it probable that in this case the transmitting agent is a mosquito or a sand-fly (Phlebotomus sp.), sometimes also a house-fly, which may carry the infection mechanically, *i.e.* not as a true host. In North Africa and Southern Europe another species of these parasites is known, which is believed by its discoverer, Dr. Nicolle, to be primarily a parasite of dogs, and to be transmitted by some means from dogs to human beings, especially children, whence it has been given the name *L. infantum*. Dr. C. Basile in Italy has succeeded recently in transmitting this species experimentally by means of fleas. Further details of Captain Patton's investigations will be awaited with interest.

LORD LISTER, O.M., F.R.S.

BY the death of Lord Lister, the world has lost one of its greatest men, and one who, without any question, conferred more benefits on humanity than any man had ever done before. His great achievement was no doubt the revolution which he carried out in the science and practice of surgery by his investigations into the causes of septic disease, and one has only to look back at the state of surgery up to the time when he began his work to gain some idea of the enormous advance which followed.

From the earliest ages the fatal consequences of wounds, whether occurring accidentally or as a result of an operation, have occupied the minds of all those who had to do with their treatment, and all sorts of attempts have been made to obviate these evils. The practice of the ancient writers was not to keep away noxious agents which interfered with the healing of wounds, as was Lister's conception, but to *make* the wound heal, and substances were applied to *make* the flesh grow, others to *make* the growing flesh firm, and others again to *make* the wound cicatrise. Amid these attempts, the tendency of the wound itself towards healing was almost entirely lost sight of; nevertheless, there were surgeons who, from time to time, were bold enough or had insight enough to protest against these views and to point out that it is to nature itself that one must attribute the ultimate healing of the wound. However, but little attention was paid to these writers, and the practice of treating the supposed poisonous state of the surface of the wound and of inducing healing by various applications still held its own.

Paracelsus was the first who came nearest the modern ideas; he supposed that there is a juice distributed in the body which keeps the various tissues in good health and repairs them when injured, and he held that the whole aim of the surgeon ought to be to prevent alterations in this liquid, these alterations resulting mainly from contact with air. Medical applications are only of use in so far as they preserve this juice and prevent its corruption.

Similar views were held by Ambroise Paré, and it was chiefly by the writings and teachings of these two men that the position of nature as an agent in healing wounds was more fully recognised. The tendency after that time was to look on the contact of the air with the wound as the source of the main trouble, and after the chemical constitution of the air was discovered, it was the oxygen in the air which was chiefly blamed for the decomposition which took place in the wounds; indeed, this view was still held very widely when Lister began his researches on the prevention of sepsis.

The first result of these views was that enormous quantities of dressings were applied over the wounds and left unchanged for a long time, with a view of excluding the air. At the end of the eighteenth century and the beginning of the nineteenth, other methods of treatment were employed, which yielded very much better results than the older ones. One of the earliest of these methods was simple water dressing, and this was followed by irrigation, by the use of the water-bath, and in some cases by the addition of various antiseptic substances to the water so employed. Others came to the conclusion that it was best to leave the wounds open, others that healing by scabbing should be promoted, while the fear of the effect of air on wounds led to the introduction, in 1816, of subcutaneous surgery. About the middle of last century various antiseptic substances were a good deal employed, especially in France—balsams, chlorine, alcohol, chloride of zinc, iodine; and, very shortly before Lister's first publication, carbolic acid was advocated by Lemaire as an application to wounds. None of these antiseptic substances were, however, used on any definite scientific ground or with any definite method, and the result was, though a certain amount of improvement may have occurred, nothing like that which was brought about by Lister's systematic work was attained.

It is quite unnecessary to go into the details of that work; that has already been done in these columns and elsewhere. Lister was the subject of an article in the NATURE series of "Scientific Worthies" on May 7, 1896 (vol. liv., p. 1), and his collected works were reviewed in NATURE of February 17, 1910. It may be said that, from the time Lister was a student, his mind had been occupied with the terrible fatal results which so constantly followed operations, however perfectly they were conducted, and he had definitely come to the conclusion that these troubles were associated with, and indeed the result of, the putrefactive changes which occurred in the blood and serum in the wound. He felt that if only these putrefactive changes could be avoided, the dangers which resulted would, in all probability, also disappear. So long as the view was held that these changes were due to the contact of the oxygen of the air with the discharges, the matter seemed hopeless, because it seemed impossible to perform an operation under conditions which would exclude the oxygen of the air. When, however, Pasteur in his work on "Spontaneous Generation," demonstrated that the oxygen of the air was quite unable to cause fermentative changes in organic fluids, and that these changes were due to living particles which fell into these fluids from the air, these particles belonging to the class of bacteria, the outlook became much more promising, for it was quite a different matter to have to do with particles which were simply floating in the air, and were often in small numbers and even entirely absent, than with gaseous substances which could penetrate everywhere.

Two courses were open in dealing with such particles, namely, to exclude them altogether, as in the experiments where the air was filtered through cotton-wool, or else to destroy their vitality, as in the experiments where the air which was admitted to the organic fluids was not filtered, but subjected to great heat. There is no doubt that Lister's first view was that the main organisms which produced this decomposition reached the wound from the air or from dust deposited on surrounding objects, although he very soon modified that view as a result of practical experience. Proceeding, however, on the view that the main contamination came from the air, the question which he put before himself was, what was the best way of dealing with the infective particles; should they be simply kept out by filtration of any air which came in contact with the wound, or should they be killed before they got into the wound, and if they were killed what would be the best way of doing it? To filter the air did not seem at all a practical plan, and therefore he at once took up the line of killing the organisms before they got into the wound, and the simplest way of doing so seemed to be by the use of chemical substances which had the power of destroying these minute forms of life, and were termed antiseptics. Curiously enough, the first chemical substance to which his attention was directed was carbolic acid, which still holds its place as one of the most potent and generally most applicable antiseptics.

His views and methods were constantly undergoing expansion and modification as the result of experience. Starting with the crude notion of bacteria in general, he very soon found that there must be a great variety of different species of bacteria, each having its own life-history and producing different noxious effects or none at all, and that the harm following the entrance of bacteria into wounds was, in the main, not due to those which produced the putrefactive fermentation. However much he modified his views and his methods of dealing with wounds, he held to the leading view that no bacteria should gain admission to wounds in a living state, although it was not long before he recognised that it was an ideal aim and that practically bacteria must gain entrance to wounds to a certain extent in spite of all precautions. This led him to postulate the second factor which had to do with the avoidance of sepsis, namely, the power which the tissues themselves possess in preventing the development of these micro-organisms, and that was the point on which he laid the very greatest stress, and in connection with that he struggled for years to reduce, and, if possible, avoid altogether, irritation of the tissues in the wound, while at the same time, as far as possible, preventing the entrance of bacteria. Hence he was constantly changing his dressings and his methods, much to the perplexity of those who had not grasped the scientific ideas which were at the bottom of his researches.

These changes had a twofold object: one to obtain a more perfect sterilisation of the air, and the various objects which came in contact with the wounds, and the other to avoid as far as possible the use of irritating substances, and more especially to prevent them coming in contact with the wound itself, and thus interfering with the natural action of the tissues in destroying any bacteria which might enter them in spite of the various precautions.

A study of his collected works which were published a year or two ago will show the remarkable perseverance with which he followed out these aims, and as examples of scientific writing, they are probably unsurpassed. He possessed to a high degree the quality of genius, in not overlooking what to the ordinary mind would appear minor circumstances. If an experiment did not turn out as he expected, he proceeded at once to ascertain the cause, and he did not throw it aside as simply an accident. In this way he was led to a great variety of information which the ordinary observer would have missed altogether.

But Lister as a surgeon did not direct his attentions solely to the treatment of wounds and the avoidance of septic troubles in connection with them. As soon as he found that he could reckon with reasonable certainty on the avoidance of these troubles, he proceeded to consider in what way he could improve the existing methods of treatment, and naturally the immunity from septic diseases opened up a greatly increased range of operative work. Hence very shortly after the successful application of his theories to practice, we find him suggesting operations and procedures as regards the treatment of diseases which had not previously been attempted, and were looked on by the older surgeons as almost criminal. Such operations, for example, as osteotomy for deformities, the treatment of recent fractures, such as fracture of the patella, by operation, extensive operations for the removal of cancerous glands in connection with cancer of the breast, the introduction of suprapubic colotomy, and a great many other procedures too numerous to mention.

Another point which should not be forgotten in connection with Lister is that it was his work which gave the main impulse to the development of the great science of bacteriology, a science which bids fair to occupy the most prominent place in medical work. It is true that he did not discover bacteria, nor did he take an active part in the bacteriological advances, but nevertheless he, along with Pasteur and Koch, may be looked on as a founder of the science. Until Pasteur's time the existence of bacteria and their life-history had been looked on as only an interesting but not very important study, and practically the only question asked with regard to them was whether they could arise spontaneously in organic fluids, or whether, like other living things, they must have had a progenitor. In other words, the battle raged for many years on the question of Spontaneous Generation. Pasteur was the observer who finally settled this question absolutely definitely, and showed that there was no such thing as spontaneous generation of living organisms, and that all organisms were derived from pre-existing ones, and he further showed that organisms were the causes of the ordinary fermentations, including the putrefactive fermentation.

Until, however, Lister seized on the facts demonstrated by Pasteur, and applied them to the treatment of wounds, practically no one had looked on these organisms as of any importance in disease. As soon as Lister showed that the exclusion of these organisms from wounds meant the disappearance of a variety of diseases to which man had been previously subject, the study of these organisms naturally advanced with great rapidity. Lister, for some years, did work in that direction himself, but comparatively little progress was made until it was taken up by Pasteur, who, with his wonderful insight, drew deductions from his observations of far-reaching value. But the great progress dates from the time when Koch appeared in the field, and demonstrated definitely the relation of these organisms to disease, and showed how they could be detected and how they could be stained and cultivated. Since that time the science has gone ahead at a very rapid pace; but without Pasteur, Lister, and Koch, and more especially without the practical demonstration of the great importance of these organisms by Lister, it is impossible to say whether this science would have been in existence at all at the present moment.

I need not say anything about Lord Lister as a man. That he was conscientious to a degree, and considered any matters brought to his notice without any personal bias, is well known to all those who had dealings with him. That he never believed ill of anyone I can testify from long association with him; that those who opposed him were mistaken in their views was only a natural conclusion from the belief that he had in his own, but that any other motive influenced them in opposing him did not enter into his calculations. Above all, he was full of sympathy for suffering humanity. He spent an enormous amount of time in his hospital work, not only in making his observations and in watching the progress of the wounds under different methods of treatment, but also in relieving the suffering of the patients. He was often remonstrated with by the committees of the hospital to which he was attached for keeping patients in the hospital for a very long time, but he looked on the hospital as an institution for curing the patients, and would not let anyone leave so long as he was likely to obtain further benefit from remaining in it. When he came to London, there were several patients in his wards in Edinburgh, chiefly cases of spinal disease with abscess, who would naturally have been sent home after he left. Rather than allow them to run the risks consequent on that procedure, Lord Lister had several of them transported to London and placed in nursing homes at his own expense, and they were kept there for months, and in one case years, until the disease was cured.

W. WATSON CHEYNE.

FUNERAL SERVICE IN WESTMINSTER ABBEY.

Upon the news of Lord Lister's death, the Dean of Westminster (Bishop Ryle) at once offered the signal honour of burial in Westminster Abbey. This, however, was rendered impossible by the circumstance that it was Lord Lister's wish that he should be laid to rest at West Hampstead Cemetery, where his wife had been interred in 1893. Accordingly, the decision was taken to hold a funeral service, and to accord the full ceremonial which would have attended an actual burial within the Abbey had that been practicable.

The body was taken to the Abbey on the evening of Thursday last, in the charge of the near relatives, being received by the Dean and clergy. It was then deposited in the Chapel of St. Faith, where an offering of prayer was held.

Impressive indeed was the funeral service next day. The King was represented by Sir Frederick Treves, Queen Alexandra by Sir Francis Laking, and Princess Louise (Duchess of Argyll) by Mr. Oswald Balfour. The Prime Minister, Lord Lansdowne, the Lord Mayor of London, and the Lord Provost of Edinburgh attended. A gathering representative of the Corps Diplomatique, Government departments, British universities, scientific and medical societies, and many private individuals, all drawn by the same desire to pay a final tribute of respect, filled the Abbey in every available part.

The foreign delegates who attended were :—

M. Gabriel Lippmann, For.Mem.R.S., president, Paris Academy of Sciences, with Profs. Chaveau, For.Mem.R.S., Dastre, and Roux; Prof. Pozzi, Academy of Medicine, Paris; Prof. E. Roux, Pasteur Institute; Prof. Garré, president, German Congress of Surgeons; Prof. H. Treub, Dutch Medical Society, Amsterdam, and University of Amsterdam.

Many foreign learned societies were also represented, in addition to the foregoing, through the nomination of men of science in this country.

On the part of the Royal Society there were present :—

Sir Archibald Geikie (president, who took part as a pall bearer); Sir Alfred Kempe (treasurer); Sir Joseph Larmor and Sir John Bradford (secretaries); Sir William Crookes, O.M. (foreign secretary); Dr. Lazarus Fletcher; and Sir John Kirk.

The pall-bearers and chief mourners were as subjoined :—

Pall Bearers.

Lord Rayleigh, O.M. (past president of the Royal Society, and Order of Merit); Lord Rosebery (Chancellor of the University of London); Lord Iveagh (Lister Institute); Sir Archibald Geikie (president of the Royal Society); Principal Sir Donald MacAlister (University of Glasgow); Sir Watson Cheyne (King's College, London); Mr. R. J. Godlee (president of the Royal College of Surgeons); Prof. Francis M. Caird (University of Edinburgh).

Sir Hector Cameron (University of Glasgow), who was to have been a pall bearer, was prevented by illness from fulfilling the duty.

Chief Mourners.

Mr. J. J. Lister, F.R.S., Dr. Arthur Lister, Miss Lister, Mr. R. G. Godlee, Mr. J. Lister Godlee, Mr. Lister Harrison, Mrs. Phear, Colonel and Mrs. Montagu Broun, Mr. P. Godlee, and Miss Christina Godlee.

At the Chapter House a procession was formed, comprising the chief mourners and immediate friends, together with representatives specially designated from civic, learned, and other institutions. Preceded by the choir and officiating clergy, the coffin was borne through the Cloisters from the Chapel of St. Faith, the while the hymn "Brief life is here our portion" was sung. From the nave to the choir the opening sentences of the Burial Service were sung, in procession, to the setting by Dr. Croft. The coffin was deposited temporarily on a high catafalque at the steps of the altar. On the pall lay the insignia of the Order of Merit, Knight of the Prussian Order "pour le Mérite," and Knight Grand Cross of the Order Danebrog.

A wreath of orchids and lilies, sent by the German Emperor, and brought to the Abbey by his Excellency the German Ambassador, was carried before the bier on its way to the choir. Floral tributes came also from the Pasteur Institute, Paris, the German Society of Surgery, and Dutch Medical Society.

After the lesson, an anthem by Handel was sung. Composed for the funeral of Queen Caroline in 1737, it was chosen for the special appropriateness of the words. These are appended :—"When the ear heard him, then it blessed him: and when the eye saw him, it gave witness of him. He delivered the poor that cried: the fatherless and him that had none to help him. Kindness, meekness, and comfort were in his tongue. If there was any virtue, and if there was any praise, he thought on those things. His body is buried in peace, but his name liveth evermore." Goss's anthem, "I heard a voice," followed.

At the conclusion of the service, and whilst the coffin was being borne from the Abbey, the "Dead March" in *Saul* was played by Sir Frederick Bridge.

The following acted as stewards in the choir, transepts, and Chapter House :—

King's College Hospital: Dr. Gillett, Major Lyne, A. C. McAllister, G. Matthews, H. P. Morton, V. E. Negus, H. A. Richards.

University College Hospital: Dr. Chubb, Dr. Cowell, A. Courts, H. Waller, G. E. O. Williams.

Royal Society: T. E. James, F. A. Towle, A. H. White.

Simultaneously with the rites in the Abbey, a memorial service was held in St. Giles's Cathedral, Edinburgh, attended by representatives of the Corporation, the University, the Royal Colleges of Physicians and Surgeons, and the Edinburgh and Leith Medical Practitioners' Association.

MESSAGES OF SYMPATHY AND RESPECT.

Expressions of sympathy and resolutions embodying appreciation for the work accomplished by Lord Lister have been received by his family and by the Royal Society from all parts of the civilised world. Last week we referred to messages from the King, Queen Alexandra, and other members of the Royal Family, and to the telegram from the Institut Pasteur. We print below a selection, based chiefly upon reports in *The Times*, of the tributes which have been paid by foreign rulers and Governments and by learned societies everywhere, to the character and work of Lord Lister.

So large a number of messages of condolence and tributes to the memory of Lord Lister have been received by his family that some delay in sending individual replies is inevitable, and it is therefore desired to convey through the medium of the Press their grateful acknowledgment of the sympathy which has been so generally expressed.

The King's message, already referred to, stated that his Majesty shares in the feeling that the loss suffered is a universal one, for the world at large owes a debt of gratitude to Lord Lister's memory for all that he achieved to save life and to mitigate human suffering.

The following letter was received from the German Ambassador:—

By order of his Imperial Majesty the German Emperor, who knew the late Lord Lister personally, I will have the honour to lay a wreath on the resting-place of the great savant.

Will you further kindly inform the late Lord Lister's relatives that, acting under instructions from my Government, I have conveyed, through the Foreign Office, to the societies of which Lord Lister was president, the sorrow of the Imperial Chancellor and the Royal Prussian Government?

A telegram was received by Sir Archibald Geikie, K.C.B., president of the Royal Society, from the Marquis di San Giuliano, the Italian Minister for Foreign Affairs, as follows:—

I beg you to express to the Royal Society the condolences of his Majesty's Government on the death of Lord Lister, whose name will live in perpetual veneration in the grateful memory of mankind. I associate myself personally with the Royal Society's mourning, being attached to that illustrious body by many touching recollections, both of my own references to Italy at more than one of their annual reunions and of eloquent tributes paid by their most eminent speakers to the scientific glories of our country.

At the meeting of the Royal Society on Thursday last, February 15, the President (Sir Archibald Geikie) referred to the signal loss sustained by the society and by the scientific world at home and abroad by the decease of Lord Lister, in whom the society had a special interest as a past president. It was moved from the chair, and resolved by the fellows present rising in their places, that the condolence of the society be sent to the family of Lord Lister, and that the society do adjourn without transacting the business of the meeting, as a mark of respect to his memory.

The Royal Society has received the following telegrams of sympathy from foreign academies and departments of State:—

Germany.

The Prussian Department of Public Instruction mourns in sincerest sympathy with the Royal Society the grievous loss which science has experienced by the decease of their former president, the great master of surgery, Lord Lister.—VON TROTT ZU SOLZ, Prussian Minister of Instruction.

The Royal Prussian Academy of Sciences send to the Royal Society their heartfelt sympathy in the heavy loss which the society has sustained by the death of their former president. We condole sincerely with you on the decease of Lord Lister as a true benefactor of mankind, whose memory will remain in imperishable honour among all nations.—Presiding Secretary, AUWERS.

Royal Saxon Society of Sciences, Leipzig, deeply moved by Lister's death, sends warmest sympathy. (No delegates.) (Unsigned.)

Medical Society, Leipzig, sincerely laments their distinguished honorary and foreign member. Personal representation unfortunately impossible.—MARCHAND.

On the occasion of the severe loss which medical science has suffered by the decease of Lord Lister, the League of German Clinics herewith gives expression to their most sincere sympathy.—WESSEL, President, Leipzig.

The Medical Faculty of the University of Munich mourns with you at the bier of Lord Lister, one of the greatest benefactors of mankind. It will always be a glory of Great Britain that she has brought forth this son.—M. GRUBER, Dean.

The Royal Bavarian Academy of Sciences regrets that during the University term none of its members is able to take part in the obsequies of England's great son, Lord Lister, but it is at one with the whole civilised world in its grief at the demise of one of the greatest benefactors of mankind whose benevolent life-work can never be lost.—HEIFEL, President.

Russia.

Imperial Academy of Medicine, St. Petersburg, sends its sincerest condolences to the Royal Society on the death of Lord Lister, whose loss has saddened not only England, but the whole medical world.—MOISSEEFF, Secretary of the Academy.

Imperial Academy of Sciences, St. Petersburg, begs Sir Archibald Geikie as honorary member to represent the academy at the funeral of Lord Lister.—OLDENBURG, Perpetual Secretary.

Austria-Hungary.

Imperial Academy of Sciences, Vienna, profoundly deplores the death of the great surgeon and benefactor of the sick, Lord Lister, whom they were proud to count among their honorary and foreign members, and express their sincere sympathy with the Royal Society in their loss.—PRESIDENT BOEHMBAWERK, Becke.

The Hungarian Academy, Budapest.—The Hungarian Academy of Sciences sends its deepest condolence to the funeral of its great member, Lord Lister.—BERZEVIUZY, President.

Other Countries.

Academy of Sciences, Paris.—Academy will send to the obsequies of Lister, Lippmann (president), Chauveau, Dastre, Roux. At meeting of the Academy on February 12, M. Lippmann made fitting reference to Lord Lister's life and work.

(A telegram from the Pasteur Institute was published in NATURE last week.)

I join your illustrious society on behalf of the University of the Italian Scientific Institute and with my own personal condolences at the irreparable loss of Lord Lister, to whom science and humanity owes so much.—MINISTER OF PUBLIC INSTRUCTION.

Accademia dei Lincei, Rome.—The Accademia dei Lincei deplores the loss of their illustrious member, Lord Lister, and begs to be allowed to be represented at the funeral by their member, Sir Joseph Larmor.—BLASERNA, President.

Christiania University.—The Medical Faculty of Christiania University expresses sympathy to the Royal Society in the great loss sustained by the British medical profession and the whole science of medicine by the death of the father of modern surgery, Lord Lister.—DECANIS HARBITZ.

Christiania Scientific Society thanks for kind telegram regarding Lord Lister, and regrets sincerely with the Royal

Society the loss of its eminent member.—Dr. H. MOHN, President; Dr. A. JOHANNESSEN, General Secretary.

Swedish Academy of Sciences, Stockholm.—Swedish Minister, Count Wrangel, instructed to represent Swedish Academy of Sciences at Lord Lister's funeral.—DAHLGREN, President.

Prof. Treub comes to funeral ceremony Lord Lister representing the University of Amsterdam.—Rector Magnificus, Prof. WINKLER.

Dutch Medical Society, Amsterdam.—Dutch Medical Society delegates Prof. Hector Treub, of Amsterdam, to Lord Lister's funeral.—Dr. SCHREVE, Secretary.

Academy of Science, Amsterdam.—Academy Science, Amsterdam, regrets deeply cannot send delegate Lord Lister's funeral.—LORENTZ.

The Swiss Society of Natural Sciences associates with the Royal Society in its great sorrow.—SARASIN, President.

NOTES.

FOR the meeting of the British Association for the Advancement of Science, which is to be held this year at Dundee on September 4 and following days, under the presidency of Prof. E. A. Schäfer, F.R.S., the following presidents have been appointed to the various sections:—Mathematical and Physical Science, Prof. H. L. Callendar, F.R.S.; Chemistry, Prof. A. Senier; Geology, Dr. B. N. Peach, F.R.S.; Zoology, Dr. P. Chalmers Mitchell, F.R.S.; Geography, Sir Charles M. Watson, K.C.M.G., C.B., R.E.; Economic Science and Statistics, Sir Henry H. Cunynghame, K.C.B.; Engineering, Prof. A. Barr; Anthropology, Prof. G. Elliot Smith, F.R.S.; Physiology, Mr. Leonard Hill, F.R.S.; Botany, Prof. F. Keeble; Educational Science, Prof. J. Adams; Agriculture, Mr. T. H. Middleton. Agriculture will form the subject of a full section for the first time. Prof. W. H. Bragg, F.R.S., and Prof. A. Keith have been appointed to deliver the evening discourses.

THE executive committee of the British Science Guild has completed arrangements for the reading of the following papers dealing with subjects in which the Guild is taking action:—Monday, February 26, coordination of philanthropic effort, Sir Edward Brabrook, C.B.; Monday, March 11, scientific aspects of technical education, Prof. John Perry, F.R.S.; Friday, March 29, synchronisation of clocks, Major O'Meara, C.M.G. With the kind permission of the president and council of the Chemical Society, the meetings will be held in the rooms of the Chemical Society, Burlington House, Piccadilly, at 8.30 p.m.

IN reply to a question relating to agricultural research, asked in the House of Commons on Tuesday, February 20, Mr. Runciman said:—A grant of 30,000*l.* per annum will be made from the Development Fund for work at research institutes in the following subjects, viz.:—plant physiology, plant pathology (mycological side), plant breeding, fruit growing, plant nutrition, and soil problems, animal nutrition, animal breeding, animal pathology, dairy investigation, agricultural zoology, and the economics of agriculture. Negotiations are proceeding as to the places at which the work will be carried on. It is proposed to allocate an additional sum of 5000*l.* for investigations of a special character during the ensuing financial year, and I hope shortly to be in a position to announce the purposes for which this sum will be expended.

THE governing body of the Lister Institute has appointed Mr. G. Udny Yule honorary consulting statistician to the institute.

MR. CHAPMAN JONES has been elected president of the Royal Photographic Society, in succession to Lord Redesdale, and has been awarded the progress medal of the society.

ON Tuesday next, February 27, Prof. E. G. Coker will begin a course of two lectures at the Royal Institution on "Optical Determination of Stress, and some Applications to Engineering Problems."

REFERRING to the recent correspondence on glazed frost, Mr. C. Carus-Wilson directs attention to two communications by him in NATURE some years ago, viz.:—"Is Hail so Formed" (January 26, 1888) and "Super-cooled Rain Drops" (February 2, 1905).

AT Messrs. Sotheby's sale on February 19, the sum of 105*l.* was realised for the Palæolithic hornstone hammer-heads found in the bottom of an old ditch at Airdens, near Bonar Bridge, Sutherland, and described and illustrated in a paper by Dr. J. Anderson, keeper of the Scottish National Museum of Antiquities.

PROF. W. BALDWIN SPENCER, C.M.G., F.R.S., has been appointed Protector of the Aborigines in the Northern Territory of Australia. A Reuter message from Melbourne on February 15 announces that Prof. J. A. Gilruth, since 1908 professor of veterinary pathology and director of the Research Institute in Melbourne University, has been appointed Administrator of the Northern Territory by the Commonwealth Government.

THE New York correspondent of *The Times* announces that an Arctic expedition, organised by the American Museum of Natural History and the American Geographical Society, with the cooperation of Yale University and other institutions, will start in the coming summer to explore and map out the new land which Rear-Admiral Peary saw from Cape Thomas Hubbard in 1906 and named Crocker Landing. The sum of 10,000*l.* is being raised for the expedition. The expedition is to be headed by Mr. G. Borup, assistant curator of geology in the American Museum of Natural History, and Mr. D. B. MacMillan, who were both members of Admiral Peary's last Polar expedition.

A FEW months ago (September 14, 1911) we announced that an influential committee had been formed with the view of erecting a monument to Dr. J. Janssen, whose work in astrophysics is known wherever spectroscopic studies of celestial bodies are carried on. It is felt that there should be an outward and visible sign, in the form of a work of art, of the esteem in which the world of science holds Janssen's services to astronomy and civilisation. Subscriptions are solicited for this purpose, and it is hoped that the response will be both ready and generous. The officers of the organising committee are:—*President*, H. Poincaré; *vice-presidents*, B. Baillaud and G. Bigourdan; *secretary*, P. Puiseux; *treasurer*, H. Dehérain, Bibliothécaire à l'Institut, Paris, to whom contributions should be sent.

THE anniversary meeting of the Geological Society of London was held on Friday last, February 16. The officers were appointed as follows:—*President*, Dr. A. Strahan, F.R.S.; *vice-presidents*, Prof. E. J. Garwood, Dr. J. E. Marr, F.R.S., Mr. R. D. Oldham, F.R.S., and Prof. W. W. Watts, F.R.S.; *secretaries*, Dr. A. Smith Woodward, F.R.S., and Mr. H. H. Thomas; *foreign secretary*, Sir Archibald Geikie, K.C.B., President R.S.; *treasurer*, Mr. Bedford McNeill. The following awards of medals and funds were made:—Wollaston medal, Mr.

Lazarus Fletcher, F.R.S.; Murchison medal, Prof. Louis Dollo; Lyell medal, Mr. Philip Lake; Wollaston fund, Mr. C. I. Gardiner; Murchison fund, Dr. A. Morley Davies; Lyell fund, Dr. A. R. Dwerryhouse and Mr. R. H. Rastall. The president delivered his anniversary address, which dealt with the natural resources of this country in the matter of coal supply, and their probable duration.

THE death is announced, at Bergen, of Dr. G. H. A. Hansen, whose name will always be associated with the discovery of the bacillus of leprosy by him in 1871. This was almost the first micro-organism associated with disease to be recognised, antedating Koch's discovery of the tubercle bacillus by ten years. Hansen regarded leprosy as a malady of an ordinary bacterial type, and he therefore hoped for the complete extinction of the disease by the segregation of the sufferers. With this end in view, he took an active part in the organisation of leper hospitals in Norway, and although his hopes have not been completely realised, these measures have considerably diminished the prevalence of leprosy in Norway. Notwithstanding the bacillus of leprosy was recognised forty years ago, it is only within the last year or two that the artificial cultivation of the organism has attained any measure of success.

IT is officially announced that the Chancellor of the Exchequer is appointing a committee to report at an early date upon the considerations of general policy in respect of the problem of tuberculosis in the United Kingdom, in its preventive, curative, and other aspects, which should guide the Government and local bodies in making or aiding provision for the treatment of tuberculosis in sanatoria or other institutions or otherwise. The committee will consist of Mr. Waldorf Astor, M.P. (chairman), Dr. C. Addison, Dr. N. D. Bardswell, Mr. David Davies, M.P., Dr. A. Mearns Fraser, Dr. A. Latham, Dr. W. Leslie Mackenzie, Dr. J. C. McVail, Dr. W. J. Maguire, Sir George Newman, Dr. Arthur Newsholme, C.B., Dr. J. Niven, M.P., Mr. M. Paterson, Dr. R. W. Philip, Dr. H. Meredith Richards, Mr. T. J. Stafford, C.B., Miss Jane Walker, and Mr. J. Smith Whitaker. The secretary to the committee will be Mr. F. J. Willis, one of the assistant secretaries of the Local Government Board.

The Times of February 10 includes an article by its well-informed correspondent in Sydney upon the Australian water supply. The article mentions the great progress which has been made in the construction of storage reservoirs for the collection of winter floods down the rivers of the Murray System. It deals mainly with the supply from the wells in Queensland and the adjacent parts of eastern central Australia, and refers to the large volumes of water yielded by some of these wells at a comparatively slight cost. Many of the bore waters cannot be used for irrigation, as they are heavily charged with salts; and though it has long been known how some of the injurious alkalies could be converted into useful plant foods, these methods have not yet been applied in practice. The article recognises that the supply from the bores tends to fall off, and that some have ceased altogether. It has recently been discovered that the water of one of the bores is radio-active, which gives support to the view that some of the water is of plutonic origin. That gas pressure helps in the outflow of the well waters has been recently shown by chemical analyses. It may be hoped that the attention now being given in Australia to this great subterranean supply of water will lead to the alteration of the old policy, whereby many of the wells were allowed to run to waste.

DR. A. P. LAURIE gave his opening lecture as professor of chemistry in the Royal Academy on February 19. His subject was "Pigments Old and New, and their Value in Detecting Forgeries." He began by describing the list of pigments which were in use at the time of Pliny. He then went on to point out what pigments had been introduced in addition to these at various times in the history of art up to the present day, such as the discovery of the preparation of real ultramarine, the introduction of lakes prepared with alum, and the introduction in more recent times of such pigments as chrome yellow, cadmium yellow, artificial ultramarine, cobalt blue, and oxide of chromium green. He then proceeded to discuss the question of how far these pigments could be identified in pictures without injuring the picture, first by means of a microscopic examination of the surface with the assistance of the micro-spectroscope, and by actual but minute tests made upon the surface of the pigments, and then by the removal of very small portions by means of delicate tools at a scale much finer than that required for surgical operations on the eye, these minute portions to be mounted in paraffin and cut in sections to be microscopically examined and tested. A systematic plan for the identification of blues when mixed with white lead was shown, and many photomicrographs, on Lumière plates, of pigments magnified to 200 diameters. In conclusion, the photomicrographs of the pigments actually found on an illuminated missal letter of the fifteenth century were shown on the screen, and the means of identifying them explained. Finally, some account was given of the mediæval methods and the treatise of the monk Theophilus.

WE record with regret the death of Mr. George Maw, which occurred at Kenley, Surrey, on February 7. Born in 1832, Maw was a manufacturer of artistic tiles and pottery at Broseley, Shropshire, where he formed a remarkable collection of living hardy plants. With wide scientific interests, Maw gave especial attention to botanical, geological, and antiquarian problems. His earlier studies dealt with English botany; in 1853 he discussed the plants of the Taw, Tamar, and Torridge Valleys; he discovered *Lilium pyrenaicum*, in a naturalised condition, near Molton, S. Devon. To enrich his garden he travelled widely in the mountains of Europe, Asia Minor, and North Africa; he discovered *Draba Mawii* on the Spanish Sierra Nevada, and *Saxifraga Maweana* on the mountains above Tetuan. In 1871 he accompanied Sir J. D. Hooker and Mr. J. Ball in an expedition to North Africa, and discussed the geology of the country traversed in the well-known work "Marocco and the Great Atlas," published by Messrs. Macmillan in 1878. About 1875 Maw began to concentrate his attention on the genus Crocus, as to which he became the recognised authority; in search of its species he travelled much in Greece and Asia Minor. After preliminary systematic and horticultural notices, Maw issued, in 1886, a magnificent monograph of Crocus containing quarto plates of sixty-seven species drawn and coloured by himself. Then his health gave way; in May, 1886, he left Shropshire, and had lived in retirement at Kenley ever since. Maw was a fellow of the Linnean society, which he joined in 1860, of the Geological Society, and of the Society of Antiquaries.

THE trial of Galileo formed the subject of the third lecture delivered on February 14 at University College by the Quain professor of comparative law (Sir John Macdonnell), on comparative legal procedure as illustrated by historical trials. From the report in *The Times* of the following day it appears that the lecturer justly rejected the legend that Galileo was thrown into a dungeon and tortured, while the truth is that, considering the usual mode of procedure of the Inquisition, he may almost be said to have been treated somewhat leniently. Too much stress should probably not be laid on the proceedings at Rome in 1616, as Galileo at the trial in 1633 was not mainly convicted because he had acted contrary to the engagement he had entered into seventeen years before not to teach or defend the Copernican doctrine, but because (as the sentence distinctly stated) he had made himself suspected of heresy. Galileo did not deny that he had in 1616 been officially informed that the theory of the earth's motion must not be taught as a physically true one, and he acknowledged that he had in his "Dialogue" expressed himself in such a manner that the reader might think that he believed Copernicus to be right. Sir John Macdonnell thinks that if the question had arisen a few years earlier or later, it is possible that the doctrine might not have been forbidden. But it should be remembered that the invention of the telescope in 1609 altered the state of affairs by revealing many analogies between the earth and the planets, thereby changing the question from a purely academic one into a very real one of interest to everybody. Galileo had also tried to offer a physical proof of the earth's motion by his curious theory of the tides, which certainly damaged his case still more. The trial does not present many points of special interest apart from the personality of the accused and the cause he advocated. Many Protestant theologians of that day detested the Copernican doctrine just as cordially as the Inquisition did, but they lacked the power possessed by the latter.

IN *L'Anthropologie*, vol. xxii., No. 6, L'Abbé H. Breuil and M. Cabre Aguilo contribute a valuable addition to their series of studies of Palæolithic man, under the title of "Les Peintures rupestres d'Espagne," describing a number of rock-paintings at the village of Albarracin, lying in the valley of the River Guadalaviar, which enters the Mediterranean Sea near the city of Valencia. The rough sketch of a primitive horse or pony, and coloured pictures of groups of cattle with their calves, are interesting. Still more remarkable figures in these groups are those of two men, one in black, the other in white, represented in the act of discharging arrows at some animals. They closely resemble figures of the same kind found in the Cogul Cave, and remove all doubts as to the significance of the latter.

WE welcome the appearance, though belated, of the first number of *The Journal of Roman Studies*, the organ of the society started last year in cooperation with the flourishing Society for the Promotion of Hellenic Studies. The most important contribution is by Mrs. S. A. Strong, a series of notes, supplementary to the official catalogue, of the remarkable exhibition, illustrative of the provinces of the Roman Empire, at the Baths of Diocletian, Rome. The exhibition has proved so successful that the authorities announce that it will remain open until the end of next April. While other countries, in particular Austria-Hungary, have contributed splendid collections of Roman provincial antiquities, it is much to be regretted that, in comparison with Germania and Gallia, that of Britannia, the rich stores of Roman antiquities in which are little known to Continental scholars, makes such a poor display. If this new Roman society had been in working order, this reproach might have been avoided; but the official attitude to Roman antiquities is obvious from the consignment, some fourteen years ago, of the Romano-British collection in the British Museum to dark corridors and dirty, inaccessible basements in favour of the Rothschild collection. It is quite time that the authorities became convinced of the need of providing adequate accommodation for valuable objects of great interest to many British antiquaries.

IN the Journal of the College of Agriculture, University of Tokyo, vol. i., No. 3, Takahashi and Satō discuss the maturing of the Japanese drink "saké," and find that this is brought about by one or more varieties of the yeast *S. anomalus* (now termed *Willia anomala*). Kurono has isolated an enzyme from both saké and beer yeasts which liberates ammonia from asparagin, and Yukawa describes two new Aspergillus fungi isolated from dried tunny fish.

IN *The Quarterly Journal of Experimental Physiology* for December, 1911 (vol. iv., No. 4), Dr. K. Mackenzie details the results of an experimental investigation of the mechanism of milk secretion, with special reference to the action of animal extracts. He finds that the mammary gland is, as regards its secretory activity, not under the direct influence of the nervous system, and that many organs, *e.g.* the pituitary body, corpus luteum, pineal body, involuting uterus, and the lactating mammary gland itself possess hormones which are capable of stimulating the mammary gland to activity.

"MEDICINES: ANCIENT AND MODERN," is the subject of an interesting article by Dr. Oliver Davis in this month's *Knowledge*. Modern remedies are largely synthetical—built up on preconceived lines by the chemist in the laboratory. The stereo-configuration of an organic compound, *i.e.* the spatial arrangement of the component atoms and groups in the compound, profoundly modify the chemical and physiological properties of a compound. This is illustrated by reference to anilin. This is a benzene nucleus into which an amino group, NH_2, has been introduced. It is far too toxic to be of much value as a medicine, but by replacing one of the hydrogen atoms of the amino group by the acetyl radicle, $COCH_3$, we obtain acetanilide or antifebrin, a well-known useful and fairly safe remedy.

IT seems to be established that Rocky Mountain spotted fever, a typhus-like disease occurring in limited districts in the United States, is conveyed by a tick (*Dermacentor venustus*). Bulletin No. 105 of the Bureau of Entymology, United States Department of Agriculture, is devoted to the bionomics of this tick, with special reference to its destruction. It is considered that systematic "dipping" of the domestic animals in the localities in which the tick is found would soon result in a very large reduction in its numbers. It is estimated that an expenditure of 23,692 dollars, spread over three years, would effect this, after which a very small annual expenditure, say 600 dollars, would suffice to prevent reinfestation.

No. 1879 of the Proceedings of the U.S. National Museum is devoted to an account, by Mr. L. J. Boettcher, of experiments which have been undertaken recently for the purpose of ascertaining the best means of preserving tusks, bones, and horns from decay and damage. Owing to desiccation, tusks of animals are exceedingly liable to crack and split after death, especially in hot and dry climates. This may be prevented by saturating them with paraffin, which may either be poured into the open end of the tusk or be imbibed by immersing the whole tusk for a certain period in a bath of melted paraffin.

UNDER the title of "The Public Utility of Museums," Lord Sudeley has issued in pamphlet form (Kingston-on-Thames: T. J. S. Guilford and Co., Ltd.) his letters to *The Times*, together with leading articles from that journal and other papers, on the subject of "personally conducted tours through our chief museums," a subject to which allusion has been previously made in our columns. Some of the difficulties experienced by the conductor of these peripatetic lectures at the British Museum are recorded at the end of the pamphlet, with suggested remedies. The idea of enlisting the services of amateurs to conduct these lectures would, we venture to think, prove unworkable.

IN the February number of *The Museums Journal* it is stated that "the Duchess of Aosta, who is a proficient big-game shot, has sent to the Natural History Museum three fine skins of the East African giraffe, secured during her recent hunting expedition. The species was not previously represented in the collection, and it is intended to have one of the specimens mounted for exhibition." As a matter of fact, these skins, which are by no means fine, were not sent by the Duchess of Aosta, although the animals from which they were taken were shot by her Royal Highness; the species (*Giraffa reticulata*) has for several years been represented by a mounted head and neck in the east corridor of the museum, and there is no intention of mounting one of the specimens.

WE have received a copy of a very interesting Guide to the Marine Aquarium at Madras, which was opened in October, 1909, and is now in full working order. The object of the aquarium is to provide an interesting display of the fishes and other marine vertebrates of Madras, and, at the same time, to furnish opportunities for their scientific study. The main entrance leads into a paved area with a central fresh-water pond, on either side of which are arranged five large tanks with glass fronts. The seaward side of the central area is occupied by a large open tank stocked with turtles, while smaller tanks are placed here and there for novelties and specimens of particular interest. The fish are captured by netting, but only a small proportion reach the aquarium, whence, once established there, they generally thrive. In one tank are exhibited both sea-snakes and fishes, and it is a remarkable fact that while none of the former have sought to attack the latter, several sea-snakes have been killed and eaten by fishes.

THE first number of *The Kew Bulletin* for 1912 is largely devoted to an account of Sir Joseph Hooker. The veteran botanist's intimate association with Kew gives special colour to the sketch of his life, and another valuable feature of the present notice is the complete list of his works which is appended. The latter, which is arranged in chronological order, dates from 1837 to 1911.

OWING to the decision to give up the botanical section of *The Annals of Scottish Natural History*, a new journal entirely devoted to botany has made its appearance. The magazine, which is to include the Transactions of the Botanical Society of Edinburgh, is entitled *The Scottish Botanical Review*. It is edited by Mr. M'Taggart Cowan, jun., with the assistance of an editorial committee, and is to be issued quarterly (price 7*s*. 6*d*. per annum). The January number covers a wide field. The geological relations of staple and migratory plant-formations are dealt with by Mr. C. B. Crampton, and critical notes on British aquatics are contributed by Mr. Arthur Bennett. Notes on alien plants, new records, and ecological nomenclature as applied to marine algæ also find a place, whilst eight pages are given to reviews and book notices. The number further contains Dr. A. W. Borthwick's presidential address to the Botanical Society of Edinburgh on modern aspects of applied botany.

AMONG the useful operations of the International Institute of Agriculture at Rome is the publication of a monthly bulletin containing summaries of agricultural investigations. These are by far the most complete hitherto issued, and they must prove of great value to agricultural investigators, whose literature is always scattered and often inaccessible. The Bulletin is published in French and English at a low price, and can cordially be recommended to the agricultural colleges in this country.

THE Live Stock Journal Almanac for 1912 contains, as usual, a history of the various breeds of stock during the past year, together with average prices and highest prices realised for pedigree animals. It is interesting to note that Great Britain still maintains its lead in live-stock breeding, and a very considerable amount of the prosperity of the agricultural community is bound up with the production of pedigree animals of high value. We read, for instance, of a young bull selling for 1050 guineas, whilst a calf sold for 1000 guineas; another bull fetched 720 guineas, while various others went for prices varying from 200 to 400 guineas.

A RECENT eruption of gas two miles off the south coast of Trinidad is described by Mr. Robert Anderson in *Science* for December 15, 1911. About three acres of blue mud were upheaved to some 30 ft. above the sea, and the gas thus formed a "crater of elevation." The locality lies on the prolongation of a line of similar gaseous activity in the island. The remarkable point about the eruption is that the gas became ignited on at least two occasions, the flames being visible fifty miles away. Mr. Anderson states that sparks have been struck from casings and tools of oil-wells by the impact of exploded boulders. He also suggests that electric phenomena, like those of Mt. Pelée, may have accompanied the eruption, and so have caused ignition.

A NEW Publication (No. 145) of the Carnegie Institution of Washington is devoted to the second part of Dr. E. C. Case's description and revision of the Permian Vertebrata of North America. This part deals with the Cotylosauria, which are generally regarded as the most primitive of known reptiles, ancestral to at least some later groups. After a brief historical summary, Dr. Case reviews all the named species in systematic order, and while quoting the original descriptions of the type specimens, adds critical remarks and new information wherever possible. He also occasionally proposes a new name himself, but it is evident that nearly all the specimens from the Permian of Texas—the chief source of the Cotylosauria proper—are too imperfect for exact determination. The late Prof. Cope's hasty method of giving names to battered fragments of bones and teeth from this formation is proved to have hindered and complicated the study of the reptiles to which they belong. One specimen, indeed, which Cope described as a skull with the external nostrils situated beneath the end of the snout (*Hypopnous squaliceps*), is now shown to be a normal skull with a second small skull, upside down, firmly adherent to the lower face of the snout and displaying its orbits, which were mistaken for the nostrils of the larger skull. Dr. Case's wide experience and careful work have enabled him to make the best use of such material, and his new memoir gives a very good general account of the osteology of the typical cotylosaurians. They seem to have been "harmless, sluggish, terrestrial herbivores, possibly fossorial in habit," and protected from their enemies by a more or less extensive bony armour.

WE have occasionally directed attention to the steps taken by the U.S. Weather Bureau for utilising and popularising the data at its disposal. In looking through its useful meteorological charts for the current month, we find it stated that the Bureau has recently installed at the Custom House in New York City a large glass weather map, embracing the area included between longitude 10° E. and 130° W., and latitude 5° and 60° N. On this the telegraphic reports received each day from land stations and from vessels at sea are entered in their proper positions, and in special cases storm tracks are also shown. In obtaining this information the Bureau has the cooperation of the wireless services of the Navy Department and the Army Signal Corps. In connection with this map there are twelve large monthly charts on rollers, each showing the average values of the various elements, for a period of twenty to forty years, for each 5° of the North Atlantic and adjacent shores, together with tracks of hurricanes and other useful information. The installation will, no doubt, be much appreciated by underwriters, shipowners, and all persons interested in maritime meteorology.

THE lecture on radio-telegraphy delivered by Prof. Howe before the Royal Society of Arts on January 31 is printed in the Journal of the society for February 2. It occupies a little more than nine pages, and gives in that small space a clear account of the fundamental principles of the subject which can be read and appreciated by anyone who has even an elementary knowledge of physical science. It does not leave the reader with a bare outline of the subject, but by means of oscillograph curves shows how in the appliances at present in use a train of waves as little damped as possible is secured, how these waves are sent in special directions, and, finally, how they are detected by the modern mineral contact type of instrument. Several important facts with regard to ease or difficulty of communication and possible interference in war time were brought out in the discussion which followed the lecture.

IN the *Revue générale des Sciences* for January 30 Dr. L. Dunoyer has an article on magnetic exploration at sea and the progress of terrestrial magnetism during the first half of the nineteenth century. He shows, in the first instance, how the elementary theory that the magnetic poles of the earth were situated on the surface was disproved by the observed variation of the dip with latitude. By means of a chart of the lines of equal dip, as observed and as calculated on the assumption that terrestrial magnetism is due to a small central magnet, he next shows how nearly this supposition reproduces the actual facts. The theory of Gauss is then given and compared with the chart of lines of equal force given by Sabine, and founded mainly on the observations of Ross. Finally, he points out how, with the advance of time, the secular changes of the magnetic elements have introduced so many uncertainties that a new survey is necessary. Such a survey the Carnegie Institution is now carrying out.

IN the current number (No. 23) of *Science Progress* a number of subjects of more than usual general scientific interest are dealt with. Sir Oliver Lodge discusses "The Æther of Space and the Principle of Relativity," and Dr. W. N. Shaw the "Structure of the Atmosphere and the Texture of Air Currents in Relation to the Problems of Aviation." Opposing views are taken in the two papers on "The Interpretation of Life" and "Vitalism," by F. Carrel and L. Doncaster respectively. Some novel experiments showing the part played by earthworms in aërating the soil are described by Dr. J. Newton Friend, more particularly as regards the rate of production by the worm of carbon dioxide. "Weeds: their Peculiarities and Distribution," by Dr. Brenchley, contains a summary of much recent work, whilst in a paper on the "Corrosion of Iron and other Metals," by Prof. Armstrong, two recent communications by Prof. W. R. Dunstan and Mr. J. R. Hill on the rusting of iron are discussed. In the latter paper the contention that the rusting of iron can be brought about by pure water and oxygen in the absence of acid is considered to be untenable, and even though "passivity" be induced by alkalis or oxidising agents, there is little doubt that in the ordinary process of rusting, carbon dioxide plays the necessary part of rendering the water a conductor, and thus establishing the conditions of electrical action.

IN a recent communication Ravenna and Zamorani (NATURE, November 2, 1911, p. 19) showed that certain seeds, which during germination produce hydrocyanic acid, have this power increased by exposure of the growing plant to light, and to an atmosphere of carbon dioxide, whereas the proportion of hydrogen cyanide is diminished by etiolation or excluding carbonic acid unless a carbohydrate, such as dextrose, is artificially supplied, when a considerable increase in its amount actually occurs even under these conditions. It was suggested that the hydrogen cyanide or cyanogenetic glucoside was formed probably by the action of inorganic nitrogen, possibly in the form of ammonia, on the carbohydrate. Experiments have since been made by Ravenna and Vecchi (*Atti dei Lincei*, vol. 20., ii., 491) on the development of hydrogen cyanide during the germination of seeds of Linum and Sorghum when small proportions of ammonium salts are present. In all cases the proportion of hydrogen cyanide formed was largely increased by the addition of 1 per cent. of ammonium chloride, as compared with seeds germinating in the presence of ordinary water alone. Hydrogen cyanide is not present in the case of Sorghum at the very commencement of germination, but only appears after a certain amount of growth has taken place and coincident with the first indication of chlorophyll. The proportion of the hydrogen cyanide gradually increases as the ammonia in the plant increases (the latter being estimated by Bosshardt's method), but in the earliest stages ammonia is present without there being any indication of hydrogen cyanide.

DEALING with the salving of submarine boat A 3, *Engineering* for February 16 states that the damage caused by the collision of this boat with the gunboat *Hazard* has been proved to be very serious. One of the rudders of the *Hazard* has been found jammed into the conning tower of the submarine boat, and the injury to the propeller disclosed when the gunboat was docked gives rise to the belief that it acted as a knife to rip the upper shell-plates of the submarine boat. These facts, supported by divers' observations, make it quite certain that no air-helmets or other appliances on board could have obviated the loss of life. Owing to the exposed position in which the A 3 lies, and to the heavy weather which has prevailed since the accident, lighters have been unable to carry out the salvage work. The task has now been handed over to the Anglo-Italian Salvage Company, which is adopting the procedure of supplying externally the buoyancy which the ship has lost by most, or all, of the compartments being flooded. A number of groups of air vessels of tubular type, each series consisting of nine rubber tubes secured at top and bottom to wooden frames fitted with the necessary valves, will be sunk by being filled with water. They will be secured to the ropes now lashed around the hull of the sunken boat, and then air will be forced through the top valves in order to drive the water from the tubes. It is hoped that the necessary buoyancy will be provided by this method.

OUR ASTRONOMICAL COLUMN.

THE NOVA, OR VARIABLE, 87.1911 PERSEI.—Photographs of the region surrounding the questionable object recently announced by Herr D'Esterre as a possible nova were secured by Herren Miethe and Seegert, of Charlottenburg photographic observatory, between January 12 and 16, and are discussed in No. 4555 of the *Astronomische Nachrichten.* Six photographs, showing images of fifteenth-magnitude stars, exhibit no certain trace of the object, but on two particularly good plates there appears, in the position of D'Esterre's object, the trace of a nebulous, indefinite image, which is probably connected with it. Further observations are to be made.

OBSERVATIONS OF JUPITER.—Vol. iv. of the *Recherches astronomiques de l'Observatoire d'Utrecht* is devoted to the publication and discussion of the observations and drawings of Jupiter made by Prof. Nijland during the period 1895–1906. In the first part, Prof. Nijland discusses 156 of the drawings in detail, giving a tabulated statement of the conditions under which they were severally made, and then directs attention to some of the general features remarked. Changes of colour of the several bands, spots, and streaks were noted from time to time, and although the material does not confirm the suggestion of periodicity made by Mr. Stanley Williams, it does not contradict it.

Part ii. deals with the spots, taking the observations *seriatim*, and there are some interesting notes concerning the variability of appearance—*e.g.* the white spots occasionally seen on the Red Spot area—of these peculiar features. In part iii. the Red Spot and its mutability are treated specially, and the volume concludes with fine reproductions of the 156 drawings of the planet.

PHOTOMETRIC OBSERVATIONS OF THE ASTEROIDS.—The importance of determining the light of the asteroids, which in several instances shows strange and puzzling variations, is emphasised by Prof. E. C. Pickering in Circular 169 of the Harvard College Observatory.

To clarify matters, Prof. Pickering tabulates the photometric measures made by different observers in seven series of forty-three asteroids, and then discusses the differences of the means from the calculated values given for the magnitudes at mean opposition in the *Berliner Jahrbuch.* He finds that the term $0{\cdot}2(m_0-9{\cdot}0)$ gives the relation between m_0 (the *Jahrbuch* magnitude) and the mean of the residuals obtained by subtracting the mean observed magnitudes from the computed magnitudes. The photometric magnitudes corresponding to the values of m_0 given in the *Jahrbuch*, 7·0, 8·0, 9·0, 10·0, 11·0, 12·0, and 13·0, are shown to be 6·6, 7·8, 9·0, 10·2, 11·4, 12·6, and 13·8, respectively.

Prof. Pickering remarks on the convenience for photometric observations of the ephemerides for the first four asteroids given in the British Nautical Almanac, and wishes that they should be extended to Eros and several other special objects, also that they should include the values of the phase angle.

OBSERVATIONS OF COMETS.—Observations of several of the comets of 1911 are reported in Nos. 4555–56 of the *Astronomische Nachrichten* from Bothkamp, Vienna, Utrecht, and Warsaw.

Dr. Schiller gives positions and describes the appearance of 1911*b*, 1911*c*, 1911*f*, and 1911*g*, and shows in a table of reduced magnitudes the probable oscillation of the intrinsic brightness of comet 1911*c* (Brooks). Prof. Holetschek gives measures of the brightness and the diameters of comets 1911*c*, 1911*f*, and 1911*g*, while Herr Tscherny gives places for, and describes the appearance of, comets 1911*c*, 1911*f*, and 1911*g*. On September 20, 1911, an eleventh-magnitude star was easily visible through the head of 1911*c*.

OCCULTATIONS OF MARS AND THE QUESTION OF THE EXISTENCE OF A LUNAR ATMOSPHERE.—During the occultation of Mars on December 4, 1911, Prof. W. Luther, observing with the refractor of the Dusseldorf Observatory, saw the half of the planet's disc which was nearest to the moon's limb become green, as though overcast by a shadow, while the outer half was as bright as usual; this was at about 17h. 7m. 22s. (Dusseldorf M.T.). Looking through his old observations, he found a note of a similar phenomenon taking place on October 16, 1902, and suggests that these observations indicate that there exists some material, extending to about 100 km. or more above the moon's surface, which is capable of modifying, or absorbing, light given out by a body passing behind it (*Astronomische Nachrichten*, No. 4556).

SOUTH AFRICAN METEORITES.—A preliminary note on the meteorites in the Bloemfontein Museum is contributed to part iii., vol. ii., of the Transactions of the Royal Society of South Africa by Mr. W. A. Douglas Rudge.

There are in the museum three specimens, two of them portions of the same fall, which occurred at Kroonstadt on November 11, 1877, and the third a single mass which fell at Winburg in 1881.

The larger of the twin fragments is very hard, yet easily friable, so that sections could not be cut; but by grinding, a surface was exposed showing masses of malleable nickel-iron set in a matrix of hard stone. The specific gravity was found to be 3·54, and that the mass was porous was shown by the fact that the weight in water increased from 989·5 to 991·4 grams after an hour's immersion. Qualitative analysis revealed the presence of iron, nickel, aluminium, calcium, silicon, sulphur, and traces of manganese, but no carbonic acid. A preliminary quantitative analysis gave:—insoluble matter 54·68, iron 30·38, and nickel 13·21 per cent.

The Winburg meteorite is very peculiar in having veins of lustrous iron-nickel alloy running through its mass of otherwise nearly pure iron. The general mass is very soft, but the crystals are harder and much brighter. The weight of the whole is about 50 kilograms, but there is evidence that it is only a portion of a larger mass. The preliminary analysis gives:—iron soluble in dilute H_2SO_4, 92·32 per cent.; iron in crystals, 2·35 per cent.; nickel in crystals, 2·00 per cent.; and carbon and earthy matter, 0·3 per cent. It would thus appear that practically all the nickel is concentrated in the bright crystalline material forming the veins.

ASTROPHYSICS IN CANADA.[1]

THE general report presented by the chief astronomer of the Dominion of Canada, Mr. W. F. King, gives detailed reports of progress made in the departments of time service, astrophysics, and geophysics.

Meridian Circle and Time Service.—The installation of this instrument has been attended with many unusual difficulties. Considerable trouble was experienced with the foundations of the meridian circle room owing to the percolation of surface water. A partial remedy was found by constructing a reservoir of 1200 gallons capacity, but as this was still insufficient during heavy rain, the pier footings becoming waterlogged, a system of drains surrounding the outside walls would seem to be necessary. Provision has been made in the collimator piers for underground lenses as permanent marks, similar to the system which has proved so satisfactory at the Cape Observatory.

The observers appear to have also had a most unusual experience with the transit circle itself. The graduated circles were not adjusted properly on their seatings; the axis pivots were found to be made of comparatively soft metal, rendering it necessary to shrink on collars of hardened steel and rework the surfaces with the lathe at the Royal Mint workshop.

Astrophysics.—The principal work in the astrophysical division has been the spectroscopic observations of radial velocities of binaries, determined from photographic spectra taken with the prism spectrograph. Five orbits have been thus investigated, η Boötis, θ Aquilæ, α Coronæ Borealis, ϵ Herculis, β Orionis. In other systems variable velocities have been discovered. Detailed records are included of measures of the spectrograms of the above stars, with the individual velocities from each plate.

A new single-prism spectrograph for radial velocity work has been designed and constructed with a strain-free mounting similar to that at the Lick Observatory. The body of the instrument is supported at two points, with a balanced action on a third, and the system is so successful that it is stated the flexure is inappreciable when the spectrograph is turned through 180°.

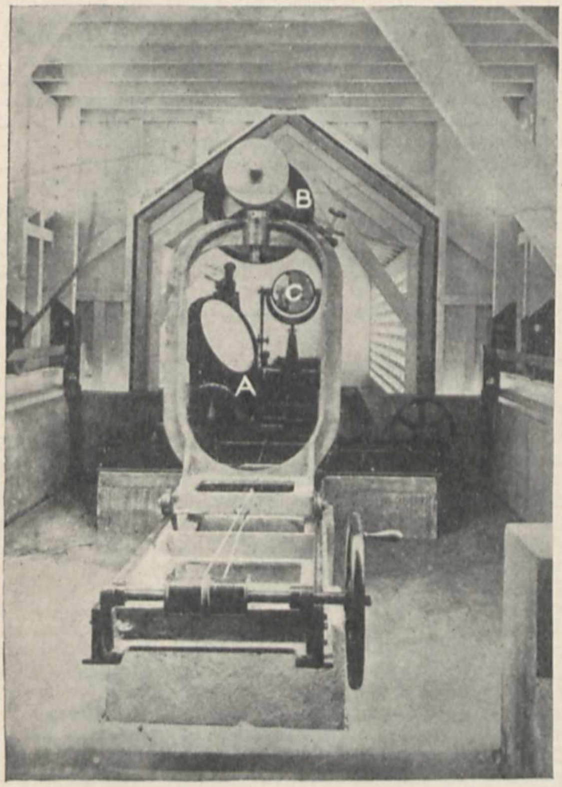
Considerable time has been spent in testing the various

[1] Report of the Chief Astronomer, Ottawa, for the year ending March 31, 1909. Department of the Interior, Sessional Paper No. 25*a*. (1910.)

instruments and experimenting on the best methods of observation. A thorough test of the new Brashear doublet for stellar photography has been made by Hartmann's zonal method, and comparison photographs with different adjustments are given in illustration of the method.

Other work in this division included micrometric measurements of double stars, comet photographs, star occultations, solar photography, and adjustment of the new large grating spectrograph and cœlostat.

The cœlostat telescope is of the form installed by Hale at Mount Wilson, known as the Snow telescope, consisting of a plane mirror cœlostat with secondary mirror, concave image mirror, and Littrow spectrograph with plane diffraction grating. The main cœlostat mirror, 20 inches diameter, driven by clockwork, reflects the sunlight in a southerly direction to a secondary plane mirror, which in turn reflects the light northwards to a concave mirror, 18 inches diameter. This forms an image of the sun slightly less than 9 inches diameter on the slit plate of



View of the Ottawa cœlostat, looking north. A, main cœlostat mirror; B, secondary cœlostat mirror; C, concave image mirror.

the spectrograph, fixed in the basement of the main building of the observatory. This arrangement of mirrors is clearly shown in the accompanying illustration, taken from the report. The whole is covered by a louvred structure, part of which can be moved to allow of the sunlight reaching the cœlostat mirror at all seasons.

The large solar spectrograph is located in the basement, and consists of a 6-inch lens of 22 feet 10 inches focal length, together with a Michelson plane diffraction grating mounted in the Littrow form. The whole instrument is mounted so as to be capable of rotation about the collimation axis, this making it possible to place the slit tangential to any required point on the sun's limb.

Some interesting photographs of comet Morehouse are given showing the varying appearance presented by the tail during October and November, 1908.

Geophysics.—In the geophysical division reports are presented showing the progress of determinations of seismology, terrestrial magnetism, gravity measurements, and latitude and longitude work on numerous stations throughout the Dominion.

CHARLES P. BUTLER.

THE PRECIPITIN REACTION.

THE precipitin reaction is also known as the "biological reaction" for proteins; it enables us to distinguish between proteins by using the animal body as a test-tube, and to establish differences between them which no other form of test-tube will detect. It is best known as a means for distinguishing human from other forms of blood. The procedure is briefly to inject an animal (usually a rabbit) repeatedly with a foreign protein; the serum of that animal then gives a precipitate with that protein, but with no other. So if the material injected is human blood, a precipitate is produced when the serum of the blood of the rabbit is added to human blood, or at any rate to the blood of the group of animals (the higher apes) to which man belongs, but not with any other sort of blood. The reaction is of value in forensic medicine, and it is also of value to the zoologist, as it enables him to demonstrate the blood-relationships of animals, and by the amount of precipitate to ascertain the degree of the relationship in figures.

A vast amount of research has centred around this discovery, Bordet, Uhlenhuth, Tchistowitch, and Nuttall being a few among the many who have devoted themselves to working out its details. A very clear and concise account of the principal facts has been recently published in a lecture given by Dr. W. A. Schmidt before the Cairo Scientific Society (*Cairo Scientific Journal*, November, 1911). Dr. Schmidt's name is known as one of those who have within recent years examined Egyptian mummies by chemical means, and his publications on the precipitin reaction have also been important. His lecture naturally deals with the question in a general and popular way, but includes a reference to some of his own work.

Among other interesting points, Dr. Schmidt has determined is the resistance of proteins to heat. It was formerly supposed that the "biological" property of proteins was easily destroyed by an elevated temperature, but Schmidt has shown that boiling for half an hour is necessary to abolish their power of reacting with a precipitin serum; and even although this is accomplished, the heated protein still retains the power when injected into an animal of inducing the formation of a precipitin which reacts with heated or boiled protein material. Further than this, protein may still be further "denaturalised" and retain a corresponding power; when, for instance, protein is coagulated by a high temperature, so that ordinary neutral reagents no longer dissolve it, a solution of it in dilute alkali will produce precipitin-formation in the blood of an injected animal, which will react only with the "denaturalised" protein used for the injection. This discovery extends the usefulness of the precipitin reaction, for with the precautions described by Dr. Schmidt it may be employed to detect proteins even though some of their principal chemical properties have been destroyed.

SCIENTIFIC MEMORIAL VOLUME, CELEBRATION OF THE 500TH ANNIVERSARY, UNIVERSITY OF ST. ANDREWS.

A NEATLY bound memorial volume of scientific papers was issued by the University of St. Andrews to mark, with other publications, its 500th anniversary last September, and is edited by Profs. McIntosh, Steggall, and Irvine. The first paper, on concrete representations of non-Euclidean geometry, by an able mathematician, Dr. D. M. Y. Somerville, consists of a description of the most important representations which have been devised for non-Euclidean geometry within the field of ordinary Euclidean geometry, viz.:—(1) the Cayley-Klein projective metric, or representation by straight lines referred to a conic as absolute; (2) the conform representation by circles orthogonal to a fixed circle; (3) Beltrami's geodesic representation on surfaces of constant curvature; (4) McClintock and Johnson's representation by "visual geometry"; (5) the representation by a net of conics through two fixed points; and (6) Poincaré's representation by diametral sections of a quadric surface.

The second paper is on the algebraic solution of indeterminate cubic equations, by Mr. Robert Norrie. The third, by Prof. Peddie, treats of the problem of partition of energy, especially in radiation, with the author's usual ability, and the same may be said of the fifth paper, by the same skilful experimenter, on the deviations of the oscillations of a viscous solid from the isochronous law. Mr. J. P. Dalton gives a careful digest of the accuracy attainable with a modified form of Attwood's machine, whilst Mr. J. B. Ritchie further extends previous researches by Prof. Peddie on the dissipation of energy and other effects observed in torsional oscillation. The last of this series is an account of interesting experiments on wave impact on engineering structures, carried out by Prof. A. H. Gibson and Mr. W. N. Elgood, resulting in the conclusion that the effective internal pressure due to wave impact cannot exceed that exerted by wave impact on the face of a breakwater, and suggesting the provision of drains opening on the sheltered face.

The section devoted to chemistry contains a critical account of a new series of methylated sugars recently obtained in the Purdie Research Laboratory at St. Andrews by Prof. Irvine. The extended application of these researches is reviewed in an excellent paper by Mr. C. R. Young, whilst Mr. W. S. Denham ably treats of new methods in the preparation of anhydrides of organic acids, and Mr. R. C. Wallace deals with the relationships of indium and thallium. These researches give an indication of the importance and variety of the work recently carried out in this department. Under the section of natural history and medicine, Prof. McIntosh gives a brief history of the chair of natural history at St. Andrews, and Prof. D'Arcy Thompson reprints his presidential address to the British Association, entitled "Magnalia Naturæ: or the Greater Problems of Biology." The next paper is by Prof. E. E. Prince, dealing with the pioneer work in scientific fishery investigations at St. Andrews, and makes mention of many workers, now scattered in diverse regions, who have extended our knowledge of the department in a noteworthy manner, and by none more than the writer of the article. The last is a medical contribution on the important subject of the toxicity of local anæsthetics, by Prof. C. S. Marshall, who carried out a series of careful experiments with no fewer than eight drugs.

No zoological researches are included in the volume, since its scope was not understood until too late for the insertion of the able contributions of such well-known investigators as Dr. H. C. Williamson, Dr. H. M. Kyle, Dr. Wm. Nicoll, and many others whose names appear in the list of publications emanating from the Gatty Marine Laboratory.

THE CONTROL OF INSECT PESTS IN CANADA.

AT the meeting of the Manchester Literary and Philosophical Society on January 9, Dr. C. Gordon Hewitt, Dominion entomologist, gave an account of the ravages of insect pests in Canada, and the means taken by the Dominion Government to combat them. The annual opening up of vast tracts of country, previously wild, destroys the balance of nature, and swarms of insects, finding fresh stores available, devastate the new growths. Some of these insects are of native origin, but are more frequently introduced. Thus the Hessian fly, *Mayetiola destructor*, Say, appeared in 1816; the wheat midge, *Diplosis tritici*, Kirby, in 1828; the chinch bug, *Blissus leucopterus*, Say, in 1866; and the Colorado potato-beetle, *Leptinotarsa decemlineata*, Say, in 1870. The larch sawfly, *Lygaconematus erichsonii*, Hartig, reached Canada in 1882, and in a few years destroyed the mature larches over practically the whole of eastern Canada. The pear-leaf blister-mite, *Eriophyes pyri*, Nalepa, was first reported from Nova Scotia about 1887, and has since spread across Canada from the Atlantic to the Pacific.

Other pests referred to included the clover-root borer, *Hylesinus trifolii*, Müller; the warble-fly; the apple fruit-miner, *Argyresthia conjugella*, Z.; the apple maggot, *Rhagoletis pomonella*, Walsh; and the San José scale, *Aspidiotus perniciosus*, Comst. It was found necessary to pass the San José Scale Act, prohibiting the importation of trees and nursery stock from countries in which the scale was known to exist; in 1901 the restriction was removed, but infected plants were fumigated by prussic acid before admission. The brown-tail moth, *Euproctis chrysorrhoea*, L., has now reached Canada, and is attacking oak, elm, and maple, in addition to fruit trees. Contrary to expectations, the severe winters of Canada do not prove to be so fatal to the larvæ; experience has shown that some 30 per cent. survive after being frozen for two months in a block of ice. Attention is therefore being given to the parasites of this species; also the severely infested trees are sprayed to kill the young larvæ.

Dr. Hewitt gave an account of the precautionary measures taken and of legislation in the Dominion, and of the history of the Entomological Department there. Educational work is undertaken, and agriculturists and associations addressed on the means of prevention and control of outbreaks. At Ontario Agricultural College, and in other provinces, men are trained to act as assistants and inspectors in this branch.

"EXTERNAL" DEGREES AT THE UNIVERSITY OF LONDON.

SIR WILLIAM RAMSAY'S letter to NATURE on the value of the "external" degrees of the University of London, published on February 1 (vol. lxxxviii., p. 445), has given rise to a number of letters upon the subject. As several correspondents traverse the same ground, and limitations of space will not permit us to publish the letters in full, we subjoin a summary of the chief points raised.

Dr. A. D. Waller, F.R.S., thinks that no useful purpose would be served by any discussion of the particular case cited by Sir William Ramsay, where it is suggested an injustice has been done to a late student of University College, and proceeds to consider the principle involved. He urges that the great desideratum as regards the superior degrees of the University—"internal" as well as "external"—is not the abolition of the "external" degree, but publicity during examination of both kinds. A candidate presenting a doctoral thesis to the University is, says Dr. Waller, in the position of an investigator presenting a communication to a learned society, and ought to be called upon, or permitted, to expound and uphold his thesis by speech and by demonstration in the presence of the University. The "external" examinations ought not, he maintains, to be abolished, for they have been, and are, of far-reaching value as affording a guide to study and a standard of excellence throughout the Empire.

Prof. T. Johnson, of the Royal College of Science, Dublin, directs attention to the fact that the University of London was founded, in part, for students whom circumstances prevent from attendance at the London courses of instruction, and argues against the abolition of the "external" side in the University. He contends that the agitation for the conversion of the examining into a teaching university had its origin largely in the unpublished desire to safeguard certain vested interests. It was no uncommon thing in the old days, he says, for a professor in a London college to find his salary reduced owing to loss of fees caused by his replacement, at the end of his term of office as an examiner, by a provincial or other examiner. "This 'anomaly' or 'injustice' was removed by the creation of the University's teaching side and intern examinerships."

Mr. W. J. Oakes, of the Oakes Institute, Walton, Liverpool, emphasises the similarity in the requirements, so far as the arts courses are concerned, for "internal" and "external" degrees, and attaches great importance to the fact that "external" candidates for science degrees must provide suitably attested evidence of practical training in a laboratory. He points out the comparatively small provision in provincial centres of scholarships to enable young men and women to attend day courses at local universities. He asks, "What are the young men who come from homes where the income is less than 200*l*. a year to do?" If no other case could be made out for the "external" degree than that of the young men who cannot possibly attend the day classes of a university, this would, Mr. Oakes says, outweigh all the arguments which can be advanced against it.

SOME PHASES OF THE COAL-DUST QUESTION.[1]

UP to the year 1875 all great colliery explosions in this country were attributed to the accidental ignition of a large volume of firedamp that had either previously existed in an abandoned empty space, or goaf (like that which admittedly caused the Whitehaven explosion in May 1910), or was supposed to have burst suddenly into the workings and filled them with inflammable gas. In the absence of a goaf, and when, for some reason or other, the occurrence of an "outburst of gas" was not assumed, the cause of the explosion was described as a mystery.

In 1845 Faraday and Lyell directed attention to the presence of crusts of coked coal-dust and to the evidences of intense heat which they had observed in the workings of Haswell Colliery after an explosion, which they, no doubt correctly, assumed had been caused by the accidental ignition of a large quantity of firedamp in the goaf. Following up that assumption, they remarked that "there was every reason to believe that much coal-gas was made from this dust in the very air itself of the mine by the flame of the firedamp, which raised and swept it along."

These words indicate clearly, I think, what was in their minds, namely, that the participation of the coal-dust was an important, but by no means an essential, incident in the firedamp explosion.

During the fifteen years preceding 1875 some French engineers expressed the opinion that coal-dust must have greatly lengthened the flame of certain small explosions of firedamp and blasting shots, and aggravated the consequences to a corresponding extent; and one of them, M. Verpilleux (whom, however, none of his contemporaries seemed disposed to follow), went so far as to compare, in relative importance, the initial flame with that of the priming, and the coal-dust flame with that of the discharge, of a gun.

I had been seeking for a rational explanation of great explosions for some years before I came to South Wales as assistant inspector on mines. Before that time I had had much experience in investigating the causes of small firedamp explosions in damp and wet mines in Scotland, but of no explosions of any kind in dry and dusty mines. Accordingly, when I found that all the great explosions in this district had occurred in mines of the latter, and none of those of the former class, I began to associate them with the presence of coal-dust. Acting under this impression, I made experiments in the summer (July 3) of 1875 with a mixture of coal-dust and air, which was made to flow through the small wooden apparatus described in my first paper on coal-dust referred to hereafter. I found that when a small proportion of firedamp, less than that contained in the return airways of practically every fiery mine, was added, the resulting mixture could be ignited by means of a naked light, and continued to burn with a dark yellow, smoky flame so long as coal-dust and firedamp were supplied to the current. This discovery proved to my entire satisfaction that coal-dust, although consisting of solid particles, played exactly the same part as a combustible gas when disseminated in the air—could, in fact, be substituted for firedamp, and did not require the extraneous heat of a firedamp flame, as imagined by Faraday and Lyell, "to distil coal-gas from it." So far as I was personally concerned, the question was solved then and there; that is to say, I had no longer a shadow of doubt that coal-dust played the principal, and firedamp only a subordinate, part in all great explosions; or, again, that coal-dust played the part that had been assigned to "outbursts of gas" by the colliery explosion experts and inspectors of mines of that day and of many previous years.

In December of the same year, when an explosion, by which seventeen men lost their lives, occurred in a dry and dusty district in Llan Colliery, near Cardiff, I made a careful study of all the circumstances, attended the inquest, and gave evidence[2] to the effect that in my opinion coal-dust had been the paramount factor in the explosion; that the coal-dust had been swept up from the floor, mixed with the air, and ignited by the explosion and flame, respectively, of a comparatively small volume of firedamp, and that this gas had itself been accidentally ignited by a naked light.

At the same time I made some further experiments with coal-dust, as well as another series to determine the height of the firedamp cap corresponding to various mixtures of air and firedamp containing carefully measured proportions of each (a subject that had not been previously investigated). I then prepared a paper entitled "On the Influence of Coal-dust in Colliery Explosions," and through the late Dr. Frankland presented it to the Royal Society, by whom it was published in the following March (Proc. Roy. Soc., vol. xxiv., p. 354).

Early in 1876 Mr. (now Sir Henry) Hall carried out his celebrated experiment with a blasting shot, and published an account of it in June of the same year; two years later Prof. Marrecco and Mr. Morison, and four years later Sir Frederic Abel, made experiments with coal-dust, and in 1886 the two inspectors of mines Messrs. W. N. (now Dr.) and J. B. Atkinson published a book describing explosions in certain mines in their respective districts, which they attributed to coal-dust.

Owing chiefly, as can now be fully appreciated, to the small proportions of volatile matter contained in the two kinds of coal-dust with which my experiments were made (about 16·5 per cent. and 18·5 per cent. respectively), and partly, no doubt, also to the swiftness of the air-current necessary to sustain it in suspension in the apparatus, I had not up to this point proved that a mixture of air and coal-dust, at ordinary pressure and temperature, could be ignited by means of a naked light. On the other hand, I had proved that, when less than 1 per cent. of firedamp was added to such a mixture, it could be so ignited, and continued to burn like a large jet of inflammable gas. Again, at p. 369 of my first paper I stated the opinion that "if coal-dust could be made fine enough, and were thoroughly mixed with dry air in the proportion of about one pound to 160 cubic feet of air, the mixture might at least be so nearly inflammable" (at ordinary pressure and temperature) "that an explosion begun in it in a confined space," like the workings of a mine, "might be propagated through it"; and, further, on September 7, 1878, I said, in *Iron*:—

"It must not for a moment be supposed by anyone who has perused the foregoing pages that because I have only spoken of mixtures of air and coal-dust, or of air, coal-dust, and firedamp, as forming feebly explosive mixtures, I mean to imply that they cannot produce any, or all, of the results observed in the most destructive explosions that have ever been witnessed. I have constantly made use of the qualifying expression "*at ordinary pressure temperature*," thereby signifying that their behaviour at extraordinary pressure and temperature, such as are brought into play when an explosion is begun in a confined space, like the interior of a mine, may be, and probably is, very different." "That they do behave very differently has long been my settled conviction. . . ."

I entertained no doubt in my own mind as to what result would follow the initial stage, but in laying the question before the Royal Society and others I could not go beyond proved facts, and hence the necessity of approaching it hypothetically in my first paper, as follows (*loc. cit.*, p. 354):—

"If it could be shown . . . that a mixture of air and coal-dust is inflammable at ordinary pressure and temperature there would be no difficulty in accounting for the extent and violence of many explosions which have occurred in mines in which no large accumulations of firedamp were known to exist; for it is only necessary to suppose that a sudden gust of wind (originated, for example, by the explosion of a small accumulation of firedamp) had swept through the adjoining galleries, raising a cloud of dust into the air, and then all the other phenomena would follow in regular order. The flame of the originally inflammable mixture would pass directly into the newly formed one, expanding its volume; the disturbance would be propagated over an ever-widening area until that area might possibly become co-extensive with the workings themselves; and the consequences would be the same as if the whole space had

[1] Abridged from the Presidential Address delivered to the South Wales Institute of Engineers on January 18 by Prof. W. Galloway.
[2] Published *verbatim* in the *South Wales Daily News* of December 22, and *Western Mail* of December 23, 1875.

been filled with an inflammable mixture before the disturbance began."

It was demonstrated a few years later (Proc. Roy. Soc., No. 219, p. 437), by means of a larger apparatus built at Llwynpia Colliery with funds provided by the Lords of Committee of Council on Education, at the instance of the Royal Society, that a mixture of air and coal-dust from the same sources and of the same quality as that which had been used in my first experiments was inflammable at ordinary pressure and temperature. The cloud of coal-dust thrown out of that apparatus into the open air, in some instances from 30 to 50 feet long by from 10 to 15 feet in diameter at its widest part, was permeated with rolling flames in identically the same manner as, although on a smaller scale than, the corresponding clouds ejected from the larger apparatus at Altofts and Liévin.

It might have been expected that this final proof would have settled the question definitely; but, as its subsequent history shows, the number of those who began to discuss it has been so great, and their opinions so diverse, that but little progress has been made during the thirty years that have since elapsed.

The object of my experiments was to elucidate the causes of great colliery explosions. They were a means to that end, and nothing more. For it appeared to me that if once the causes were known a means of prevention would be easily discovered, but that, so long as explosions continued to be attributed to outbursts of gas, which could neither be foreseen nor prevented, the safety lamp would be looked upon as the miners' only shield against a constantly threatening danger.

Proneness to attribute all explosions to firedamp was the real stumbling-block to progress. It held the French engineers and many others in bondage for thirty-one years after 1875, and was only finally and effectually removed by the occurrence of the Courrières explosion and the sensational phenomena subsequently revealed in the experiments at Altofts and Liévin.

After arriving at the conclusions narrated above, I sketched out in another article, which was published in *Iron* in 1878, what appeared to me to be two necessary additions to the Coal Mines' Regulation Act, as follows:—

(1) "No shot must, on any pretence whatever, be fired in a dry mine until the floor and sides of the working place, or gallery, in which it is situated have been drenched with water, and rendered artificially damp, to a distance of at least 15 yards from the shot-hole."

(2) "In every naturally dry mine water shall from time to time be sprinkled on the roadways, and in the neighbourhood of the working places, in sufficient quantities to render them damp at all times, both by night and day."

In 1886 the first of these two rules was adopted in the Coal Mines' Regulation Act, 1886–7, but 20 yards was specified instead of 15; the second was voluntarily adopted almost immediately in many mines in South Wales and elsewhere, and was made compulsory by the Prussian Government in 1899–1900, but is not insisted on by the law of this country.

I can still conceive of no better safeguard against the dangers of shot-firing than that of rendering the dust harmless with water in the manner now specified in the Coal Mines' Regulation Act, provided it be properly carried out. As regards the second precaution, I am now of opinion that universal watering might be safely dispensed with if a zone of wet ground of adequate breadth were created round about every accumulation of explosive gas or every point at which such an accumulation is liable to occur in open spaces near the working places or accessible to the workmen.

Although French engineers had taken a prominent part in the assigning of a certain *rôle* to coal-dust thirty or forty years ago, they rejected the coal-dust theory from the first, and continued to oppose it until within the last few years, concentrating the whole of their attention, as M. Taffanel tells us, upon discovering the best means of dealing with firedamp. As an indication of their attitude, I may quote the words of M. H. Le Chatelier, who, writing in 1890 regarding the three supposed special causes of explosions, viz. barometric variations, coal-dust, and outbursts of gas, expressed himself as follows:—

"The first is purely imaginary, the second is insignificant in the absence of explosive mixtures of firedamp and air, the third alone is really serious, but happily it occurs only under very exceptional circumstances."[3]

It is remarkable, therefore, that the sudden blow which eventually shattered this opposition and brought the coal-dust question into world-wide prominence, namely, the great disaster at Courrières Colliery in 1906, in which more than 1100 men perished, should have fallen upon France herself. The effect was immediate; commissions and committees were hastily called together or revived, thousands of pounds were forthcoming for experiments, apparatus on a comparatively gigantic scale was erected in England, France, and the United States, and experiments were resumed in an artificial gallery in Austria that had been disused for several years.

In the midst of this great awakening in the coal-mining world, the Mines Department of the Prussian Government, which formulates and promulgates the laws governing the safety of the Westphalian coal mines, remained apparently unmoved.

In 1884 the Prussian Firedamp Commission made experiments with coal-dust on a fairly large scale in an artificial gallery at Königsgrube, Saarbrücken, some of which were seen by Lord Merthyr and myself on October 24 of that year. The dust employed in these experiments was collected from the floors of various collieries producing coal of different qualities, and as it was submitted to the test without having been sifted to remove the coarser particles and reduce it to a uniform degree of fineness, the different kinds naturally gave different results. As a consequence, the commission reported that although some kinds of dust produced explosive phenomena, and were therefore highly dangerous, others did not do so under the same conditions, and might, therefore, be considered safe. Acting under this impression, they recommended, first, a system of watering in a general way in dangerous mines; secondly, the use of brisant and short-flaming explosives in place of gunpowder in all dusty mines; and, thirdly, the thorough damping of the dust for a distance of at least 10 metres in front of every blasting shot.[4]

Soon after the completion of the experiments water-mains were laid in the Saarbrücken mines, which belong to the Prussian State,[5] and later some of the large Westphalian mines began to follow their example; but very little was done in this direction until after the occurrence of a disastrous explosion at Carolinenglück Colliery on February 17, 1898, by which 116 men were killed.

Experiments with shots charged with gunpowder on the one hand, and with brisant explosives on the other, in the presence of inflammable gas and coal-dust, were begun more or less simultaneously in Germany, France, and other Continental countries, and in England both with brisant explosives and water-cartridges, early in the nineteenth decade of last century. I had the honour of conducting those carried out in this country during a period of several years, with the collaboration of Lord Merthyr, who was a member of the Royal Commission on Accidents in Mines, under the auspices of which they were made.

As the result partly of the voluntary, partly of the legislative, action taken in this country, it will be seen from the following table that there has been a marked diminution in the number of deaths from explosions during the last thirty years, notwithstanding the increase of more than 50 per cent. in the number of men employed and in the output of coal:—

Year, or Average of Period Named.

Period		Output	Men employed underground	Number of deaths
1 year ...	1851	—	—	321
1 ,, ...	1852	—	—	264
10 years ending	1862	—	—	216
,, ,, ,,	1872	128,680,321	403,281	238
,, ,, ,,	1882	168,921,705	461,024	263
,, ,, ,,	1892	203,322,840	588,446	147
,, ,, ,,	1902	250,940,800	747,509	104
9 ,, ,,	1911	—	—	134

[3] Le Grisou et ses Accidents, Extrait de la Revue Générale des Sciences pures et appliquées. No. 20, du 30 Octobre, 1890, p. 19.

[4] Hauptbericht der Preussischen Schlagwetter Commission, p. 221 (1887.)

[5] Die Entwickelung des Niederrheinisch-Westfälischen Steinkohlen-Bergbaues, vol. ii., p. 6 (1904).

The high average of the last period of nine years is due to the occurrence of two great explosions, admittedly of coal-dust, in which 480 men were killed. To my personal knowledge these two explosions might have been avoided had ordinary precautions been taken of the kind referred to above. But for these two explosions the average of the last nine years would have been 80 instead of 134, or the lowest on record for sixty years.

In the United States, the greatest coal-producing country in the world, the coal-dust question attracted scant attention until 1907, when the total death-roll from coal-dust explosions, so-called "windy shots," and gunpowder explosions reached the appalling figure of 1148.

In 1908 Congress was induced to vote a sum of money for the investigation of mine explosions; the Geological Survey was entrusted with the work, and on December 3 of the same year a testing station that had been built at Pittsburg during the interval was formally opened.

The recent experiments have corroborated the announcement made many years ago that an explosion capable of propagating itself through the workings of a mine cannot be initiated unless the cloud of dust and air is both large dense, and is ignited by a flame preceded by an air-wave.

The quantity of dust ordinarily in the air, or raised by the passage of a train of mine waggons, however rapidly they may be moving, is far too tenuous to be in the slightest degree inflammable.

M. Taffanel states[6] that the minimum quantity of the very highly inflammable coal-dust employed in his experiments that must be suspended in still air before the mixture can be ignited by a large flame like that of a comet lamp is 1 lb. to 80 cubic feet; that the probability of a dust-cloud of that density being formed in any mine working under normal conditions is extremely feeble; and that even "in working places called *very dusty* or *smoking* the density does not exceed more than a few grams per cubic metre" (say, one-third of an ounce in 80 cubic feet, or about one-fiftieth of that required to render the mixture inflammable).

I mention these facts in order, if possible, to counteract the exaggerated notions that have sometimes of late been expressed regarding the dangerous nature of coal-dust even in a state of quiescence, some persons seeming to credit it with qualities akin to those of gunpowder.

The relative fineness of the dust, proportion of volatile matter contained in it, and quantity present per unit of length in the experimental gallery determine the velocity of the flame and the pressure attained by the explosion at any point. When all three conditions are favourable the velocity and pressure increase rapidly with the distance traversed, and if the distance is sufficiently great the pressure is liable to burst the gallery, as it did in one or two instances—at Altofts and Liévin. As the dust for experiments is prepared mechanically from pure coal, and may be made far finer than the average of that found in any colliery, it follows that the velocity and pressure of explosions in the artificial galleries may be, and no doubt in many cases are, far greater than those that occur in an explosion in a dry and dusty mine, for in the latter the dust swept up by the airwave which precedes the flame contains a mixture of coarse and fine particles of both combustible and incombustible matter. But the coarse particles of both and the fine particles of incombustible matter reduce the temperature of the flame, and, consequently, both its velocity and pressure must necessarily be reduced in a corresponding ratio.

It is recognised, then, that the conditions under which experiments are made in an artificial gallery are not quite the same as those which obtain in a mine, and that the results observed in the one case may be essentially different in many respects from those experienced in the other. Hence it arises, probably, that although experiments have been assiduously carried on in artificial galleries for several years, no distinct pronouncement has yet been made as to the best means of either preventing or arresting explosions.

The Altofts gallery has been lent to a joint committee consisting of the original committee of colliery owners and members of the Royal Commission on Mines, which is stated to be about to undertake further experiments; M. Taffanel, who conducts the experiments for the French colliery owners, continues his experiments, and has sketched out a programme for many more; the Austrian investigators have made experiments with mixtures of coal-dust and cement-dust, with watered zones, and with what they designate water-curtains, which have not given satisfactory results; and, lastly, the experiments at the Pittsburg gallery have been only of a preliminary character so far as described up to the present, and have shed no particular light on the subject.

So far, then, no finality has yet been arrived at, and all the investigators have intimated that they have many more experiments still to carry out. But since these experiments were begun, and since the dangerous nature of coal-dust has been publicly demonstrated by their means, two explosions, fit to take rank with the most disastrous of last century, have occurred in this country, showing that the demonstrations have been futile so far as stimulating spontaneous action on the part of some managers to take even ordinary precautions is concerned. Partly for this reason, and partly because we may have to wait for some years longer before the investigators arrive at a unanimous decision as to what they think ought to be done, it would perhaps be well in the meantime to adopt a course that would undoubtedly have the effect of vastly reducing, if not entirely eliminating, the risk of explosions, both in damp and dry mines, by establishing three simple rules of the following import:—

(1) That in all dry mines the dust within the radius of a shot-hole now specified by the Coal Mines Act be damped *with sprinklers attached to a water-main*. (I am of opinion that the distance of 20 yards from the shot-hole, within which the dust is required to be watered according to the existing law, is unnecessarily great, and that with the short-flaming explosives and water-cartridges now in use a distance of 10 yards is ample.)

(2) That in all dry mines the dust be damped within a certain minimum radius of every accumulation of inflammable gas, or place in which the air shows a cap of one-quarter of an inch or upwards in height, by the same means as those mentioned in the first case.

(3) That all work be prohibited in both damp and dry mines within a certain minimum radius of every accumulation of inflammable gas, or place in which the air shows a cap of more than one-quarter of an inch in height, excepting only that required for the removal of the accumulation, or foul air, respectively.

[6] Cinquième Série d'Essais sur les Inflammations de Poussières, Août, 1911, p. 68.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The Coal Owners' Associations of the South Midland district, realising that rescue work in mines is a subject in connection with which research is desirable, have arranged with the University for the appointment of a lecturer in mine rescue work. The stipend of the lecturer will be defrayed by the Coal Owners' Associations, the amount offered being 250*l.* per annum. The functions of the lecturer will be not only to give lectures and instruction in the subject at the University, but also to be responsible for the organisation of rescue work, and to superintend the equipment and training of rescuers throughout the district.

Mr. John Furneaux Jordan has been appointed Ingleby lecturer for the current year.

LONDON.—The report of the Royal Commission on University Education in London, recommending a central building for the University, to which we referred in an article published in NATURE (January 4), has already produced an important scheme for the acquisition of a vacant site of more than 100,000 square feet immediately behind the extension of the British Museum. The site consists of four plots, two on each side of the new British Museum Avenue, on one of which it is proposed that a spacious hall should be built for the University, the other three plots being used for administration, library, small lecture theatres, rooms for graduates, and headquarters of the Officers Training Corps. The site is part of the Bedford estate, and it is stated that the Duke of Bedford is prepared to dispose of it for the purposes suggested. Apparently the scheme had not at the time of its publication received the approval of the Senate of the University, and has been launched in anticipation of that approval and of support from wealthy benefactors of the University. The site is central in position and adequate in area, while its proximity to the British Museum is obviously a great recommendation.

OXFORD.—Prof. W. Odling, F.R.S., has sent the Vice-Chancellor a formal intimation of his resignation of the Waynflete professorship of chemistry, to take effect from the end of Trinity term, when he will have completed forty years' tenure of the office.

DR. E. T. WHITTAKER, F.R.S., Royal Astronomer of Ireland, has been appointed professor of mathematics in the University of Edinburgh, in succession to the late Prof. Chrystal.

MR. CLEMENT STEPHENSON has offered a gift of 5000*l.* to the Armstrong College, Newcastle, towards the proposed building for the new agricultural department of the college for advisory work among farmers in the north-east of England. The scheme of the department has been planned at the invitation of the Board of Agriculture, and the gift has been accepted with the cordial thanks of the council of the college.

THE University of St. Andrews has decided next July to confer the honorary degree of LL.D. upon Prof. G. F. L. P. Cantor, professor of mathematics at the Friederichs University, Halle; Prof. G. G. Henderson, professor of chemistry in Glasgow Technical College; Prof. J. P. Kuenen, of Leyden, formerly professor of physics in University College, Dundee; and Sir John Batty Tuke, who for many years represented the Universities of Edinburgh and St. Andrews in Parliament.

THE Central Technical College Old Students' Association appeals for subscriptions for a memorial to Prof. Ashcroft, who died suddenly on December 14, 1911. It is proposed to place a tablet to his memory in the college, and to assist his son, who is now about fourteen years old, to follow and complete the course of training which Prof. Ashcroft had planned for him. Donations should be addressed to Dr. E. F. Armstrong, 98 London Road, Reading, if possible before the end of this month.

HIS MAJESTY THE KING has been pleased to direct that the Glasgow and West of Scotland Technical College shall henceforth be known as "The Royal Technical College, Glasgow." This new title will fittingly commemorate the visit paid by King Edward to the college when he laid the memorial stone of the new buildings in May, 1903. The buildings are now complete, and contain about seven acres of floor space. Their cost, together with site and equipment, amounted to more than 360,000*l.*, all of which sum, except about 90,000*l.* from the Scottish Education Department, was provided by voluntary donations. Last session there were 536 day students and 4842 evening students in attendance, while the continuation classes in science affiliated to the college, and extending throughout the six surrounding counties, contain more than 8600.

WE learn from *The Sydney Morning Herald* that three new chairs are to be established at the University of Sydney in consequence of the additional vote for the work of the University sanctioned by the Legislature. The new professorships deal with botany, applied chemistry, and economics. The chair of botany is required for the agricultural curriculum. With regard to the chair of organic and applied chemistry, it has long been felt to be desirable that organic chemistry and its various applications to the products of the country should be fully taught. The Government has also given the University a liberal grant to assist the library, and has made a grant for this year for the provision of apparatus for the medical faculty and for the engineering department. The sum of 2500*l.* has been set apart for the extension of the departments already existing in the University, in addition to a vote to assist in providing retiring allowances for old officers of the University when the time comes that they are no longer able to perform their duties.

THE programme for the Congress of the Universities of the Empire, to be held in London this year, has now been published. On the morning of July 2, Lord Rosebery, Chancellor of the Universities of London and Glasgow, and Lord Rector of the University of St. Andrews, will take the chair, and the subjects for discussion will be:—(1) question of specialisation among universities; (2) inter-university arrangements for post-graduate and research students. On the morning of July 3, Lord Curzon of Kedleston, Chancellor of the University of Oxford, will preside, and (1) the relation of universities to technical and professional education and to education for the public services, and (2) interchange of university teachers, will be discussed. During the afternoon of the same day the subject will be the problem of the universities in the East in regard to their influence on character and moral ideals. At the morning session on July 4, Lord Rayleigh, Chancellor of the University of Cambridge, will preside, and the subjects discussed will be:—(1) conditions of entrance to universities and the mutual recognition of entrance tests; (2) action of universities in relation to the after-careers of their students. In the afternoon the chairman will be Lord Haldane, Chancellor of the University of Bristol, and the subject of university extension and tutorial class work will be introduced. At the concluding session on July 5, Lord Strathcona and Mount Royal, Chancellor of the Universities of Aberdeen and McGill, will preside, and the subjects will be:—(1) the establishment of a Central University Bureau: its constitution and functions; (2) the position of women in universities.

AT the annual dinner of the Court of the University of Leeds, Lord Haldane was the principal guest. In responding to the toast of "The Visitors," he dealt, among other important matters, with the application of science to industry. Lord Haldane said, we learn from *The Times*, that the biggest men are those who can seize rapidly on the ideas which science gives and transform them into practice. This is one of the things we have learnt from the great German nation, which in this matter has set an example to the whole world. But we never can do the best merely by copying, and we have to work out things according to our nationality and individuality. England is working to-day on some very remarkable lines of her own. In Germany one is struck by the enormous number of students of the middle classes in the universities and the great technical institutes. Here we have done something else. We may be behind in some things, but in one thing we are ahead of the rest of the world, and that is the way in which we have brought the influence of university life to bear upon the best brains in our artisan classes. The system of evening instruction, which is distinctive of our newer universities, is a very extraordinary system, and it fits in well with the remarkable aptitude of our workmen for producing, if only they get the chance, a quality of goods which is at least equal to the quality produced by any other workmen in the world. Add science to the top of that, and we need not be afraid. Although our universities may find it a burden to carry, they are doing the greatest service to the State by the splendid part they play in extending the influence of learning to the artisan classes.

THE current issue of *The Empire Review* opens with an article on the Imperial College of Science and Technology, by Sir Alfred Keogh, K.C.B., rector of the college. An excellent account is provided of the progress of the college during the last three years. The greatest demand upon the resources of the governors has been for buildings. As a consequence of the change in methods, the old buildings occupied by the Royal School of Mines, the Metallurgical and Geological Departments, have been abandoned, and new buildings are now approaching completion. The new laboratories represent the best obtainable, and to maintain a close connection between industrial opinion and academic methods, the Institution of Mining and Metallurgy has been asked to form an educational advisory board, and has consented to act as referees whenever doubt or difficulty may arise. In the case of the City and Guilds College, the task of the governing body has been easy, and their efforts have been limited to the development of advanced engineering in new premises.

Great attention has been given to the development of the botanical departments, the work of which is directed largely towards the specific demands of the vegetable industries, whether at home or abroad. Great progress has been made and a demand has arisen for a new building to house two new departments, one dealing with the technology of woods and fibres, the other with physiology and pathology, and the governors have authorised its erection and equipment. Similarly, the School of Zoology has been extended and developed in many new ways, and has become the resort of many advanced students. Soon, too, it is hoped to call into being a great department of chemical technology. In fact, Sir Alfred Keogh has to record a gratifying account of strenuous endeavour on the part of the authorities, succeeded by an immediate and remarkable success.

PROF. W. C. UNWIN, F.R.S., president of the Institute of Civil Engineers, was the guest of the evening at the fourteenth annual dinner of the Old Students' Association of the Central Technical College, held on Saturday, February 10. Mr. W. Duddell, F.R.S., occupied the chair, and was supported by a very representative gathering of about 180 old Centralians and their friends. The guests included Sir John Wolfe Barry, K.C.B., F.R.S.; Sir Wm. White, K.C.B., F.R.S.; Profs Armstrong, Dalby, Klugh, and Mather, from the City and Guilds College; Prof. S. P. Thompson, of Finsbury Technical College; and Prof. H. McLeod, a former colleague of Prof. Unwin's at Coopers Hill. The toast of Prof. Unwin was proposed by the chairman, who emphasised his services to the Central Technical College, to education, and to engineering, and read letters and telegrams of congratulation received from old students in all parts of the world. Mr. H. A. Humphrey, one of the first and most distinguished of Prof. Unwin's students, seconded the toast, after which a presentation was made to Prof. Unwin. In replying, Prof. Unwin gave some account of his career, and more particularly of the early days of the Central. He laid stress on the high standard of knowledge at entry required for their matriculation examination, and the value of the training given by the complete course; he regretted the interference with this course which the submission to the London University examinations had entailed. Sir John Wolfe Barry, who is to be the next president, proposed the association in appropriate terms, emphasising the value of such organisations. In reply, Dr. E. F. Armstrong referred to the fact that the membership was approximately 1000, and stated that they were there that evening, not only to do homage to their former professors, but also to honour those members of the City and Guilds Institute who by great expenditure in time and money had founded and maintained the college of which they were all so proud.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, February 6.—Mr. E. G. B. Meade-Waldo, vice-president, in the chair.—Mrs. Rose Haig **Thomas**: A breeding experiment with pheasants. The experiment was undertaken to confirm a previous one, in which it had been observed that a male pheasant had transmitted to his F 2 ♀ offspring the female plumage of his species. The following cross produced the same result:—

Phasianus formosus ♀ × *Phasianus versicolor* ♂.

F 1 ♀ × *P. versicolor* ♂.

F 2 ♀♀♀♀♀ ♂ ♂.

The five hens hatched in F 2 had grown up, and were all *versicolor* in pattern, colour, dimensions, and moral character. One of these hens had been kept to breed with to test her purity, and the skins of the other four were exhibited, together with the skins of a *Ph. formosus* ♀ and a *P. versicolor* ♀ for comparison. The results of these two experiments did not appear to conform to the theory that the cock was homozygous for sex ♂♂. These experiments had also shown that the male had not transmitted to his female F 2 offspring such constant purity of male plumage. In the first experiment, Silver × Swinhoe, out of four males three were "Si. Sw.," one only pure "Sw.," and the only two males that lived in the second experiment, *formosus* × *versicolor*, were both "Fo. Ve."—J. T. **Cunningham**: Mendelian experiments on fowls. The paper described the characters of ten individuals of the F 2 generation reared from a pair of F 1's produced by a cross between Silky ♀ × Bankiva ♂ made by Mr. D. Seth-Smith. The characters recognised were seven in number, namely, colour of plumage, character of plumage (whether silky or normal), comb, pigmentation of skin and internal tissues, toes (*i.e.* presence or absence of extra toe), feathering of legs, crest on head. The Silky of the original cross had white "silky" plumage, rose comb, crest on head, double hallux, feathered legs, and black pigmented skin. The Bankiva had black-red plumage of normal structure, single comb, unfeathered shanks, normal toes, and normal unpigmented skin, no crest. The dominant characters in the F 1 were coloured plumage of normal structure, rose comb with crest, pigmented skin, feathered legs, and double hallux, but several of these characters showed irregular dominance or intermediate condition. The most important results recorded in the paper were imperfect segregation in the F 2 generation in at least two of the characters, namely, the absence of pigmentation in the plumage and the absence of pigmentation in the skin and tissues. The recessive white of the plumage occurred in four individuals, in all of which, but especially in one, some pigment was present. Only one specimen apparently recessive with regard to the absence of pigmentation in the skin had been examined *post mortem*, and in this unmistakable traces of pigmentation in the skin and peritoneum were observed.—J. Lewis **Bonhote**: A further collection of mammals from Egypt, received from Captain S. S. Flower. The communication dealt with some twenty species, of which the following two were described as new:—*Meriones crassus pallidus*, from Atbara, Sudan, similar to *M. crassus sellysii*, from which it differs in its larger size, paler coloration, and more pointed snout. *Acomys russatus aegyptiacus*, from the desert near Cairo. A race of *A. russatus*, from which it differs in its smaller size and much yellower coloration.—H. Wallis **Kew**: The pairing of pseudoscorpiones. The paper was based on observations made by the author on living specimens of *Chelifer* (*Chelifer*) *latreillii*, Leach, and *Chelifer* (*Chernes*) *cyrneus*, L. Koch.

PARIS.

Academy of Sciences, February 5.—M. Lippmann in the chair.—C. **Moureu** and Amand **Valeur**: The question of the symmetry of sparteine. Details of the properties of the hydriodides and iodomethylates of sparteine. There is no proof of the two nitrogen atoms in this alkaloid being symmetrical, and the stereoisomerism of the two sparteine iodomethylates is proved.—A. **Lacroix**: The volcanoes of central Madagascar. The *massif* of Itasy.—E. **Vallier**: The present position of the ballistic problem.—S. **Pozzi**: Some cases of ossification of the ovary.—Henri **Parenty**: A temperature regulator of precision. The instrument described by E. Esclangon in a recent number of the *Comptes rendus* was anticipated by MM. Parenty and Bricard in 1896.—A. **Perot**: The wave-length of the solar line D_1. The results of the application of the interference method to the study of the line D_1. A curve is given showing the increase of the wave-length as a function of the distances from the centre along a line N.-S.—G. A. **Tikhoff**: The photographic registration and reproduction of the twinkling of the stars. A photograph is taken of the spectrum of the star by means of a prism objective, a uniform movement perpendicular to the length of the spectrum being imparted to the sensitised plate. In the case of Sirius, the changes of intensity of different rays are usually independent of each other, whilst in the case of the planet Venus all the rays change simultaneously.—M. **Tzitzéica**: The Laplace equations with quadratic solutions.—Henri **Lebesgue**: The problem of Dirichlet.—G. **Cotty**: A class of quadratic forms with four variables connected with the transformation of Abelian functions.—Gabriel **Sizes**: The multiple resonance of bells. Details of the harmonics given by the four principal bells of Montpellier Cathedral.—E. **Besson**: The condensation of water vapour by expansion in an atmosphere of carbonic acid. The experiments were recorded photographically. Condensation commenced for expansion between 1·30 and 1·32; if the gas was previously ionised by exposure to the Röntgen rays for two seconds, the condensation appeared a little sooner. The importance of removing all traces of air in these experiments is emphasised.—L. **Verain**: The dielectric constant of carbon dioxide in the neighbourhood of the critical point. The results of measurements of the dielectric constants of liquid and gaseous carbon dioxide for temperatures between -4° and 30° C. are shown graphically. The constant varies between 1·00 and 1·60, the experimental error being under 0·05. At $31·4^\circ$ C. the values for the gas and liquid become identical.—G. **Urbain**: A laboratory balance with electromagnetic compensation for the study of systems giving off gas with a sensible velocity. The final adjustment of this balance is made by altering the intensity of an electric current in a solenoid acting upon a small magnet suspended from one of the beams. The balance described had a maximum load of 0·1 gram and a sensibility of 0·01 milligram.—Marcel **Boll**: The application of the electrometer to the study of chemical reactions in electrolytes.—E. **Baud**: A general law of solution.—Pierre **Achalme**: The *rôle* of the inter-atomic electrons in catalysis.—A. **Seyewetz**: The preparation and properties of a silver oxybromide. This oxybromide is prepared by the action of an aqueous solution of benzoquinone containing potassium bromide upon finely divided silver, and purifying the crude product by crystallisation from hot ammonia solution. The analyses correspond to Ag_7Br_5O.—A. **Guntz** and M. **de Greift**: Copper amalgam. The properties of the amalgam depend on whether it has been prepared in the cold by electrolysis or by heat. The former leaves the amalgam HgCu when submitted to great pressure; the latter, under similar treatment, leaves nearly pure copper.—G. **Vavon**: A method of preparation of the aromatic alcohols. The addition of hydrogen to the aromatic aldehydes in the cold under the catalytic action of platinum black gives high yields of aromatic alcohols. Numerous applications of the reaction are described, proving the method to be a general one.—V. **Grignard** and Ch. **Courtot**: Some new α-indene derivatives.—E. **Chablay**: The reduction of the amides and esters of the fatty series by the metal-ammoniums. The amides give the sodium derivative and the corresponding sodium alcoholate.—Louis **Ammann**: The influence of the extraction liquid upon the composition of the beet-root pulps from sugar works and distilleries. The residues from the sugar works are less valuable as cattle food than those from the distilleries, and this difference is mainly due to the nature of the liquid used in the extraction of the beet.—E. **Boullanger**: The action of flowers of sulphur upon vegetation. Small quantities of sulphur mixed with the soil have a favourable action upon the growth and yield of various plants.—A. **Berg**: The diastatic activity of the various organs of *Ecballium elaterium*. The physiological function of the pulp surrounding the seeds.—A. **Trillat**: The action of putrid gases upon the lactic ferment.—H. **Cardot** and H. **Langier**: The localisation of stimulations in the unipolar method.—J. **Thiroloin** and M. **Jacob**: Prolonged forms of experimental pancreatic diabetes.—L. **Grimbert** and J. **Morel**: The determination of the acidity of the urine. The calcium salts are removed from the urine by addition of potassium oxalate, and the ammonia determined and allowed for.—Gabriel **Bertrand**: The importance of manganese in the formation of the conidia of *Aspergillus niger*. In the absence of manganese the conidia of this mould are not formed. The amount of manganese required is extremely small.—M. **Javillier**: The influence of the suppression of zinc in the culture medium of *Aspergillus niger* on the secretion of sucrase by this mould. Aspergillus deprived of zinc allows no sucrase to diffuse into the culture medium nor into distilled water. The cells secrete sucrase, but the quantity is much less than when a trace of zinc is present.—J. **Dewitz**: Experimental apterism in insects.—Georges **Bohn**: Variations in sensibility in relation to the variations of internal chemical state.—E. **Vasticar**: The structure of the spiral membranous sheet of the slug.—M. **Fabre-Domergue**: The bacterial purification of oysters by treatment with artificial filtered sea water.—Louis **Calvet**: Remarks on the parasitic Bryozoa, *Watersia paessleri*.—L. **Joubin**: The cephalopods captured in 1911 by the Prince of Monaco.—L. **Sudry**: The importance and function of air-borne dusts.—G. **Grandidier**: A new example of the extinction of giant animal forms closely allied to existing species.—M. **Parvu**: The natural defence of rocks against the destructive action of the sea.

February 12.—M. Lippmann in the chair.—Ch. **Bouchard**: An optical sphygmo-oscillograph. A description of an optical arrangement designed to reduce, so far as possible, the inertia of the Marey sphygmograph.—M. De Launay was elected a member of the section of mineralogy in the place of the late A. Michel Lévy.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the fourth quarter of 1911. Observations were possible on fifty-five days, and the results are given in tabular form.—Emile **Borel**: The fundamental theorems of the theory of real variable functions.—Jules **Drach**: The differential equations of geometry.—Federigo **Enriques**: The theorem of existence for algebraic functions of two independent variables.—A. **Lapresle**: The distribution of pressures and velocities in the disturbed region round a surface in a uniform current of air. The region was explored with the aid of a Pitot tube.—M. **Julhe**: The permeability to hydrogen of balloon envelopes. An additional layer formed of calico impregnated with a solution of gelatine in glycerine is placed inside the ordinary material. It prevents large losses of hydrogen.—Paul **Jégou**: The effect of secondary resonance in the receivers used in wireless telegraphy.—G. **Reboul**: Photochemical actions and photo-electrical phenomena. Ultra-violet light from a quartz mercury lamp was allowed to fall on a metal plate, and the emission of the negative charges studied.—Eugène **Bloch**: The use of photoelectric cells as photophones. An extension of the experiments of Bergwitz on the changes in the resistance of potassium by exposure to light.—Albert **Colson**: Methods of observation of the dissociation of nitrogen peroxide. Data are given for the dissociation pressures of nitrogen peroxide measured by three methods. These are compared with the dissociation phenomena observed for the same gas in chloroform solution, and it is shown that the results do not agree with the view that the dissolved and gaseous particles are identical.—M. **Dubrisay**: Chemical equilibria in solution. An experimental study of the reversible reaction between succinic acid and barium acetate.—H. **Baubigny**: Researches relating to the action of alkaline sulphites on copper salts. It is proved that a dithionate is formed when copper sulphate is acted upon by an excess of alkaline sulphite.—Eyvind **Boedtker**: Some menthone derivatives. A proof of the constitution of the derivatives obtained by the interaction of benzylidene-menthone and alkylmagnesium bromides.—H. **Gault**: The lactonisation of the α-ketonic esters.—H. **Cousin**: The action of bromine and chlorine upon dehydro-dicarvacrol.—G. **Malfitano** and Mlle. A. **Moschkoff**: The formation of dextrine from starch by drying. Starch placed in a vacuum over phosphorus pentoxide was found to become increasingly soluble in water. This is attributed by the authors to the formation of dextrin, and regarded by them as evidence that in the starch particles water serves as a link between the $C_6H_{10}O_5$ molecules.—E. **Bodin**: The purification of oysters in filtered artificial sea water. The author's experiments confirm those of Fabre-Domergue on the possibility of purifying oysters by artificial storage without commercial depreciation.—E. **Rouquette**: The sterilisation of drinking water by the action of ozonised oxygen and chlorine compounds in the nascent state. The simultaneous action of sodium bisulphate, hydrogen peroxide, and bleaching powder is suggested. The complete sterilisation of the water is shown to be rapid, the residual salts are harmless and very small in amount, and the cost is not excessive. It is of special service in cases of urgency.—A. **Magnan**: The cæcum in mammals. In previous papers the author has shown the relation between the length of the cæcum and the nature of the food in birds. It is shown that a similar relation holds in mammals.—Mieczyslaw **Oxner**: Experiments on the faculty of learning in the marine fishes, *Coris julis*. A small piece of coloured paper was suspended on a line above a baited hook. The fish learnt to associate the hook with the paper, as after being twice caught on successive days, it refused the bait when the paper was attached, but took it when the paper was removed.—F. **Kerforne**: The tectonic of the region south of Rennes.

BOOKS RECEIVED.

Calcul et Construction des Alternateurs Mono- et Polyphasés. By Prof. H. Birven. Translated by P. Dufour. Pp. 179. (Paris: Gauthier-Villars.) 6 francs.

Théorie de la Couche Capillaire Plane des Corps Purs. By Dr. G. Bakker. Pp. 95. (Paris: Gauthier-Villars.) 2 francs.

Organisation et Direction des Usines. D'après de livre allemand intitulé "Der Fabrikbetrieb" de A. Ballewski. By A. Mayer. Pp. vi+220. (Paris: Gauthier-Villars.) 7.50 francs.

Kant's Gesammelte Schriften. Herausgegeben von der Königlich Preussischen Akademie der Wissenschaften. Band xiv. Dritte Abtheilung: Handschriftlicher Nachlass. Band i.: Mathematik-Physik and Chemie-Physische Geographie. Pp. lxii+637. (Berlin: G. Reimer.) 19 marks.

Ruins of Desert Cathay. Personal Narrative of Explorations in Central Asia and Westernmost China. By M. Aurel Stein. Vol. i. Pp. xxxviii+546+plates and map. Vol. ii. Pp. xxi+517+plates and maps. (London: Macmillan and Co., Ltd.) 2 vols. 42*s*. net.

Diesel Engines for Land and Marine Work. By A. P. Chalkley. With an introductory chapter by Dr. R. Diesel. Pp. xi+226. (London: Constable and Co., Ltd.) 8*s*. 6*d*. net.

Mineralogy. By F. Rutley. Eighteenth edition. Pp. viii+267. (London: T. Murby and Co.) 2*s*. net.

Vanished Arizona. Recollections of the Army Life of a New England Woman. By M. Summerhayes. Second edition. Pp. 319 (Salem, Mass.: The Salem Press Company.) 1.60 dollars.

Practical Chemistry for Engineering Students. By A. J. Hale. Pp. xvi+192. (London: Longmans and Co.) 3*s*. net.

An Experimental Course of Physical Chemistry. By Dr. J. F. Spencer. Part II. Dynamical Experiments. Pp. xvi+256. (London: G. Bell and Sons, Ltd.) 3*s*. 6*d*.

Solutions of the Exercises in Godfrey and Siddons's Solid Geometry. By C. L. Beaven. Pp. 164. (Cambridge: University Press.) 5*s*. net.

Examples in Arithmetic, Part I. Taken from A School Arithmetic. By H. S. Hall and F. H. Stevens. With Answers. Pp. vii+115+xxii. (London: Macmillan and Co., Ltd.) 1*s*. 6*d*.

A.B.C. of Hydrodynamics. By Lieut.-Colonel R. de Villamil. Pp. xi+135. (London: E. and F. N. Spon, Ltd.) 6*s*. net.

The Gardener and the Cook. By L. H. Yates. Pp. x+260. (London: Constable and Co., Ltd.) 3*s*. 6*d*.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 22.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: The Variation of the Specific Heat of Water investigated by the Continuous Mixture Method: Prof. H. L. Callendar, F.R.S.—Index to Reports of Physical Observations—Electric, Magnetic, Meteorological, Seismological—made at Kew Observatory: Dr. C. Chree, F.R.S.—On the Velocities of Ions in Dried Gases: R. T. Lattey and H. T. Tizard.—The Observation by means of a String Electrometer of Fluctuations in the Ionisation produced by γ Rays: Prof. T. H. Laby and P. W. Burbidge.—The Wave Problem of Cauchy and Poisson for Liquid of Finite Depth and for Slightly Compressible Liquid: F. B. Pidduck.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Supply and Transmission of Power in Self-contained Road Vehicles and Locomotives: J. C. Macfarlane and H. Burge.

FRIDAY, FEBRUARY 23.

ROYAL INSTITUTION, at 9.—The Gyrostatic Compass and Practical Applications of Gyrostats: George K. B. Elphinstone.

PHYSICAL SOCIETY, at 5.—A Method of Accurate Comparison of Quantities of Radium: Prof. E. Rutherford, F.R.S., and Mr. Chadwick.—The Absorption of the γ-rays by Gases; Mr. Chadwick.—On Wave-form Sifters for Alternating Currents: A. Campbell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Works for the Prevention of Coast-erosion: W. T. Douglass.

SATURDAY, FEBRUARY 24.

ROYAL INSTITUTION, at 3.—Molecular Physics: Sir J. J. Thomson, F.R.S

ESSEX FIELD CLUB, at 6 (at Essex Museum, Stratford).—Report on the Lichens of Epping Forest. II.: R. Paulson and P. G. Thompson.

MONDAY, FEBRUARY 26.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Economic Geography of the Tyne: A. J. Sargent.

ROYAL SOCIETY OF ARTS, at 8.—The Loom and Spindle: Past, Present and Future; Primitive Weaving Appliances: Prehistoric, Ancient, and Modern: L. Hooper.

INSTITUTE OF ACTUARIES, at 5.—On the Principle Provisions of the Law of Bankruptcy in England, with References to some Decisions of Interest to Life Insurance Companies: N. J. Carter.

TUESDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 3.—Optical Determination of Stress, and some Applications to Engineering Problems: Prof. E. G. Coker.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: Some Features of the West African Government Railways: F. Shelford.—*Probable Papers*: (1) Roller and Ball Bearings; (2) The Testing of Anti-friction Bearing Metals: Prof. J. Goodman.

WEDNESDAY, FEBRUARY 28.

GEOLOGICAL SOCIETY, at 8.—Late Glacial and Post-glacial Changes in the Lower Dee Valley: L. J. Wills.—The Glen Orchy Anticline (Argyllshire): E. B. Bailey and M. Macgregor.

ROYAL SOCIETY OF ARTS, at 8.—Education in Science as a Preparation for Industrial Work: H. A. Roberts.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, FEBRUARY 29.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Bacterial Production of Acetylmethylcarbinol and 2.3. Butylene Glycol. II: Dr. A. Harden, F.R.S., and Dorothy Norris.—An Instrument for Measuring the Distance between the Centres of Rotation of the Two Eyes: H. S. Ryland and B. T. Lang.—The Locomotor Function of the Lantern in *Echinus*, with remarks on other Allied Lantern Activities: Dr. J. F. Gemmill.—The Relation of Wild Animals to Trypanosomiasis: Capt. A. D. Fraser, R.A.M.C., and Dr. H. L. Duke.—The Transmission of *Trypanosoma nanum* (Laveran): Dr. H. L. Duke.—The Development of a Leucocytozoon of Guinea-pigs: E. H. Ross.

FRIDAY, MARCH 1.

ROYAL INSTITUTION, at 9.—The Total Solar Eclipse in the South Pacific, April, 1911: Dr. W. J. S. Lockyer.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Construction of Masonry Dams: H. J. F. Gourley.

SATURDAY, MARCH 2.

ROYAL INSTITUTION, at 3.—Molecular Physics: Sir J. J. Thomson, F.R.S.

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