THURSDAY, MAY 12, 1904.

SANITARY ENGINEERING.

Refuse Disposal and Power Production. By W. Francis Goodrich, A.M.Inst.M.E. Pp. xv+384. (Westminster: Constable and Co., Ltd., 1904.) Price 16*s*. net.

THE destruction of town refuse by fire is a comparatively modern development; the first furnaces erected for such a purpose were constructed to the designs of Mr. Fryer at Manchester in 1876, and these furnaces, though considerably modified, are still at work. The gross insanitary character of the ordinary system of refuse disposal is patent to everyone who has occasion to move about in the neighbourhood of any of our large cities; the refuse is deposited in tips; often an old quarry or gravel pit is selected for this purpose, and the refuse is dumped into these cavities until they are filled up. How unsatisfactory this is has been proved by the fact that outbreaks of disease have occurred directly traceable to the existence of these heaps of abomination. The author states that an outbreak at Fratton was certified by the medical authorities to be due to the contagion brought by flies bred in the pestiferous heaps of Portsmouth refuse which had been deposited in this neighbourhood. These refuse heaps in the summer time breed flies in millions, and they are the constant resort of rats, which spread from them all over the neighbourhood, and how readily most dangerous diseases are disseminated by both these agencies is well known to all medical authorities. We had this fact brought home to us clearly during the late campaign in South Africa, when the nurses and doctors in the field hospitals were frequently able to tell that a patient being brought in was a typhoid sufferer from the swarms of flies round him.

Fortunately the Local Government Board is setting its face steadily against a continuation of this insanitary practice, and the recent example at Bury St. Edmunds, quoted by Mr. Goodrich, where the board refused to sanction a loan for the purpose of purchasing land for a tip, is a striking illustration of this modern tendency. Refuse tipping at sea, owing to the fact that much of the refuse is liable to be washed back on the foreshore, and also that it has frequently to be stored for lengthy periods owing to stormy weather, is an equally unsatisfactory method.

The book is fully illustrated, and two or three of the illustrations, reproduced from photographs, show the filthy state of affairs brought about by town authorities neglecting to avail themselves of modern appliances. The author discusses very fully the various systems of burning refuse in destructors which have been adopted in this country, for it is chiefly in Great Britain that fire purification has been adopted, and the various systems of charging the refuse into the destructor cells are described in detail; the direct charging systems are compared very fairly with the hand or shovel feeding systems.

Though the former, from the sanitary point of view, naturally appears the more desirable, there can be little doubt from the figures given by Mr. Goodrich that there is not much economy in labour by the adoption of direct charging, since the labour of dragging the material from the drying hearth forward on to the grates is greatly increased. The first types, founded on a system of natural draught and low temperatures in the cells, undoubtedly did much to retard the development and the introduction of destructors, and in this connection to Mr. Charles Jones, of Ealing, must be given much credit, because his cremator certainly led the way to the design of the modern forced draught high temperature destructor.

Illustrations and descriptions are given of most of the destructors which have been used up to the present time, and then the author deals exhaustively with the labour cost in the different systems, with the utilisation of the clinker, and with the application of the steam generated to electricity works, sewage works, or waterworks. The figures given for the labour cost show very striking variations in the different towns, ranging from as low as 6¾*d*. per ton of refuse burnt to as high as 2*s*. 10*d*.; the higher cost in a few cases arises from the fact that the quantity of refuse to be destroyed is comparatively small, and therefore the three shift, eight hour system, which is the more economical, cannot be adopted.

The disposal of the clinker no longer presents any real difficulty, as in the modern destructor the temperature is easily kept high enough and sufficiently steady to produce a thoroughly hard, well burnt clinker suitable for many purposes. The late Mr. J. McTaggart, of Bradford, did much in directing attention to the various uses to which the clinker could be applied, and the results he obtained were remarkable; clinker bricks, clinker tiles, clinker mortar, clinker concrete were some of the products into which his waste material was converted, and Bradford led the way in showing that by the utilisation of this residuum, which amounts on an average to about one-third of the weight of the total refuse consumed, much of the cost of running a destructor can be repaid. The utilisation of the steam generated has also made great strides during the past few years, and at the present time there are, the author states, sixty combined electricity and destructor works either running or under construction in this country, several of them of considerable size, the electricity generated being used both for lighting and for traction.

The author gives a comparative statement showing the number of electrical units generated per ton of refuse destroyed in twenty of these stations, the figures ranging from as low as 15 to as high as 80 per ton of refuse burnt. He quotes, from reports of station engineers, opinions which show conclusively that whatever difficulties may have been experienced at first, owing to variations in the steam pressure, at the present time it is quite as easy to run a plant satisfactorily with steam produced from the waste heat of the destructor furnaces as when generated in an ordinary boiler using coal or other fuel. About thirty-eight towns are using steam from the destructors for driving pumping plants in connection with sewage disposal works, and the town of Sheerness has taken a still bolder departure in the application of such steam to work pumps supplying the town with water. This latter scheme was carried out by the author himself, and he is thus able to give full details as to the economical results of this installation; the first six months' working showed a saving of nearly 500*l.*, equal to a reduction of 3*d.* per 1*l.* in the town rates. The comparative advantages of steam jet blowers and fans are contrasted, and Mr. Goodrich clearly leans towards the former as the more economical in the long run; in this connection he lays great stress upon the absolute necessity of systematic tests of the waste gases in order to determine whether or not combustion is going on under the most economical conditions; a diagram given on p. 157 shows how serious the heat losses may be if excess air is used.

The second half of the book is devoted to a description of all the refuse destructors which have been put to work in Great Britain and abroad up to the present time. The date of the installation, the type and make of destructor, the number of cells, the number and type of boilers, height of chimney, the type of draught used, the purpose for which the power is used, the weight of the refuse destroyed daily, and the labour cost per ton of refuse destroyed are all given. Most complete information in regard to this important subject has thus been brought together, and there can be no doubt that it will prove a most useful reference volume to those engaged in planning such plants, and to municipal authorities who are considering the desirability of erecting destructors. Up to the present the various details and results given by Mr. Goodrich have been scattered through the *Proceedings* of one or two of our engineering societies, or embodied in the reports of borough engineers, and it can have been no light task to gather together the mass of information in this book. We have no hesitation in saying that it will be a standard book of reference for several years to come, and it is in a form in which it will be comparatively easy, in the re-issue of fresh editions from time to time, to keep it up to date.

T. H. B.

GEMS AND PRECIOUS STONES.

Precious Stones, a Popular Account of their Characters, Occurrence and Applications, with an Introduction to their Determination, for Mineralogists, Lapidaries, Jewellers, &c., with an Appendix on Pearls and Coral. By Prof. Max Bauer. Translated from the German, with additions by L. J. Spencer. Pp. 627; with 20 plates and 94 figures in the text. (London: Charles Griffin and Co., Ltd., 1904.) Price 42*s.* net.

Gems and Gem Minerals. By Dr. Oliver Cummings Farrington. Pp. 229; with 16 coloured plates and 60 half-tone and line engravings. (Chicago: A. W. Mumford, 1903.)

THE publication in 1890 by the Scientific Publishing Company of New York of Dr. G. F. Kunz's valuable "Gems and Precious Stones of North America" showed for the first time the possibility of producing, by modern methods of photolithography, illustrations of gems, either cut or uncut, which would give some idea of their characteristic colour, transparency and lustre. The two works of which the titles appear above have adopted the same methods of illustration, and the plates are scarcely inferior in beauty and in fidelity to the originals to those which adorn Dr. Kunz's well known book.

Prof. Max Bauer's "Edelsteinkunde" was issued in parts in 1895 and 1896, and at once took a foremost place in scientific literature as the standard work on all subjects relating to gems. It deals not only with the methods adopted by mineralogists and others for determining the mineral species to which gem stones must be referred, but with such questions as their artificial production, counterfeiting of gems, and their alteration by heating, &c.—questions upon which it is often very difficult to obtain satisfactory and trustworthy information. While mainly devoted to gems viewed from the scientific standpoint, much valuable information is added on the cutting, mounting and price of gems, while the accounts of the localities and mode of their occurrence are exceptionally full and complete, the descriptions being illustrated by sketch-maps and plans of workings. The coloured plates give some idea of the brilliancy and exquisite beauty of the original objects, whether these be crystals in their matrix or cut stones. They are scarcely, if at all, inferior in these respects to those in the work of Dr. Kunz already referred to, and higher praise than this can scarcely be given.

Mr. Spencer has been well advised in undertaking the translation, with the aid of his wife, of this important standard work. But the book as it now appears in English dress is much more than a mere translation. Mr. Spencer's familiarity with the bibliography of mineralogy is well known, and he brings to his task, in addition, wide knowledge and experience gained in connection with his work in the splendid national collection of minerals at South Kensington. The author of the work has supplied references to the more important papers which have been issued since the first appearance of the book, and these with many other works, including the valuable annual reports on the production of gem stones by the United States Geological Survey, have been consulted by the translator, many new and valuable facts being added. It would be easy to show, however, that even during the decade that has not quite elapsed since the book was written, much new information has accumulated on many of the subjects dealt with, and to incorporate this, as the translator points out in the case of the diamond, so as to bring the matter quite up to date, would involve the complete re-writing of whole sections. The work is, nevertheless, so complete, trustworthy and up to date that no better guide to the study of gems can be indicated to the student, the worker, or the dealer in these interesting objects.

The general account of precious stones occupies 110 pages, and, as the translator admits, would have to be considerably enlarged if full justice were done to the optical methods of discriminating the mineral species. This, however, would have only a limited interest for general readers, and therefore is perhaps wisely omitted.

The account of the diamond takes up no less than 150 pages, and, large as is the amount of information collected, there is much more that might with advantage have been included if all the researches of recent years could have been utilised. As it is, the book brings together an enormous mass of details which could only be obtained by long and patient research among widely scattered sources of information. The corundum and beryl gems, topaz, opal, &c., are also very fully treated; but an important feature of this work is the account given of the large number of crystalline minerals, quite unknown to lapidaries and the general public, which are capable of being employed as gems, and as such, are scarcely, if at all, inferior in beauty to the stones which have become famous and are so universally sought after. The varieties of zircon, spinel and tourmaline, which, in the hands of a good lapidary, are capable of yielding gems of exquisite colour and beauty, are well described in this work; while the numerous minerals which more rarely yield transparent and lustrous varieties that can be cut as gems are indicated by the author. In this connection we may point out that even the rare and beautiful varieties of spodumene—known as hiddenite and kunzite—have been included in this edition. The appendix on pearls and coral is interesting, and is necessary to complete the book as a work of reference on the subject. We heartily congratulate the author on having found so competent and judicious a translator, and the translator on having devoted his attention to a work so well worthy of having labour spent upon it

Dr. Farrington's book is on a much smaller scale than Prof. Max Bauer's, but the illustrations are of the same beautiful character. The general account of precious stones has to be compressed into 65 pages, but, as might be expected from the author, the matter is accurate and is very judiciously arranged, while some of the discussions, like those on the superstitions connected with precious stones, are full of interest. The account of the several minerals—not only those so commonly employed as gems, but the rarer ones which can be cut and used in the same way—is, as in the case of Max Bauer's treatise, very full and accurate; but the treatment of each has, from the scope of the work, to be much more concise. The typography and general appearance of the book are of the excellence we are in the habit of finding in the best publications of the American Press J. W. J.

SPECIALISED CHEMISTRY.

Synthetische Methoden der organischen Chemie. By Theodor Posner. Pp. xxxi+435. (Leipzig: Veit and Co., 1903.)

CHEMICAL literature has assumed such enormous proportions during the last two decades that it is at times almost like seeking a needle in a haystack to endeavour to find whether certain branches of the subject have previously been worked at or not. The difficulty is not so much on account of the variety of books written on the different branches of chemistry, although their number is colossal, but because there are so many journals and periodicals, and because these are so widely distributed.

A chemist who studies or works along a special branch of the subject might hope that all others who work on similar lines would endeavour to publish their results in one or other of a limited number of journals. Actually this is not the case, and as a consequence he must either take in an immense number of periodicals, most of which time will not permit him to glance at, much less study, or he must join some society which takes in these journals. There is, of course, another and very real objection to taking in a vast number of journals—the expense. Those who devote themselves to scientific research are not—generally speaking—endowed with excessive riches. Chemists, therefore, are ready to welcome works which are accurate compilations of scientific research, but even here, *vanitas vanitatis,* the books are out of date almost before they have left the press. However, they are good and useful up to the time at which they were published, and may save a good deal of back reference.

The book before us is such a compilation. When one is engaged on research it is of the greatest possible advantage to be able to consult a work which will tell us at a glance all the most important methods for carrying out this or that operation.

For example, a chemist may be dealing with a substance which he suspects may be a ketone. He is aware that ketones form oximes, hydrazones, semicarbazides, &c., but he may not have at his fingers' ends all the methods which can be employed to bring about these reactions. Dr. Posner's book will be of great help to him in such circumstances.

The book commences with a florid introduction, from which we gather the author's object in writing the book. It is briefly to give a collection of synthetical methods which are of general applicability. Special syntheses for particular compounds are not given, even when they are of great individual importance. In only giving general reactions we think the author was well advised, otherwise the book must have assumed unwieldy proportions.

Under the heading of sulpho-acids we find various methods for sulphonating the hydrocarbons, chloro-ccmpounds, amido-compounds, &c. Dr. Posner rarely condescends to give exact methods of preparation, this, we presume, because very full references are appended at the bottom of each page. This is all very well where one has a large library which contains the books and journals from which the references are taken, but it rather detracts from the value of the work. The great advantage of such a work as this should be its enabling one to dispense with a large number of reference books.

The book is divided into four main parts. The first part deals with the hydrocarbons, and commences with a short description of the different classes of hydrocarbons in the aliphatic series. We then come to a short description of some of the methods of preparation of acetylene and diacetylene. This leads us up to ring hydrocarbons and ring syntheses. Part ii. treats of the single derivatives of the hydrocarbons, such as the halogen, nitro, amido, &c. The third part is devoted to the study of the poly-compounds. The sugars are here dealt with, and are very fully given. On p. 265 there is a very useful diagram showing schematically the sugar syntheses. The fourth part treats of heterocyclic compounds.

The theoretical introductions at the commencement of the subsections are succinct, and give one an idea of the particular class of substance in a few sentences. A little more space might have been given to the quinones. Under this heading we only find one and a half pages, most of which is devoted to benzoquinone. There are, indeed, other references to quinones in the book, but these do not deal with the modes of preparation.

The compilation of a book such as this requires an immense amount of work, and we think, taking it as a whole, although there are a good many omissions, that Dr. Posner is to be congratulated on having brought out a really useful work. F. M. P.

CHEESE-MITES.

British Tyroglyphidae. By Albert D. Michael, F.L.S., F.Z.S., F.R.M.S., &c. Vol. ii. (London: Printed for the Ray Society, 1903.)

THIS is a second volume only by date and binding; otherwise it is part and parcel of the first, completing the story with all the scientific skill in description and illustration, the critical acumen, and the due proportion of enlivening touches to which attention was directed in these columns two years ago. An annotated list of the principal known or supposed species, not hitherto recorded as British, is a valuable supplement, here thrown in as a free gift beyond the requirements of the title. An interesting addition to the group of cheese-mites is furnished by the new genus and species, *Fusacarus laminipes*, a little fusiform broad-legged acarid discovered by Mr. Michael in moles' nests, sometimes abundant, yet not present in every nest, and never observed upon the mole itself.

Among statements of economic importance may be noted the author's remarks on *Tyroglyphus longior*, Gervais. Of this he says:

"It seems to me to be found in almost all houses upon dried provisions, often swarming in enormous numbers. I have also found it most prolific on hay and fodder, often increasing in countless millions. I once had a sample of hay sent me from a large haystack on a first-class farm in Ireland; the whole stack had practically been destroyed by this Acarus; there were, weight for weight, as large quantities of Acari as of hay in the sample."

On the other hand he vindicates *Histiogaster entomophagus* (Laboulbène) from the reproach, conveyed in its specific name, of devastating entomological collections. Also he agrees with the French acarologists in being hard of belief that the mite which Riley and Planchon called *Tyroglyphus phylloxerae* was at all likely to benefit the French vine-growers by its importation. For one thing, in his opinion, France already possessed the mite in question under an earlier name, and for another, he holds that cheese-mites in general are not at all partial to feeding on insects until the insects are not only dead, but dried, in which condition the dreaded Phylloxera ceases to be a devastator of vineyards. But if Riley's mite does the wine-producer no essential good, *Carpoglyphus anonymus*, Haller, does the wine-vendor positive harm. Anything, indeed, might be expected of a creature so reprobate that it devours the gold size of the very cell in which it is being reared for scientific observation. But this species, which in very Irish fashion has been named "the nameless," further outrages sentiment by being, what the lower animals so seldom are, a set of little drunkards. They defy the great wine-merchants of Paris by increasing in immense quantities inside the wine bottles, "maintaining their position on the surface of the wine without getting drowned by standing on minute pieces of cork," and in this ideal home for inebriates drawing their nourishment from the wine.

Directly in his preface and incidentally elsewhere Mr. Michael directs attention to the unsatisfactory process by which chains are being riveted on zoologists in regard to nomenclature. His remarks are opportune. It may easily come to be supposed that the important compilation of "Das Tierreich" represents on this and some other questions a consensus of opinion. But that is contrary to the fact, the apparent consensus meaning nothing more than a (possibly very reluctant) concession to a supposed need for uniformity, by which the value of "Das Tierreich" itself is not a little likely to be seriously impaired. Moreover, the rules which appear to have been agreed on by the committee of the International Zoological Congress are themselves under more than one grave disadvantage. The report brought up to the highly representative meeting of that congress at Cambridge in 1898 was for some esoteric reason withdrawn from discussion. This opportunity being lost, a larger committee was appointed, but the rules appear to have been settled by only five of the members, Great Britain being left unrepresented at the critical time, through the withdrawal of two members and the absence of a third. After all, perhaps, it is consoling to reflect that rules can only find their ultimate sanction in the practice of the best writers, and work like Mr. Michael's helps one to maintain that British zoology is neither dead nor sleeping, and that it cannot in the long run be left out of account.

OUR BOOK SHELF.

Zoology: Descriptive and Practical. By Prof. Buel P. Colton. Part i. Descriptive. Pp. x+375; 201 figures. Price 4*s*. 6*d*. Part ii. Practical. Pp. xvii+204. Price 2*s*. (London: D. C. Heath and Co., 1904.)

THE author points out in an admirable preface that the study of natural history in schools should follow the seasons, and that animals should be studied in relation to their surroundings. "The study of the relations of animals to their surroundings is a constant investigation of cause," and the pupil has above all to inquire into the meanings of facts. But exercises in classification, in the detailed analysis of types, in definition making, and so on, are also, he maintains, of great value. The book has been read critically by numerous teachers—some of whom are well known experts—so that it ought to be well-nigh faultless within its limits. The descriptive part begins with insects, leaving difficult groups like Protozoa and Cœlentera to near the end; it is elementary in its mode of treatment, with refreshing breaths of the open air, admirably free from technicalities, and always clear. But the author has tried far too much, and his terseness is repeatedly gained at the expense of accuracy. We do not see the object of attempting a complete survey in a book like this, of dragging in sirenians and brachiopods—the whole show, in short—when the exigencies of space appear to have made it impossible to say about many classes anything worth reading. If the author had been less ambitious of completeness, his book would have been more useful. The practical part of the book, which includes a large variety of material, and mostly consists of simple directions and suggestive questions, is in our opinion a much stronger piece of work. The studies on insects, the crayfish, the earthworm, the turtle, the snake, the rabbit, and many more, considered both as intact living creatures and as objects for anatomical analysis, are admirably conceived and well worked out. The Socratic method is adhered to throughout, and the practical volume will be found very valuable both by teachers and students. It presupposes for the natural history lessons more time and more freedom than is usually allowed in Britain. It should also be noted that there are terse directions on several topics which are rarely alluded to in books on practical zoology, such as skinning birds and mounting insects. Our general impression is that Prof. Colton, who is evidently a skilful teacher, should have expanded and illustrated the *practical* part of his book, incorporating in it all that is personal and distinctive in the *descriptive* part.

J. A. T.

Among the Garden People. By Clara D. Pierson. Pp. viii+236; illustrated. (London: John Murray, 1904.) Price 5*s.*

OUR American friends, if not actually ahead, are well up to our level in the matter of encouraging and protecting the native birds of gardens and plantations, and the author has therefore been well advised in arranging for an English edition of the work before us. She has been equally well advised in changing the original title of "Dooryard Stories" for the one this dainty little volume now bears, for few amongst us, we think, are aware that "dooryard" is American for "garden." The American title is, however, still retained in the page-headings.

The book is essentially one for juvenile readers, being written in the form of simply worded stories, in which the birds are made, so far as possible, to tell their own tale according to what may be supposed to be their own ideas. Despite a certain amount of confusion which is almost sure to arise from the misappropriation of the names of familiar English birds for totally different American species, it is certainly an important element in the natural history education of young people that they should be made to understand that the birds of distant lands differ markedly from those of their own, and, as the author observes, it may be a decided advantage to those who visit in mature years the New World to have already made some amount of acquaintance with its feathered denizens.

Not that this volume is by any means absolutely restricted to the birds of American gardens, for it tells us a good deal about some of their four-legged enemies, such as red squirrels and chipmunks. Some of the American names, such as the latter, are explained in a short glossary, in which we are somewhat amused to find the raccoon described as "an American animal, allied to the bear family, but much smaller, and much hunted both for its flesh and its fur." Surely something a little more exact and more to the point could have been supplied by the author's naturalist friends.

The numerous "three-colour" plates are for the most part good and artistic representations of the species they portray, and the volume may be recommended as an attractive gift-book for young people.

R. L.

New Physical Geography. By Ralph S. Tarr, B.S., Professor of Dynamic Geology and Physical Geography at Cornell University. Pp. xvi+457. (New York: The Macmillan Company, 1904.) Price 1 dollar.

AS Prof. Tarr says in his preface, the teaching of physical geography is still in its experimental stage. The publication of this volume, which is the third on the same subject by the same author, who now "does not flatter himself that he has produced the ideal," shows there is work yet to be done by teachers of geography. But whether this volume is ideal or not, it is certainly an excellent text-book of the subject. Prof. Tarr begins with a short and not altogether satisfactory chapter on the earth as a planet, and proceeds to a treatment of the lands of the globe. These chapters are followed by descriptions of atmospheric and oceanic phenomena, which are less extended than in the author's previous books, and by an account of the physiography of the United States. The volume concludes with chapters treating of life in its relation to the land, air, and ocean—the last one being called "Man and Nature." Several subjects usually included in books on physical geography are relegated to appendices, and among these may be mentioned: revolution of the earth, latitude and longitude, tides, magnetism, and meteorological instruments. There are 568 illustrations, most of which are of a striking and instructive character.

Quiet Hours with Nature. By Mrs. Brightwen. Illustrated by Theo. Carreras. Pp. xvi+271. (London: T. Fisher Unwin, 1904.) Price 5*s.*

MRS. BRIGHTWEN writes in a way that is sure to gain the attention of young people. Her sketches are in no sense formal scientific descriptions of the familiar animal and plant life of this country, but they are likely to arouse an interest in natural history and to lead readers to observe for themselves. The book shows clearly how much worth close inspection and study an English garden contains, and rightly indicates there are common phenomena which still remain unexplained. The book is well illustrated and deserves to be a favourite with boys and girls.

Le Monde des Fourmis. By Henri Coupin, Lauréat de l'Institut, &c. Pp. 160. (Paris: Delagrave.)

THIS is a small popular book relating to the habits, architecture, and intelligence of ants, and largely consists of extracts from the works of Huber, Forel, Lubbock, Moggridge, and other well known writers, chiefly French and English. The subject of the book cannot fail to interest those previously unacquainted with it, but it contains little that will not be familiar to everyone who has read any recent works on ants. It is very inferior to such a book as Ernest André's "Les Fourmis," published in 1885, but we believe that this has been out of print for some time. We may add that M. Coupin's book contains a few illustrations of a very inferior description.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Life-history of Radium.

IN a letter under the above title in NATURE of May 5, Mr. Whetham brings forward some results dealing with the hypothesis that radium is being produced from uranium. May I be permitted to state that I have been engaged during the last twelve months in an experimental examination of this hypothesis? In the paper in which the suggestion was made that radium may be being formed by the disintegration of a parent element possessing heavier atomic weight (Rutherford and Soddy, *Phil. Mag.*, May, 1903, p. 587), this sentence occurs:—"The point is under experimental investigation by one of us, and a fuller discussion is reserved until later." Mr. Whetham's letter makes it desirable that the results that have been obtained during the past year should be published.

Twelve months ago I purified a kilogram of uranium nitrate until the quantity of radium present was less than 10^{-13} gram. This was the limit of detection by means of the electroscope employed, using the maximum or equilibrium amount of accumulated radium emanation as the test for the presence of radium. It was arrived at by direct comparisons with the emanation from a standard milligram of radium bromide, by subdivision until its presence could no longer be detected. Unfortunately, owing to the large amount of radium in the laboratory, subsequently introduced for the purpose of the helium research, the electroscopes have been affected, and it is not possible at the present time to be sure of such minute effects as originally. But it may be stated that less than 10^{-11} gram of radium has accumulated in the kilogram of uranium during the past twelve months. This practically settles the question so far as the production of radium *from uranium* is concerned.

In a paper read recently before the Royal Society by Sir William Ramsay and myself, an experimental determination of the rate of change of radium was given. It was shown that rather less than one-thousandth part changes per year. The rate of change of uranium may be taken as a million times slower, since its radio-activity is a million times less; so that, in one kilogram of uranium nitrate, about 5×10^{-7} gram would change per year. The quantity of radium produced was less than 10^{-11} gram, so that the conclusion is arrived at that if uranium changes into radium, less than one-ten thousandth of the theoretical quantity is produced during the first year's accumulation.

The result, of course, may be explained by assuming the existence of intermediate forms between uranium and radium. But from a general consideration of the whole question from the point of view of the disintegration theory, several such hypothetical forms, each with an extended life, must be assumed. So that unless modifications are made in the theory, which at present are not justifiable, the evidence may be taken as indicating that uranium is not the parent element of radium. The experiments will be continued from year to year with the kilogram of uranium nitrate. But as I am leaving England immediately, and shall be away several months, I take the opportunity of presenting the results of the unfinished research, and hope at a later date to give a fuller account.

FREDK. SODDY.

University College, Gower Street, W.C.

IN their communication to the Royal Society of April 28, Sir William Ramsay and Mr. Soddy by direct measurements determine the rate of decay of radium as one thousandth of the mass per annum, giving as the average life of the radium atom about one thousand years.

* This rapid rate of decay, of course, renders it quite out of the question to assume that in the radium now existing on the earth we are dealing with the residue of a larger quantity reduced by decay to its present amount. If we carry backwards so great a rate of change we, in fact, arrive at the existence of such large amounts quite a few thousand years ago as to postulate a red hot earth almost within historical times. We are thus either compelled to assume that the rate of transformation observed does not apply generally to terrestrial radium, but only to radium separated by chemical treatment from pitchblende, or that the existing store of radium is derived by steady supply from some substance of greater atomic weight. The first hypothesis, in view of what is known as to the intimately atomic nature of radio-activity, may be dismissed.

That the probable source of radium is uranium is advocated by Prof. Rutherford in his book on radio-activity. From a conversation with Sir Oliver Lodge I gather that he also considers this not improbable. The reasons for it need not be given here.

Now if radium is derived from pitchblende, the rate of change of radium is a measure of the rate of change of pitchblende, supposing a steady state of supply and loss has been attained. This last condition I think we are entitled to assume, although doubtless from the mathematician's point of view a perfect equality would be improbable. But I will quote Prof. Rutherford ("Radio-activity," p. 334):—"Since radium has a short life compared with that of uranium the amount of radium produced should reach a maximum after a few thousand years when the rate of production of fresh radium—which is also a measure of the rate of change of uranium—balances the rate of change of that product."

Let us now assume as an approximation that from 1000 kilos. of uranium the yield of radium under the most favourable conditions would be one decigram. It may here be observed that the fact of pitchblendes varying in their content of radium is only what is to be expected under the conditions of preservation of the ore, exposed as it is to chemical attack, or, as Prof. Rutherford points out, to the action of percolating water. We have in seeking to learn the content of radium for our present purpose to take the maximum observed.

The one decigram of radium transforms into substances of lesser atomic weight at the rate of one-tenth milligram per annum. Now this is also the annual supply from 1000 kilos. of uranium. In other words, the uranium breaks down at the rate of $1/10^{10}$ part of its mass per annum. The average life of the uranium atom is according to this ten thousand million years.

In determining this average life from so short a period of observation we, of course, make the assumption that the death rate observed is an average one, and that a steady state is attained truly founded on the mean longevity of a vast number of individuals of varying ages, varying rates of loss of corpuscular temperature as well as of varying amounts of initial corpuscular energy, such conditions as would attend material evolution according to Prof. J. J. Thomson's fascinating book "Electricity and Matter." Similar assumptions must be made before we could deduce the average longevity of a vast population from a short period of observation of the death-rate.

On these assumptions an interval of time is indicated which may be considered a minor limit to the antiquity of matter in our part of the universe. For if the average life is really 10^{10} years, must we not assume that some of the atoms now expiring as uranium were existing ten thousand million years ago? Geological time, as we guess it, is but little more than a moment in the being of so great an era—as thirty-six seconds is to an hour.

Whether we will ever be able to obtain direct *proof* of so remote an antiquity is impossible now to say, but it is remarkable that the rate of change of thorium to thorium X affords the same average longevity for the atom of thorium as we arrive at on the data above for uranium, or again from the known rate of change of uranium to uranium X. Thus Rutherford gives 10^{-16} to 10^{-17} as the change-rate per second to thorium X. The change-rate 10^{-10} for a year's disintegration will be found to lie between these limits.

J. JOLY.

Trinity College, Dublin, May 1.

Behaviour of Radium Bromide Heated to High Temperatures on Platinum.

IT may be of interest to record that radium bromide obtained from Schuchardt, of Görlitz, and stated to be pure, melts at 728° C. This number is arrived at by observations on minute specks of the substance heated upon the platinum ribbon of the meldometer.

At higher temperatures—up to 1600°—there is every appearance of decomposition, a quiescent glass finally remaining on the hot platinum. After the experiment it is found that the platinum is deeply pitted, and that in some of the pits the limpid glassy substance remains imbedded. This glass is insoluble in hot or cold water or in HCl even after prolonged immersion in the hot acid. It can be removed only partially from the platinum by scraping. Its refractive index is low.

The pitting would most readily be accounted for by supposing a platinum bromide formed, but what, then, becomes of the radium? Is an alloy formed? The ribbon is found to be still radio-active after the experiment, but feebly so. I have not made quantitative observations for possible recovery of activity. J. JOLY.

Trinity College, Dublin, May 7.

Electromotive Force between Two Phases of the Same Metal.

FROM the microscopic study of the changes which take place in metals in hardening and annealing, I had been led to the conclusion that metals may occur in two phases, a hard or amorphous phase and a plastic or crystalline phase (*Proc.* Roy. Soc., vol. lxxii. pp. 218, 232). In seeking for independent evidence of this, it occurred to me to try if there existed a measurable electromotive force between the two phases, and I have now obtained definite proofs that this is the case in all the metals which have been tested. In the case of silver, a thermo-junction consisting of a hardened and an annealed wire gave an E.M.F. of 128 micro-volts at a temperature of 250° C. This temperature appears to be near the transition point, and beyond this the E.M.F. falls to zero, as the wires are then both in the same phase. Further experiments on the subject are in progress, and the results will be published in due course.

GEORGE BEILBY.

11 University Gardens, Glasgow, May 7.

A Simple Method of Showing Vortex Motion.

IF a little aqueous fluorescein be placed in a glass tube drawn out to a capillary bore, and supported vertically over a tall cylinder of water, so that the orifice is just beneath the surface, the fluorescein will descend through the water in a fine stream.

If the water be quite tranquil and free from any rotatory motion, this stream will continue straight, unbroken, and clearly defined to the bottom of the jar.

Let a tap be given to the stand supporting the tube; a slight swelling will appear on the issuing stream and gradually increase in size, widening as it goes, while the part immediately behind it becomes more and more slender, and finally parts altogether.

The separated portion continues to widen, and the velocity of the centre being greater than that of the edge, it acquires a motion of rotation, and becomes a perfect vortex ring. If a succession of taps be given to the stand, a series of such rings are formed in regular order. As their velocities diminish, their cross sections increase; they alternately pass through one another, and their motion can be observed with great ease on account of the slowness with which it takes place. I do not know if this method of producing vortices is new or not, but at all events it possesses the merit of simplicity. P. E. BELAS.

Royal College of Science, Dublin, May 3.

Napier's Logarithms.

STUDENTS interested in this subject may be recommended to consult "The Construction of the Wonderful Canon of Logarithms," by John Napier, Baron of Merchiston; translated from Latin into English, with notes and a catalogue of the various editions of Napier's works, by William Rae Macdonald, F.F.A. (William Blackwood and Sons, Edinburgh and London, 1889.) G. B. M.

THE EXCAVATOR'S VADE MECUM.[1]

IF any man living is qualified to write a book on the subject of excavating it is Prof. Petrie, than whom no one has had a longer and wider experience or more consistent success. And, as a perusal of these pages will show, the work of excavation is something more than the mere overturning of earth with the spade and extraction of such treasures as may be concealed beneath it. There is not only the organisation and direction of labour, with all the knowledge of human—and especially of the Oriental—nature that it involves, the adaptation to physical conditions, the comprehension of the history and geography of the country, and, last but not least, the unerring eye for the disposition of cemeteries or temple sites which is almost an instinct rather than a matter of experience. The ideal excavator must, in addition, be a skilful draughtsman and photographer; he must have some knowledge of chemistry, geology, mechanics, and surveying, besides—*cela va sans dire*—the archæological knowledge which enables him to identify, estimate, and classify on the spot the results of his researches.

That the writer of this book fulfils perfectly in his own person all these requirements, he would probably be the first to deny; but his long experience has given him a title to speak, as it were, *ex cathedra* on all such subjects, and though the work deals almost exclusively with excavation from an Egyptian point of view, it will henceforth be indispensable for its practical value to all investigators in any part of the world. In fact, it contains so much practical advice on every possible head that one may fancy the would-be follower of Prof. Petrie somewhat staggered at the task set before him. The apparatus laid down as essential for preservation and packing of objects alone would seem to necessitate the transport of a whole Whiteley's or Gamage's to the Egyptian deserts. We have been sufficiently curious to compile a list of materials named in these two chapters. They include barrels, zinc trays, brushes of various kinds, paraffin wax, tapioca water, emery paper, gelatine, benzol, silicate solution, glycerine, nitric acid, fuller's earth, sheets of glass, plaster, ammonia, hydrochloric acid and other chemicals, in addition to tools and other more obvious necessities. But perhaps the author regarded this list as a counsel of perfection, as he gives a much shorter one on pp. 112–113.

Seriously, however, all such hints are extremely valuable, and provide for every contingency and every difficulty that may arise in the course of an excavation. The only valid objection that might be taken to them is that much of what is said is perfectly obvious to a person of average intelligence, and that plenty of good work on these lines has been done elsewhere besides in Egypt. However, Prof. Petrie takes his subject seriously and with genuine enthusiasm, and his system affords a welcome contrast to that of the excavator for mere pleasure or for unblushingly commercial ends, to whom archæological results are nothing, and whose labours therefore confer no benefit on any save himself. If we may venture on a word of criticism in general, we may say that he is inclined to be somewhat too severe on the work done by museums and by the stay-at-home archæologist. The explorer, as Mr. Hogarth well pointed out in his charming "Wandering Scholar," can never supply the place of the scholar; happy is he who combines both capacities in his own person, as it has been given to few to do; but the one will always be complementary to the other. Hence we think Prof. Petrie too much inclined to regard excavation (even with all its con-

[1] "Methods and Aims in Archæology." By W. M. Flinders Petrie. Pp. xviii+208; with 66 illustrations. (London: Macmillan and Co., Ltd. New York: The Macmillan Co., 1904.) Price 6s.

comitant labours) as in itself comprising archæology. This cannot be; the excavator supplies the materials, and it rests with him to supply them in a scientific and workmanlike manner; but the years of study which they often demand must be the lot of the student, who, we can assure our author, would often be only too grateful if he had the chance of combining both functions.

The subject is distributed over fourteen chapters, beginning with the qualifications of the excavator himself, the experience or instinct necessary for identifying sites or finds, and three chapters dealing with the actual work in the field—the labourers, methods of turning and raising earth, and recording on the spot. Then follow successive chapters on copying and drawing, photography, preservation of objects, packing, and finally publication. The last four are of a more general nature, dealing with the systematising of results, the nature of archæological evidence, the ethics of archæology, such as the rights of the State, and lastly, the fascination of history by way of epilogue. Space forbids a detailed description of the many interesting points and valuable suggestions contained in these chapters, but the book will be found eminently readable even by those who cannot hope to wield the spade.

FIG. 1.—The clearing of the Osireion at Abydcs, Egypt.

We cannot, however, lay it down without a feeling that the author is throughout too prone to disregard the work of other archæologists; for instance, on p. 123, where he complains that no one since Montfaucon (whose work, by the bye, is singularly useless) has attempted the collecting of series of objects in a *corpus*. Has he never heard of M. Reinach's invaluable *répertoires* of Greek sculpture and vases? Is he not aware that the German Archæological Institute is issuing a magnificent publication of Greek terracottas? And is not a *corpus* of coins under consideration? We purposely pass over the growing number of museum catalogues of all kinds, which if not *corpora*, are still a step in that direction.

The book is illustrated by sixty-six photographic or outline reproductions, of sites, operations, and monuments, the titles of which are at times somewhat oddly arranged (*e.g.* Figs. 36–37), but they are clear, well chosen, and instructive. We have selected for reproduction the frontispiece, representing the clearing of the Osireion at Abydos by a chain of boys with baskets, extending more than forty feet down. The index errs if anything on the side of redundancy; such headings as "carefulness, means of securing"; "chain of boys"; "choice of facts"; "finest lines in drawing"; "list of plates"; "red paint"; "wet squeezes," are not only superfluous, but contrary to all the rules of good indexing.

H. B. W.

PROF. A. W. WILLIAMSON, F.R.S.

ON Friday last, May 6, there passed away, full of years and of honour, Alexander William Williamson, one of the most notable of British chemists, and one who, in the heyday of his intellectual activity, exercised a remarkable influence on the development of chemical theory. He had been in failing health for some years past, and such was the seclusion in which he lived of late that his tall manly form and striking features were practically unknown to the younger generation of chemical workers. Indeed, after his retirement, in 1889, from the position of Foreign Secretary of the Royal Society, which he held for some sixteen years, and after the termination of his active connection with the British Association for the Advancement of Science, of which he was treasurer for many years, he rarely visited London, and unless on an occasion when it was represented to him that his influence and the weight of his authority were needed in support of some reform, it was difficult to induce him to revisit the scenes of scientific activity in which he had himself played so strenuous and so eminent a part. Until within the last few years, when his mental powers were obviously failing, he continued to take a keen interest in the progress of science, and it was easy to engage his attention on the broad general lines of its development.

Williamson's mind was cast in a large mould, and, although at times he could occupy himself with even small details if he recognised that these were significant or possibly fruitful of theoretical consequence, he was apt to be impatient of the somewhat tiresome minutiæ with which modern chemical literature abounds. He was probably never a great reader of such literature at any period of his career, and his physical infirmity made it increasingly difficult for him to keep himself informed. At the same time the very limitation of his physical powers, his partial paralysis, and his poor eyesight, probably conduced to his eminence as a speculative thinker. He was gifted with a strong logical mind, and was an acute reasoner, and a clear, vigorous, and independent thinker, capable of broad and striking generalisation. Knowledge, we know, dwells in heads replete with thoughts of other men, wisdom in minds attentive to their own. Except by personal contact, Williamson was largely debarred from the knowledge of other men's thoughts; by the very circumstances to which allusion has been made he became more attentive to his own. Like most original thinkers he was somewhat tenacious of opinions, and apt to be dogmatic in their utterance. His beliefs were too hardly won to be lightly discarded. But although at times impatient of contradiction, he had too strong a regard for truth, was too sincere and broad-minded a man to persist in any opinion, if its unreasonableness was made clear to him. Like Carlyle, his philosophy was largely swayed by his emotions, and like Carlyle's, his judgments on men and things were apt to be tinctured by the mood of the moment—a fact which may serve to account for seeming inconsistencies in their expression.

He had a high sense of duty, and of the responsibilities of his position as a representative man of science. Although, like many strong men, fond of power, he was in no sense a self-seeking man, and was contemptuous of the artifices by which smaller and more ambitious men seek to gain preferment.

Williamson was born at Wandsworth on May 1, 1824; hence he had just completed his eightieth year at the time of his death. Much of his early life was spent on the Continent. He began the study of chemistry under Gmelin at Heidelberg, in the old cloisters which formerly did duty as class rooms and laboratory, but soon joined Liebig at Giessen. Whilst at Giessen he published, so far back as 1845, his first paper on "The Decomposition of Oxides and Salts by Chlorine," in which he determined the conditions of production of hypochlorous and chloric acids, and the cause of the difference in the mode of action of chlorine upon alkalis and alkaline earths, and upon salts. The main outcome of this paper has long since been worked into the text-books. It is of interest as throwing light upon the theory of the action of bleaching solutions. The experimental material for a short paper on "Ozone" was likewise accumulated at Giessen. In this paper, which also appeared in 1845, Williamson concluded that the peculiar properties belonging to the oxygen set free by the agency of the electric current are produced by the admixture of a *peroxide or acid of hydrogen,* whereas by the action of phosphorus on atmospheric air the same substance is *not* produced. His surmise that a compound of hydrogen and oxygen existed possessing some of the characteristic properties of ozone but dissimilar from Thénard's hydrogen peroxide has not been established by subsequent investigation.

At about this time Williamson took his degree, and in 1846, whilst still at Giessen, published an important paper on "The Blue Compounds of Cyanogen and Iron," which probably contains more determinative analytical work than any other of his memoirs. In it he describes the formation of prussian blue in different circumstances, and the influence which these exercise on its composition, giving particular attention to the presence of potassium, which materially affects the colour and dyeing power of the product.

These, with two short papers, one relating to the theory of ozone, and another on the constitution of œnanthol, which he published in Liebig's *Annalen,* comprise the outcome of the Giessen period. He then passed on to Paris, where he came under the influence of Comte. It is hardly to be supposed that a man of his temperament, and in such surroundings, could remain wholly unaffected by the events of 1848. His position, however, was made secure by Graham, who came over to Paris to offer him the chair of practical chemistry in University College, to which he was appointed in 1849, and where he continued to teach for thirty-eight years.

In 1850 Williamson published his epoch-making paper on the "Theory of Ætherification." It was first read to the chemical section of the British Association at the Edinburgh meeting of August, 1850, and in its original form as "communicated by the author" occupies about seven pages of the *Philosophical Magazine.* Certainly no chemical paper of equal length ever exercised so profound an influence on contemporary thought. This memoir, although frequently referred to, is probably seldom read by the chemical student. And yet written more than half a century ago there is scarcely a term in it which needs alteration to bring it into harmony with modern chemical terminology or present day doctrine. It is a model of concise reasoning, founded upon happily devised experiment. Williamson clearly traces for us the genesis of the idea which led him to his capital discovery. His original intention was not to elucidate the theory of the manufacture of ether; he says his object in commencing his experiments was to obtain new alcohols by substituting carburetted hydrogen for hydrogen in a known alcohol, and for this purpose he acted upon sodium ethylate with the iodide of the carburetted hydrogen which was to be introduced in the place of that hydrogen—an expedient which he says he hopes may render valuable services on similar occasions. To his astonishment the compound thus formed had none of the properties of an alcohol—it was nothing else than common ether, $C_4H_{10}O$. This simple observation threw a flood of light upon the relations of alcohol and ether, which Williamson proceeded to develop by a train of reasoning, and to prove by a series of experiments which are now among the commonplace observations of every lecturer in organic chemistry wherever the science is taught. Williamson not only illustrated these relations by arguments and proofs which are absolutely unassailable, but by a course of reasoning which instantly riveted the attention and secured the adhesion of the whole chemical world, he demonstrated the true process of etherification, and thereby reconciled the teaching of apparently irreconcilable facts. It must have been with a special gratification that the young man of twenty-six penned the following lines, which happily summarise the position he had attained.

"Innovations in science frequently gain ground *only* by displacing the conceptions which preceded them, and which served more or less directly as their foundation; but, if the view which I have here presented be considered a step in our understanding of the subject, I must beg leave to disclaim for it the title of innovation; for my conclusion consists in establishing the connection and showing the compatibility of views which have hitherto been considered contrary; and the best possible justification of the eminent philosophers who advocated either one of the two contending theories, is thus afforded by my reconciling their arguments with those of their equally illustrious opponents." An observation no less tactful than true.

The paper is epoch-making in more senses than one. In it Williamson not only foreshadowed his adherence to the doctrine of types which in his subsequent teaching he did so much to elucidate and extend, but he likewise seeks to import into the general process of chemical action the conceptions of dynamics. The simple words with which he concludes his paper sound somewhat archaic to-day, but fifty-four years ago they must have startled the members of Section B. "In using the atomic theory, chemists have added to it of late years an unsafe, and as I think, an unwarrantable hypothesis, namely that the atoms are in a state of rest. Now this hypothesis I discard, and reason upon the broader basis of atomic motion."

Williamson was not a prolific writer, and his fame mainly rests upon his work of this period and upon what he achieved during the first ten years of his professorial activity. He published comparatively little between 1854 and 1864, but under the stimulus of the new movement, he took an active part in the formulation of what is still current doctrine, and produced a series of papers on the principles of chemical classification, valency, and nomenclature which exercised a powerful influence on chemical teaching in this country.

Williamson was elected into the Royal Society in 1855, and served on the council from 1859 to 1861, again from 1869 to 1871, and for a third time from 1873 to 1890, during which period he acted, as already stated, as foreign secretary. In 1889–1890 he was made a vice-president. In 1862 he received a Royal medal. He was twice president of the Chemical Society—viz., in 1863–65 and again in 1869–71, and was one of the six presidents who had been fellows of the Society for upwards of half a century who were present at the memorable banquet in 1898. He was largely instrumental in establishing the present series of abstracts of foreign chemical literature which form so valuable a feature of the *Journal* of the Chemical Society.

In 1873 he was president of the British Association. His merits as a man of science received wide-spread recognition. He was an honorary graduate of Dublin, Edinburgh, and Durham, a member of the Institute of France and of the Berlin Academy, and of many scientific societies on the Continent and in America.

T. E. THORPE.

ÉMILE DUCLAUX.

IN the death of Émile Duclaux science has lost one of her most devoted and brilliant workers. His career has formed the principal link between the bacteriology of the present day, and what may be called the heroic period in the history of micro-biology which followed on the unveiling, by the genius of Pasteur, of the secret of fermentation, and the consequent opening out of avenues through which innumerable problems could be successfully attacked.

The Pasteur Institute will in particular mourn its loss, for, owing to the charm of his personality and the extraordinary catholicity of his scientific enthusiasms, he was a worthy successor to the great leader, and the continuance of that brotherliness which was such a striking feature among the little community of scientific investigators in the Rue Dutot must in considerable measure be attributed to his influence.

Duclaux was born at Aurillac, on June 24, 1840. He was not a son of fortune, and it was only by dint of hard struggle and a determination which was capable of much self-denial that he succeeded in becoming a *Normalien* in 1859. At the Ecole Normale he studied principally chemistry and physics, and left the school as *Agrégé* in 1862.

At that time Pasteur, who had returned to the Ecole Normale as director of scientific studies, had recently established the positions of Agrégés préparateurs, whereby an able and earnest young graduate might remain for a few years as a research-assistant to one of his masters.

For some three years Duclaux remained préparateur to Pasteur, and was his first lieutenant during the celebrated investigations into the causes of diseases in wine and into the silkworm disease, which had nearly ruined some of the Departments of France.

In 1865 he became Docteur ès Sciences, presenting a thesis upon fractional distillation. In the same year he was appointed a professor at the *lycée* in Tours, and during the following year became acting professor of chemistry at Clermont. It was at Clermont that Pasteur stayed with Duclaux during the troublous times of the war, and it was here that the intimacy and affection which ceased only at the death of Pasteur was established between them. It was at Clermont, also, that he numbered among his students Roux, whom he introduced to Pasteur.

From Clermont, Duclaux went to Lyons as professor of physics, where he remained until he accepted, in 1878, the chair of physics and meteorology at the Institute Agronomique in Paris. In 1886 he became professor of biological chemistry at the Sorbonne, which position he held until his death. When the Pasteur Institute was completed, he transferred his classes to the Rue Dutot. At the death of Pasteur, Duclaux was elected to succeed him as director, and for the last nine years the great work of the Institute has been developed under his guidance. He, however, has not taken any direct part in that portion of its activities dealing with infective diseases, but has confined himself more particularly to the chemical and industrial side of micro-biology.

When one considers the scientific work of Duclaux, the first and most striking point is the wide range of subjects it includes. Trained as a chemist and physicist, he has occupied chairs in both these subjects, and has published a not inconsiderable number of original researches in the domains of pure chemistry and physics. At the same time his most important work was biological. Like Pasteur, he was a chemist who worked at biology, but principally at that department of biology dealing with the physiology of micro-organisms and the chemistry of enzymes, and he brought his training in the exact sciences to bear upon investigations of a biological character, with the greatest success.

The list of his original contributions to scientific journals contains upwards of eighty papers, and includes papers on molecular physics, chemistry, meteorology, physiology of digestion, enzymes, vegetable physiology, bacteriology, and technological papers on milk, butter, wine, sericulture; and he is also the author of several books. In "Ferments et Maladie" and "Le Microbe et la Maladie" he gave popular expositions of the results achieved by the Pasteurian method, and the complete change thereby produced in the standpoint from which infectious diseases were regarded.

In 1896, Duclaux published his "Pasteur, Histoire d'un Esprit," which deals with the researches of the great master from first to last, pointing out the condition of knowledge on the various subjects before Pasteur had brought them, one by one, under the influence of his imagination and accurate experimentation. This forms one of the most brilliant descriptions of the operation of scientific method in unravelling the relationship of phenomena; its perusal might well form a portion of the education of every student of science.

The most important of Duclaux's published books is the "Traité de Microbiologie"—the four volumes of which appeared during the years 1898 to 1901—each chapter of which bears the stamp of the author's individuality, and contains many original observations not published elsewhere. "L'Hygiène sociale" embodies a series of lectures given at the École des hautes Études sociales, in which he points out forcibly that the development of our knowledge regarding the causation of disease has devolved upon us new responsibiliities as individual citizens, and in which he advocates an intelligent propagandism rather than legal insistence.

On one occasion Duclaux felt himself constrained to leave the peaceful search after truth which he had been pursuing all his life in his laboratories, and to enter upon the turmoil of the public platform. This was on the occasion of the Dreyfus case, when, thinking the cause of truth was imperilled, he, with complete disregard of all personal considerations, and, as it happened, with most disastrous consequences to his health, threw himself into that fierce struggle with invincible ardour. He, with Zola, Grimaux, and some other *intellectuels*, founded the Ligue des Droits de l'Homme, and it was whilst addressing a meeting of this League that he was seized with an attack of apoplexy. He made a slow recovery, and regained sufficient health to resume his work at the Institute, but has now succumbed to a second seizure from which he never regained consciousness.

Owing to the versatility of his genius and the wide field of scientific subjects which occupied his attention during a very active life, it is difficult to form an adequate estimate of the importance of his scientific work. It will be, perhaps, on account of his researches into the ferments and the chemical processes associated with the life and activities of micro-organisms that he will be best remembered by the world of science; but for those who have had the privilege of being his pupils and associates it will be the memory of the kindly guide and critic, whose enthusiasm was a continual spur to effort, and whose ideas were ungrudgingly at the disposal of every disinterested inquirer into truth, that will remain for ever foremost. CHARLES J. MARTIN.

SIR H. M. STANLEY.

THE death of Sir H. M. Stanley on Tuesday, at sixty-three years of age, deprives the world of a man of action, and geography of one of its greatest pioneer explorers. It can truly be said that he changed the map of Africa by the results of his expeditions, and his picturesque narratives created public interest in the problems of African exploration.

Stanley's adventures in Central Africa while engaged in the search for Livingstone attracted great attention, and his famous book, "How I Found Livingstone," in which the expedition is described, has become a classic work of travel. Commissioned to find Livingstone, of whom nothing had been heard for two years, Stanley reached Zanzibar in January, 1871, and on November 10 of the same year met the explorer at Ujiji, on Lake Tanganyika, where Livingstone had just arrived from Nyangwe. The two travellers explored together the north end of Tanganyika, and proved conclusively that the river Rusizi flowed into and not out of the lake, and that Tanganyika had no connection with the Nile system. In February, 1872, Livingstone started on the journey from which he never returned, and Stanley made his way back to Europe.

In 1874, Stanley left England for the expedition to Central Africa which has immortalised him. The writer of the obituary notice in the *Times*, from which some of the particulars here given have been derived, points out that little more than the position of Victoria Nyanza was then known; its shape was all wrong; our knowledge of Albert Nyanza was incomplete; Lake Tanganyika was imperfectly defined; and nothing was known of the region that lies between Lakes Albert and Tanganyika. Stanley's expedition changed all that. He proceeded from Bagamoyo west and north to Victoria Nyanza, tracing a river which he believed (erroneously, we now know) was the remote source of the Nile. He circumnavigated the lake, and for the first time proved to satisfaction that it was one great lake and not a group of small lakes, and that its shape was very different from that laid down in Livingstone's map. Westwards to Muta Nzige, as Lake Albert is called by the natives, Stanley and his great following marched. They struck a bay (Beatrice Gulf), which is now recognised as part of a southern lake, afterwards named by Stanley Lake Albert Edward. Important rectifications and additions were made in the country lying between Victoria Nyanza and the lakes to the west, and thence south to Ujiji. Stanley circumnavigated Tanganyika, rectifying its contour, and proving conclusively that the lake had an outlet in the river Lukuga.

Leaving Nyangwe in November, 1876, Stanley reached Boma, near the mouth of the Congo, in August, 1877. This journey across Africa lasted two years and nine months. The results to geography were certainly immense; it is doubtful if on any other single expedition so much had been done to fill up the great blank in the map of Africa. The narrative of this expedition was given by Stanley in "Through the Dark Continent."

The magnitude of Stanley's discovery we are only now realising, when the multitude of mighty tributaries north and south are being opened up, and we are able to form an estimate of the vast basin of the Congo.

Stanley had scarcely landed in Europe, in 1878, when the King of the Belgians solicited his aid in the opening up of the Congo. In the following year he returned to the Congo; and this was the beginning of what really soon became the Congo Free State, under the sovereignty of the King of the Belgians.

In 1887, Stanley went again to Africa—this time in search of Emin Pasha. Emin was found, but the expedition met with several disasters. Finally, marching through new country, exploring the Semliki River, Mount Ruwenzori, and Lake Albert Edward, Stanley and his followers made their way by the south of the Victoria Nyanza to the coast, he reaching Zanzibar on December 6, 1888, leaving Emin behind on the mainland.

On this expedition Stanley succeeded in solving some important problems in the hydrography of Africa and adding much to our knowledge of its geography. Among the geographical results were the discovery of the Semliki River, which issues from Lake Albert Edward and enters the south end of Lake Albert Nyanza, the Ruwenzori range between these two lakes, and the south-western extension of Lake Victoria. The results of this expedition are described in the volume "In Darkest Africa."

Stanley has been termed "the Bismark of African exploration," and in many respects the comparison is not inappropriate; for the work he accomplished united into one great whole the *disjecta membra* of African exploration, and it was carried out with firm nerve and unflinching will.

INTERNATIONAL ASSOCIATION OF ACADEMIES.

THE following is a list of the delegates who, according to the latest advices, will attend the General Assembly of the International Association of Academies, to be held at the Royal Society's Rooms at Whitsuntide:—

Amsterdam.—Koninklijke Akademie van Wetenschappen, Prof. H. G. van de Sande Bakhuyzen and Prof. M. J. de Goeje. *Berlin.*—Kgl. Preussische Akademie der Wissenschaften, Prof. H. Diels, Prof. W. Waldeyer, Prof. W. von Bezold and Prof. R. Pischel. *Brussels.*—Académie

Royale des Sciences, Prof. Léon Fredericq and Prof. Chevalier Edouard Descamps. *Budapest.*—Magyar Tudomanyos Akademia, M. Charles Than and M. Ignatius Goldziher. *Christiania.*—Videnskabs Selskabet, Prof. H. Mohn and Prof. G. Guldberg. *Copenhagen.*—Kongelige Danske Videnskabernes Selskab, Prof. J. L. Heiberg and Herr Paulsen. *Göttingen.*—Königliche Gesellschaft der Wissenschaften, Prof. E. Ehlers, Prof. F. Leo, Prof. F. Kielhorn and Prof. E. Riecke. *Leipzig.*—Kgl. Sächsische Gesellschaft der Wissenschaften, Prof. Dr. Flechsig and Prof. Dr. Credner. *London.*—Royal Society, Sir William Huggins, Mr. A. B. Kempe, Prof. Larmor, Mr. Francis Darwin, Sir Michael Foster, Lord Kelvin, Prof. Armstrong, Mr. George Darwin, Prof. Forsyth, Sir David Gill, Prof. Liversidge, Sir Norman Lockyer, K.C.B., Prof. Schuster, Dr. Waller, Sir William Ramsay, K.C.B., Mr. Bateson and Prof. Milne. *London.*—The British Academy for the Promotion of Historical, Philosophical, and Philological Studies, Lord Reay, Right Hon. James Bryce, Sir R. C. Jebb, Dr. Caird, Sir C. P. Ilbert, K.C.S.I., Right Hon. Sir A. Lyall, G.C.I.E., K.C.B., and Prof. Rhys Davids. *Madrid.*—Real Academia de Ciencias, Señor José Echegaray and Prof. Santiago Ramon y Cajal. *Munich.*—Kgl. Bayerische Akademie der Wissenschaften, Prof. Ferdinand Lindemann and Prof. Karl Krumbacher. *Paris.*—Académie des Inscriptions et Belles Lettres, M. Georges Perrot, M. Emile Senart, M. le Comte de Lasteyrie, M. H. Omont, M. M. Collignon and M. J. Lair. *Paris.*—Académie des Sciences, M. Mascart, M. Gaston Darboux, M. Henri Poincaré, M. H. Moissan, M. A. de Lapparent and M. A. Giard. *Paris.*—Académie des Sciences Morales et Politiques, M. Georges Picot, M. Paul Leroy-Beaulieu, M. Glasson, M. le Comte de Franqueville, M. Boutroux, M. le Baron de Courcel, M. Henri Joly and M. Paul Meyer. *Rome.*—R. Accademia dei Lincei, Prof. Giacomo Ciamician and Count Ugo Balzani. *St. Petersburg.*—Académie Impériale des Sciences, Msr. A. S. Famintzin and Prof. C. H. Salemann. *Stockholm.*—Kongl. Vetenskaps Akademien, Prof. G. Retzius and Prof. S. E. Henschen. *Vienna.*—Kaiserliche Akademie der Wissenschaften: A.—Mathematish-naturwissenschaftliche Klasse, Prof. Viktor von Lang, Prof. Sigmund Exner, Dr. Edmund Mojsisovics, Edler von Mojsvar, and Prof. Heinrich Obersteiner. B.—Philosopisch-historische Klasse, Prof. Theodor Gomperz, Prof. Joseph Karabacek and Prof. Leopold von Schroeder. *Washington.*—National Academy of Sciences: Its foreign members—Sir Archibald Geikie and Prof. E. Ray Lankester.

NOTES.

THE following candidates selected by the council of the Royal Society were duly elected at the meeting on Thursday last, May 5:—Dr. T. G. Brodie, Major S. G. Burrard, Prof. A. C. Dixon, Prof. J. J. Dobbie, Mr. T. H. Holland, Prof. C. J. Joly, Dr. Hugh Marshall, Mr. Edward Meyrick, Dr. Alexander Muirhead, Dr. G. H. F. Nuttall, Mr. A. E. Shipley, Prof. M. W. Travers, Mr. Harold Wager, Mr. G. T. Walker, and Prof. W. W. Watts.

AN influential committee has been formed for the purpose of striking a medal in honour of the memory of the late Prof. Cornu. The committee includes many members, foreign associates and correspondants of the Institute of France, as well as other leaders in the scientific world. The medal will be in bronze, silver bronze and silver, and the price will be 15 francs, 20 francs, and 50 francs respectively. Subscribers for the medal are invited to send their subscriptions to M. E. A. Martel, 8 rue Ménars, 2e Arrondissement, Paris.

AT its meeting on Monday, May 9, the Academy of Sciences of Paris elected Prof. Barrois, of Lille, to fill the vacancy left in the section of mineralogy by the death of the illustrious Fouqué. This recognition of the claims of one of the most distinguished geologists of the present day will be welcomed far and wide, and nowhere more warmly than in the British Isles, where M. Barrois has many attached personal friends, and where he has himself done so much to illustrate the geology of this country.

AS was generally expected, Prof. Rothpletz has been appointed to the chair of geology in the university at Munich and to the directorship of the State geological collections—the posts left vacant by the death of the lamented K. von Zittel. He has long been connected with the university, and has gained a wide reputation as an accomplished field geologist and a good palæontologist. His researches into the tectonics of the Alps have attracted much attention in this country, where he has many personal friends, and where he has made many geological excursions.

AT a meeting of the U.S. National Academy of Sciences on April 21, Sir William Ramsay, K.C.B., was elected a foreign associate of the academy.

A REUTER message from Cape Town reports the arrival there of the steam yacht *Scotia*—the vessel in which the Scottish Antarctic Expedition sailed.

THE death is announced of Mr. Eli Sowerbutts, who for the last twenty years had acted as secretary of the Manchester Geographical Society, which he was largely instrumental in founding. Mr. Sowerbutts was in his seventieth year.

PROF. ÉMILE BOURQUELOT, of Paris, Sir Henry Littlejohn, and Dr. J. Wilson Swan, F.R.S., have been elected honorary members of the Pharmaceutical Society of Great Britain. The following have been elected corresponding members of the society:—Prof. E. Perrot, Paris; Prof. Heinrich Beckurts, Brunswick; Prof. Carl Hartwich, Zürich; Mr. S. T. Dunn, of the Hong Kong Botanical Gardens; and Dr. G. W. Parker, British Guiana.

THE following have been elected honorary members of the Royal Institution:—Prof. E. H. Amagat, Prof. L. P. Cailletet, Prof. J. M. Crafts, Prof. H. A. Lorentz, Prof. E. W. Morley, Prof. E. C. Pickering, Prof. and Madame Curie, Prof. H. L. Le Chatelier, Prof. G. Lippmann, Prof. J. W. Bruhl, Prof. G. H. Quincke, Prof. E. Fischer, Prof. F. W. G. Kohlrausch, Prof. H. Landolt, Prof. L. Boltzmann, Dr. H. Kamerlingh Onnes, Dr. G. Lunge, Prof. P. T. Cleve and Prof. P. Zeemann.

PROF. VAN 'T HOFF offers through the medium of the *Zeitschrift für physikalische Chemie* a prize of 60*l.* for the best and most complete synopsis of the literature of catalytic phenomena. Competitors are required to send in their papers before June 30, 1905, to the editors of the *Zeitschrift*, 2 Linnéstrasse, Leipzig, and the judges are Profs. van 't Hoff, Arrhenius and Ostwald.

AN international congress on philosophy has been arranged to take place at Geneva from September 4 to 8 under M. Ernest Naville as honorary president and Prof. Gourd as acting president. The languages used will be English, French, German and Italian. The congress will be divided into five sections, dealing with history of philosophy, general philosophy and psychology, applied philosophy, philosophy of the sciences, and history of science. The secretary is Dr. Ed. Claparède, 11 Champel, Geneva.

THE British Fire Prevention Committee offers a gold medal and a purse of 20*l.* for the best fable for children calculated to serve as a warning against the danger of playing with matches or fire. Two silver and four bronze medals will also be given as additional awards for meritorious essays. The conditions can be obtained at the committee's offices, 1 Waterloo Place, London, S.W., upon application by letter, enclosing a stamped addressed envelope.

FOLLOWING the example of some other counties, a society has been formed for the photographic record and survey of Kent. The society is promoted by the South-Eastern Union of Scientific Societies, and its objects are "to make and preserve by permanent photographic prints, records of the present condition of objects of archæological, historical, or scientific interest: the geology, fauna, and flora of Kent; the customs and costumes of its people, notable events, and portraits of its prominent men and women." Good promise of support has already been received, and a successful first exhibition in June seems assured, but further help is desired. The organising secretary (*pro tem.*) is Mr. H. Snowden Ward, Hadlow, Kent.

A CORRESPONDENT of the *Times* directs attention to some of the geographical work done by the late Admiral Makaroff. In the early eighties of last century, Makaroff wrote a brochure of 147 pages, with nine charts, on the interchange of the waters of the Black Sea and Mediterranean, which was published by the Russian Academy of Sciences and awarded a full premium. On his return from his voyage in the *Vitiaz* in 1893 he wrote a report of his observations—848 pages and 33 charts. The report was likewise published and awarded a full premium by the Russian Academy. In 1901 he published an account of his ice-breaking steamer the *Yermak* and her work under the title of "The *Yermak* in the Ice."

WE are not concerned in these columns with the cause or course of the war between Japan and Russia, but it is impossible to read of the remarkable achievements of the Japanese without remembering that they owe their success to the encouragement of education and science. A writer in the *Daily Graphic* points out that while probably 95 per cent. of the Russian soldiers are illiterate, not more than 5 per cent. of the Japanese are illiterate, and he attributes the Japanese successes to their intelligence and initiative. It does not seem possible for the Russian soldiers to be placed in dispersed positions to think and act for themselves. "As for the officers," the writer continues, "where is genius to come from? The broad, liberal-minded men have been sent to Siberia, and all who have shown the characteristic mark of leadership in its contempt for bureaucracy have set a seal on their careers." Whatever may be said about Russia, it is certain that Japan is now furnishing the world with an example of "the influence of brain-power on history." Last September Sir Norman Lockyer referred in his British Association address to "the intellectual effort made by Japan, not after a war, but to prepare for one." Recent events have shown that the nation which endows universities and encourages science is making the best possible provision for military or naval conflict as well as for industrial competition.

IN the death of Dr. Charles Ricketts, at the advanced age of eighty-six, geological science has lost an ardent local worker, who practised as a physician for many years at Birkenhead, and devoted his leisure to the study of geology, more especially in Cheshire and Lancashire. He was twice president of the Liverpool Geological Society, and most of his geological papers were published in the *Proceedings* of that society. An interesting article, which he communicated in 1883 to the *Geological Magazine*, was on the influence of accumulation and denudation in causing oscillation of the earth's crust; in this he embodied deductions made and published by him as early as 1865. Dr. Ricketts was for many years a regular attendant at the meetings of the British Association.

THE fossil foot-prints of the Jura-Trias of North America form the subject of a memoir by Dr. R. S. Lull (*Mem.* Boston Soc. Nat. Hist., vol. v., No. 11, April). Two groups of foot-prints have been found impressed on the ancient shales and sandstones, the one bipedal and the other of quadrupedal gait. Both groups are considered to belong to dinosaurs. These are the only vertebrates the gait of which when erect could have been a true walk or run with alternating steps, which without exception the bipedal tracks show, there being no instance of the record of a jumping form. Of the truly quadrupedal forms, those referred to Batrachopus may have belonged to a true dinosaur which had retained, among other primitive characters, the ancestral quadrupedal gait. The mode of progression was a true walk like that of a mammal, and not the crawl of modern reptiles.

THE Geological Survey has issued a colour-printed drift map of the area around London, on the scale of one inch to a mile, in four sheets, price 1*s.* 6*d.* each. The execution of this map has been carried out at the Ordnance Survey Office, and the colour printing is in all respects excellent. The map is intended to replace the old hand-coloured geological map of London and its environs, the cost of which was 30*s.* This reduction in price will be a boon to all interested in the geology of the metropolitan district. The new map does not cover quite so large an area as the old one, but it extends on the north to Watford, Enfield, High Beech and Kelvedon Hatch; on the east to Brentwood, Upminster, West Thurrock, Greenhithe and Kingsdown; on the south to Shoreham, Croydon, Sutton, Ewell and Byfleet; and on the west to Chertsey, Staines, Uxbridge and Rickmansworth. The results of a recent six-inch survey of the Thames valley deposits have been incorporated on the new map, the brickearths not having previously been accurately defined.

WE have received from the president of the International Aëronautical Committee a summary of the balloon and kite ascents made in various countries during the months of January to March. Among the highest altitudes reached we may mention the ascents from Paris, 15,000 metres; Pavia, 13,000 metres; Strassburg, 15,500 metres; Munich, 13,000 metres; Pavlovsk, 18,960 metres; Guadalajara, 13,220 metres; and Zürich, 14,430 metres. Mr. Dines's kite at Oxshott attained an altitude of 1100 metres. The meteorological results are reserved for future discussion; unfortunately several of the records have not been recovered.

THE daily weather report issued by the Meteorological Office on May 4 contains a small inset chart showing the total amount of rainfall recorded in the United Kingdom in the seventeen weeks ended April 30, together with the percentage of the average amount. In all districts excepting the north-east of England the fall has been in excess of the average. In the extreme north (Scotland) the amount is 121 per cent. of the average, and in the extreme south (Channel Islands) 144 per cent.; in the north-west of England it is 122 per cent. In Ireland the amount is 126 per cent. in the north and 116 per cent. in the south. In the east and north-east of England the fall has been practically normal.

A LETTER received from Mr. W. Comery, Llandilo, Carmarthenshire, gives an account of variations noted in the parts of the flower of the primrose during the current year, and provides data for comparison with the observations recorded by Mr. T. G. Hill in the *Annals of Botany*, June, 1902. According to our correspondent, variation in the number of parts was confined to 4 and 6, except in the cases where one flower had 8 sepals, 7 petals, and 6 stamens, two were decamerous, and one was trimerous. The corolla showed the greatest amount of variation; of ninety-four irregular flowers, 79 per cent. showed reduction in the number of petals, and the proportion of long styled to short styled was nearly 7 : 3, but of twenty flowers showing increase in the number of petals the proportion was exactly inverse.

AN extensive series of observations on the number of fungus spores present in the air has been made by Mr. K. Saito (*Journ.* of the College of Science, Imp. Univ., Tokyo, Japan, xviii., art. 5). The observations were made in the Botanic Garden, streets, operating theatre of the hospital, and certain rooms. It was found that the spores were more numerous in warm and damp than in cold and dry weather, and that rain and snow diminished while a strong wind increased their number. The commonest species were *Cladosporium herbarum, Penicillium glaucum* and *Epicoccum purpurascens*. Three new species are described. The article is illustrated with charts and a number of figures; the latter would prove useful in the identification of the species of fungi that might be met with in laboratories, &c.

WITH the exception of one on field-practice with the aneroid, and a second on the moths of the family Geometridæ, the articles in the second part of vol. xvi. of the *Proceedings* of the Royal Society of Victoria are devoted to palæontological and geological subjects. Three of these are communicated by Mr. F. Chapman, who describes Jurassic Foraminifera and Ostracoda from W. Australia, Palæozoic and Mesozoic invertebrates from W. Australia and Queensland, and various Palæozoic fossils from Victoria. Mr. C. M. Maplestone discusses the fossil Selenariidæ of the last named colony.

ACCORDING to the report for last year, the hatching of sea-fish at Piel has been most successful, nearly 15,000,000 fry having been obtained from about 17,000,000 eggs. This gives a total loss of rather less than 11 per cent. for the whole operations, which is almost certainly vastly below what occurs in nature. It is incidentally mentioned by Prof. Herdman that plaice in the closed Scotch waters have been found to run much larger than on the over-fished Lancashire coast. The feature of the report under consideration—namely, that on the Lancashire Sea-Fisheries Laboratory—is, however, undoubtedly Dr. J. H. Ashworth's elaborate and beautifully illustrated account of the life-history and structure of the lug-worm, which is the result of several years hard and careful work.

AMONG recent mathematical papers published in the United States may be noticed the following:—L. E. Dickson, determination of all the subgroups of the known simple group of order 25920 (*Trans.* Amer. Math. Soc., v. p. 126); C. N. Haskins, on the invariants of quadratic differential forms (*ibid.*, p. 167); C. Arzelà, note on a series of analytic functions (*Ann. of Math.* (2), v., p. 51); A. G. Greenhill, the mathematical theory of the top (*ibid.*, p. 67); H. A. Converse, on a system of hypocycloids of class three (p. 105); E. B. Wilson, projective and metric geometry (p. 145); W. F. Osgood, on a gap in the ordinary presentation of Weierstrass's theory of functions (Amer. Math. Soc. *Bull.*, March). The first number of vol. xxvi. of the *American Journal of Mathematics* is accompanied by a portrait of Prof. Noether; its principal contents relate to the theory of groups, but there is a paper by Prof. Bromwich on caustics which is of a less abstract character.

MESSRS. J. AND A. CHURCHILL have published a sixth edition of "A Manual of Dental Anatomy: Human and Comparative," by Mr. Charles S. Tomes, F.R.S.

MESSRS. ILIFFE AND SONS, LTD., have published sixth editions of "Photography for All," by Mr. W. Jerome Harrison, and of "Practical Enlarging," by Mr. John A. Hodges. The price of each book is 1*s*. net.

A SIXTH edition of "A Treatise on Hydromechanics. Part i. Hydrostatics," by Dr. W. H. Besant, F.R.S., and Mr. A. S. Ramsey, has been published by Messrs. George Bell and Sons. For the present edition the text has been carefully revised, and considerable additions have been made to some sections of the book.

A SECOND edition of Mr. T. W. Cowan's "The Honey Bee: its Natural History, Anatomy, and Physiology," has been published by Messrs. Houlston and Sons. The first edition was reviewed at length in our issue of April 23, 1891 (vol. xliii. p. 578). It is consequently only necessary to add that the present edition has been revised and corrected.

THE delegates of the Clarendon Press have taken over the series of geographical memoirs known as "The Regions of the World," which is under the general editorship of Mr. H. J. Mackinder, and in future this series will be published by Mr. Henry Frowde. Two new volumes will be issued this year—"North America," by Prof. Israel Russell, of the University of Michigan, at the end of this month, and "India," by Sir Thomas Holdich, K.C.I.E., in the early autumn. It is hoped that "The Far East," by Mr. Archibald Little, will soon be in the press.

IN the March number of the *Journal of Physical Chemistry*, Messrs. H. E. Patten and W. R. Mott describe experiments on the electrolytic deposition of metallic lithium from solutions of lithium chloride in ethyl, propyl, butyl and amyl alcohols. By the use of organic solvents the electrolytic separation of metals not obtainable from aqueous solutions seems possible in many cases.

IN the April number of the *American Chemical Journal* Messrs. H. C. Jones and F. H. Getman discuss the nature of concentrated solutions of electrolytes. As the result of an extended investigation of the freezing points, boiling points and conductivities of such solutions, the authors arrive at the conclusion that combination takes place between the solvent and the dissolved substance. As a consequence of this, such solutions are really more concentrated than they would appear to be from the amount of dissolved substance present in them, and many of the discrepancies exhibited by concentrated solutions are explainable.

THE April number of the *New Philosophy*, published by the Swedenborg Scientific Association, contains some interesting notes in reference to Swedenborg's work in chemistry. Whilst Prof. van 't Hoff acknowledges it as the first work which anticipated the modern science of stereochemistry, others regard Swedenborg's work as having had absolutely no influence upon chemical thought or discovery. Prof. F. W. Clarke recently described it as "the prototype of a class of speculative treatment, considerable in number, some of them recent, and all of them futile."

IN the current number of the *Zeitschrift für anorganische Chemie,* Prof. B. Brauner describes the preparation and properties of acid sulphates of the rare earths. The cerium salt has the formula $Ce_2(SO_4)_3.3H_2SO_4$, and salts of the same type have also been obtained for lanthanum, praseodymium, neodymium, samarium and yttrium. These acid sulphates are only incompletely converted into the normal salts at high temperatures, and the author's opinion is that all atomic weight determinations of the rare earth metals, in which the sulphates obtained synthetically have been employed, are on this account inaccurate.

IN the March number of the *Physical Review,* Mr. T. E. Doubt describes some experiments dealing with the effect of the intensity on the velocity of light. The results of these experiments justify the conclusion that for light travelling in air a change in intensity in the ratio of 1 to 290,000 does not alter its velocity by as much as 57 centimetres per second. In the case of water, a change in intensity in the ratio of 1 to 43,000 does not alter the velocity by as much as 80 centimetres per second, that is, by 1 part in 1000 million parts.

THE additions to the Zoological Society's Gardens during the past week include a Pig-tailed Monkey (*Macacus nemestrinus*) from India, presented by Mrs. Mackenzie Fraser; a Smooth-headed Capuchin (*Cebus monachus*) from South-east Brazil, presented by Mr. Arthur Collins; a Ruffed Lemur (*Lemur varius*) from Madagascar, presented by Lady Constance Stewart Richardson; a Pigmy Hog (*Porcula salviana*) from Bhotan, presented by Mr. D. H. Felce; two Markhoors (*Capra megaceros*) from North-east India, two Punjaub Wild Sheep (*Ovis cycloceros*) from North-west India, presented by Colonel Deane; three Chinchillas (*Chinchilla lanigera*) from Chili, presented by Mr. Andres Ker; two Coypu Rats (*Myopotamus coypus*) from South America, presented by Mr. H. L. Horsfall; two Ring-tailed Pigeons (*Columba caribbaea*) from Jamaica, presented by Mr. D. Seth-Smith; two Spur-winged Geese (*Plectropterus gambensis*) from West Africa, presented by Mr. J. Lemberg; two Nutmeg Fruit Pigeons (*Myristicivora bicolor*) from Moluccas, two Imperial Nicobar Fruit Pigeons (*Carpophaga insularis*) from the Nicobar Islands, four Andaman Teal (*Nettion albigulare*), three Andaman Banded Crakes (*Rallina canningi*), six Great-billed Andaman Parrakeets (*Palaeornis magnirostris*) from the Andaman Islands, presented by the Government of India; an Exanthematic Monitor (*Varanus exanthematicus*) from West Africa, presented by Mr. Dayrell; a Rufescent Snake (*Leptodira hotambioea*) from South Africa, presented by Mr. B. McMillan; an Allen's Bassaricyon (*Bassaricyon alleni*), six Red and Black Snakes (*Erythrolampus venustissimus*) from South America, an Australian Cassowary (*Casuarius australis*), a Gould's Monitor (*Varanus gouldi*), a Lace Monitor (*Varanus varius*), a Blue-tongued Lizard (*Tiliqua scincoides*), a Derbian Wallaby (*Macropus derbianus*) from Australia, a Sooty Phalanger (*Trichosurus fuliginosus*) from Tasmania, two Australian Barn Owls (*Strix delicatula*) from Australia, an Orton's Guan (*Penelope ortoni*) from Ecuador, a Gold-crested Mynah (*Ampeliceps coronatus*) from India, a Sarus Crane (*Grus antigone*) from Northern India, five Lineated Sand Skinks (*Chalcides lineatus*), South European; four Californian Newts (*Molge torosa*) from California, deposited; a Black Ape (*Cynopithecus niger*) from the Celebes, ten Crested Pigeons (*Ocyphaps lophotes*) from Australia, purchased.

OUR ASTRONOMICAL COLUMN.

SOLAR WORK AT THE SMITHSONIAN ASTROPHYSICAL OBSERVATORY.—Incorporated in the annual report of the Smithsonian Institution, for the twelve months ending June 30, 1903, is a report of the work performed in the Astrophysical Observatory, during that period, by Mr. C. G. Abbot who is in charge.

A new horizontal telescope of 20 inches aperture and 140 feet focal length, fed by a novel form of two-mirror cœlostat, and fitted with an apparatus for thoroughly churning the air inside the tube during the observations, has been mounted for the bolographic study of the solar image, and especially sun-spot energy spectra and the absorption of the solar envelope.

The most notable result of the study of the atmospheric absorption during the above named period was the decreased transparency of the atmosphere, at Washington, for all wave-lengths, but especially for the violet and ultraviolet radiations. Other results showed that this result was not caused by an excess of moisture in the atmosphere. Several plates which are included in the report show a diagrammatic view of the new instrument, typical "bolographic energy" and "atmospheric transparency" curves, a curve showing the distribution of radiation in the normal solar spectrum outside the earth's atmosphere, and a photograph of the large cœlostat with the second mirror.

METEOR RADIANTS OBSERVED AT ATHENS.—A communication from Prof. D. Eginitis to No. 3941 of the *Astronomische Nachrichten* gives a list of the radiants observed at Athens during 1902. Two radiants not given in Denning's "General Catalogue" were recorded in June and July, respectively, as follows:—

June 27, 10h. 58m. – 12h. 16m. (Athens M.T.) $\alpha = 230°, \delta = +73°$
July 29, 10h. 40m. – 11h. 27m. („) $\alpha = 85°, \delta = +85°$

Several of the radiants obtained from the observations at Athens differ considerably both in time and position from their respective values given in the above named catalogue.

The observed radiant for the Perseid shower spreads over a large area, and the principal centre, situated near to η Persei, alters its position considerably. The Perseids from the region near to α Persei were generally red and bright, whilst those from near η Persei were fainter and of a reddish-yellow colour.

SOLAR FACULÆ AND PROMINENCE VARIATIONS.—In a paper communicated to No. 3, vol. xxxiii., of the *Memorie della Società degli Spettroscopisti Italiani,* Prof. Mascari analyses the latitude and frequency variations of faculæ, as observed at Catania, in a manner similar to that recently used by Sir Norman and Dr. Lockyer, whose results he corroborates, for the spots and prominences.

After discussing the data obtained from his observations in a series of tables and curves, he arrives at the following general conclusions:—(1) The zone of maximum activity of the groups of faculæ lies between the mean latitude $\pm 45°$ and the equator, and pursues a movement parallel to, and coincident with, that of the spots, but the inverse of that of the prominences. (2) The faculæ beyond the principal maximum, in the equatorial region of each hemisphere, are not represented in the polar regions. (3) The centre of maximum activity of the prominences occurs generally in the region of minor activity of the faculæ.

MAGNITUDE OBSERVATIONS OF NOVA PERSEI.—In No. 3941 of the *Astronomische Nachrichten,* Father Hagen, S.J., gives a list of the magnitudes of Nova Persei as observed at Georgetown (U.S.A.) with a 12-inch refractor, from June 19, 1901, to April 18, 1903. The magnitude on the latter date, from an observation made when the Nova was near the horizon, was 11·05.

A similar list of magnitude observations, made at Kalocsa by Father M. Esch, S.J., during the period July 8, 1901, to March 22, 1902, is given in No. 3943 of the same journal

COMET 1904 *a.*—Numerous observations of this comet are recorded in Nos. 3943–4 of the *Astronomische Nachrichten.* Dr. Hartwig, observing at Bamberg on April 17, recorded the total magnitude as 9·0, and the magnitude of the nucleus alone as 10·0. The comet had a broad divided tail 4′ long, the mean position angle of which was 211°; the coma was 1′·5 in diameter.

The following is a continuation of the ephemeris published by Herr M. Ebell:—

Ephemeris oh. M.T. Berlin.

1904		α h. m. s.		δ ° ′
May 22	...	14 37 10	...	+57 57
„ 26	...	14 20 29	...	+58 1
„ 30	...	14 6 26	...	+57 44

An error, due to the ambiguity of a necessarily brief telegram, was contained in a previous paragraph concerning this object. This comet is a new one discovered by Mr. Brooks, and *not* the Brooks's comet of 1896 returned.

ORBIT OF THE SPECTROSCOPIC BINARY ι PEGASI.—No. 53 of the Lick Observatory *Bulletins* is devoted to a detailed discussion of the definitive orbit of ι Pegasi by Dr. Heber D. Curtis. The elements obtained have been derived from measurements of forty-three plates taken during the period October 7, 1897, and December 1, 1903, inclusive.

Three sets of elements, each one giving a nearer approximation to the observed values than the one preceding it, were evolved, and the derivation of each set is given in full detail. The final set gives a velocity of $-4 \cdot 12 \pm 0 \cdot 11$ km., and a period of $10 \cdot 21312 \pm 0 \cdot 00006$ days. Owing to the small eccentricity of the orbit, viz. 0·0085, the epoch of periastron is not very certain, but is given as 1899 June $14 \cdot 966 \pm 0 \cdot 352$ days.

IRON AND STEEL INSTITUTE.

THE annual meeting of the Iron and Steel Institute was held at the house of the Institution of Civil Engineers on May 5 and 6 under the presidency of Mr. Andrew Carnegie. The report of the council, read by the secretary, Mr. Bennett H. Brough, showed that the institute continues to make satisfactory progress. The president then presented the Bessemer gold medal to Mr. R. A. Hadfield (Sheffield). The announcement was made that awards of 100*l*. from the Carnegie research fund had been made to John Dixon Brunton (Musselburgh), Dr. H. C. H. Carpenter (National Physical Laboratory), E. G. L. Roberts and E. A. Wraight conjointly (London), Frank Rogers (Cambridge), and Walter Rosenhain (Birmingham), and a renewed award of 50*l*. to O. Boudouard (Paris). The Andrew Carnegie gold medal for research was awarded to Pierre Breuil (Paris), and a special medal to Percy Longmuir (Sheffield).

The first paper read was by Mr. A. Dupré and Captain M. B. Lloyd, H.M. Inspector of Explosives, on explosions produced by ferrosilicon at Liverpool on January 12 and 21. The explosion was most probably caused by water having got into the interior of the drums containing the ferrosilicon; the gas evolved formed, with the air in the drums, an easily ignited explosive mixture, which was fired by the heat produced by the friction of the hard lumps against each other when the drums were moved about, or possibly by the spontaneous ignition of some phosphuretted hydrogen contained in a pocket in the material, and liberated suddenly by the breaking of a lump on the drum being moved. Although the accidents were not attended by very grave results, it is important that all those who have to handle ferrosilicon should be alive to the possible dangers attaching to it, and by keeping it in a dry and thoroughly well ventilated place prevent the accumulation of inflammable gas as far as possible.

Prof. H. Louis (Newcastle-on-Tyne) then read a paper on the manufacture of pig iron from briquettes at Herräng, Sweden. The mining and smelting of the ore present many novel features. Briefly the scheme of operations is as follows:—The ore as mined is conveyed from the various mines by aërial wire rope-ways to the crushing works, where it is broken and crushed wet; the pulp runs to the magnetic concentrators, which take out the magnetite; the latter is conveyed by a small aërial rope-way to the briquetting house, where it is stamped into briquettes, which pass next through the briquetting furnace, in which they are burnt; they are then hoisted up to the top of a pair of charcoal furnaces, where they are smelted for high-class pig iron; the waste gases from the blast furnace fire the briquetting furnaces, and supply gas-engines which furnish the blast and also drive the dynamos of a central electrical station, from which power is conveyed to the concentrating works, as well as to the various mines for hoisting, pumping, &c. Several of the principles embodied appear destined to play an important part in the metallurgy of iron in the near future.

Mr. Cosmo Johns (Sheffield) read a paper on the production and thermal treatment of steel in large masses. He indicated some of the conditions which differentiate works' practice from laboratory research.

An interesting feature of the meeting was an exhibition of pyrometers. At the Barrow meeting of the Iron and Steel Institute, the suggestion was made that, in view of the growing importance of pyrometers to the steel industry, arrangements should be made to enable members to see the actual working of different pyrometers in order to enable them to form their own opinions of the relative merits of the appliances available for metallurgical purposes. The council readily adopted this suggestion, and appointed a committee, consisting of Mr. R. A. Hadfield (vice-president), Mr. J. E. Stead (member of council), and Mr. B. H. Brough (secretary), to make the necessary arrangements for the exhibition. Invitations were sent to all the leading makers to exhibit pyrometers and to furnish brief descriptions of them. The descriptions occupied a pamphlet of sixty-two pages, and dealt with the following types:—(1) Baird and Tatlock pyrometer, (2) Bristol's recording air pyrometer, (3) Callendar and Griffith resistance pyrometer, (4) Le Chatelier pyrometer, (5) Mesuré and Nouel optical pyrometer, (6) Roberts-Austen recording pyrometer, (7) Rosenhain and Chalmers pyrometer, (8) Siemens electrical pyrometer, (9) Siemens water pyrometer, (10) Uehling pneumatic pyrometer with Steinbart automatic recorder, (11) Wanner optical pyrometer, (12) Wiborgh's thermophone, (13) Zaubitz pyrometer. In conclusion, a list of patents relating to pyrometry, compiled by Mr. H. G. Graves, and a full bibliography of the subject were given.

Mr. C. Lowthian Bell (Middlesbrough) read an important paper on the manufacture of coke in the Hüssener oven at the Clarence Iron Works, and its value in the blast furnace. The results show that with this oven a coke can be made giving as good results in the furnace as that made in the old beehive oven.

Dr. H. C. H. Carpenter and Mr. B. F. E. Keeling submitted a paper on the range of solidification and the critical ranges of iron-carbon alloys. The research, which was carried out at the National Physical Laboratory, confirms, broadly speaking, the accuracy of Bakhuis-Roozeboom's diagram. Further, the results indicate that the diagram will be amplified in certain parts when the equilibrium between the various phases has been more fully studied, viz. on account of (1) the small thermal change at about 790° for alloys with carbon content 0·8–4·5; (2) the slow thermal change at about 600° found over the whole range of alloys; (3) the evolutions of heat at about 900° found in alloys with carbon content of 3·87 and 4·50.

Mr. H. C. Boynton (Harvard University) submitted a paper on troostite, in which he gave the results of experiments made with the object of furnishing facts in regard to the identity of this constituent of steel, which, although mentioned by prominent metallurgists, has not apparently been generally accepted or understood.

A paper on the synthesis of Bessemer steel was presented by Mr. F. J. R. Carulla (Derby), in which he gave particulars of the manufacture of steel rails in 1874 by the acid process of a quality so uniform as to leave nothing to be desired. He urges that modern requirements should be equally well fulfilled, and that endeavours should be made to introduce improvements in the Bessemer process so as to prevent its being altogether put aside in favour of the open-hearth process.

Mr. W. J. Foster (Darlaston) submitted a paper on the thermal efficiency of the blast furnace, in which he gave the results obtained with the furnace at Darlaston 72½ feet high, in which the materials smelted are chiefly silicates of iron.

Mr. W. Rosenhain (Birmingham) contributed a paper on the plastic yielding of iron and steel. He described some new observations explaining the curved slip-bands in iron and mild steel. This curvature is shown to be probably due to a multitude of minute steps, and a reason is thus suggested why this stepping should be so marked a feature in iron, while it is so comparatively rare in certain other metals. This reason is that the ferrite crystals in ordinary iron and steel are formed by crystallisation from a solid solution, while the ordinary crystals of lead, for instance, are formed by crystallisation from a true liquid. The truly crystalline character of slip-bands is further demonstrated in a novel manner by the observation of slip-bands in iron following and revealing the gliding planes of twin crystals. Finally, the view has been advanced that the strength of inter-crystalline cohesion in pure metals and certain forms of alloys is due to the interlocking of the skeleton arms which the crystals develop during their first formation. According to this view, the inter-crystalline boundaries take the form of regions of mixed orientation, and certain consequences are to be deduced from this consideration. It is argued that, since a region of mixed orientation must offer greater resistance to slip than a region of uniform orientation, the inter-crystalline boundaries form a network of cells upon which the true resistance of the metal depends. Plastic deformation sets in when these cell-walls begin to give way; in doing so they carry with them the less resisting masses of the crystalline grains. In this way the observed relation between slip-bands and inter-crystalline boundaries is explained. Observations of a frequent doubling of the inter-crystalline boundaries between ferrite grains in pure iron and the "bordered boundaries" and "spines" in strained metal are adduced as further evidence in support of this view of the structure of inter-crystalline boundaries.

Mr. B. H. Thwaite (London) contributed a paper on the use of steel in American lofty-building construction. During the past five years some 200,000 tons of steel have been annually consumed in steel frame construction in the United States.

Mr. P. Breuil (Paris) submitted a report on the work carried out by him as a Carnegie research scholar. It dealt with the relations between the effects of stresses slowly applied and of stresses suddenly applied in the case of iron and steel. He showed that the tests made with nicked bars, a widely extending practice in France, were just like those made with plain bars, but much less clear and precise. The nicking of test bars simply introduces a further complication.

Mr. P. Longmuir (Sheffield) submitted a report on his research, as a Carnegie scholar, on the influence of varying casting temperature on the properties of steel and iron castings. With mild steels the influence of casting temperature does not appear to show on the tensile properties. Low casting temperatures, however, appear to induce a type of brittleness not evidenced in the tensile test, but shown in the working life of the metal. It is possible that many of the mysterious fractures of steel, which has previously passed a rigorous inspection, may be traced to the original ingot having been cast at too high or too low a temperature.

THE SOUTH AFRICAN ASSOCIATION.

THE second annual meeting of the South African Association for the Advancement of Science was held at Johannesburg during the week commencing April 4. At the opening meeting Lord Milner presided, and Sir Charles Metcalfe delivered his presidential address, which, in addition to a review of the scientific advances during the preceding year, contained a number of comments on some of the causes which have effected the great advances in scientific knowledge in recent years.

Portions of the address appeared in the Johannesburg *Star*, and we have selected from them a few extracts of scientific interest. The only address which has reached us is one given by Mr. E. B. Sargant on "The Education of Examiners," and an abridgement of this will probably appear in our next number. For the subjoined abstracts of other addresses and papers we are indebted to the Johannesburg *Star*.

Presidential Address.

Referring to diseases of stock, Sir Charles Metcalfe said:—In Rhodesia, Dr. Koch has been spending the whole year in laborious and patient investigation of the African coast fever among cattle, and he has now reported that he has found that it is caused by a blood parasite which can be readily identified by a demonstration of the specific organism, that it is different from Texas fever, or so-called red-water, that it is not transferable directly, that sick animals can be stabled with healthy ones without communicating the disease, and that the disease can only be spread by ticks. Further, that the blood of animals which have recovered and become immune is not free from parasites, and that the disease therefore can be produced in healthy animals by the transfer of parasites from salted animals by means of ticks, and though fencing, dipping and spraying are beneficial, yet as they have only a temporary value, Dr. Koch recommends that these precautions should be supplemented by inoculation with the blood of animals that have recovered whenever disease breaks out in the vicinity.

Turning to another subject, the president continued:—the geodetic survey of Africa, the inception and continuation of which owe so much to our past president, Sir David Gill, is being proceeded with both in the Transvaal and in northern Rhodesia beyond the Zambezi. It is intended to extend it northwards more or less, probably along the route of the Cape to Cairo railway, that projected line which to many appears, perhaps, to belong to the things of dreamland. You, however, who know South Africa well will agree with me that in this country it has generally been found that the sanguine man has ever been the truest prophet. When this geodetic survey has been connected up with that of Europe, which has now been extended as far north as Spitsbergen, we shall have an arc from that point to Cape Town—the longest arc that is possible to us on this globe. All civilised nations have found the advantage of having proper and accurate maps, and it is hoped that a useful work may now be undertaken in South Africa by a system of secondary triangulation. This work will necessarily take many years to complete; every year, however, the recorded results will be of value, as they will enable correct maps to be compiled showing the topography and main features of the country and the situation of the larger farms, of the most important and more populated districts in the first place, and then of the more remote parts of the country.

Introducing the subject of anthropological research, the president remarked that Prof. Haddon, when president of the Anthropological Institute, expressed himself strongly on the urgency of anthropological research. "In view," he said, "of the decrease of the native races by the advance of civilisation and the changes in the habits of the survivors, no time is to be lost in the acquisition of scientific knowledge by direct observations." There is wide scope and much opportunity in South Africa for such research, though Sir Charles Metcalfe said "the argument about their decrease and the use of the word 'survivors' read strangely to us, who see the native races not decreasing but happily increasing in numbers as well as in material prosperity."

Later in his address Sir Charles Metcalfe directed attention to the fact that for research into the causes and preventives of disease, both in human beings and in animals, there is a great field in South Africa. Continuing, he remarked, "The various Governments here have shown commendable vigour in dealing with those terrible scourges, rinderpest, plague, and red-water, and have acted in a spirit of the truest economy by securing the services of the most able men of science of the day in their investigation. When England was ravaged by rinderpest, no remedy was discovered; the animals affected were simply destroyed at a cost of some nine millions of money. It was left for South Africa, at a later date, when knowledge was more advanced by the admirable work of the scientific investigators engaged on that task, to be the first to discover a preventive for that disease, a fact of which this country may well be proud. I have mentioned Dr. Koch's great work in the investigation of cattle fever in Rhodesia. He has also at the same time undertaken researches into some others of the diseases affecting animals in South Africa, amongst them that most familiar but terrible disease which we call horse-sickness, a disease by which the country loses not only many thousands of pounds annually by the deaths of valuable animals, but also the large amount that otherwise might be realised by the breeding of horses and mules. I understand that Dr. Koch is sanguine as to the result of his researches. Time alone will show whether his efforts or those of Dr. Edington and other labourers in this field have given us the much-to-be-wished-for certainty of rendering horses and mules immune from this disease. Work is being carried on in the investigation of the other manifold sicknesses to which animals are liable in South Africa, but 'science is slow,' and much more time and patient research are necessary before we can arrive at what we look forward to—a period when we shall no longer be helpless and at the mercy of these devastating pests."

Papers read before Section A.

The genesis of soils, with special reference to the Transvaal, by Mr. A. F. Crosse. The author pointed out that the bulk of the parent rocks are of small potential value as soil formers. Illustrative of these deductions, he instanced the well known poverty of granite soils, and in contrast gave as an example the fertile soils of the Marico and Rustenburg districts. In these districts, situated around the edge of the granite, are numerous intrusions of basic rock, of high agricultural potentialities—as a result, the soils formed therefrom are the richest in the country. Mr. Crosse is optimistic as regards the future of agriculture in the Transvaal. Given a fair proportion of the revenue obtained from the taxation of the industry devoted to the intelligent fostering of agriculture, he did not see why, with the aid of science, farming on a fairly large scale should not give a fair return to the agriculturist, and so maintain that most necessary class—the yeoman farmer.

The metallurgy of the Transvaal, by Mr. J. Williams, president of the section. The author said that the mining of gold, until very recently, had been conducted in a very primitive manner. The Plattner process, for a long time, was the only one which held the field, but it could only be used in conjunction with some method of concentration. It was, however, left to Mr. McArthur to show that cyanide could be used commercially for the extraction of gold. Mr. Williams then proceeded to give an outline of the modern process of extraction as used in the Transvaal.

Some practical observations on forestry, by Mr. D. S. Muldoon. The author gave a list of trees that grew well in the Transvaal, and were of high economic value. He also mentioned the advisability of planting trees along the railway lines; these trees would be of use in affording shelter to the locomotives, which could, therefore, maintain more steam, especially in high winds, and when the trees were full grown the railway would have its own supply of timber for sleepers, beams, &c. A knowledge of forestry should also be given in the State schools, and children encouraged to plant trees, shrubs, and plants around the waste places surrounding the school sites. The utility and value of trees indigenous to the country were also touched upon. The advisability of street tree-planting in the towns of the Transvaal was also pointed out, and the attention of the president was directed to the need for a Forestry Bill dealing with timber on Crown lands.

Duration and areas of heavy rainfalls, by Mr. D. C. Leitch. The author gave figures as found by observatories in England and America on the rates of rainfalls, quoted Prof. Talbot's formula, and gave some results obtained in the Transvaal. He quoted one instance where 4·86 inches of rain fell in one hour, whereas the heaviest rainfall in the British Isles does not exceed the rate of 1·8 inches per hour. The author mentioned that the recent Bloemfontein flood was said to be due to a rainfall of 2½ inches over 14 square miles of catchment area.

Mr. G. A. Denny read a paper on diamond drilling and prospecting by drilling.

The prehistoric monuments of Rhodesia, by Mr. E. P Mennell. The author discussed the question as to the origin of the larger of the various ruins which occurred in Rhodesia, depicting the possibility of the structures having been erected by indigenous tribes.

Nature-study in South Africa, by Mr. Sclater. The author pointed out the weakness of the type system of the study of biology. The love of nature should be fostered by the teacher taking children into the field. For example, in the case of birds, the child should be taught to note the times of migration, and inquire to what extent migrating birds nest in South Africa. They knew very little about the mammals of South Africa. They knew little about the life-history of frogs and toads. The habits of spiders opened up a large field for study. He urged that pupils should be encouraged to collect so as to form school museums.

The cyanide process from the standpoint of modern chemistry, by Dr. J. Moir. Dr. Moir described the solution, precipitation, &c., of gold on the line of the ionic theory, and showed that various reactions which had formerly been considered obscure could quite well be explained by it.

Some economic problems in metallurgy on the Witwatersrand, by Mr. Harry S. Denny. The author dealt with the salient features of metallurgical practice on the Witwatersrand from the point of preliminary breaking to the handling of slimes and sand residues.

The evolution of the treatment of by-products on the Witwatersrand, by Mr. M. Torrente. The author summarised the principal by-products produced in a mine as follows:—In connection with the battery: concentrates, black sands, sweepings, slags, pots, ashes, battery chips, and screenings. In connection with chlorination works: pots and ashes. In connection with cyanide works: concentrates, sands and slimes, slags, white slimes, Prussian blue, scrapings, sweepings, skimmings, dross, litharge, brick dust, test bottoms, sump sediments, ashes, crucibles and liners. The list is large, and if there is to be any profit, the cost of recovery must necessarily be less than 4*l.* a ton. Although, said the author, much has been attained, plenty of problems still await solution. On the Rand money is lavishly spent if there seems the remotest chance of effecting an improvement. The friendly rivalry, as well as the interchange of ideas and experiences, all help in the same way, and this is one of the most noticeable features of the scientific life of the Rand.

The chemical industry of the Transvaal: a forecast, by Mr. W. Cullen. The author remarked that on account of the gold industry being such a large factor in the prosperity of South Africa, they were sometimes inclined to overlook the possibilities of others. The chemical works and the dynamite industry managed to exist now with practically no protection, and this ought to make them look around. Proceeding, he outlined the existing chemical industries of the Transvaal—the total making a very poor show. He included the cement works at Pretoria, which, he said, was now manufacturing an article equal to European brands. Looking ahead, he asserted that the term metallurgy, as used in the Transvaal, would soon have a much wider meaning than at present, and would embrace that of zinc, lead, copper, and possibly tin and iron. Foremost among the chemical imports was that of cyanide, and he was optimistic about the possibility of manufacturing it in the Transvaal at a profit. The plague, and the greater attention being paid to matters sanitary, had created a steady demand for chloride of lime, all the raw materials for which were to be found in the country. There would soon be a great demand for artificial manures, and here again nearly everything was at hand. Among other possible industries, he mentioned that of candles and oil from the shale which was abundant, alkali from by-products, glass, soap, alcoholic fermentation and distillation, when potatoes and mealies became cheaper, &c.

The contact process of sulphuric acid manufacture, by Mr. E. Weiskopf. Results of some further observations upon the rate of evaporation, by Mr. J. R. Sutton.

Papers read before Section B.

Biological and ethnological observations on a trip to the north-east Kalahari, by Dr. Schonland.

The geological features of the diamond mines in the Pretoria district, by Mr. Herbert Kynaston, director of the Geological Survey, and Mr. A. L. Hall. The authors, after describing briefly the area and situation of the Transvaal diamond fields, proceeded to give an account of the general geological structure of the district in which they occurred. The diamond pipes contributed a group situated on the high ground forming the watershed between the Elands and Pienaars Rivers, about 22 miles east of Pretoria. They have been intruded into the uppermost beds of the Pretoria series—a formation consisting of quartzites, shales, and diabase sheets, lying between the dolomite and the Waterberg sandstones—and are found to be surrounded partly by quartzite and partly by intrusive sheets of diabase and felsite. Their situation is, in the authors' opinion, associated with lines of weakness which have been set up by the movements and dislocations which have affected the Pretoria series in the diamond field area. In the case of the Premier Mine, the pipe is almost entirely surrounded by a felsitic rock, which is intimately associated in places with a diabase. This diabase and felsite, in fact, pass gradually the one into the other, and form the lower and upper portions respectively of a large intrusive spot. The walls of the Premier pipe at lower levels, however, appear to consist of the quartzite which underlies this sheet.

Alien plants spontaneous in the Transvaal, by Mr. Joseph Burtt-Davy. The author dealt with the question, Where do our immigrant plants come from? An analysis shows that the regions where the immigrants are native are approximately as follows:—the Mediterranean region (*i.e.* the countries of south Europe, west Asia, and North Africa, immediately bordering the Mediterranean Sea), approximately 42 per cent.; tropical Asia, approximately 10 per cent.; tropical Africa, approximately 9 per cent.; tropical America, approximately 18 per cent.; northern Europe, approximately 7 per cent.; South Africa, approximately 6 per cent.; temperate North America, approximately 3 per cent.; Australia, approximately 3 per cent.; temperate South America, approximately 2 per cent.; Central Asia, approximately 1 per cent. The means by which plants migrate from country to country were then considered. The author said these fall under two heads:—(*a*) artificial means or by the agency of man; (*b*) natural means. The former methods are responsible for far the largest part of modern plant migration. They include (1) dispersal of roots and seeds by farm machinery; (2) conveyance of seeds and bulbs in the earth around the roots of nursery stock; (3) conveyance of seeds in the packing material of warehouse and shop goods; (4) conveyance in hay and other forage; (5) conveyance in impure samples of farm and garden seeds; (6) intentional introduction as useful or ornamental plants, subsequently escaping the garden or farm and becoming naturalised; (7) conveyance from port to port in the ballast of sailing vessels; (8) conveyance in railway trucks, which drop seeds at stations along the road; (9) conveyance by trek oxen and waggons, which drop them along the roadside; (10) conveyance along the tow-path; (11) conveyance by irrigation water.

The natural means are as follow:—(12) spreading by runners as in the tweekgranesk; (13) spreading by underground rhejoines, as in Johnson grass or evergreen millet; (14) spreading by running roots, as in the Canada thistle; (15) special structures of the cupule, enabling it to throw seeds for long distances; (16) the provision of flying apparatus attached to seeds, so that they are carried by the wind—one of the most common methods; (17) drifting by the wind over snow or frozen ground; (18) tumbleweeds; (19) conveyance by floods and streams; (20) burr-weeds, &c., carried in the hair and wool of animals, one of the most common contrivances for distribution; (21) seeds and pieces of plants carried on the feet of water-birds and aquatic reptiles; (22) kraal weeds, the seeds of which pass through animals undigested; (23) spiny fruits and branches carried by animals.

Trout acclimatisation in South Africa, by Mr. B. Bennion. Trout acclimatisation was dealt with generally, and the history of trout acclimatisation in South Africa—in Natal, Cape Colony, and the Transvaal—was given very fully.

The science of bacteriology and its commercial aspects, by Mr. W. H. Jollyman. The object of this paper is largely to answer the question, What practical results accrue from the study of the science of bacteriology? The reply is divided into four sections, showing (1) the assistance the science renders to medicine in the matter of diagnosis of disease; (2) the improved treatment, and consequent lessened mortality resulting from a knowledge of the causal agents; (3) the public health and sanitary science aspects of the study; (4) the work bacteria do in other than medical fields. Towards the end of the paper Mr. Jollyman said, the recent plague epidemic is testimony to the value of bacteriological work; what might have happened had not the early cases been examined bacteriologically one cannot tell, but it is quite certain that the value of an early diagnosis has been incalculable. With regard to the non-pathological side of the question, the remarks made about brewing, butter-making, sewage disposal, soil fertility, &c., will suffice to indicate the commercial value of scientific investigation into these branches. What is going to happen in the future as the result of the study of bacteriology it is impossible to foretell. On the medical side, men are endeavouring to find out more about the causes of human diseases, and to follow up these discoveries by the introduction of specific cures. Veterinary bacteriologists are doing the same work for animals.

In what may be called the bacteriology of the trades, there is no question that there is a great deal to be done; brewing, tobacco-curing, manufacture of organic chemicals—possibly glycerin—and soap manufacture may before long become bacterial work, and so on. In fact, the study of these, the smallest living things known, leads to results of the greatest commercial value.

The bacteriological and other aspects of miners' phthisis, by Dr. L. G. Irvine. The author mentioned the urgent matter of prevention of this disease, and, putting the question as to why the disease should be more prevalent on the Rand than in most other mining centres, he stated that this was due to three reasons. First, the rock was hard and the mines were dry; second, the number of rock-drills used was proportionately great; and third, the quantity of explosives used was also proportionately large.

Notes on some pathogenic bacteria as found in the Transvaal, and their variations from their European prototypes, by Mr. F. H. Joseph.

Papers read before Section C.

Survey practice in the Transvaal, by Mr. P. B. Osborn. The author traced the development of survey practice in the Transvaal from the time of the first crude subdivision of land by the Voortrekkers to the present systematised scientific methods.

Geodetic surveying, by Mr. W. H. Greathead. The author first defined geodetic surveying as the art of surveying extended to large tracts of the earth's surface, in which account must be taken of the curvature of the earth, and proceeded to describe the delicate apparatus and methods used in measuring base lines for the Natal and Cape Colony survey; also the apparatus for the Rhodesian survey.

The mine surveyor and his work on the Witwatersrand, by Mr. A. E. Payne. The present Government is preparing, said the author, to establish the mine surveyor as a professional man. The detailed knowledge of the great variety of subjects coming within the scope of his work is worthy of consideration. He should become the technical adviser of the mine and be encouraged to develop his work from the professional point of view of a mine surveyor.

Fire protection in the mines, by Mr. G. H. Thurston. The Rhodesian tick fever, by Dr. Theiler. Having first pointed out the necessity for preventing the disease by wide publication of the methods to be adopted and by legislation, the author proceeded to discuss the geographical distribution and history of the malady.

The bacterial purification of sewage, by Mr. F. S. Prentice. Some conditions respecting irrigation in the new colonies, by Mr. W. Reid Bell. The blizzard of June 9–12, 1902, by Mr. C. M. Stewart, secretary, Meteorological Committee of Cape Colony. Seldom has South Africa been visited by a snowstorm of such severity, duration, and so extensive as that which started approximately at 6 p.m. on the evening of June 9, 1902, and continued practically without intermission at many places until the morning of June 12. Judging from the barometric readings, this storm seems to have originated in an area of low pressure in the centre of the colony, while the pressure in the west and south was increasing rapidly.

Papers read before Section D.

The handling of young children, by Mr. P. A. Barnett. The author pointed out that by people who recognised no scientific basis for education there is a good deal of random criticism of the efforts made to use systematically the data provided by other sciences. We want more system—not less; though the science of education remains yet to be formulated.

A paper on special assessment was read by Mr. Stephen Court.

Drawing for young children, by Mr. E. B. Sargant. The author said it was well recognised at the present day that the old plan of beginning to teach drawing by making the children produce a series of straight lines tended to disgust young children with the subject for their whole school life. It was much easier to draw circles than straight lines, as appeared natural if the mechanism of the arm was considered. It was also better to begin with drawing rather than with writing, and to practise from the shoulder at first, then from the elbow, and finally from the wrist and fingers. This plan prevented the straining of the eyes at a time when short sight was likely to be produced very early. There was also a great deal to be said for beginning with the brush and colour rather than with the pencil or chalk. Mr. Sargant then proceeded to consider in detail the code of the Orange River Colony, which gave effect in drawing to these principles.

General Business.

At a council meeting of the association on April 4, Sir Charles Metcalfe, the president, alluded to the visit of the British Association to Johannesburg next year, and said he had been in frequent correspondence with members of the committee which had been appointed in England, including Sir Norman Lockyer and Prof. Dewar. Everything is now settled except the route, the fixing of which it has been considered better to postpone until nearer the date. There is also the question as to who should be president for the year, and though this has not been decided yet, there was no doubt there would be a very good president coming out for the meetings. The greatest man of science of the day, Lord Kelvin, who would be eighty-one years of age next year, was resolved to come. With regard to the status of members of the South African Association, they would naturally be entitled to attend all the meetings of the British Association. The proposal was that there should be three days' meetings at Cape Town and three days' meetings at Johannesburg, with shorter sessions at Durban, Kimberley, Bulawayo, and other places visited.

Sir Charles Metcalfe also referred to the arrangements to be made in connection with the visit of the British Association at the annual business meeting of the South African Association. Certain local papers will be read, and these will be chosen by the local committees of the places where meetings are held, so that those who come from distances may have the opportunity of hearing a good paper dealing with the chief object of interest in that particular centre.

THE NEW ZEALAND VEGETABLE CATERPILLAR.

FEW among the smaller natural productions of New Zealand have attracted more attention than the so-called vegetable caterpillar of New Zealand, of which we have just received a very fine specimen from Messrs. Armbrecht, Nelson and Co., of Duke Street, Grosvenor Square, W. Fungoid parasites are sufficiently common in all parts of the world, but are not generally conspicuous enough to be much noticed by any persons but naturalists. Many of the largest and most remarkable moths of the Australian region belong to the families Cossidæ and Hepialidæ, represented in Europe by our goat moth and swifts, and the caterpillars of several species of these are known to be infested by various parasitic fungi belonging to the genus Cordyceps, Fries, which convert the whole substance of the caterpillar into a woody substance, and then sprout from it to a length of several inches.

As in the case of larvæ attacked by insect parasites, these (which are usually about four inches long when full grown) live until they are ready to assume the pupa state, when they bury themselves in the ground, die, and the fungus sprouts upwards, generally from the neck of the caterpillar, sometimes acquiring the length of nearly a foot, and sprouting up from the ground above the caterpillar. Very rarely two, or even three, of these filaments may sprout from a single caterpillar. The best known species is *Cordyceps Hugelii*, Corda (*Sphaeria Robertsii*, Hooker), which is extremely abundant in New Zealand.

"The New Zealander's name for this plant-caterpillar is Hotete, Aweto, Weri, and Anuhe. The natives eat the plants, which when fresh have the flavour of a nut, and also use them, when burnt, as colouring matter for their tattooing, rubbing the powder into the wounds, in which state it has a strong animal smell" (Gray, "Notices of Insects that are Known to Form the Bases of Fungoid Parasites" (1858), p. 6, note quoting from Taylor). Almost every writer in New Zealand has discussed the vegetable caterpillar in more or less detail, notably Taylor and Hochstetter, in addition to Gray's important paper quoted above. Mr. G. Massee's "Revision of the Genus Cordyceps" (*Annals of Botany*, vol. ix. pp. 1–44, pls. i. and ii., March, 1895) may also be consulted.

It is probable that more than one species of New Zealand caterpillar is infested by, perhaps, more than one species of Cordyceps. *C. Hugelii* (*Robertsii*) is usually said to be parasitic on the larva of the large green moth *Hepialus* (*Œnetus*) *virescens*, Doubleday, but Mr. G. V. Hudson points out in his "New Zealand Moths and Butterflies" (p. 132) that this cannot be the case, because the larva of that insect burrows in the wood of trees, and forms its pupa in the galleries, and not in the ground. He suggests that it may infest the larva of *Porina Mairi*, Buller, a brown moth with black and white spots and markings; but this seems equally improbable, for this is a very rare moth, of which very little seems to be known. More information on these curious parasites and their hosts is very desirable.

W. F. KIRBY.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—A meeting of the University Junior Scientific Club was held on May 4. Mr. H. B. Hartley exhibited an unpublished portrait of Sir Richard Owen. Mr. A. S. MacNalty read a paper on William Harvey.

The eleventh Robert Boyle lecture will be delivered on June 3 in Balliol College Hall by Prof. J. J. Thomson, F.R.S. His subject will be "The Structure of the Atom."

The Romanes lecture will be delivered by Sir Courtenay Peregrine Ilbert, K.C.S.I., Balliol College, on Saturday, June 4, at 3 p.m., in the Sheldonian Theatre. The subject of his discourse will be "Montesquieu."

A meeting was held in the schools on Friday, May 6, to discuss the question of the organisation of post-graduate study. The president of Trinity was in the chair. The meeting was largely attended by those who are interested in the encouragement of research. Prof. Poulton moved a resolution advocating the expediency of "the further utilisation of fellowships for the purposes of research." This was seconded by Profs. Ellis and Gardner, and carried unanimously. Dr. Farnell moved a resolution favouring "the better organisation of the teaching resources of Oxford." He wished to see the boards of faculty take a more active part in organising the teaching resources, which now suffer from considerable dislocation. The boards ought to be able to give the status of professor to a college tutor, and assign him an income from university funds. The general principle of Dr. Farnell's resolution was carried.

CAMBRIDGE.—Sir Michael Foster has been re-appointed a manager of the Balfour (Animal Morphology) Fund.

Applications for leave to occupy the university tables at the Naples and Plymouth Zoological Stations are to be sent to Dr. Harmer, King's College, by May 26.

Mr. Frank G. Smart, M.B., has generously endowed a university studentship for research in botany of the value of 100*l.* a year for two years. The first election will be made in July.

The Board of Agricultural Studies reports the continued progress of the department, which last term had forty students. A number of field experiments have been instituted, and are in progress on the university farm and in the adjoining counties, under the supervision of Prof. Middleton and his staff.

THE Drapers' Company has decided to grant 15,500*l.* to the University College of South Wales for the purpose of erecting the structure of the proposed new library, in lieu of 10,000*l.* conditionally granted in 1895.

IT is announced in *Science* that at the recent Convocation of the University of Chicago, President Harper acknowledged a gift of 1000*l.* for special investigation in the department of physics, by the president of the board of trustees, Mr. Martin A. Ryerson, and a gift of 2000*l.* by Miss Helen Snow as a memorial to George W. Snow, her father, to rebuild the horizontal telescope at Yerkes Observatory, which was injured by fire.

AMONG the many educational enterprises of the Lancashire County Council, the system of technical instruction for fishermen, which is being much appreciated by the fishermen along the Lancashire coast, deserves special comment. The county council has arranged for batches of fifteen fishermen at a time to attend at the Piel (Barrow) Hatchery and Marine Laboratory to be instructed in the habits and conditions of breeding of various kinds of fish. The course lasts a fortnight, during which time the fishermen reside at Piel. The county council allows each man 5*l.* towards his expenses. We have received from Prof. W. A. Herdman, F.R.S., a copy of the syllabus of the lessons in marine biology given in these practical classes, and it shows that in addition to an introductory course, time is found for the fishermen to dissect and study the mussel, shrimp, crab, cockle, oyster, and fish parasites, and also to become acquainted with the leading facts about the breeding of these and other forms of life. Such courses of work as these must be of great value to fishermen.

IN his presidential address to the British Association last year, Sir Norman Lockyer used the two-power principle by which our naval expenditure is determined to illustrate and emphasise his appeal for State aid for universities equivalent to any two nations commercially competing with us. Recognising that universities are the chief producers of brain-power, and therefore the equivalents of battleships in relation to sea-power, examination was made of the provision for university education in Germany and the United States and that existing in this country. The result showed clearly that "instead of having universities equalling in number those of two of our chief competitors together, they are by no means equal to those of either of them singly." In connection with this comparison, it is of interest to notice that in answer to a question asked in the House of Commons last week, the average annual cost of maintaining in commission a first-class battleship of about 13,000 tons was stated to be, in round numbers, 94,000*l.* The State contribution to the whole of our universities and colleges amounts to about 156,000*l.* a year, that is, less than the sum required to keep two battleships in commission.

IN a dedication address at the opening of Palmer Hall, Colorado, Prof. S. Lawrence Bigelow dealt with the growth and function of the modern laboratory. The address is printed in *Science* of April 22. Eighty years ago, said Prof. Bigelow, there was not, in any country, a single laboratory for the purpose of teaching chemistry, though, of course, the subject had been taught for many years by means of lectures forming a recognised part of a medical course. To Liebig, at Giessen, belongs the credit of establishing the first chemical laboratory ever opened to students in a university. This was soon after 1824, the year in which he began his work at Giessen. So far as the foundation of laboratories in America is concerned, the address states that chemistry was taught in the laboratory in the medical department of Harvard University at an early date, and in 1846 a new medical school was built, the basement of which was devoted to a chemical laboratory capable of accommodating 138 students. At Yale Prof. B. Silliman and his son established a laboratory of analytical chemistry, and it became of sufficient importance to be incorporated as part of the university in 1847. The University of Michigan is generally recognised as being the first to introduce the laboratory method in teaching. A building exclusively for the teaching of chemistry was finished in this university at a cost of 1200*l.*, including the equipment, and was in use in 1856. But, as Prof. Bigelow remarked, it would be harder to find a university without moderately good laboratories to-day than it was to find one with them in 1850. The concluding sentences of the address will appeal to all men of science:—"Our laboratories have overwhelmingly justified their cost by their past history, and are justified in making greater demands than ever, by the importance of the functions which they fulfil. It is to be hoped that philanthropists will be still more liberal than they have been, and that the people will tax themselves more than they ever have, through their legislatures, to give to all schools, colleges and universities. Such money is the fire insurance and the life insurance of society as a whole, guaranteeing the maintenance of law and order, and the ability of the next generation to support the burden of advancing civilisation, when its turn comes."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 25.—"On the Compressibility of Solids." By J. Y. **Buchanan**, F.R.S.

The solids dealt with in this research are the metals platinum, gold, copper, aluminium, and magnesium. Their absolute linear compressibilities were directly determined at pressures of from 200–300 atmospheres at temperatures between 7° and 11° C. The determinations were made by the same method, and with the same instrument which the author used for the determination of the compressibility of glass in 1880 (Roy. Soc. Edin. *Trans.*, vol. xxxix. p. 589).

The instrument consists essentially of a powerful force pump and a tubular receiver to take the samples of metals to be experimented on. These must have the form of rod or wire. The steel tube which forms the receiver has a length of 75 inches and an internal diameter of 5/16 inch. It is closed at each end by thick glass tubes having a bore of between one and two millimetres. In the present investigation the metals were all used in the form of wire (No. 22 S.W.G.). Inside the steel tube they are supported in an axial position by an internal concentric tube, and their ends project into, and are visible through, the glass terminals. Each glass terminal is commanded by a microscope with micrometer eye-piece and standing on a substantial platform, altogether independent of the rest of the apparatus. When the wire is properly placed in the receiver and the microscopes are in position, the pressure is raised to the desired height, as indicated by the manometer, and the ends of the wire are observed and their positions with reference to the micrometers noted. The pressure is then carefully relieved, and a displacement of both ends is seen to take place and its amplitude is measured. The sum of the displacements of the ends, regard being had to their signs, gives the absolute expansion of the wire in the direction of its length, when the pressure on its surface is reduced by the observed amount, and consequently also the compression when the process is reversed. From this the linear compressibility is at once obtained. If the mass of the wire be isotropic, then its cubic compressibility is obtained by multiplying the linear compressibility by three. The wires used were all well annealed before the experiment, with the exception of the magnesium.

In order to bring the ends into a suitable position for observation with the microscopes, the length of the wire had to be between 75 and 75·5 inches. The actual length was measured exactly in each case, and it averaged 75·32 inches (1·913 metres).

The manometer which indicates the pressure in the instrument is simply a mercurial thermometer with a very thick bulb. The scale on it is an arbitrary one, and its value as a measure of pressure is fixed by observing its reading in comparison with the principal piezometer which was used by the author during the voyage of the *Challenger*. The standard of pressure is therefore an open-air column of sea-water of known properties. The micrometers in the eye-pieces of the microscopes were standardised by reference to a stage micrometer which was verified at the National Physical Laboratory. Their values were very nearly equal, with the powers used. One division in the eye-piece corresponded to 0·000422 and 0·000417 inch respectively on the stage, or to about 1/180000 of the length of the wire.

In the paper the results for each metal are given in a separate table. It will be sufficient to reproduce the summary, Table I. In it the compressibilities of English flint glass and of the glass of which ordinary German tubing is made, as well as that of mercury, have been included for purposes of comparison. The compressibility of mercury rests upon a large number of observations made in the *Challenger* (Chem. Soc. *Journ.*, 1878, vol. xxxiii. p. 453).

Table I.—Summary.

Substance	Year	Atomic Weight	Density	Compressibility	
				Linear	Cubic
Platinum... ...	1904	194	21·5	0·1835	0·5505
Gold	,,	197	19·3	0·260	0·780
Copper	,,	63	8·9	0·288	0·864
Aluminium ...	,,	27	2·6	0·558	1·674
Magnesium ...	,,	24	1·75	1·054	3·162
Mercury	1875	200	13·6	1·33	3·99
Glass, flint ...	1880	—	—	0·973	2·92
,, ,, ...	1904	—	2·968	1·02	3·06
,, German	,,	—	2·494	0·846	2·54

It is pointed out that the number of metals experimented on is too small to permit any confident generalisation.

It will, however, be observed that in the case of the five metals used as wire, their compressibility increases as their density and atomic weight diminish, yet there is no reason to suppose that the compressibility is a continuous function of the atomic weight, like the specific heat. Mercury, although in the fused state, shows this clearly. But besides this, it happens that two pairs out of the five metals, namely, platinum-gold and aluminium-magnesium, are contiguous in the atomic weight series, yet the compressibility of magnesium is, roughly, double that of aluminium, and the compressibility of gold is half as much again as that of platinum. If, however, we compare gold and copper, which occupy parallel positions in Mendeléeff's scheme, we see that they are very much alike, and the same holds with regard to magnesium and mercury, which occupy a homologous position. If these facts indicate anything more general, we should expect the metals of the palladium and iron group to have a low compressibility like platinum, zinc and cadmium to have a very high compressibility like magnesium, and thallium an intermediate but still considerable compressibility like aluminium.

It will be observed that the two kinds of glass mentioned in Table I. are more compressible the greater their density. This may, however, be due to a specific feature of the oxide of lead which enters largely into the composition of the flint glass.

Referring to the use of glass exposed to high internal pressure, the author says:—In the work connected with this paper, which extended over the greater part of four weeks, fifteen glass terminals gave way, and oddly enough, the failures were as nearly as possible equally distributed between the two ends; eight of them fell to the left arm and seven of them to the right arm. The bursting of a terminal causes no inconvenience beyond the trouble of replacing it, because the construction of the instrument enables air to be completely excluded from it, and the quantity of water in it to be kept within such limits that its resilience is of no account. When a tube bursts it usually splits longitudinally up the middle into two slabs. One of these almost always remains entire; the other is sometimes broken into fragments, but there is never any projection of material unless the instrument has been carelessly put together and air admitted. The paper concludes with an account and an illustration of some curious *microseismic effects* produced on the wires by the explosion of the glass terminals.

Geological Society, April 13.—Dr. J. E. Marr, F.R.S., president, in the chair.—The discovery of human remains under the stalagmite-floor of Gough's Cavern, near Cheddar: H. N. **Davies**. Gough's Cavern opens at the base of the cliffs on the south of Cheddar Gorge. Human and animal remains have been discovered at different times. The principal deposits are a stalagmite-like travertine overlying cave-earth. When excavating part of a fissure running northward a human skeleton was discovered, associated with flakes, scrapers, and borers of flint, embedded in cave-earth. The remains of the skeleton excavated comprise the skull, the bones of an arm, a leg, and part of the pelvic girdle. The other bones were allowed to remain *in situ*, and may now be seen. The position of the skeleton was that which would have been assumed by a drowned man. Interment is unlikely, because of the shape of the fissure, which was choked up with débris and calcareous deposits. The stature of the man was 5 feet 5 inches; he was of muscular build, with prognathous jaws, a straight thigh, a platycnemic tibia, and a thick dolichocephalic skull. The animal remains found in the cave-earth of other parts of the cavern are those of mid- and late Pleistocene age, and this evidence, together with that derived from the position and character of the skeleton, and the workmanship of the flakes, points to a period towards the close of the Palæolithic or the opening of the Neolithic age.—History of volcanic action in the Phlegræan Fields: Prof. Giuseppe **De Lorenzo.** The author recognises three chief periods in the volcanic history of the district:—(1) The eruptions which took place under the sea during the Pleistocene period. Their surviving products can be grouped in two divisions. The older of these (*a*) is represented by the piperno and grey pipernoid tuffs of the Campania. These deposits consist of grey trachytic tuff, with scattered black scoriæ, and with a varying proportion of non-volcanic sediment. The vents whence they were ejected are now no longer to be traced. The author is disposed to regard the piperno as a trachytic lava with schlieren, the dark lenticles being made up of such minerals as augite, ægirine, and magnetite, while the lighter matrix is felspathic (anorthose) with a spherulitic structure and microliths of ægirine and augite. The second phase (*b*) of the first eruptive period is represented by ashes, lapilli, pumice, and sands, intercalated with marine shell-bearing clays and marls, and also with conglomerates and breccias. (2) Above the records of the first volcanic period lie those of the second—the yellow tuff, which forms the most characteristic of the volcanic formations of the Phlegræan Fields. It is a yellow, compact, well stratified aggregate of trachytic detritus, through which are scattered fragments of tuff and lava. Its average thickness exceeds 300 feet. It was a submarine accumulation. Owing to the uniformity of its lithological characters, this tuff has not furnished evidence of a definite order of succession in the eruptions to which it was due. It is possible to recognise vents from which the tuff was discharged. (3) After the discharge of the yellow tuff the volcanic tract appears to have been upraised into land, and to have been exposed to a period of subaërial denudation. Vents made their appearance and discharged fragmental materials, differing from the tuff in showing a greater variety of composition, and in the proofs which they furnish of a succession of eruptions, and a gradual southward shifting and diminution of the eruptive energy. The largest and most ancient of the volcanoes of this latest period is that of Agnano. Not improbably it was from this eruptive centre that the trachy-andesitic lava of Caprara issued. The crater-lake of Avernus belongs to the latest group, and perhaps it was the water percolating from this basin to the thermal springs of Tripergole which, in September, 1538, gave rise to the explosion that built up Monte Nuovo—the youngest of the cones of the Phlegræan Fields.

Entomological Society, April 20.—Dr. F. A. Dixey, vice-president, in the chair.—Mr. M. **Jacoby** exhibited a ♂ specimen of the beetle *Sagra senegalensis* with ♀ characters, received from Mr. Barker in Natal.—Dr. Norman **Joy** exhibited *Orochares angustata,* Ev., taken at Bradfield, Berks., in December, 1903—the second recorded British specimen; a species of Tychius, which he said might be a variety of *Tychius polylineatus,* Germ. (not now included in the British list), or, more probably, a new species closely allied to it, taken near Streatley, Berks., last year; and two specimens of *Pselaphus dresdensis,* Herbst., taken near Newbury this year.—Mr. C. O. **Waterhouse** exhibited an unnamed species of Nemoptera from Asia Minor, resembling *Nemoptera huttii* from Australia.—Mr. F. **Enock**

read a paper on nature's protection of insect life, illustrated by colour photography, and exhibited a number of lantern slides.—Mr. P. I. **Lathy** communicated a paper on new species of South American Erycinidæ.—Major Neville **Manders**, R.A.M.C., communicated some breeding experiments on *Catopsilia pyranthi*, and notes on the migration of butterflies in Ceylon.—A discussion followed on specimens of the dipterous families Stratiomyidæ to Crytidæ, opened by Mr. G. H. **Verrall**, who said the object of the discussion was to determine the number and distribution of the British species comprised in these families. Colonel J. W. Yerbury said that on behalf of Prof. Poulton he had been asked to exhibit some specimens the interest of which mainly lay in the specific names used, which names were useful as showing the nomenclature employed by a past school of dipterologists, and might give a clue to the manner in which some reputed species have found their way into the British list. He directed special attention to *Ephippiomyia ephippium*, an insect reputed to have been taken at Combe and Darenth Woods, but which was without doubt of German origin; *Isopogon brevirostris*, probably the identical specimen referred to in Curtis's "British Entomology" as having been taken on The Devil's Ditch, Newmarket; and *Laphria marginata*, stated to have been bred from a hornet's nest. Mr. Colbran J. Wainwright, exhibiting two specimens of Anthrax, said that hitherto Mr. Verrall had believed that we had lost two certain species of Anthrax in this country, *A. fenestratus* and *A. paniscus*. His two specimens, though allied to *A. paniscus*, were abundantly distinct. One had been taken by Mr. R. C. Bradley at Bournemouth, the other by Mr. W. G. Blatch at Poole, but at present no name could be given to the species.

Chemical Society, April 20.—Prof. W. A. Tilden, F.R.S., president, in the chair.—The following papers were read:—The vapour density of hydrazine hydrate: A. **Scott**. The author finds that at 98°·8 the vapour density is 15·8 instead of 25 as required by N_2H_6O; at 138° the dissociation into $N_2H_4+H_2O$ is complete, and at higher temperatures a certain amount of decomposition into nitrogen, ammonia and water occurs.—The combining volumes of carbon monoxide and oxygen: A. **Scott**. The results of the author's experiments indicate that the molecular concentration of carbon monoxide is slightly greater than that of oxygen, the combining volumes being CO : O : : 1·9985 : 1 with carbon monoxide from calcium oxalate, and 1·9994 : 1 with that from formic acid.—A revision of the atomic weight of rubidium: E. H. **Archibald**. The mean values of the atomic weight of rubidium obtained from fourteen analyses were 85·490 and 85·484 from the ratios AgCl : RbCl and Ag : RbCl respectively. Analyses of rubidium bromide led to the value 85·483, obtained from either of the ratios AgBr : RbBr or Ag : RbBr.—Experiments on the synthesis of the terpenes, part i., synthesis of inactive terpineol, dipentene and terpin hydrate: W. H. **Perkin**, jun. Pentane-αγε-tricarboxylic acid, when digested with acetic anhydride and subsequently distilled, is converted into δ-ketohexahydrobenzoic acid. The ester of this acid reacts readily with magnesium methyl iodide, yielding *cis*-δ-hydroxyhexahydro-*p*-toluic acid, which with fuming aqueous hydrobromic acid is converted into δ-bromohexahydro-*p*-toluic acid, which in turn yields Δ^3-tetrahydro-*p*-toluic acid when heated with pyridine and sodium carbonate. The ester of the latter with an excess of magnesium methyl iodide yields terpineol. From the synthetic terpineol so obtained dipentene and terpin hydrate were readily prepared in the normal manner.—A lævorotatory modification of quercitol: F. B. **Power** and F. **Tutin**. The lævorotatory modification described by the authors was obtained from the leaves of *Gymnema sylvestre*, a plant belonging to the family Asclepiadaceæ, and indigenous to Banda and the Deccan Peninsula.—The constituents of the essential oil of Californian laurel: F. B. **Power** and F. H. **Lees**. The Californian laurel, *Umbellularia californica*, yields an essential oil with a pale yellow colour and an odour at once aromatic and irritant. It was found to contain eugenol, *l*-pinene, cineol, safrole, eugenol methyl ether, veratric acid, and a new, unsaturated, cyclic ketone, *umbellulone*, $C_{10}H_{14}O$. To the last of these the peculiar pungency of the oil is due.—Some derivatives of umbellulone: F. H. **Lees**. A description of derivatives of umbellulone.—Ammoniacal double chromates and molybdates: S. H. C. **Briggs**. The compounds

$$CuCrO_4,3\tfrac{1}{2}NH_3,\tfrac{1}{2}H_2O;\ CuMoO_4,2NH_3,H_2O;\ CuWO_4,4NH_3 \text{ and } ZnWO_4,4NH_3,3H_2O$$

have been prepared and are described in the paper.—The hexahydrated double chromates. Magnesium and nickel compounds: S. H. C. **Briggs**.—Bornylcarbimide: M. O. **Forster** and H. M. **Attwell**. A description of this and related substances.—Reduced silicates: C. **Simmonds**. The substance left when lead silicates are reduced by heating in hydrogen is shown to be a compound which can be regarded as a combination of the metal and silica, in the same sense as the original silicate is a combination of the metallic oxide and silica. Similar results were obtained with the silicates of copper, iron, nickel and cobalt.—Picryl derivatives of urethane and thiourethane: J. C. **Crocker** and F. H. **Lowe**. The authors show that the reaction between picryl chloride, thiocyanates and alcohols is due to the formation of the ψ-thiourethanes of the type PiN : C(SH).OX as intermediate products, which subsequently react with picryl chloride and pass into the picriminothiocarbonates PiN : C(SPi).OX.—The oxime of mesoxamide and some allied compounds, part iii., tetra-substituted derivatives: M. A. **Whiteley**. A description of a number of these compounds is given.

Royal Microscopical Society, April 20.—Dr. Hy Woodward, F.R.S., vice-president, in the chair.—A large tank microscope, made by Thomas Ross, presented to the society by the committee of the Quekett Microscopical Club, was exhibited. It was made not later than the year 1870, and was designed for the purpose of examining objects contained in aquaria.—The annual exhibition of pond life was given this evening by fellows of the society, assisted by members of the Quekett Microscopical Club.

PARIS.

Academy of Sciences, May 2.—M. Mascart in the chair.—The action of terrestrial magnetism upon a tube of nickel steel (invar) intended for use as a geodesic pendulum: G. **Lippman**. The alloy of nickel and iron known as *invar*, which possesses a coefficient of expansion only one-twentieth that of brass, has obvious advantages for pendulum observations. This steel, however, is magnetic, and it was thought possible that the disturbing influence introduced in this way might be too large to be neglected. The magnetic moment of a tube of this material was determined, and the possible error on a pendulum observation calculated. It was found to be negligible, and hence invar can be advantageously substituted for brass in the pendulum.—The effect of small oscillations of the external action on systems affected with hysteresis and viscosity: P. **Duhem**.—Geodesic and magnetic work in the neighbourhood of Tananarive: P. **Colin**.—Polyvalent antipoison serums. The measurement of their activity: A. **Calmette**. The antihæmolytic power is a measure of the antitoxic power of a serum, and a method is described by which the former can be determined in glass.—Observations of the Brooks comet (1904 *a*) made with the bent equatorial at the Observatory of Lyons: J. **Guillaume**.—On a new apparatus for measuring the power of motors: Ch. **Renard**. The axle of the motor is connected to a bar carrying two aluminium vanes, the latter being capable of adjustment as regards their distance from the axis. This having been previously calibrated against a dynamometer, the determination of the horse-power of a motor is reduced to the determination of the angular velocity.—The Adolphe bridge at Luxembourg (1899–1903): M. **Séjourné**.—On the comparison of spectro-photometric determinations: P. **Vaillant**.—The sensibility of the azimuth balance: V. **Crémieu**. An extension of the theory of the azimuth balance, a description of which has been given in an earlier paper.—On the *rôle* of the centrifugal force component in the determination of the sense of rotation of cyclones and water vortices: Bernard **Brunhes**.—On the electrolytic solution of platinum. A new method for preparing platinocyanides: André **Brochet** and Joseph **Petit**. When platinum is used as the anode in a solution of potassium cyanide, it remains unattacked. With an alternating current the platinum is readily attacked, a current density of 20 to 80 amperes per square decimeter dissolving from 0·4 to 0·6 gram per ampere hour. With barium cyanide, barium platinocyanide is formed by the action of the alternating current; the yield of the platinocyanide is good.—The origin of the Blondlot rays given off during chemical reactions: Albert **Colson.** Chemical reactions in which Blondlot rays are given off are always accompanied by physical actions, such as contraction or cooling.—On cacodylic acid and amphoteric bodies: P.-Th. **Muller** and Ed. **Bauer.** Different physicochemical methods all lead to the same conclusion, that cacodylic acid and its sodium salt have the same constitution; it follows that an amphoteric body is not necessarily a pseudo-acid.—The reduction of silica by hydrogen: A. **Dufour.** Silica is reduced at a high temperature by hydrogen, water and hydrogen silicide being formed. The inverse reaction is possible. This reduction explains the phenomenon of devitrification of silica tubes when heated in the blowpipe, and also gives a satisfactory explanation of the experiments of Boussingault and of Schutzenberger on the formation of the silicide of platinum by silica at a distance in a current of hydrogen.—On the zinc aluminium alloys: Hector **Pécheux.** By treating zinc with aluminium in various proportions, nine different well defined alloys have been obtained, the physical and chemical properties of which are described.—The action of diazobenzene chloride upon diphenylamine: Léo **Vignon** and A. **Simonet.** Phenyl-diazoamidobenzene is obtained in this reaction.—On allyl and propenyl-alkyl ketones: E. E. **Blaise.**—The application of the Grignard reaction to the halogen esters of tertiary alcohols: L. **Bouveault.** By carefully regulating the temperature the chloride of tertiary butyl alcohol reacts normally with magnesium; the product absorbs carbon dioxide, giving pivalic acid. The reaction with ethyl formate was also studied.—On the symmetrical dichloromethyl ether: Marcel **Descudé.** Trichloride of phosphorus and polyoxymethylene react on heating in the presence of a little zinc chloride, giving a good yield of the above substance.—On a method of isolating cytoplasmic substances: Maurice **Nicloux.**—New researches on aucubine: Em. **Bourquelot** and H. **Hérissey.**—Abnormal hybrids: C. **Viguier.**—On the biology of *Sterigmatocystis versicolor*: Henri **Coupin** and Jean **Friedel.**—A food substance obtained from the pith of the Madagascar palm: R. **Gallerand.** The flour made from this palm is distinguished by its richness in albumenoid matter, of which it contains 10·5 per cent.—On the presence of tin in the department of Lozère: Marcel **Guédras.**—Nervous oscillations studied by means of the *n*-rays emitted by the nerve: Augustin **Charpentier.**—The modifications undergone by the digestive apparatus under the influence of diet: Camille **Spiess.**

DIARY OF SOCIETIES.

THURSDAY, MAY 12.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—If the discussion on Messrs. Merz and McLellan's paper is concluded at the meeting of May 5, Messrs. Parsons, Stoney and Martin's paper on the Steam Turbine as applied to Electrical Engineering will be read and discussed.

MATHEMATICAL SOCIETY, at 5.30.—Some Mathematical Instruments: C. Cooke (communicated by Major P. A. MacMahon).—On the Evaluation of Certain Definite Integrals by Means of Gamma Functions: A. L. Dixon.—Generalisations of Legendre's Formula

$$KE'-(K-E)K'=\tfrac{1}{2}\pi:$$

A. L. Dixon.—Note on the Integration of Linear Differential Equations: Dr. H. F. Baker.—On Perpetuant Syzygies: A. Young and P. W. Wood.

SOCIETY OF ARTS, at 4.30.—British Grown Tea: A. G. Stanton.

FRIDAY, MAY 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Milky Way Charts of the Heavens to Argelander's Scale 1°=20mm., with description by H. Dennis Taylor and Alfred Taylor of the Lenses and Mount: J. Franklin-Adams — Methods of Correcting Moon's Tabular Longitude: P. H. Cowell.—The Definitive Places of the Standard Stars for the Northern Zones of the Astronomische Gesellschaft: A. M. W. Downing.—Note on the Formulæ connecting "Standard Coordinates" with Right Ascension and Declination: F. W. Dyson.—*Probable Paper*.—On the Pivot Errors of the Radcliffe Transit-Circle: A. A. Rambaut.—On the new Greenwich Micrometer for Measurement of Photographs of Eros: Communicated by the Astronomer Royal.—Further Analyses of the Moon's Errors with the Mean Elongation as Argument: P. H. Cowell.

MALACOLOGICAL SOCIETY, at 8.—List of Mollusca collected during the Commission of H.M.S. *Waterwitch* in the China Seas, 1900–1903, with Descriptions of New Species: Surgeon K. Hurlstone Jones, R.N., and H. B. Preston.—On a Carboniferous Nautiloid from the Isle of Man: G. C. Crick.—Notes on the Genus Anoma: E. R. Sykes.—New Land Shells from New Zealand: Henry Suter.

MONDAY, MAY 16.

SOCIOLOGICAL SOCIETY at 5.—Eugenics; its Definition, Scope and Aims Francis Galton, F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Anniversary Meeting: Address by the President.

TUESDAY, MAY 17.

ROYAL INSTITUTION, at 5.—Meteorites: L. Fletcher, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—On some Nudibranchs from East Africa and Zanzibar. Part v.: Sir Charles Eliot.—Description of a new Tree-Frog of the Genus Hyla, from British Guiana, carrying Eggs on the Back: G. A. Boulenger, F.R.S.—Notes upon the Anatomy of certain Boidæ: F. E. Beddard, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.—Local Expenditure and Local Indebtedness in England and Wales: R. J. Thompson.

SOCIETY OF ARTS, at 8.—Pewter and the Revival of its Use: Lasenby Liberty.

WEDNESDAY, MAY 18.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Note on Grayson s Rulings: E. M. Nelson.—Exhibition of Flower Seeds under Microscopes: C. Beck.

CHEMICAL SOCIETY, at 5.30.—Action of Nitrosyl Chloride on Pinene: W. A. Tilden.—The Electrolytic Estimation of Minute Quantities of Arsenic: H. J. S. Sand and J. E. Hackford.—The Decomposition of the Alkylureas (a Preliminary Note): C. E. Fawsitt.—The Action of Sodium Methoxide and its Homologues on Benzophenone Chloride and Benzal Chloride. Part ii: J. E. Mackenzie and A. F. Joseph.—The Formation of Periodides in Nitrobenzene Solution, II. Periodides of the Alkali and Alkaline Earth Metals: H. M. Dawson and Miss E. E. Goodson.

THURSDAY, MAY 19.

ROYAL SOCIETY, at 4.30.—The Bakerian Lecture will be delivered by Prof. E. Rutherford, F.R.S., on the Succession of Changes in Radio-active Bodies.—The following papers will probably be read in title only:—On Saturated Solutions: Earl of Berkeley.—On the Liquefied Hydrides of Phosphorus, Sulphur, and the Halogens, as Conducting Solvents. Part i.: B. D. Steele and D. McIntosh. Part ii.: D. McIntosh and E. H. Archibald.—On the General Theory of Integration: Dr. W. H. Young.

INSTITUTION OF MINING AND METALLURGY, at 8.—Miners' Phthisis—its Causes and Prevention: Dr. J. S. Haldane and R. A. Thomas.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Discussion on Messrs. Parsons, Stoney and Martin's paper, entitled The Steam Turbine as applied to Electrical Engineering.

FRIDAY, MAY 20.

ROYAL INSTITUTION, at 9.—The Radiation and Emanation from Radium: Prof. E. Rutherford, F.R.S.

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