THURSDAY, NOVEMBER 28, 1901.

PUBLIC HEALTH ADMINISTRATION IN AMERICA.

Municipal Sanitation in the United States. By Chas. V. Chapin, M.D., Superintendent of Health of the City of Providence. Pp. viii + 970. (Providence, R.I.: Snow and Farnham, The Providence Press, 1901.)

THIS work is not a treatise on the principles of sanitation, and, in fact, these principles are rarely referred to; it is rather a compendium of sanitary practice in the United States of America. The author devotes but little space to an expression of his own views, but his opinions whenever given are such as will meet with very general approval. In the introduction he states that the preparation of the present volume was primarily undertaken to meet his personal needs. An investigation along several lines of public health work suggested the utility of a comprehensive study of sanitary methods, and, as a consequence, this volume was prepared, in the hope that the material gathered together will prove as useful to other health officers as it has to the author.

The work is designed for American readers, but much of it will prove interesting and suggestive reading to those who have to do with sanitary administration in this country. The points which will perhaps strike the British reader most are: The extent to which the sanitary law or procedure may vary in different States; the scope and stringency of certain sanitary regulations; and the frequent paucity of efficient machinery to see that the law is observed. It is comparatively easy to frame an almost ideal set of sanitary statutes and regulations, but it is a very difficult matter to enforce them thoroughly, and it is evident that sanitary administration does not always keep pace with sanitary legislation in the United States. The average of all those cities of America, given in a rather long table on pp. 128 and 129 of the work, show the population for one inspector to be about 30,000; but in Providence there is only one to every 87,000 of population. A great many health officers, we are informed, receive no compensation at all, but serve their fellow-citizens simply from public spirit; thus in Minnesota in 1898, of 214 health officers, 83 received no pay, and one of these was in "a city of 5000 inhabitants." In villages, towns and cities of small or moderate size, the health officer is expected to do nearly all the sanitary work of the community. He acts as the secretary to the Board of Health, and attends personally to communicable disease, attaching placards, giving instructions and often doing the disinfection himself. He also investigates nuisances and often serves notices for abatement. As a general rule, the scale of pay to the health officers is very similar to that in Great Britain. It is, moreover, very generally the custom in cities, often of moderate size, for the health officer to be entrusted with the duty of collecting and recording the deaths in the population.

In America, boards of health, which are now established in all the States except Georgia, Idaho, Montana, Oregon and Wyoming, are given more or less legislative and executive authority in matters which experience has shown they can best control, but as a rule the State Board of Health is considered chiefly as an advisory board. In many cases the State reserves to its State Board of Health executive powers in matters of quarantine, the control of communicable disease and diseases of animals, the adulteration of food, &c.; and the State Board of Health in Massachusetts has, in addition, set an example in the work of investigation which it will be difficult for others to equal, and that Board's extensive experiments upon water and sewage purification are highly valued by sanitarians in this country. The principles of local self-government in sanitary as in other affairs is in the main recognised and adhered to. Outside of municipalities the sanitary organisation, usually in the form of boards of health, may be established either in townships or counties. Of the thirty-six States, twenty have provided for a county form of sanitary government, and sixteen have a township form of sanitary government.

Reference may here be made to a few matters of public health administration in the United States which are of special interest to British readers. The use of preservative in milk or cream is altogether forbidden in some States, and several State and municipal standards for milk require 3·5 per cent. of fat and 9 per cent. of solids non-fat—a higher standard than that which obtains in this country; and in the city of New York, condensed milk must contain fat to the amount of 25 per cent. of the milk solids. A few States (New York, &c.) require the application of the tuberculin test to cows kept in the city, and many States now attempt to secure the destruction of herds most affected with tubercle and to help farmers to free their herds from tuberculous animals. How much they have really accomplished in this direction is not entirely clear, but it does not appear to be great. Considerable opposition is experienced, and little is done save on the application of the owners themselves.

In most communities a placard or sign is put upon the infected premises to notify the public of the presence of infectious disease. Laws requiring the vaccination of school children have been declared constitutional in Indiana, Pennsylvania, New York and California; sometimes it is the teacher who is required by the statute to enforce the law, by excluding the unvaccinated; more often, however, it is the school board or school committee who are supposed to have full control of the teachers. Garbage (animal and vegetable matters from dwellings, shops, markets, &c.) is rarely removed less often than once a week, but in Washington it is removed *seven* times a week; in New York, Philadelphia and some other towns, *six* times; and six times weekly in the summer months of the year in many other instances. The dry refuse (ashes and rubbish) is not usually quite so frequently removed; the work is done in New York and Brooklyn *six* times a week, and in many cities two or three times a week, but in most communities the interval between removals is one week.

There is little doubt that more than one-half of the water furnished in the United States is wasted, for the *per capita* consumption in American is twice as great as that in European cities, and in the few American cities which are metered the *per capita* consumption is not one-half what it is in the unmetered cities. It appears to be the experience in America that meters diminish waste, but do not

limit the legitimate use of water. In many States and cities either the ice is inspected or the source from which it is obtained, or the local sanitary authority controls its cutting or sale.

Spitting on the floor of public conveyances or on the side-walks—a dirty habit which creates a nuisance and favours the spread of tuberculosis—is prohibited by regulations which have been very generally adopted. It has, however, been found insufficient to forbid spitting on the floor of conveyances, as it is said that persons seeing such a rule have deliberately spat upon some other portion of the conveyance. A recent State definition of a nuisance (Utah, 1899) is very commendable. A nuisance is "whatever is dangerous to human life or health, and whatever renders soil, air or water impure and unwholesome." The Board of Health of Boston adopted regulations in 1900 for control of the barbers' trade; *inter alia*, mugs, shaving brushes and razors must be immersed in boiling water after every separate use thereof; alum, &c., used to stop the flow of blood, must be so used only in powder form and applied on a towel; the use of powder-puffs and sponges is prohibited; and every barber must cleanse his hands thoroughly immediately after serving each customer. These refinements of sanitation must be very difficult to enforce.

There are excellent reasons why the care of the sick poor should be a part of health department work, and the care of these is in a number of States wholly or partially in the charge of the health department. In most cases it is the outdoor or dispensary work which is given to the health department, but in rarer instances that department also manages the public general hospitals.

The sweating system is said to be associated with, if it be not the direct cause of, the most terrible phase of human life that is to be found in the United States. The "sweat-shop" is a manufactory in the dwellings of the very poor, among whom, if the home be healthy, the labour reasonable and the wages fair, such work is by no means to be discouraged; but the conditions of labour are often such as lead to the destruction of the home by the overcrowding and intense application and competition and the starvation wages of the sweating system. American legislation fails, like our own, to bring about any sufficient amelioration of the disease and misery entailed by the sweating system.

In conclusion, reference may be made to a very useful and full appendix of handbills, forms, notices, &c., used by different sanitary authorities in the United States, which adds much to the value of an interesting and important work.

THE CORRESPONDENCE OF HUYGENS.

Oeuvres complètes de Christiaan Huygens. Publiées par la Société Hollandaise des Sciences. Tome neuvième, Correspondance 1685-1690. Pp. 663 + 3 plates. (La Haye: M. Nijhoff, 1901.)

THE monumental edition of Huygens' works has now reached its ninth volume, and at least one more will be required to complete his voluminous correspondence. When reviewing previous volumes we remarked that many private letters of a non-scientific nature might well have been omitted, as their insertion is the principal cause of the great extent to which the work has grown; but this complaint does not apply to the volume now before us, in which there are scarcely any letters which one could wish omitted, as the few which do not treat of scientific matters give interesting glimpses of life and manners.

In the beginning of 1685 Huygens was still negotiating with the French Government about his return to Paris, and it is not quite clear whether he wanted to go back or not, and whether the revocation of the edict of Nantes was really the sole obstacle. Anyhow, nothing came of the correspondence, and he stayed on at The Hague till the spring of 1688, when he settled at Hofwijck, a property in the neighbourhood of the city which had belonged to his father (who died in March 1687) and of which his elder brother, Constantyn, lent him the use. As Constantyn was secretary to the Prince of Orange, his time was naturally much taken up with affairs of State, but he still found time to correspond with his brother on his favourite pursuit of telescope making, until he had to accompany William III. on his memorable expedition to England in 1688. Several letters give vivid pictures of the great anxiety felt in Holland after the departure of the fleet and the surprise and joy at the rapid progress of the Prince from Torbay to London. The interesting news contained in the letters of Constantyn from London inspired Huygens in the summer of 1689 with a wish to renew old acquaintances and make new ones in England, and accordingly he spent more than two months there, associating with Boyle, Halley, Newton (whom he now met for the first time), his old correspondent Duillier and others. The greatest scientific event of the time was, of course, the publication of Newton's "Principia" two years before. In June 1687 Duillier wrote to Huygens from London that some of the Fellows of the Royal Society were much excited over the approaching publication of a new work by Newton, and mentioned shortly some of the subjects dealt with in it. In reply, Huygens wrote that he was longing to see the book and did not object to the author not being a Cartesian, provided he did not make such an assumption as that of universal attraction. No doubt he and Newton must have had some conversations on the subject in 1689, and two memoranda by Newton on motion in a resisting medium probably date from this visit of Huygens to London. They were already published in 1701 together with a few notes written by Huygens in his copy of the "Principia," which after his death was acquired by a certain Groening, who imagined that Newton's memoranda (which are in his own handwriting) were also written by Huygens. In the "Discours de la Cause de la Pesanteur," published in 1690 with the "Traité de la Lumière," Huygens proves the earth to be an oblate spheroid and explains why the seconds' pendulum is of different length in different latitudes. But he assumes that gravity has its seat at the centre of the earth only, and in the appendix (written after the publication of the "Principia") he refuses to admit that all the particles of two or several bodies attract or tend to approach each other, as it seems clear to him that such attraction cannot be explained by any principle of mechanics. And in a letter to Leibnitz in

the same year he says that he often wonders how Newton could take the trouble to make so many researches and difficult calculations which have no foundation but this principle of universal attraction, which seems to him an absurd one.

With Leibnitz, Huygens was in fairly constant correspondence during the year 1690, chiefly on the subject of the differential and integral calculus, to which Leibnitz invited his attention; these letters have already been published more than once, but are here illustrated by several extracts from the notebooks of Huygens. After the publication of the "Traité de la Lumière" in 1690 (written in Paris twelve years earlier), Leibnitz wrote to express his surprise at, and satisfaction with, the undulatory theory, adding that when he saw how well it accounted for double refraction he passed from esteem to admiration. Papin also wrote to express his general approval, but otherwise there are very few allusions in the correspondence to the wonderful theory of Huygens, which had to lie dormant for more than a century before it even began to be seriously examined and to gain adherents. It is very curious that Newton should reject the undulatory theory of light while Huygens refused to accept the theory of universal gravitation, on both of which theories our modern natural philosophy is founded. But while the objections of Huygens did not retard the progress of the theory of gravitation, Newton's rival theory of light is certainly responsible for the long neglect of the true theory set forth by his Dutch contemporary.

Among the subjects which throughout Huygens' life continued to occupy his mind the improvement of clocks held one of the foremost places, and he never ceased to hope that in this way the important problem of finding the longitude at sea might be solved. Already, in 1662, he had his clocks tried at sea on a voyage from The Hague to London, but the attempt was a complete failure. Although he had in the meantime made the important invention of spiral-spring balances, he felt that even with this essential improvement no watch was to be trusted on a long voyage owing to the great influence of changes of temperature on the rate, and he therefore determined to try his pendulum clocks again at sea. In 1685 he cruised in the Zuyder Zee with two clocks suspended from the ceiling of the cabin in gimbals, and though the sea was very rough one of the clocks kept going the whole time. Encouraged by this success and being assured that the motion of a large ship would be far less violent than that which one of the clocks had been able to withstand, he had the experiment repeated in the following year in a ship belonging to the Dutch East India Company on a voyage to the Cape, giving the captain very detailed instructions as to the management and rating of the clocks. On the return of the *Alcmaer* in 1687 he learned that the clocks had kept going, though not as regularly as he had hoped. Huygens sent a lengthy report to the Company, with a large chart (reproduced in this volume) showing the track of the ship, first as estimated by the pilots, then as calculated by means of the clocks (passing right across Ireland and far to the east of the first one), and finally the same "allowing for the centrifugal force of the earth." This last track agrees fairly well with that laid down by the pilots. The matter was not lost sight of in the following years, notwithstanding the many other occupations of Huygens, and at the end of the volume we find again a number of letters exchanged between him and Graaf, who had brought the *Alcmaer* home from the Cape and who was then about to try the experiment again in another ship. But a great many years were to pass before Harrison solved the problem in quite a different manner.

It is impossible to read this splendid edition of Huygens' correspondence without being struck with the great care bestowed by the editors on their work. Throughout the volumes every allusion to persons, to contemporary events or to scientific matters is explained and commented on in footnotes, often of considerable length, which form a most valuable adjunct to the work. At the head of each letter it is stated where the original is to be found, whether it has been previously printed, and what letter it is in reply to or which one contains the reply to it. Future historians of the science of the seventeenth century will, indeed, have cause to thank the Haarlem Society of Science and especially the editors to whom this national undertaking has been confided.

In addition to the chart already mentioned, the volume contains a plate with views and plans of Hofwijck, where Huygens spent the last seven years of his life, and as frontispiece a fine portrait of the elder Constantyn Huygens from a drawing by his great son.

J. L. E. D.

ELEMENTARY BOTANY.

A Laboratory Course in Plant Physiology. By William F. Ganong, Ph.D. Pp. vi+147. (New York: Holt and Co., 1901.)

Methods in Plant Histology. By Charles J. Chamberlain, Ph.D. Pp. viii + 159. (Chicago: University Press, 1901.)

First Studies of Plant Life. By Geo. Francis Atkinson, Ph.B. Pp. xii+266. (Boston, U.S.A.: Ginn and Co., 1901.) Price 2*s.* 6*d.*

DR. GANONG seems to us to express sound views on the teaching of science in general and of plant physiology in particular, and the remarks on pp. 9 and 10 of his introduction might well be taken to heart by teachers; the same observation applies to his section on "Teaching and Learning," and careful consideration of the rest of this interesting manual convinces us that the author has much of the spirit of the true teacher in him. In other words, he has a share of that genius which calls forth from his students the desire to do something more than merely gather the opinions and statements of others as to the meaning of all those movements, exchanges of matter, increases in size and alterations in volume, &c., which constitute life.

It seems to us that a student who conscientiously works through the subject of this book, in the manner inculcated by the text and imbued with the spirit of inquiry manifested by the author, must learn much that is worth learning, both on account of its value as knowledge of the ways of living plants and on account of its significance in philosophy.

The experiments are as a rule simple, to the point, and

adequately but not over described ; while the results, instead of being merely set forth by the teacher, have to be looked for and thought about by the student himself.

Faults there are, and probably must be in such a book, and we could criticise somewhat severely the meagre plan of a physiological laboratory submitted on pp. 29–30, and the outline course of study of structure and of the properties of protoplasm ; but against these deficiencies may fairly be set some neat suggestions and devices, as, for example, those on comparative polygons (p. 15) and for experiments on germination, root-pressure, geotropism, &c. We do not like such terms or expressions as "borrowable" (p. 58), "diagramming" (p. 75), "other tropisms" (p. 132), and quite fail to understand how it can be said (p. 135) of locomotion that it is "almost purely ecological, with but a slight basis in pure physiology."

Nor can we pass over the following without protest : "5. What is the chemical composition of living protoplasm ?" (p. 52). It is obvious on reflection that we know nothing of the chemical composition of *living* protoplasm.

We are also struck with the untidy appearance of some of the experiments—*e.g.* Fig. 13—though not all.

The information (pp. 71–72) regarding nutritive solutions, and (p. 100) water cultures is too meagre ; and to say of absorption (of lithium citrate) "But perhaps such absorption is too obvious to need special experiment" is a flagrant departure from the excellent principles inculcated elsewhere.

On the other hand, surely the following precaution with the clinostat is of the order of trivialities : "The clock will need winding once in two days, and while the cork is removed for the purpose, it should be kept slowly revolving in the hands" (p. 121).

A clearly written, excellently printed and compact little handbook for the beginner in laboratory practice has long been wanted, and Dr. Chamberlain's volume comes nearer to satisfying the want than many. But it has, in our opinion, one fundamental drawback which would spoil its claims to be—what it might have been—*the* elementary laboratory book of methods for botanists, namely, in attempting to be both a guide to laboratory methods and a handbook of exercises in plant-histology, each of its double functions being too incomplete in treatment. For instance, the meagre description of the paraffin bath on p. 4 should either be clearer or omitted altogether, and the practical value of the curious formulæ for alcohols on p. 9 seems to us not obvious. On the other hand, the recommendation to inoculate a mouse with *Anthrax* (p. 76) can hardly apply to an elementary student, and several of the studies—*e.g.* of *Xylaria* (p. 83), *Marsilea* (p. 111), &c.—seem to us both unsuitable and inadequate in treatment. The poor photographic figures of nuclei in *Lilium* are also unnecessary.

In spite of these criticisms the first half of the book contains many useful hints on methods, and we should like to see it expanded, to the ultimate exclusion of the second half.

Dr. Atkinson's little book has a wealth of excellent illustrations and some ideas of value to the teacher and student of purely elementary botany or "Nature study," but it only brings out once more the clear issue that all such teaching depends for its efficiency on the genius of the individual teacher. In the right hands, Chapters xv.–xvii., for instance, dealing with the formation of starch in the living plant, will assume delightful aspects. We do not doubt that this would be the case in the hands of the author, but even his simple style and ingenious illustrations show only the more clearly that all depends on the personality of the teacher in these fundamental matters. The section on "Battles of Plants in the World" is excellent reading, but we doubt if children could be made to appreciate the subject except in the open air and in the company of the ideal teacher, who is rarely or never present with the book.

TRUTH AND ERROR IN VON KÖLLIKER.

A. von Kölliker's Stellung zur Descendenzlehre. Ein Beitrag zur Geschichte moderner Naturphilosophie. Von Dr. Remigius Stölzle. Pp. 172. (Aschendorffsche Buchhandlung, Münster i. W., 1901). Price Mk. 2.

DR. REMIGIUS STÖLZLE, professor of philosophy in the University of Würzburg, has paid his illustrious scientific colleague A. von Kölliker a great compliment. He has dissected Kölliker's works, and separated the wheat from the chaff, as he did not long ago in the case of Karl Ernst von Baer. The analysis of nine important works, from an article on Darwinism in 1864 to the veteran's interesting "Erinnerungen" in 1899, is careful and scholarly, and the critical exposition is arranged so clearly that the reader can find out at once what Kölliker thought about variation, heredity, natural selection, or the like. While the author has very strong convictions, he expresses these with a dignified restraint, and says nothing harder against naturalists than that it is a pity to be too busy to take advantage of philosophical discipline. For those who are fond of argument the book will serve as an interesting introduction to the problems of organic evolution.

Prof. A. von Kölliker's contributions to biology—through more than half a century—have been many and varied ; indeed, the magnitude of his work, alike in quantity and quality, is a lasting example to the spirit of research ; and, though it is difficult always to read with patience, Stölzle's detection of "fundamental errors" is really part of a tribute to the anatomist's greatness. Is not criticism, after all, the sincerest form of flattery ? But there is, by the way, a lack of discernment or of the sense of humour in placing Profs. Fleischmann and Weismann side by side among those who are responsible for recent "Angriffe oder Verdikte" on Darwinism.

The first great error is a purely mechanical interpretation of nature, the second is a denial of purposive principles, and the third is an evolution theory which is said to leave no *rôle* for the Creator. In evidence of these hateful heresies there is no lack of citation of chapter and verse ; nor is it to be supposed that the author simply *calls* them "Irrgänge des Denkens" ; he seeks to substantiate his accusations, and to those who agree with him the case will doubtless appear convincing.

But there is a brighter side to the picture ; there is truth as well as error in the writings of Albrecht von Kölliker. Of permanent truth (von bleibender Wahrheit)

is his critique of Darwinism; it has stood the test of time and is now admitted as justified, "and Darwinism, for scientific circles at least, is at its last gasp. Weismann, the toughest champion of Darwinism, can now write over all his works devoted to the rescue of the selection-principle, '*In vanum laboravimus.*'" These are brave words, but the game is "bluff."

A second "permanent truth" expressed by von Kölliker was that organic evolution can only have come about through internal factors, for von Kölliker is one of the many who have groped after "an unknown factor," a "phyletische Lebenskraft." It has often seemed like a clue, this idea of an internal tendency to progress, but it has not as yet led us anywhere; and we relapse from obscure talk about "bathmism" into an ætiology like Topsy's "specks I growed." There may be some with the bad taste to prefer Weismann's "germinal selection."

A third "permanent truth" in von Kölliker's position is that "he regarded all theories of descent, including his own, as having only the status of probabilities," and this is to appraise them rightly. In other words, evolution-theories were to him, as to most clear-headed people, simply conceptual formulæ more or less justified by their success in fitting the facts. Here, at least, those who regard von Kölliker's heresies as expressive of a useful scientific method and those who denounce them as errors of judgment, those who stand by the selection-idea and those who think that it has been literally worked to death, may find a provisional peace, until they begin again to try if they cannot get "any forrarder."

J. A. T.

OUR BOOK SHELF.

A Treatise on Medical Jurisprudence. By G. V. Poore, M.D., F.R.C.P., Professor of the Principles and Practice of Medicine, University College, London. Pp. xxiv+533. Eighteen illustrations. (London: John Murray, 1901.)

THE book before us consists essentially of a series of lectures delivered by Dr. Poore at University College during the time when he occupied the chair of medical jurisprudence in that institution; now that he has passed to another sphere of duties, it is well that his labours as a teacher of this most important subject should endure in the concrete form of a manual. The lectures have been freely edited by himself, and doubtless touched up by others, but in spite of this they remain still essentially lectures, delivered in a pleasant colloquial style; if from the point of view of highly systematised contents, something by this method has been lost, something has also been gained, in that the volume before us may certainly be designated one of the most readable which it has ever fallen to our lot to peruse.

To turn from the manner of the book to its matter, it is quite impossible in a short notice to do adequate justice to the mass of fact which it contains. The book is not very fully indexed, and to get an adequate idea of its contents the table of contents itself must be read. This consists of a series of detailed chapter headings which are repeated throughout the book at each chapter.

Inter alia we would draw special attention to Chapter ii., which deals with the legal relations of the medical profession. The subject-matter of this chapter, as in many others throughout the book, is elucidated by illustrative cases culled from the records of the Law Courts. Amongst these cases we may mention the Tichborne, Palmer, Lamson and Maybrick cases, each of which is fully described under the subject which renders them of permanent interest to the medical jurist. With regard to the toxicological part of the subject, the author adopts the wise method of only dealing with the symptoms produced by, and the detection of, those poisons which have actually been used criminally. An interesting chapter on food-poisoning is, we venture to think, not strictly within the scope of the work. The criminal of to-day is perhaps turning his attention to ptomaines, and it may be that the criminal of the near future will actually employ them. It is only to be hoped that modern chemistry will be equal to the task of their identification. A very useful chapter for the medical practitioner is the one upon insanity, and the one immediately following, upon the legal relations of the insane. In these two chapters he will find full information with regard to what is very often a puzzling subject, viz. what to do and how to do it when one is suddenly called to a case which obviously requires restraint. Is it to be wondered at that the busy medical man has sometimes to be censured for not complying with the law when, as Dr. Poore tersely puts it, the law in question contains more than three hundred sections and clauses, and weighs half a pound?

The volume concludes with eleven appendices upon various subjects of importance to medical jurists. Amongst these may be mentioned a most interesting appendix (illustrated) by Dr. J. G. Garson upon "The metric and finger-print identification of criminals as carried out at New Scotland Yard."

We may close our remarks by saying that Dr. Poore's book deserves, and will surely have, a very wide circulation, supplementing rather than replacing the more systematised and voluminous works upon this subject.

F. W. T.

Ueber Museen des Ostens der Vereinigten Staaten von Amerika; Reisestudien. By A. B. Meyer. Part ii. Illustrated. (Berlin, 1901.)

IN this fasciculus the learned Director of the Royal Zoological and Ethnographical Museum of Dresden concludes his interesting account of the museums and libraries of the United States visited during his recent tour. Here we may avail ourselves of the opportunity of correcting a misrepresentation of the author's opinions which unfortunately occurs in our notice of the first portion of his work. Instead of stating that Americans are ahead of us in the matter of museum fittings, Dr. Meyer awards the preeminence in this respect to European institutions, although he is fain to confess that as regards libraries and library installations we are not abreast of America.

In the present part Dr. Meyer discusses the chief public institutions of Chicago connected with art, literature and science, namely, the Field Columbian Museum, the Academy of Sciences, the Historical Society, the Art Institute, the John Crerar, the Newberry, and the Chicago Public Libraries and the University. The Field Columbian Museum, which was opened in August 1893, during the Chicago International Exhibition, under the title of the Columbian Museum of Chicago, owes its existence to private liberality, and in May 1894 was renamed in honour of its founder, Mr. M. Field, of the firm of Marshall Field and Co. On Saturdays and Sundays the Museum is open free to the public, but on other days a small admission fee is charged, although the scholars attending elementary and secondary schools are always admitted without charge. Dr. Meyer furnishes his readers with a plan of the ground floor and another of the galleries, and discusses the general arrangement of the rich collections and the mode of cataloguing. At the conclusion of his article he expresses himself dissatisfied with the building, which he considers inadequate to the contents, urging that if this were remodelled the Museum ought to take rank among the first in the world.

Of the other institutions named, Dr. Meyer considers that the small museum of the Academy of Sciences is a model of its kind; and that the Art Museum is in many respects remarkable, and, like the other institutions, worthy the best attention of all interested in such matters. The Newberry and John Crerar Libraries, which are for reference only, display many features of their own, and will in the near future be of the highest importance as the scientific libraries of the Central United States. The Chicago Public Library, on the other hand, is a circulating one, which lends out, according to the author, millions more volumes than any other institution in the world; it is, in fact, a unique institution. As to the University, which is described in considerable detail, Dr. Meyer has no doubt that it is assured of a great future, the progress it has made and the influence it exerts, after an existence of only a decade, being little less than marvellous.

To all practically interested in museum and library work and progress, Dr. Meyer's observations and criticisms should be invaluable. R. L.

The Mechanical Triumphs of the Ancient Egyptians. By Commander F. M. Barber, U.S. Navy. Pp. x + 123. (London: Kegan Paul and Co., Ltd., 1900.) Price 3*s.* 6*d.*

THE writer is a well-read sailor, who has devoted much time to answering as plausibly as possible the common query of travellers, "How did the Egyptians transport such great stones from their quarries as the stones for the pyramids, the colossi and obelisks, and lift them to their present positions?"

He discusses the Egyptian knowledge of the mechanical powers, the capstan and windlass known in the first three dynasties, the single pulley B.C. 3500, the inclined plane very early, the screw and the Spanish windlass also early.

He thinks that the heavy stones of the lower parts of the pyramids were brought on rafts by water, then up long inclined planes of gentle slope to their actual positions. The lighter stones of the upper parts may have been lifted, possibly also the casing stones, by levers, but he finds reason to believe that the screw-jack was in common use for this and other purposes. He describes the quarrying, the carrying and polishing of very hard stones with such tools as the Egyptians possessed; he is much at home in his discussion of the shapes and strength of boats used for conveying two obelisks at a time and how they were towed, and he compares the modern methods of lifting obelisks into position with his plausible account of how the ancients performed such operations.

Cours de Mathématiques à l'Usage des Élèves-Architectes et Ingénieurs Professé à l'École des Beaux-Arts. Par Carlo Bourlet. Pp. iii+244. (Paris: C. Naud, 1902.) Price fr. 8.

THIS is an elementary treatise on what is often called higher mathematics, the parts of which are taken up in the following order:—Differential calculus; analytical geometry of two dimensions with calculus applications; integral calculus; three-dimensional geometry. It seems to be made up of the most elementary parts of three or four treatises, but there is nothing new in the treatment. One might have expected the author to illustrate the well-known rules of differentiation by showing how applicable they are to the problems of the builder and engineer, to have greatly shortened the proofs and lessened the number of rules for differentiation, and so forth; but we here find practically nothing of the kind. The conic sections are still the important curves; the student gets rules enough for the most elaborate differentiation and integration and, in fact, enters in the most orthodox way upon a course of pure mathematics; but this book is in no way written to satisfy the special needs of the architect or engineer. But the author is to be praised for teaching the calculus, in however dry a manner, before coordinate geometry. We wish he had used the calculus to help in teaching coordinate geometry, but he only makes a combination after he has taught both subjects.

Physical Determinations. By W. R. Kelsey, B.Sc., A.I.E.E. Pp. xii + 316. (London: Edward Arnold, no date.) Price 4*s.* 6*d.*

THIS book contains, in a space of 310 pages, 185 sections each of which deals with generally one and sometimes more experiments. The subject-matter spreads over the whole range of physics. It is consequently packed tightly; and so the author has had to omit details, but he has endeavoured to give sufficient information to enable a class to start work without waiting for individual instruction from the demonstrator. It is claimed that the book contains most of the exercises which have been set at the London Intermediate and B.Sc. examinations.

The exercises are of very variable degree of difficulty and are not graded, so that a teacher adopting this book for elementary classes will have to make a careful selection. One use of the book will be to look up the whole subject the night before an examination.

S. S.

Proceedings of the Aristotelian Society. New Series. Vol. i. Pp. 239. (London: Williams and Norgate, 1901.)

THE existence of the Aristotelian Society illustrates one of the best features of English philosophical study, its freedom from the tendency, often so strongly marked in continental countries, to organise itself into little schools, each with some master, whose decisions are unquestionable, and his band of unquestioning disciples. The present volume, like its predecessors, is pleasingly marked by the tone of free inquiry and unprejudiced discussion natural to a society in which adherents of the most various philosophical principles attempt to make themselves reciprocally intelligible. The contents of the book include contributions to most departments of philosophy, except that there is no paper dealing directly with ethics. Among the essays concerned with metaphysics the most important are the three in which Dr. Shadworth Hodgson, the Nestor of the society, defends his well-known views on causation, substance, and the nature of the conscious subject of psychology, and the discussion of identity by Mr. G. E. Moore. Of the papers on other subjects perhaps the most attractive is Mr. Sturt's on "Art and Personality." Mr. Beneke's discussion of the "Aspect Theory of the Relation of Mind to Body" is suggestive, though impaired by the writer's voluntary abstention from metaphysical thoroughness. A. E. T.

The Play of Man. By Karl Groos. Translated by Elizabeth L. Baldwin. Pp. ix + 412. (London: Heinemann, 1901.)

PROF. GROOS'S work, "Der Spiel des Menschen," has already been noticed in this column, in connection with the appearance of the German original. It is therefore superfluous to say more than that the work, both for wealth of information, soundness of judgment and charm of literary style, is in every way worthy of its earlier companion study of "The Play of Animals." Apart from its purely psychological interest, the book has a serious value for the pedagogue who desires to form his own judgment as to the educational effects of games and the uses and dangers of the play-impulse. It is to be hoped that so good a book will have in its English dress the deserved success already attained in this country and America by "The Play of Animals." The translator has done her work well, and Prof. Baldwin contributes a preface and a few footnotes.

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 Red (C) Line of Hydrogen and the Zeeman Effect.

FOR some months we have been engaged in an investigation of the effect of a magnetic field on the more conspicuous lines of certain elementary gases, including the case of helium referred to by Prof. Gray and Dr. Stewart in your issue of November 21. We have employed a very fine echelon grating of twenty-six plates by Hilger. One observation that we have already made is, perhaps, of sufficient interest to deserve mention in your columns. The red (C) line of hydrogen was unmistakably divided before the application of the magnetic field. A reference to Michelson's papers on the application of interference methods to spectroscopic measurements showed that he had announced the red hydrogen line to be a very close double as long ago as 1887. A more detailed examination of the visibility curve is given in the *Philosophical Magazine* for September, 1892, from which it appears that the curve is practically the same as that due to a double source, whose components have the intensity ratio 7 : 10, and in each of which the light is distributed according to the exponential law resulting from Maxwell's theory of velocities. The distance between the components is given as $1{\cdot}4 \times 10^{-8}$ millim., so that it should be well within the power of the echelon as at present constructed to resolve the line.

Under the influence of the magnetic field each component is widened, and by using a double-image prism as recommended by the late Prof. Preston to separate the constituents, is seen to give rise to the normal triplet.

It is necessary for these observations to use a vacuum tube giving a bright crimson light in the capillary portion, and it is an advantage to have the tube in connection with the pump and a supply of hydrogen while under observation.

We hope to be able to publish quantitative results regarding this and other lines when our researches are further advanced.

BLYTHSWOOD,
H. S. ALLEN.

Blythswood Laboratory, Renfrew, N.B., November 25.

On the Probability that the Son of a very highly-gifted Father will be no less Gifted.

AN abstract was presented last Thursday to the Royal Society by Prof. Karl Pearson of results that apparently showed in a most conclusive way "that the mental characters in man are inherited in precisely the same manner as the physical." His data and work have yet to be communicated, but the figures, which were given separately, for four physical characters in from 800 to 1000 pairs of brothers, and for seven mental characters in another equally large set, are closely the same in all eleven instances, and they seem to substantiate his conclusion up to the hilt.

As the question of inherited ability may thus be brought again to the front, perhaps you will allow me space to refute a specious objection which is likely to be adduced, as it has already been urged with wearisome iteration, namely, that the sons of those intellectual giants whom history records, have rarely equalled or surpassed their fathers. In reply, I will confine myself to a single consideration and, ignoring what Lombroso and his school might urge in explanation, will now show what would be expected if these great men were as fertile and as healthy as the rest of mankind.

The objectors fail to appreciate the magnitude of the drop in the scale of intelligence, from the position occupied by the highly exceptional father down to the level of his *genetic* focus (as I have called it), that is to the point from which his offspring deviate, some upwards, some downwards. They do not seem to understand that only those sons whose upward deviation exceeds the downward drop can attain to or surpass the paternal level of intelligence, and how rare those wide deviations must be.

The exceptional quality of the father is only one of four elements that contribute in apparently equal shares to determine the position of the genetic focus. The other three are (1) the quality of the mother, (2) that of the paternal ancestry, (3) that of the maternal ancestry. In the case we are supposing the mother may occupy a high, though almost necessarily a lower, position on the scale of intelligence than the father. Where, for instance, could an intellectual giant like Napoleon find an equal mate? The average ancestry, whether of the father or of the mother, are always more or less mediocre, some ancestors being above and others below the general level of intelligence. Consequently the exceptional quality of the father, considered apart from his ancestry, is not likely to raise the position of the joint genetic focus of himself and the mother by more than a quarter of its amount. Let us consider the far from overstrained case of a father whose intelligence exceeds mediocrity by an amount that lies between seven and eight times that of the "probable error" of the distribution of racial intelligence. Extending the nomenclature employed in my lecture, which you published on October 31, his class would be Y. I will suppose his wife to be a woman of such ability that her equal is only to be found once in every fifty persons, that is of class U. Then the class of the mid-parent would be half-way between Y and U, or W. Regression which is due to the joint ancestral influences would degrade W by at least two classes, that is from W to U, which makes a total drop of four classes from the Y from which we started. Only those children who deviate upwards to that large extent can equal their father. But the conditions are still harder than they appear, because of the closeness with which the sons are clustered round the common filial (or genetic) centre. Their modulus of deviation is less than that of racial deviation, so that it would need fully five steps of filial deviation to reach the required level, and hardly one in 300 deviates do that. He might have many sons more or less distinguished, sons classifiable as W, X, or V, as experience shows to be the case, but the probability of a Y father having a Y son is remote. All the same, a Y father is more likely than any one man of a lower class than his own to have such offspring, but as the latter are very numerous the supply of Y men comes chiefly from them.

I have looked again at my "Hereditary Genius," written many years ago, under the light of newer knowledge, and feel that the evidence there recorded of the inheritance of ability is quite as strong as theory would lead us to expect.

I must not trespass further on your space, though the subject tempts one to go far into details. FRANCIS GALTON.

Pigments of Nudibranchiate Mollusca.

LAST summer, on the coast of California, I had occasion to study three species of the beautiful genus Chromodoris, all of them hitherto undescribed. Technical descriptions have been sent for publication elsewhere, but the purpose of the present note is to call attention to the interesting pigments possessed by these animals. *C. universitatis* (so called because it bears the colours of the University of California) is a large species, more than 2½ inches in length, of a rich dark ultramarine blue, the edges of the mantle and foot bright cobalt blue. The mantle has two longitudinal series of oblong very bright orange spots, about seven in a series; there are also five orange spots on the anterior part of the mantle. The sides of the foot also exhibit a row of orange spots.

When the animal is placed in formalin (4 per cent.) it immediately gives into solution a strong blue colour. This colour is even dissolved out, though more slowly, by sea water after the death of the animal. The blue solution is bleached by caustic potash, and is immediately turned pink (about the colour of apricot flowers) by hydrochloric acid.

The orange spots are not affected by formalin, but, curiously, when seen through the blue solution, they appear bright red. *C. porterae* (from La Jolla) is a small species, about 11 mm. long, blue as in the first species, with two rather broad longitudinal stripes of bright orange on the mantle. There is an inconspicuous median line of a lighter blue. After death the blue (evidently the same pigment as that of *C. universitatis*) dissolves out, and the body becomes a sort of pale greenish, with the dorsal stripe on the mantle very white. The orange bands are not affected.

The third species, *C. mcfarlandi* (from La Jolla and San Pedro), is about 35 mm. long, the mantle brilliant purple with a yellow margin and three longitudinal yellow stripes. The end

of the foot is purple, with a longitudinal orange stripe. The orange pigment is evidently the same as that of the other species, but the purple is different from the blue and does not dissolve out in formalin.

No doubt all these pigments represent "warning coloration."

T. D. A. COCKERELL.

East Las Vegas, N.M., U.S.A., November 10.

The Ash Constituents of Some Lakeland Leaves.

A FURTHER series of experiments bearing on the question indicated in this journal (vol. lxiii., No. 1634, p. 396) was undertaken during the summer and autumn of this year. It was deemed advisable to extend the research over a pretty wide range of subjects, so as to be able, if possible, to catch some kind of clue towards the correct elucidation of the causes operative in the case. The capital object in view was to ascertain the exact amount of inorganic constituents (especially silica and lime) which the leaves extract from the soil at different periods of their life, so as to determine whether this particular amount has any connection with the chemical composition, &c., of that particular soil. In all cases the entire leaf and petiole were used dried at 100° and then incinerated, the same vessel and the same source of heat being used for each separate incineration.

Leaves of	Date.	Percentage of crude ash.	Percentage of silica (SiO_2) and of lime (CaO) in the crude ash.	
			SiO_2	CaO
Beech	May 17	4·8		
,, ...	July 30	5	17	27·4
,, (brown)	Nov. 3	6·8	27·2	23·7
Oak	Aug. 17	5·8	12·2	29
,, (brown)	Nov. 3	6·8	14·5	37·5
Hazel	June 10	3·3		
,, ...	Aug. 4	5·7	6·2	26·8
,, (orange)	Oct. 27	6·3	15	28·6
Alder	July 29	4·9	1·8	31
,, (falling)	Nov. 1	5·7	1·7	33·6
Linden	May 30	5·5		
,, (yellow and brown)	Oct. 18	10·8	2·5	34·8
Ash	June 12	7·7		
,, ...	Aug. 2	6·7	1·5	37·7
,, (yellow)	Oct. 27	9·5	5·3	34·3
Elder	May 21	8·7		
,, (yellow)	Oct. 24	8·5	9·5	31·5
Scots pine (old leaves)	Aug. 19	2·5	9·4	15·9

On reviewing the foregoing table there would seem at first sight to be nothing remarkable therein; but a little collation and comparison serve to throw a more searching light upon the subject. All these trees and shrubs have sprung from a siliceous gravelly soil charged with basic constituents, but rather poor in lime (well under 12 per cent.). Nevertheless, the leaves of ash, alder and oak have managed to secure an amount of lime which may be regarded as nearly, if not quite, their full complement of that substance. The high proportion of lime in alder leaves may be referred to the very low proportion of silica; but this is hardly feasible in the case of the ash and oak. The ash-leaf, with a feeble proportion of silica, maintains a considerable quantity of potass and an amount of lime necessary to neutralise the organic acids which it produces in very notable degree. The oak-leaf, with far less potass in autumn, demands for the annulment of its organic acids (chiefly oxalic) a supply of lime apparently commensurate with its unique faculty for the production of starch. It will be specially observed that while, as indicated by the similar ratio of ash, the leaves of beech and oak have reached on November 3 a coequal measure of decay, that of the beech is evidently farther fallen. The leaves were selected for the experiment from beech trees flourishing right vigorously on the sandy shelving banks of the bays which indent the upper reach of Ullswater. The result was so remarkable that the experiment was repeated with every care and precaution, but the amount of silica remained as imperturbably high as before. The tree is a decisive alien in Lakeland and its seeds never ripen here, but in a sheltered situation on a sandy bottom it presents an aspect of unquestionable health and sturdy adaptation to the circumstances.

P. Q. KEEGAN.

Patterdale, Westmorland.

Note on a Point of Chemical Nomenclature.

THE use made by Mr. Goodwin and myself, in a recent communication to the Chemical Society, of the term *alphyl* is the occasion of an interesting letter from "A. T. de M.," published in NATURE (October 31, p. 648). The history of the term *alphyl* and its replacement by Prof. Vorländer's term *arryl*, or, better, *aryl*, the form in which it has been generally adopted, is correctly stated. In the interest of so important a matter as uniformity in chemical nomenclature I willingly agree with "A. T. de M.," and will adopt *aryl* instead of *alphyl* for monovalent aromatic hydrocarbon radicals (C_6H_5, $C_6H_4CH_3$, &c.).

But Prof. Vorländer goes further than this, and his view is advocated by "A. T. de M." He proposes to alter the well-understood meaning of the term *alkyl*, to retain the term *alphyl* with a new meaning and to introduce the combination *alpharyl*. These proposals seem to me not only confusing, but unnecessary. Let us retain *alkyl* in its old meaning, adopt *aryl* for monovalent aromatic hydrocarbon radicals and use *acyl* for all monovalent acid radicals. The terms *alkylene*, *arylene* and *acylene* might be adopted for the corresponding divalent radicals without introducing a new termination. For the radical benzyl and its homologues, if it be thought desirable, *ar-alkyl* could be employed.

ALFRED SENIER.

Queen's College, Galway, November 17.

Does Man use his Arms in Locomotion?

IN "Monkeys; Their Affinities and Distribution," by Dr. A. R. Wallace (reprinted in his "Studies; Scientific and Social," vol. i.), the author gives (p. 183) as one of the characters in which man *differs* from all the monkey tribe—"*the perfect freedom of the hands from all part in locomotion.*"

My object in writing is to point out the peculiar way in which the majority of people move their arms and hands when walking or running. One may safely say that everybody, adults and children, at one time or another exercise this movement. The natural way in which children run is to "paddle" with the arms and hands, though trained runners do not do so.

Now is it not possible that this muscular movement of the fore-limbs in opposite directions in the act of locomotion is a survival of the four-legged mode of progression of man's remote ancestors? The anthropoid apes, we know, get about by the aid of their arms and hands; while the baboons walk much in the same way as dogs do. The examples and illustrations could be enlarged upon indefinitely, and it is not for me to do so. I believe that this theory has been thought of before, but I am unable to find any trace of it in the books I have consulted. I should be very grateful if any of your readers would enlighten me on the subject.

BASIL W. MARTIN.

Elm House, Hampstead.

CELEBRATION OF THE JUBILEE OF M. BERTHELOT.

THE Berthelot jubilee, celebrating the fiftieth anniversary of the publication of Marcellin Berthelot's first scientific work, was held in the Great Hall of the Sorbonne, in the University of Paris, on Sunday, November 24. The President of the Republic, M. Loubet, was in the chair, surrounded by the Ministers of the Cabinet, the Ambassadors of the various countries in the French capital, and numerous delegates from foreign and from local scientific societies.

The hall, a large amphitheatre, capable of seating more than 3000 persons, was packed with those who delighted to do honour to M. Berthelot. Behind the daïs, in the

front of which the President was seated, is a large fresco representing Arts and Science; and round the amphitheatre there are niches containing busts of Robert de Sorbon, the founder of the Sorbonne, or University of Paris; of Richelieu, Pascal, Descartes, Lavoisier and Rollin—the *élite* of the Frenchmen who have exercised influence on French education and on arts and sciences. On the right of the President the band of the Garde Républicaine welcomed him with the Marseillaise, the audience all standing, and the proceedings began punctually at 10 a.m. They were opened by a discourse from the Ministre de l'Instruction publique, M. Leygues, who gave an impassioned address on the services which M. Berthelot had rendered to French education; he noted how the ubiquity of M. Berthelot's genius had led him to pay attention, not merely to scientific work, but also to extend his purview to the systems pursued in schools and to the primary and secondary education of French citizens. M. Darboux, sécretaire perpetuel of the Academy of Sciences, in a careful and well-delivered address, alluded specially to M. Berthelot's contributions to general science and to the recognition of his labours, testified by the international response to requests for subscriptions, and to the numerous societies and associations which had presented him with addresses. M. Darboux was succeeded by M. Fouqué, president of the Academy of Sciences, who echoed what M. Darboux had said and expressed the gratification of the Academy that one of its members, who had devoted his life to the pursuit of truth for its own sake, had, in receiving respect and recognition from the whole civilised world, conferred honour on the body of which he had so long been a member, and whose proceedings he had enriched by so many valuable contributions.

M. Moissan, now professor of chemistry at the Sorbonne, gave in his address an account in general terms of M. Berthelot's contributions to chemical science. As early as 1855 Berthelot's work on sugar, which led to the synthesis of formic acid and of alcohol, directed the attention of chemists, who had formerly regarded analysis as the chief aim and end of chemical work, to synthesis. Although the idea of a "vital force" had been attacked by Wöhler and Liebig, still Berthelot, by numerous brilliant syntheses, contributed more than anyone, during the decade 1855–65, to render the idea untenable. In this he was helped by his friends Pasteur and Claude Bernard, each of whom, at the later date, was laying the foundations of the work which rendered his name immortal. M. Moissan aptly remarked, in alluding to "vital force," "nous avons d'autant plus de théories que la chose est moins claire." Sketching rapidly Berthelot's work on acetylene, on explosives, on thermochemistry, on the absorption of nitrogen by plants, and his contributions to chemical history, he having translated and edited numerous Greek and Arabic writers on the subject, he concluded by the remark that, owing to the universality of his knowledge and attainments, M. Berthelot must be regarded as the last of the "encyclopædists." The address was concluded by the phrase, "Nous vous remercions pour nous avoir donné un peu plus de la verité."

M. Gaston Paris, one of the executive of the Collège de France, was the next speaker. He alluded to the long connection which had subsisted between M. Berthelot and the Collège de France. In 1851 he was recommended by Balard as deserving of the position of his "préparateur," or assistant. After eight years, however, he migrated to the École de Pharmacie, where, in 1865, he was made "Professeur titulé" of organic chemistry. Shortly after, however, he was recalled to his old home, the Collège de France, where he has remained ever since, in spite of numerous calls to accept more lucrative positions elsewhere.

After a few words from the president of the Academy of Medicine, Emil Fischer, the eminent professor of chemistry of Berlin, read an address in German from the Prussian Academy of Sciences, and at the same time presented one from the German Chemical Society; Dr. J. H. Gladstone followed, introducing first Prof. Ramsay, who, after a few prefatory remarks, read the address sent by the Royal Society, and next Prof. Emerson Reynolds, who presented an address from the Chemical Society, of which he is president; and lastly Dr. Gladstone handed in an address from the Royal Institution. Prof. Lieben, of Vienna, conveyed the congratulations of the Imperial Academy of Vienna; and Prof. Guareschi, those from the Academy of Turin. M. Troost, the former professor at the Sorbonne, read a list of academies and societies which had sent congratulatory addresses, so numerous that nearly a quarter of an hour was occupied by the mere recitation of the names; and concluded by reading a personal telegram from the King of the Belgians, conveying His Majesty's felicitations, and announcing that the Queen Regent of Spain had conferred on M. Berthelot the Grand Cordon of the Order of Charles III.

The following translation of M. Berthelot's speech in acknowledgment of the tribute to his genius and scientific work is from Monday's *Times*:—

I am deeply touched and really embarrassed by the homage which you are offering me to-day. These honours, I am aware, are not due merely to your affection for my person, I must attribute them also to my age, my long labours, and to certain services which I have been able to render to our Fatherland and to my fellow men. Your sympathy makes the lamp which is about to be extinguished in the everlasting night shine with a final brilliancy. The respect of humanity for old men is the expression of the solidarity uniting present generations with those that have preceded us and with those that are to follow. What we are, in fact, is only to a very slight degree attributable to our personal labour and individuality. We owe it almost entirely to our ancestors, ancestors by blood and our spiritual ancestors. If each of us adds something to the common domain in the field of science, of art, of morality, it is because a long series of generations have lived, worked, thought and suffered before us. It is the patient labours of our predecessors who created the science that you are honouring to-day. Each of us, whatever his individual initiative, must also attribute a considerable portion of his success to contemporary *savants* concurring with him in the great common task. In fact, no one—let us proclaim it loudly—no one has the right to lay exclusive claim to any of the brilliant discoveries of the past century. Science is essentially a collective work, prosecuted during the course of time by the efforts of a multitude of workers of all ages and every nation succeeding one another and associated by a tacit understanding for the search of pure truth, and for the application of this truth to the continuous transformation of the condition of all men.

Of yore *savants* were looked upon as a little group of amateurs and men of leisure maintained at the charge of the working classes, and executing a task of luxury and pure curiosity for the amusement and distraction of those favoured by fortune. This narrow and unjust view which paid so little heed to our devotion to the truth and our services, this prejudice, finally disappeared when the development of science showed that the laws of nature were applicable to the practice of industries, and had as a consequence the substitution for the old traditional and empirical receipts of the profitable rules of the theories based on observation and experience. To-day who would venture to regard science as a sterile amusement in presence of the general increase of national and private wealth which results therefrom? To confine ourselves to mentioning the most interesting perhaps of the services which science has rendered, it suffices to compare the servile and miserable condition of the popular classes in the past as revealed to us by historical documents with their condition at present, already so advanced in dignity and well-being without counting the just hopes of which they are pursuing the realisation. Is there a statesman who doubts the services, greater still, which are to be looked for as the result of this incessant progress? Science

is the benefactor of mankind. Thus it is that the tangible utility of scientific results has convinced the State that laboratory work should be encouraged and sustained, because it is economically a benefit to all, and for the public health. Science carries still further its legitimate pretensions. It claims to-day at once the material direction, the intellectual direction, and the moral direction of human society. Under its impulse modern civilisation marches with a more and more rapid stride.

Since the first half of the century that has just gone by, not to go further back, the world has strangely changed its face. Men of my generation have beheld coming on the scene by the side of and above that nature which had been known since antiquity, if not an antiphysis, a counter nature, as is sometimes said, yet a superior and in a way transcendent nature where the power of the individual is multiplied a hundredfold by the transformation, hitherto unknown or not understood, borrowed from light, magnetism and electricity. Nor is this all. Let us rise to a loftier and more fruitful range of ideas. From the deeper knowledge of the universe and the physical and moral constitution of man there results a fresh conception of human destiny governed by the fundamental ideas of human solidarity between all classes and all nations. In proportion as the ties uniting the peoples are multiplied and made tighter by the progress of science and the unity of doctrines and precepts which science deduces from the facts which it notes and which it imposes without violence, yet relentlessly, upon all convictions, these ideas have assumed a growing and more and more irresistible importance. They are tending to become the purely human bases of moral life and of the politics of the future. Hence the *rôle* of *savants* as individuals and as a social class has constantly grown in modern States.

But our duties towards other men grow at the same time, let us never forget that. Let us proclaim it in this enclosure, in this palace of French science. It is for no selfish satisfaction of our private vanity that to-day the world does homage to the *savants*. No! It is because it is aware that a *savant* really worthy of the name devotes a disinterested life to the great work of our epoch, I mean to the amelioration, too slow, alas, to our mind, of the lot of all, from the rich and fortunate to the humble, the poor, the suffering. This was what nine years ago in this very hall the State and the authorities affirmed by honouring Pasteur. This is what my friend Chaplain has sought to express on this fine medal which the President of the Republic is to offer me. I know not if I have completely fulfilled the noble ideal traced by the artist, but I have striven, at all events, to make it the object and the end, the governing aim of my existence.

The medal (or rather *plaque*) with suitable inscription was then presented to M. Berthelot by M. Loubet, the President of the Republic, and, according to continental fashion, the ceremony was concluded with a fraternal embrace.

Such is a brief account of the proceedings at this very interesting ceremony; and one is led to seek for analogies in our own country. The Kelvin jubilee at Glasgow and the Stokes jubilee at Cambridge may be cited as events of a similar character; but in France the ceremony appeared to be of greater national importance, owing to the presence of the Head of the State, the Ministers and the Ambassadors. In his reply M. Berthelot alluded humorously to the former position of science; it was regarded as a harmless pursuit, carried on by amateurs and men of leisure at the charge of the working classes, for the amusement and distraction of those favoured by fortune; it has now become one of the most potent influences for civilisation that the world has known, and will ever retain that position. Is it possible that in England the former view of science still retains some hold on the people, and that in France this aspect of science has long been outlived? Whether this be so or not it is certain that all Englishmen will join with the whole French nation in congratulating M. Berthelot on the completion of so many years of work, and will wish him health and a long life during which he may enrich the world by further investigations into the wide domain of Nature.

BERTHELOT, AND THE METALS OF ANTIQUITY.

THE metals of antiquity are among the many subjects which, from time to time, have been studied by M. Berthelot. It is principally by two different methods that he has investigated the matter: (1) the writings of ancient alchymists, (2) the analysis of metallic objects sent him by modern explorers. In 1885 Berthelot published a handsome volume, "Les Origines de l'Alchimie," in which he described his researches among the Greek papyri, and the still older documents of the Egyptian, Chaldean, Jewish, Gnostic and Chinese philosophers. In succeeding years he brought out several volumes under the title of "Collection des Anciens Alchimistes Grecs," under the auspices of the Minister of Public Instruction.

By far the most important for the present purpose is the collection of papyri at Leyden. The Papyrus X is more especially chemical. It dates from the end of the third century, but contains the lore of earlier times. It is described in fairly full detail in the *Annales de Chimie et de Physique*, 1886, vol. ix. Berthelot shows that the earlier alchemy was not founded upon purely chimerical fancies, but rests upon positive experiment, by which the adepts made imitations of gold and silver and precious stones, or taught how to increase their weight. In interpreting these ancient writings we are met with a great difficulty in fixing the meaning of the terms used for the metals and gems and the preparations made from them, the vagueness of the language being augmented by the idea that these substances were susceptible of transmutation into one another, and also by the Platonic doctrine of a primary matter from which everything may be derived. In this particular papyrus there are no less than 101 receipts for making gold, asèm (electrum), silver, &c., and the processes to be adopted. These are described by Berthelot as being genuine and definite, and not overlaid with fanciful notions; but the later philosophers and commentators were strangers to practical work and governed by mystic ideas: thus there was supposed to be a connection between the seven known metals and the seven planets, seven colours and seven transmutations. The later alchymists threw their energies into the search after the philosopher's stone which was to transmute baser metals into gold.

More important, perhaps, than his studies of the ancient manuscripts has been the prominent part which Berthelot has taken in examining chemically the metallic objects which have been unearthed by the great explorers of the present day. These researches are being carried on over the greater part of the countries bordering the Mediterranean and extending to the Persian Gulf. It is hardly necessary to say that they are enabling us to picture to ourselves these great nationalities of old in a way that was never before possible. The part that Berthelot has taken is not that of an explorer, but that of a scientific analyst; and it has been mainly confined to the metals employed in these ancient civilisations. He commenced by examining different Assyrian objects from ancient Chaldæa, some from the palace of Sargon at Khorsabad, others from the mounds of Tello excavated by M. de Sarzec, now in the museum of the Louvre. M. Place had found in the palace of Sargon a stone coffer containing votive tablets, covered with cuneiform inscriptions giving the date of foundation of the palace as B.C. 706. Of the four now in the museum of the Louvre, one is of gold, another of silver, a third of bronze and the fourth of the rare mineral crystallised carbonate of magnesia. Judging from the inscriptions two of the other tablets are believed to have been of lead and tin. The discoveries at Tello consisted of a vase of antimony, a metal which had subsequently been lost sight of for many centuries; a tablet of metallic copper, much corroded, but free from tin; and a little figure of pure copper, bearing the name

of King Gudea, which fixes its date somewhere about 4000 years before the Christian era. This led Berthelot to speculate why these specimens were made of copper instead of the harder bronze, which, so far as his experience had then gone, was used by all the ancients. He applied to Maspero for some specimens of the oldest copper of which the date could be identified. Maspero recommended to him the so-called sceptre of Pepi I., an Egyptian king of the sixth dynasty, 3500–4000 B.C. This was in the British Museum, but, through the good offices of M. Waddington, it was placed in the hands of M. Berthelot with permission to analyse a small portion from the interior. It proved to be of pure copper. It was a natural supposition that tin was unknown in that remote age; and this was confirmed by the discovery in Chaldæa of some little figures serving to support votive tablets, associated with bricks that bore the name of King Ourmina, who is supposed to have reigned 4000 years B.C. They were also of copper, without either tin or zinc.

In the meantime Prof. Flinders Petrie had been carrying on his excavations in Egypt and had asked me to analyse some copper tools and utensils from early tombs and other ruins. They proved to contain little or no tin, though many of them contained arsenic. Evidence of the gradual transition from the use of pure copper to that of copper alloyed with tin was accumulating from various quarters, but the most striking, perhaps, was that furnished by Tell el Hesy, the Lachish of scripture. It was explored by Mr. F. J. Bliss, and is described in his book entitled "A Mound of Many Cities." The lower portion of this mound represents the Amorite city, dating about 1700 B.C.; it contained large weapons of war made of copper without admixture of tin. Above this are the remains of the Israelitish city, where the copper is replaced by bronze, till in the upper layers of the mound the bronze is gradually replaced by iron. Greece has also furnished its contributions. The analyses of Roberts-Austen, Damour and others had shown that the implements first used at Tyryns, Mikenai and other towns were of copper with little, if any, admixture of tin; and similar evidence is coming forward from Cyprus, Crete and other quarters. At Hissarlik, the reputed Troy, the analysis of the objects found in the first and second cities showed that they were made of copper with mere traces of tin, while in the third and more recent cities the copper was mixed with varying amounts of tin, from 4 to 8 per cent. or thereabouts.

These researches were followed by an important paper in the *Annales* of 1895, in which Berthelot discussed the nature and origin of the metals employed by the ancient Egyptians of various epochs, especially copper, tin, gold and silver. The general result was that up to the sixth dynasty the copper used was practically what they obtained from the ores; after this the copper was mixed with small quantities of tin, rarely exceeding 6 per cent. At about the twelfth dynasty 10 per cent. became the usual proportion, forming a very serviceable bronze, but occasionally as much as 16 per cent. was used.

In the same paper he investigates the cause of the "sickness" of copper objects in our museums. They often fall to pieces through the formation of atacamite, a cupric oxychloride. This is started by the presence of chloride of sodium in the soil and the carbonic acid and oxygen of the air, and is a curious and complicated case of continuous chemical action.

It became a matter of interest to explore the ancient workings for copper, turquoise and hæmatite in Wady Maghara in the Sinaitic peninsula, which is known to have been a source of supply in the time of the third Egyptian dynasty. M. de Morgan made a careful search, at M. Berthelot's instigation, and found not only specimens of the ores, but also remains of the tools that had been used. The mines are believed to have been abandoned about the time of the eighteenth dynasty, in consequence of the poverty of the ores. The tools were of copper, hardened sometimes by a little tin and at other times by arsenic.

More recently Berthelot has examined some copper objects found at Tello, believed to be of very high antiquity. One was a huge lance of very red metal, the others were adzes and hatchets. They were almost pure copper. It may be an open question whether any attempt was made at this period to harden copper by the introduction of other metals.

From the palace of Sargon there were also obtained objects of gold foil, which was not adulterated with copper or lead, but contained a considerable amount of silver; this, however, may simply indicate that as native gold commonly contains more or less silver, it had been used in the state in which it was found without any intentional admixture. Berthelot also tested some gold objects from Egypt, the one dating from the sixth and the other from the twelfth dynasty, and found the amount of silver varied from 3·2 to 4·5 per cent., while the gold of the Persian period was practically pure.

But a more ancient chapter of Egyptian archæology was opened by the recent researches of M. de Morgan, late Director-General of Antiquities in Egypt. He explored an enormous tomb of a very ancient king, which he supposes to be that of Menes, of the first dynasty, approximately 4400 B.C. Among the objects found here were a long bead and two or three other morsels of metal, which M. Berthelot certifies to be of gold, together with some articles in copper. Further explorations at or near Abydos, by M. Amélineau, have shown the existence of tombs of kings about the same period containing many copper utensils, which M. Berthelot found to be of almost pure metal, but sometimes containing a little arsenic.

These tombs are now being very carefully explored by Prof. Flinders Petrie, and the results are published by the "Egyptian Exploration Fund" in three large volumes, "Diospolis Parva," and "The Royal Tombs of the Earliest Dynasties," parts i. and ii. It would appear that in these prehistoric times the metals mostly used were gold and copper; objects made of silver and lead are found, but they are rare.

As gold occurs native and is of a striking colour, we need not wonder that it attracted the attention of men in the very earliest periods. It is astonishing the large amount of exquisite gold jewellery, inlaid with gems, that has been found, not only in the tombs of Queen Ahhotpu and of the four princesses buried at Dahshur about 2350 B.C., but in these far more ancient royal tombs. In one of them Flinders Petrie found four gold bracelets encircling the arm bone of a royal personage, presumably the wife of King Zer. These are made of gold, set with turquoises and amethysts, and so beautifully wrought that the soldering cannot be detected by the eye. My analysis of the gold foil found in three of these tombs showed that it contained about 13 per cent. of silver, and was evidently the pale gold commonly known in the Levant. The gold worked in the Nubian mines appears to have been of a purer quality.

The last paper that has been communicated by Berthelot contains a description of a very curious case, or shrine, found at Thebes. It is of the time of Queen Shapenapit, daughter of King Piankhi, who lived in the latter part of the seventh century B.C. This inlaid case is remarkable as containing, in addition to the ordinary metals of the time, a small piece of crude platinum, weighing between five and six milligrammes. It had evidently been worked with the hammer, and had probably been mistaken by the artificer for silver.

Though not himself one of the explorers in the field, Berthelot must ever be remembered for the important part he has taken in drawing attention to, and interpreting the results of their wonderful discoveries.

J. H. GLADSTONE.

THE USE OF THE WIRE SAW FOR QUARRYING.

PROF. C. LE NEVE FOSTER has conferred a great benefit on the Welsh mining industry by directing attention to a new method of slate-mining recently tried in the Pyrenees. At Labassère the wire saw is employed to make horizontal cuts across the inclined beds of slate, severing off great blocks without blasting. Believing that a similar system could be employed with advantage in North Wales, Prof. Le Neve Foster recommended that Mr. G. J. Williams, H.M. Assistant Inspector of Mines, should study the question on the spot. The Home Secretary having acceded to this suggestion, Mr. Williams has drawn up a very valuable report, which is published as an appendix to Prof. Le Neve Foster's annual report to the Home Office for the year 1900. The investigation clearly shows that slate might be worked in many quarries in North Wales by the wire saw method with conspicuous advantages. There would be lessened blasting, fewer falls of ground, less waste of good rock, reduced cost of working, less cost of explosives, a saving in the cost of unproductive work, a saving in the cost of removing rubbish, no need of quarrying worthless rock in underground workings, and the cost of examining and securing the roofs and pillars would be done away with.

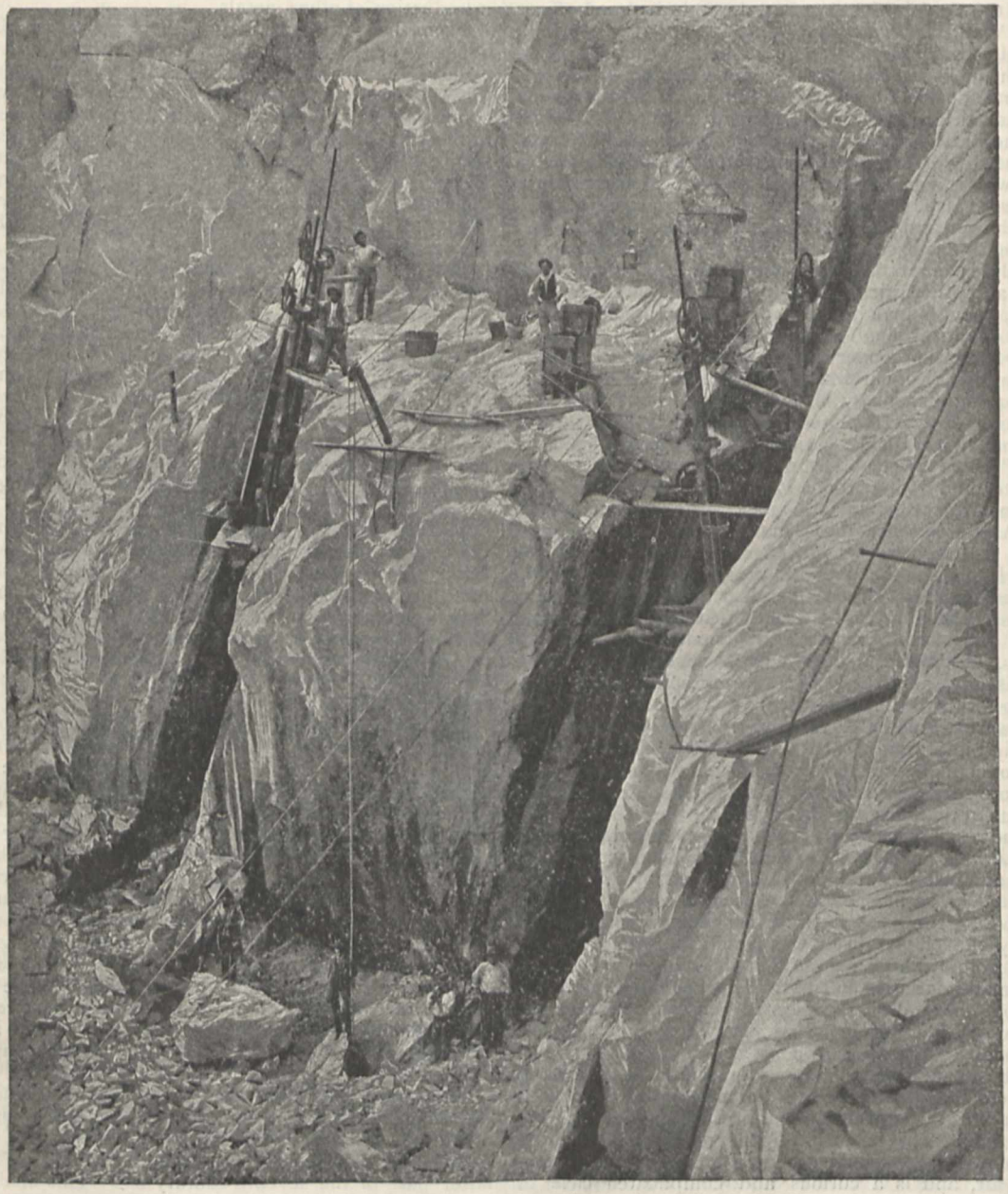

FIG. 1.—Use of the wire saw at Carrara.

The helicoidal wire saw has been employed for quarrying marble in Belgium and in Italy for some years. It is an endless cord, composed of three hard wires twisted together, which is made to travel along by machinery and

is fed continuously with sand and water, the sharp particles of sand gradually cutting a groove. As the groove is deepened the cord must necessarily be kept applied to the rock. This is effected by guiding-pulleys mounted in pits sunk at the ends of the proposed cut. These pulleys must be at least 20 inches in diameter, and the pits somewhat larger. For sinking these pits there are employed in some Belgian quarries a rotative borer composed of a steel tube cutting an annular groove. The wire saw was applied at Carrara for subdividing blocks of marble, but the impracticability of using the revolving cylinder or hand labour for sinking inclined pits was an obstacle to its further use. The difficulty was, however, overcome by Mr. A. Monticolo, who invented an ingenious appliance which he termed a penetrating pulley, with which it is possible to replace the somewhat costly pit by a bore-hole 3 inches in diameter. The penetrating pulley consists of a disc 20 inches in diameter and ¼ inch thick, with a semicircular groove round its periphery deep enough to take half the thickness of the wire, the other half projecting. The disc is mounted on a pivot and is supported by a hollow steel shaft of slightly smaller diameter than the bore-hole. To the shaft is attached a series of tubes of equal diameter forming a column that may be lengthened at will, in the interior of

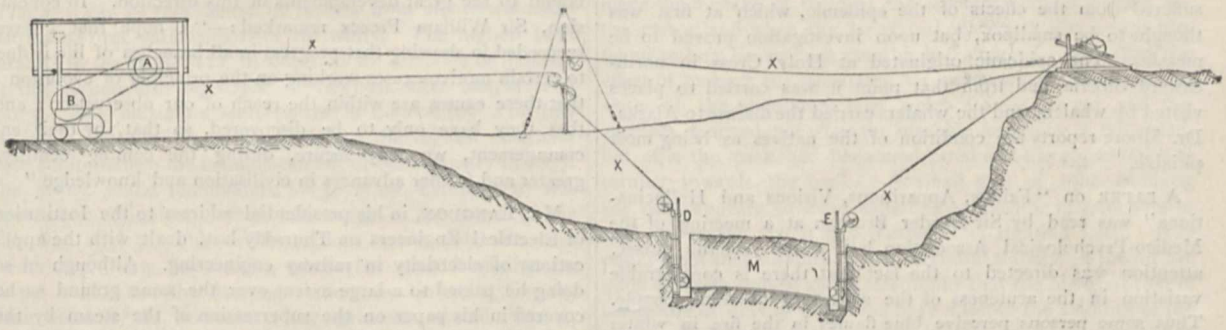

FIG. 2.—Installation of the helicoidal wire saw at a quarry. ×, helicoidal wire; A, fixed pulley; B, motor; C, tightening arrangement; D, E, wire saw and grinding pulleys; M, block of marble being quarried.

which is a fine tube serving for the lubrication of the pivots. As the cut deepens the pulley is fed down automatically by means of an eccentric. For cutting a groove, two bore-holes, to receive the shafts carrying the axes of the pulleys, are first made by hand or by the diamond drill.

The pulley was first applied in March 1898 at the Campanile quarry, Carrara, where cuts have been made 50 feet long and 16 feet deep, inclined at an angle of five degrees from the horizontal. The highly satisfactory results obtained with the penetrating pulley serve to show that there is a great saving of expense by the substitution of bore-holes for pits, far less waste of valuable marble, and increased rapidity of quarrying and consequently increased output.

Almost simultaneously with the publication of Mr. Williams' report, the *Revue Générale des Sciences* published an exhaustive article by Mr. J. Boyer on the present condition of the French marble industry. This article is profusely illustrated and contains a large amount of information relating to the use of the wire saw. From this article the two illustrations accompanying this note have been borrowed.

NOTES.

DR. F. MCCLEAN and Sir John Murray, whose names were included in the list of the new Council of the Royal Society given in NATURE of November 14, are unable to serve; and the two Fellows recommended for election in their places are the Right Hon. Sir John Gorst and Prof. H. H. Turner.

SIR WILLIAM ROBERTS-AUSTEN, K.C.B., F.R.S., will deliver the tenth "James Forrest" lecture at the Institution of Civil Engineers on April 17, 1902, the subject being "Metallurgy in Relation to Engineering."

THE governing committee of the Allegheny Observatory has decided to erect a 30-in. reflector at that institution as a memorial to the late Prof. Keeler. As it is expected that the funds subscribed will exceed the estimated cost of the instrument (2000*l.*), the balance will be used either to found a general fellowship for the study of astrophysics, or the award of a Keeler medal for work in the same field.

THE Royal Society of Public Medicine of Belgium has awarded Prof. Corfield, of University College, London, its bronze medal in recognition of his devotion to public health work.

A SUCCESSFUL kinematograph of the Severn bore was exhibited by Dr. Vaughan Cornish at the meeting of the Royal Geographical Society on Monday. This is, we believe, the first time that the impressive movement of a tidal bore has been recorded by photography and the phenomenon reproduced before an audience by a series of moving pictures.

A NEW Highland meteorological station has been established at Achariach in Glen Nevis, 4¾ miles S.E. of the Low Level Observatory at Fort William, and 2¼ miles S.W. of the observatory on Ben Nevis. The station is about 150 feet above sea-level, and the observations in the valley will be especially interesting in connection with the study of descending currents of cold air from the glens in the vicinity.

THE Council of the Royal Meteorological Society has designated Dr. Alexander Buchan, F.R.S., as the first recipient of the Symons gold medal in recognition of the valuable work which he has done in connection with meteorological science. This medal, which is to be awarded biennially, was founded in memory of the late Mr. G. J. Symons, F.R.S., the distinguished meteorologist and originator of the British Rainfall Organisation. The medal will be presented at the annual meeting of the Society on January 15, 1902.

A REUTER telegram announces that the *Gauss*, with the German Antarctic Expedition on board, arrived at Cape Town on Saturday morning, after being six weeks overdue. After leaving Hamburg on August 11 the *Gauss* touched at Las Palmas, and St. Vincent Islands. Deep-sea soundings were taken towards the west, but the ship did not go so far as the American coast. The *Gauss* was under sail the whole time, and the scientific observations made are said to be most satisfactory. The vessel will remain at Cape Town for ten days, and will then proceed to Kerguelen Island.

ON Monday evening M. Santos Dumont was entertained at dinner by the Aëro Club of the United Kingdom. The chair was taken by Major-General Lord Dundonald, and among the company present were the Brazilian Minister, Lord Suffield, Sir Norman Lockyer, Colonel Templer, director of military ballooning, Sir J. Crichton Browne, Prof. D. S. Capper, Colonel R. E. B. Crompton, R.E., Sir V. Kennett-Barrington, Prof. John Perry, Dr. Boverton Redwood, the Hon. C. S. Rolls and Mr. R. W. Wallace. In acknowledging the toast of his health, M. Santos Dumont said that he hoped in a few months' time to make some trials with a dirigible air-ship above London.

AN illustration of the way in which a disease present in one species or race in a mild form may produce most severe effects when introduced into a region inhabited by another race, has been sent to us by Prof. T. D. A. Cockerell. It appears from trustworthy reports that the natives of western Alaska are rapidly disappearing from the effects of an epidemic of measles. Dr. Moore, assistant surgeon of the United States quarantine service, states that at least one-third of the native population at Cape Prince of Wales, Nome, Port Clarence, St. Michael, Kuskokwim, Unalaska, Pribyloff Islands, Nunivak Island and St. Lawrence Island, and those along the Yukon River, have suffered from the effects of the epidemic, which at first was thought to be smallpox, but upon investigation proved to be measles. The epidemic originated at Holy Cross in north-eastern Siberia, and from that point it was carried to places visited by whalers, and the whalers carried the disease to Alaska. Dr. Moore reports the condition of the natives as being most pitiable.

A PAPER on "Fairies, Apparitions, Visions and Hallucinations" was read by Sir Lauder Brunton at a meeting of the Medico-Psychological Association last week. At the outset, attention was directed to the fact that there is considerable variation in the acuteness of the senses of different people. Thus some persons perceive blue flames in the fire in winter and some persons hear the shrieks of bats, whilst others are sensible of neither. In the same way there are people who feel things which others do not feel. Apparitions are probably due to abnormal conditions of the apparatus required for the reception of external impressions. The vessels inside the brain may be capable of contraction, like those outside, and in that case there would be anæmia of parts of the brain and consequently affections of vision, hearing, smell and taste. Epilepsy is connected in the minds of psychologists with migraine. In many people migraine is preceded by a vision of zigzags, rather like a procession. A troop of spirits in this form appears in Doré's illustrations to the "Inferno." It was suggested as not unlikely that both Dante and Doré suffered from headache of this kind. Stories of fairies might partly be referred to visions as well as to the aboriginal race mentioned by Prof. Rhys. Speaking of Mahomed, Sir Lauder Brunton described his visions, trembling fits and convulsions, and said it was curious to speculate how different might have been the course of the world's history if the prophet had been thoroughly dosed with bromide of potassium.

SIR WILLIAM PREECE, K.C.B., F.R.S., covered a wide field in the address which he delivered on November 20 at the opening of the new session of the Society of Arts. He surveyed the most prominent points of scientific progress during the nineteenth century, and from the trend of advancement suggested some developments of the immediate future. The great scientific discoveries of the past century dealt with in the address were (1) the principle of evolution; (2) the atomic structure of matter; (3) the existence of the æther and the undulatory theory of light; (4) the principles of electromagnetic induction and electrolysis; (5) the principle of the conservation of energy. Limitations of space prevent us from printing the address in full, but the following are a few extracts from it. The trend of research at the commencement of the twentieth century is to prove that the basis of all matter is fundamentally the same, and that the true atom has not yet been reached.—The criterion of true advance in knowledge is the possession of standards and of means of accurate measurement. We commence the twentieth century remarkably well equipped with both these requisites. The engineer has only to take care of his "Joules," or units of energy, and his machines will take care of themselves.—The only excuse for disaster due to magnetic disturbance is ignorance. The stars are always with us for guidance and comparison. Magnetic science must be maintained by well-equipped laboratories, by continuous observations, by the distribution of reports and by up-to-date records and corrections of charts. We seem to have learnt all we can of magnetism, and we commence the twentieth century without any indication of a new directing force. We have local magnetic disturbing elements to measure, and certain dangers due to storms, snow, rain and fog to remove. We want better warning of approach to land, and better communication between ship and ship and ship and shore. The twentieth century is bound to see great developments in this direction. In conclusion, Sir William Preece remarked:—"I hope that I have succeeded in showing that progress in all branches of life is due to certain motive causes working on the principle of evolution; that these causes are within the reach of our observation; and that they have only to be discovered, so that, by their encouragement, we may secure, during the coming century, greater and further advances in civilisation and knowledge."

MR. LANGDON, in his presidential address to the Institution of Electrical Engineers on Thursday last, dealt with the applications of electricity in railway engineering. Although in so doing he passed to a large extent over the same ground as he covered in his paper on the supersession of the steam by the electric locomotive in November 1900, he treated the subject from a more general and less technical standpoint. Hitherto electricity has played a small, but indispensable, part in the working of steam railways, for telephone, telegraph and lighting purposes; but Mr. Langdon realises that the problem of the conversion of our steam railroads is one pressing for immediate attention. The magnitude of the railway interests is so enormous that it is necessary to give the question the most careful consideration, or disastrous results may accrue. The reckless investment of capital in electric railways to compete with existing lines is not likely, Mr. Langdon points out, to be profitable for shareholders in either concern, and he seems to deprecate competition of the kind foreshadowed by the projected new electric railway between Manchester and Liverpool. It is, however, for the railway companies themselves to show that they are on the alert and are prepared to meet the growing demands of the country; for if the necessary reform does not come speedily from within, it is they, we think, who will be likely to suffer disaster. Electrical engineers have before them a work compared with which their past achievements are but trifling; in carrying it out let them by all means go carefully, but do not let them consider that synonymous with going slowly.

AMONG the notes in *The Engineer* (November 22) a remarkable motor-car performance is recorded. M. Fournier, the well-known French motorist, drove a 40-horse-power petrol car one mile in 51⅘ seconds, approximately 70 miles per hour. The tract was a straight and level piece of road known as the Ocean Parkway, New York.

A PAPER of much interest on the balancing of locomotives has just been read before the Institution of Mechanical Engineers

by Prof. W. E. Dalby. As is well known, although there are some engines with their reciprocating and revolving parts *unbalanced*, the counterpoising of the various parts forms a most important item in the designing of the engine, and a point which, if neglected, is afterwards easily discernible on the footplate. The paper, which is divided into nineteen separate articles, deals with the subject in a very lucid manner, and each article is thoroughly treated. We find taken as examples two typical English engines (a passenger and goods on the L. and Y. Railway) and an 8-coupled engine, class E Baldwin Company of America. In the article in which the distribution of the reciprocating mass between the coupled wheels is discussed, three figures are of special interest, being diagrams showing: (1) All revolving mass and two-thirds reciprocating mass in driving-wheel (only); (2) all revolving mass and two-thirds reciprocating mass equally distributed (on all wheels); (3) all revolving mass and all reciprocating mass equally distributed (on all wheels). In dealing with four-cylinder locomotives the author points out how balancing can be effected without the use of balance weights attached to the wheels, by properly proportioning the "masses" and "crank angles."

Symons's Meteorological Magazine for November contains a summary of the climate of the British Empire for the year 1900, so far as it can be represented by reports from eighteen stations distributed over various parts of the world. The highest temperature in the shade (112°·2) occurred at Adelaide on January 1; this station also registered the highest solar temperature, 170°·5. The maximum temperatures at London (95°·2 on July 16) and Toronto (98°·0 on August 6) are the highest noted for these stations since the commencement of the summary in 1877. The lowest shade temperature (−34°·8 on February 9) was recorded at Winnipeg, where the range in the course of the year was 135°·3. The driest stations were Adelaide and Fredericton (New Brunswick), where the mean humidity was 66 per cent., and the dampest station was Colombo, Ceylon, mean humidity 81 per cent. The greatest rainfall was at Calcutta, 89·3 inches, and the least at Malta, 16·1 inches.

THE pilot chart of the North Atlantic and Mediterranean for the month of December, just issued by the Meteorological Office, shows that there were still a few icebergs on the edge of the bank eastward of Newfoundland as late as October. On the great circle track to Belle Isle, and also within the Strait, there has been a perceptible diminution in the quantity of ice reported, so that from the scores of bergs sighted about July and August they have now dwindled to an occasional one. It is, however, interesting to notice in this connection that the Dundee whalers recently returned from Davis Strait report much ice blocking up the west side of the strait and drifting southward last summer, while in the early part of October what was probably a portion of the same ice was reported to be sweeping down along the Labrador coast in great quantities. There is thus some probability of the next ice season off the Newfoundland coast being an early one. Realising the importance to the mariner of a clear understanding of the laws governing the movements of cyclonic disturbances—how he should combine his observations of the wind direction with the barometric variations to obtain, under all circumstances, a fair idea of his position in the storm field, and to ascertain approximately the line of progression of the central part of the system—the article on Atlantic storm systems published in one of the earlier charts is reproduced at the commencement of the season of winter storms. An inset chart illustrates the conditions obtaining over north-western Europe during the north-westerly type of weather, that of December 1895 being in the ascendent for more than a fortnight. At this season the winds of the Mediterranean region are shown to be influenced by disturbances which follow two well-defined paths, one from the Bay of Biscay to Sardinia and away to Cyprus, the other taking a north-easterly course from about Gibraltar to Corsica and across Italy to Dalmatia.

MR. HALCOTT C. MORENO has published in the *Proceedings* of the American Academy of Arts and Sciences a paper on ruled loci in n-fold space. Corresponding to a developable and its edge of regression in ordinary space, we have the loci derived from a flat of $n-1$ dimensions whose equation involves a single arbitrary parameter, these loci representing the ultimate intersections of two, three or more flats of the family. In like manner loci corresponding to ruled surfaces are obtained from an $n-2$ flat whose equations involve a single parameter, and the further case is considered of an $n-k$ flat also involving a single parameter. Several of the conclusions obtained are analogues of results given for three-dimensional geometry in Salmon's well-known treatise.

THE accident to the aëroplane machine with which Herr Kress has been experimenting on the reservoir of the Vienna waterworks forms the subject of a critical article in the number, for November 16, of *Die Umschau*, a paper which has previously given several well-written articles on this and other systems of experimenting in aërial navigation. Herr Kress made the mistake of building the machine without waiting for the motor, and when the latter was at length obtained it was found to be a heavier one than he had ordered. This had the effect of making the apparatus top-heavy when sailing on the water on the aluminium boat which formed its car, and the accident occurred, not when the machine was going at full speed, but after the pace had been moderated and the apparatus was turning towards the bank. A small gust of wind catching the sails appears to have caused the machine to heel over to such an extent that it was incapable of righting itself. It is pointed out that stability in the water and stability in the air are quite different things, and Kress thinks that the high position of the centre of gravity would not have affected the stability of the machine if it had been supported in the air by its wings, nor would a side wind have had the same power of overturning it.

IN a recent issue of the *Proceedings* of the American Academy of Arts and Sciences (vol. iii. p. 507) Mr. E. C. Starks gives a complete list of the numerous synonyms which have been applied to the component bones of the fish-skeleton. It may be hoped that naturalists will agree to adopt the names selected by the author as the best designations of the individual bones.

TO the November issue of the *Zoologist* Capt. G. E. H. Barrett-Hamilton communicates a further note on the origin of sexual dimorphism and of nuptial weapons and ornament. In the same journal Mr. F. Cohern narrates his experiences during a bird-collecting trip to the north of Iceland, with a list of the species obtained. He speaks of the extraordinary abundance and tameness of the birds, and believes that he has obtained a new form of pipit, although this opinion does not appear to be shared by his fellow ornithologists.

THE August issue of the *Boletim* of the Para Museum contains a paper by Dr. E. Goeldi on two Brazilian rodents, one of which (*Blarinomys breviceps*) was first described from its fossil remains, but is now known also by a single recent example. The same author gives an illustrated description of the gigantic catfish of the Amazons locally known as the piraïba. In assigning to this fish a new scientific name (*Piratinga pira-aïba*) the author states that in its young state it has long since been described by Lichtenstein as *P. filamentosa*. If this be so, the new title seems superfluous.

THE whole of part iv. of vol. xiii. of the *Journal* of the College of Science of Tokio is occupied by an elaborate dissertation on the development, structure and metamorphosis of

that remarkable organism described in the larval form by Jahannes Müller in 1846 as Actinotrocha, and in the adult state by S. Wright in 1856 as Phoronis. The identification of the free-swimming Actinotrocha as the larva of the compound and stationary Phoronis is one of the discoveries for which science is indebted to Kowalewsky; but the question still remains undetermined whether the organism should be placed with the Gephyrean worms or with the Hemichordata. In spite of the numerous papers which have been devoted to this curious form, the author, Mr. Iwaji Ikeda, states that its life-history has hitherto been very imperfectly worked out, and it is to this that he has devoted much of his attention. Another point is the manner in which the free-swimming larvæ establish colonies in certain definite and limited localities. From the fact that the colonies are subject to periodical decay it is suggested that the organism annually changes its generation. It may be remarked that although in the title of the paper the name Actinotrocha is employed, in the text the family is alluded to as the Phoronidæ, while various species of Phoronis are mentioned.

NUMBER 12 of Sir George King's "Materials for a Flora of the Malayan Peninsula," reprinted from the *Journal* of the Asiatic Society of Bengal, is occupied entirely by the eleven genera of Myrtaceæ, including the ninety-six Malayan species of Eugenia.

WE have received the first three numbers of the *Bulletin* of the Imperial Botanic Garden of St. Petersburg, edited by Prof. A. Fischer v. Waldheim. The *Bulletin* is intended to appear at irregular intervals and to be devoted to original treatises, not before published, in all branches of botany, critical notices, and reports and communications from the Imperial Botanic Garden. In the present instalment the papers are in Russian, with brief French or German abstracts. They include articles on the Exoascaceæ of the Caucasus, "migrating lichens," biological observations on buckwheat, lichenological notes, &c.

THE origin and distribution of the cocoanut palm forms the subject of an interesting paper by Mr. O. F. Cook in a recent issue of the United States National Herbarium. It is contended that this most useful tree must have originated on the Pacific coast of South America and spread from thence to Polynesia and Asia. It is pointed out that all the other species of cocos are natives of South America. The cocoanut palm was found upon the Pacific coast by early Spanish explorers. Mr. Cook also claims an American origin for the banana and yam.

A RECENT number of the Australian *Town and Country Journal* is largely occupied with an illustrated account of the new mining school recently opened in connection with Sydney University. The erection of this school is largely due to the exertions of Prof. A. Liversidge, F.R.S. It is now well equipped with machinery and laboratories, and should prove of great value for training men to conduct metallurgical operations. The University of Sydney grants a degree in mining engineering, and the course of instruction given at the school is mainly in preparation for this degree.

LIEUT.-GENERAL C. A. MCMAHON contributes notes on some peridotites, serpentines, gabbros and associated rocks from Ladakh, north-western Himalaya, to the Memoirs of the Geological Survey of India (vol. xxxi. part iii.) These rocks are found intrusive in the Tertiary volcanic series. Mr. Vredenburg (vol. xxxii. part i.) discusses very fully the results of recent artesian experiments in India, pointing out that many of the so-called "artesian wells" are not fed by water under pressure. He gives records of numerous borings and concludes that artesian wells cannot be of utility in any extensive scheme of irrigation. Mr. T. H. Holland (vol. xxxiv. part i.) draws attention to a peculiar form of altered peridotite in the Mysore State, whereby a simple dunite has been changed into a breunnerite-picrolite-talc rock. He remarks that it is important to distinguish between this "primary" or contemporaneous alteration, due to the action of vapours originally contained in the magma, and the "secondary" changes that may be induced subsequently and are unconnected with the processes of consolidation.

THE publication of a ninth edition of "Stieler's Hand-Atlas" has been commenced by Mr. Justus Perthes, Gotha. The work will be issued in fifty parts, which will appear at intervals of two or three weeks.

PROF. ANDREW GRAY'S work on "Dynamics and Properties of Matter," being Part i. of his "Treatise on Physics" (J. and A. Churchill), is shortly to appear in the German language. The work of translating has been undertaken by Prof. Auerbach, of Jena.

A CATALOGUE of the Indian Decapod Crustacea in the collection of the Indian Museum, Calcutta, is in course of preparation by Major A. Alcock, F.R.S. It is proposed to issue the catalogue in three collateral and independent series, one for the Bachyura, another for the Macrura, and a third for the Anomura. The first fasciculus of Part i. has been received and contains an introduction to the monograph, and descriptions, with plates, of the Dromides or Dromiacea.

MR. JOHN HEYWOOD has published the second part of Book II. of "Machine Drawing for the use of Engineering Students in Science and Technical Schools and Colleges," by Mr. Thomas Jones and Mr. T. Gilbert Jones. The part contains forty-five plates, upon which drawings of engine and pump details are given; and descripitive text, with exercises, accompanies each plate. Students of engineering and machine construction will find the drawings of service in showing the details of engines and pumps constructed at the present time.

THE sixth part of Prof. A. Engler's elaborate monographs of the families and genera of African plants (Monographieen afrikanischer Pflanzen-Familien und -Gattungen) has been published by Mr. W. Engelmann, Leipzig, and can be obtained from Messrs. Williams and Norgate, London. The work, it will be remembered, is being prepared under the auspices of the Prussian Academy of Sciences, and when completed will be a most valuable account of the plants of the African continent. The present part deals with the Anonaceæ and is by Profs. Engler and L. Diels.

A SERIES of regional floras of India has been projected by the Director of the Botanical Survey of India, and the first part has been issued by Messrs. Taylor and Francis. In this volume Mr. T. Cooke deals with "The Flora of the Presidency of Bombay" from the order Ranunculaceæ to Rutaceæ. The increase of knowledge of the botany of the Presidency in recent years may be judged by the fact that the present part of the projected work (comprising 192 pages) contains descriptions of more than 130 species not included in Dalzell and Gibson's "Flora of Bombay," published in 1861. We propose to review the work when it has been completed.

MESSRS. G. PHILIP AND SON have recently published a pair of globes—one terrestrial and the other celestial—for the low price of three shillings. The globes are mounted on slender brass tripods, and each can be rotated on an axis. The diameter of each globe is four inches. It is, of course, not possible to represent any details upon a terrestrial globe of this size, or to find many stars by means of the celestial globe, but a young student may derive instruction from them as to the relative positions of the great land masses of the earth and the meaning of the celestial sphere.

TEACHERS and students of botany often find it difficult to obtain the plants or other botanical material required by them for examination. A pamphlet received from Messrs. James Backhouse and Son, Ltd., The Nurseries, York, reminds us that this firm has a special scientific department for the purpose of supplying living and preserved material for use in classes or private study. Practically every specimen or preparation required in a course of botany is kept on hand ready for dispatch, and if it is not in stock it will be obtained. The facilities thus afforded for obtaining botanical material should promote the study of botany in schools and encourage investigation by private students.

SINCE the classical work of Bunsen on the cacodyl compounds, many attempts have been made to prepare monomethylarsine, the analogue of methylamine, hitherto without success. In the *Berichte* for November 9, Messrs. A. W. Palmer and W. H. Dehn give an account of the preparation of this substance in a pure state. Indications of the existence of such a compound were obtained three years ago, by the reduction of methyldichlorarsine, but as this is costly and difficult to prepare, a more suitable starting point was found in cacodylic acid. This on reduction with amalgamated zinc dust and hydrochloric acid gives the $CH_3.AsH_2$, which is separated from the hydrogen which accompanies it by passing through a U-tube surrounded by a mixture of solid carbon dioxide and ether. Monomethylarsine is a colourless, mobile liquid, which boils under ordinary atmospheric pressure at 2° C. and possesses the penetrating objectionable smell of cacodyl. It rapidly attacks indiarubber, and combines immediately with oxygen, without, however, catching fire spontaneously, in this respect differing from dimethylarsine. The production of monophenylarsine from monophenylarsenic acid is described in the same paper.

IN continuing his researches on ammonium amalgam M. Moissan has arrived at some interesting results which he describes in the current number of the *Comptes rendus*. Sodium amalgam was allowed to act upon ammonium iodide in solution in liquid anhydrous ammonia at a temperature of about −39° C. Under these conditions the sodium amalgam reacts upon the ammonium iodide and becomes more fluid, without the formation of any gas. The sodium iodide formed together with the excess of sodium were then removed by liquid ammonia at a temperature of −40° and then with ether at −80° C. The solid ingot thus produced was then placed in a tube kept at −90° and connected with a mercury pump. It was found that a perfect vacuum could be maintained in the apparatus without any gas being given off by the ingot. The temperature was then allowed to rise, when a mixture of ammonia and hydrogen gases in the proportion of two of the former to one of the latter was given off. All these facts would appear to point to the conclusion that the radical NH_4 is actually present in the metallic mass prepared at −39°, but M. Moissan believes that this is not really the case, there being a possibility that a metallic ammoniacal hydride is formed. He has found that when sodium amalgam reacts with a solution of ammonia in water, there is a slow evolution of gas without foaming. If, however, sodium hydride in solution in sodium amalgam is placed in the same liquid, there is at once a foaming mass produced, which may last for two or three days. Further experiments are promised in this direction.

THE additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius*) from South Africa, presented by the Lord Dunleath; a Toque Monkey (*Macacus pileatus*) from Ceylon, presented by Mrs. de Koop; a White-crowned Mangabey (*Cercocebus aethiops*) from West Africa, presented by Mr. S. J. Dean; a Grecian Ibex (*Capra aegagrus*), South-East European, presented by Mr. B. A. Isaac; a Common Water Buck (*Cobus ellipsiprymnus*) from South Africa, four Viscachas (*Lagostomus trichodactylus*) from Buenos Ayres, a Black-headed Oriole (*Oriolus melanocephalus*), an Orange-headed Ground Thrush (*Geocichla citrina*), two Indian Shamas (*Cittocincla macrura*) from India, deposited.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN DECEMBER.

Dec. 3. 13h. Juno in conjunction with moon. Juno 0° 14′ S.
4. 22h. Venus at greatest elongation, 47° 15′ E.
9. 9h. Uranus in conjunction with the sun.
11–13. Epoch of the Geminid meteoric shower (radiant 109°+33°).
13. 23h. Mars in conjunction with Saturn. Mars 1° 18′ S.
14. 6h. 43m. to 7h. 39m. Moon occults β Capricorni (mag. 3·4).
15. Venus. Illuminated portion of disc = ·445.
Mars. Illuminated portion of disc = ·980.
16. 9h. 46m. Minimum of Algol (β Persei).
17. 3h. Mars in conjunction with Jupiter. Mars 0° 52′ S.
18. 7h. 24m. to 8h. 9m. Moon occults λ Piscium (mag. 4·7).
19. 6h. 35m. Minimum of Algol (β Persei).
22. 1h. Sun enters Capricornus. Winter commences.
22. 2h. Neptune in opposition to the sun.
23. 5h. 53m. to 6h. 12m. Moon occults ε Tauri (mag. 3·7).
27. 10h. 42m. to 11h. 50m. Moon occults A^2 Cancri (mag. 5·8).
31. 9h. Juno in conjunction with the moon. Juno 0° 18′ N.

LEONID METEORS, NOVEMBER 1901.—Mr. G. C. Thompson sends the results of observations at Penarth of Leonid and sporadic meteors on the nights of November 14–15 and 15–16. Between November 14, 11.35 p.m., and November 15, 1.55 a.m., four bright Leonids were observed, all exhibiting characteristic green streaks, four probable Leonids, without streaks or train, one of doubtful origin, and four sporadic meteors. On the night of November 15–16 no meteors were observed until after midnight, but between 12.20 a.m. and 12.50 a.m. one bright Leonid was seen, two probable Leonids, and four sporadic meteors.

Mr. J. R. Henry, writing from Dublin, says "there was a distinct display here of meteors from the Leonid radiant on the morning of November 15. During a watch kept from 10.20 to 11.15 on the night of November 14 only three meteors of the first or second magnitude were observed. The first was a fine bolide which passed a few degrees to the right of Gemini towards Leo at about 10.55. The watch was resumed at 12 o'clock under somewhat restricted conditions as regards position, which faced the east. From 1 to 3.30 meteors shot steadily from the Sickle at the rate of about twelve per hour for those of the first or second magnitude. No sporadic shooting stars above the third magnitude were noted in this part of the sky. The brightest meteor, equal to Sirius, was observed at 2.40 a.m. It passed somewhat slowly from the Sickle to a position 20° below Procyon. A brilliant flash illuminated the eastern horizon at 3.30 a.m."

MOTION OF THE GREAT RED SPOT ON JUPITER.—In *Popular Astronomy*, vol. ix. pp. 448–490, Mr. W. F. Denning discusses the observations secured of the position of the great red spot during the period 1894–1901, illustrating the result by a curve showing the drift in longitude of about 50° in that time. An observation made on 1901 September 5 is interesting from the fact that it was exactly seventy years after that of 1830 September 5, when H. Schwabe at Dessau first drew the hollow. During this interval of 2,208,980,280 seconds the planet has made 61,813 rotations, giving a mean period of 9h. 55m. 36·56s.

The observations at Bristol have mostly been made with a power of 312 on a 10-inch reflector.

PRELIMINARY INVESTIGATION OF THE DIAMETER OF MARS.—Prof. T. J. J. See, in continuation of his work on planetary diameters, gives the results of old and new measures of the disc of the planet Mars in *Astronomische Nachrichten*, Bd. 157, No. 3750. The measures published from 1651–1901 are tabulated and divided into two categories, according to their being determined with the wire micrometer or the heliometer. The values obtained in these two ways are markedly different, the mean diameter from the wire micrometer being 9·678, that from the heliometer 9·338, at mean distance. This discrepancy has been usually attributed to irradiation. A considerable number of experimental trials have been made at the Washington Observatory in order to get a trustworthy value for the correction due to this cause, and the results obtained from a recent series of determinations, using liquid screens in the eyepiece, are given. The polar diameter of the planet is thus estimated as

$$9''\cdot222 \pm 0''\cdot013$$
$$= 6687 \text{ km.} \pm 10 \text{ km.}$$

Assuming an oblateness of 1 in 200, the equatorial diameter may be taken as $= 9''\cdot30 = 6743$ km.

DEFINITIVE ORBIT ELEMENTS OF COMET 1899 I.—Mr. C. J. Merfield, of Sydney, has computed the definitive elements of the orbit of this comet from the available observations during the period 1899 March 4–August 10.

Elements.

Epoch of osculation 1899 March 12.
T = 1899 April 12·978010 G.M.T.

$$\left.\begin{aligned} \omega &= 8^\circ\ 41'\ 46''\cdot48 \\ \Omega &= 24\ 59\ 59\cdot93 \\ i &= 146\ 15\ 30\cdot29 \end{aligned}\right\} 1900\cdot0$$
$$\log q = 9\cdot5139795$$
$$\log e = 0\cdot0001521$$
$$e = 1\cdot00035029.$$

In the course of the article many hitherto isolated descriptions of the varying appearances of the comet during its period of visibility are brought together. Throughout March 1899 the comet appeared as a nebulous mass 4′ or 5′ of arc in diameter, with a central condensation. After perihelion passage many changes commenced to be presented. Prof. Perrine, at Lick, observed the nucleus to be double, and obtained measures of the components, the distance between them increasing from 12″–18″ of arc during the period 1899 May 11–14. This feature was later confirmed by Prof. Barnard, who measured the two nuclei with the Yerkes refractor, and found the separation to increase from 29″–38″ of arc during 1899 May 20–23. This increasing distance would appear to be partly due to an actual separation of the two portions of the nucleus, but this has not yet been examined sufficiently to be decisive.

On 1899 June 5 a considerable increase of brightness was noticed by many observers, the nucleus being estim ated by Dr. Hartwig to be 9·5 magnitude and the whole comet about 5·0 magnitude, the diameter of the coma being about 12′ of arc. Dr. Schorr recorded that the nucleus appeared to be excentrically situated. (*Astronomische Nachrichten*, Bd. 157, No. 3747–48.)

THE CHEMISTRY OF THE ALBUMINS.

THE albumins, using this term in its widest and most general sense, form almost the last of the great natural groups of substances which have hitherto presented an impenetrable front to the attack of the synthetic chemist. With the progress of organic chemistry, some, at all events, of the alkaloids, the sugars and the glucosides have yielded up their secrets of constitution and configuration so fully that their synthetic preparation has crowned the labours of the investigator and confirmed the deductions he has drawn from a study of the reactions and transformations of the products found in nature. But the chemistry of the albumins, in which lie locked up the secrets of animal and vegetable growth, of health and disease, perhaps even of life and death, has not yet progressed beyond the preliminary stages of investigation—the establishment of criteria of purity and methods of separation, and the study of reactions and decomposition products. These first studies have, indeed, added much of great value and importance to our knowledge of this supremely interesting class of compounds, but the very complication of the results obtained has produced rather a feeling of mental bewilderment than one of increased insight and comprehension.

In these circumstances the report of a lecture by Prof. Kossel on the "Present Position of the Chemistry of the Albumins," which is contained in a recent number of the *Berichte*, will be of special interest to both physiologists and chemists. The lecture forms one of that series of addresses on special branches of chemistry, delivered by the foremost of those engaged in active work upon them, which has been for some years one of the most valuable and attractive features of the activity of the German Chemical Society, and one well worthy of imitation.

From the admirable account of the subject there given, it appears that in several directions important advances have been made, and we propose here to indicate shortly the nature and tendency of these, after first pointing out some of the difficulties which have not yet been overcome.

In the first place, no entirely satisfactory criterion of chemical individuality has yet been found for the albumins, all the prevailing methods which the chemist has been forced to employ for their purification and separation—precipitation by various reagents, coagulation, differences of solubility, and even crystallisation—being pronounced insufficient to guarantee the individuality of the product. This is due partly to the colloidal nature of these substances, a property which is most probably conditioned by their enormously high molecular weight, and partly to their great tendency to form loose compounds with other substances, and especially with such as occur along with them in the tissues of plants and animals.

A second difficulty lies in the great number of different substances belonging to this class which have been prepared, even with the imperfect methods at present at our command, and in the bewildering complexity of the products of decomposition obtained from many of them by such simple means as hydrolysis.

One instance may suffice to illustrate this point and at the same time serve as an enumeration of the various chemical groups obtainable from a complicated member of the class. Certain nucleoproteids yield on hydrolysis the following products, each of which represents a different group in the molecule of the mother substance:—arginine, histidine, lysine, leucine, asparaginic acid, glutamic acid, pyrrolidinecarboxylic acid, the purine bases, thymine, phosphoric acid, two groups containing sulphur, and separate groups yielding furfuraldehyde, skatole and lævulinic acid; most of these groups are, moreover, with great probability contained several times over in a single molecule.

Fortunately, however, all the albumins are not as complicated as this, and it is by the discovery of simpler members of the class and by a quantitative study of the products of their decomposition—researches almost entirely due to Kossel and his co-workers—that the most substantial advance of recent years has been made. These, the least complex albumins yet known, have been obtained from the spermatozoa of certain fish and have received names denoting their origin, *e.g.* salmin, sturin, clupein, &c. They possess strongly basic properties, turn red litmus blue and form salts with acids, yet unite with this chemical activity the high molecular weight and colloidal properties of the albumins, and have hence been termed the *protamines*. Their comparative simplicity is, however, shown by the nature of the products formed from them by hydrolysis.

The more familiar and complex members of the group, such as casein or egg-albumin, yield on hydrolysis a large number of different products, which may, however, be grouped in four main classes:—

(1) A compound capable of yielding urea. This is invariably found in the form of *arginine*, or guanido-amidovaleric acid, a compound which may be regarded as at the same time a derivative of urea and of diamidovaleric acid.

(2) The diamido-acids, at least three members of which have been recognised, including the group contained in arginine.

(3) The monamido-acids, ten or eleven different acids having all been found.

(4) A number of other products such as ammonia, furfuraldehyde, pyrrolidinecarboxylic acid, humus-like substances, &c.

The proportions in which the representatives of these classes are produced vary greatly for the different albumins, casein, for example, yielding very little arginine (about 5 per cent.) and a large proportion of monamido-acids (75–85 per cent., including at least three or four different acids).

Now the simplest protamines, of which salmin may be taken

as a typical representative, are found to be almost entirely converted by hydrolysis into two compounds: nearly 90 per cent. of their nitrogen, or 84 per cent. of their actual weight, is found as arginine (classes 1 and 2) and several per cent. of their nitrogen as monamidovaleric acid (class 3), the nature of the small remaining amount of product being as yet unknown. Basing himself on the qualitative simplicity of these products and the large preponderance of arginine, Kossel proposes, for the purpose of classification, to regard arginine, or rather the group from which it is derived, as the chemical nucleus of the albumin molecule, from which all the albumins may be derived by the addition of other groups. Increase in the complexity of the structure of the albuminous molecule is rendered evident by the appearance of a multiplicity of individual substances in classes 2, 3 and 4 of the products of hydrolysis. Thus sturin, a more complex protamine, yields only 58 per cent. of arginine, together with 25 per cent. of two diamido-acids (lysine and histidine, class 2), and a monamido-acid, the relations by weight showing that in this case four molecules of arginine are produced for one each of lysine and histidine.

A means of passing gradually from the chemical structure of these non-albuminous, ultimate products of hydrolysis back to that of the mother-substances, the albumins themselves, is afforded by the circumstance that the hydrolysis can be so effected, especially by means of the various proteolytic enzymes, that intermediate products, the albumoses and peptones, are formed. These, although certainly simpler in structure than the original albumins, still show the characteristics of the class, and it is the knowledge of their composition that must form the proximate object of research. For this purpose the intermediate products obtained from the protamines, which are known as the *protones*, afford the simplest material, and the results of these researches will be eagerly awaited.

A certain amount of progress has indeed already been made in the examination of the albumoses and peptones derived from the more complex albumins, for it has been shown that certain of the constituent groups of the original molecule are absent from some of the albumoses derived from it, whilst present in others, a proof that the molecule has been divided into dissimilar groups. This is true, for instance, of the tyrosine- and indole-forming groups of fibrin, which are present in protalbumose, but absent from heteroalbumose.

The highest degree of complexity among the albumins is exhibited by the glucoproteids and the nucleoproteids, of the decomposition products of which an illustration has already been given. These appear to be compounds of albumins with other—*prosthetic*—groups, such as the hexoses, hexosamines, purine derivatives, &c., and even inorganic groups like phosphoric acid.

In conclusion, it is pointed out that the old idea of albumin as a substance of fixed and definite properties must be abandoned; it must be recognised that the albumins form a group comprising many substances which differ greatly in structure and properties. In accordance with the general principle of evolution, the aim of the investigator must be to find a chemical system of albumins which, progressing from the simplest up to the most complex member, shall reveal to us the true nature of these mysterious substances.

SCOPE AND FUNCTIONS OF MUSEUMS.[1]

IT is my lot, as director of the Natural History Museum in London, to have my attention very closely directed to the question as to what a public museum should aim at, what should be its objects, and how it should be organised for effecting them. I am inclined to think that few people ever ask themselves why we have museums, how they came to exist, and why public funds are expended on them, both by municipalities and by the State.

The word "museum" is in itself a strange one, which has acquired a special and restricted meaning. In Germany a club for music and discussion of art and science, with the maintenance of a library, and sometimes with a beer garden attached, is often called a "museum," much as we call a club an Athenæum. In England and in France the word museum—by a process which I cannot trace—has within the past two centuries become applied to what used to be called a "cabinet of curiosities (or rarities) of art and nature." You will find that all our great museums, and many local museums, owe their origin to such cabinets or collections of rarities. Thus the British Museum originated with the collections of Sir Hans Sloane, and the Ashmolean and University Museums at Oxford had as their nucleus the collection of miscellaneous objects of interest formed by the Cornish antiquarian and naturalist Tradescant. These collections were always, in the first instance, of the most miscellaneous kind. An elephant's skull, a glove worn by Queen Elizabeth, a thunderbolt and a cannibal's spear are samples of the objects placed in these collections side by side. When such "cabinet" or "collection" of rarities attained to celebrity, its fortunate possessor (in the eighteenth century) made a habit of bequeathing it, or possibly selling it, to some public body, so that it might be maintained for ever as a show for the delight and instruction of future generations of men. That seems to be the origin of public museums, and it goes on repeating itself even at the present day. A collector gives his collections to a public body, to a city Corporation, or to the State, or to a local Board, or a Committee; the charge is accepted, and another "museum" is instituted.

Whilst it is certainly ungrateful to look a gift horse in the mouth, or to scrutinise too closely the collection bequeathed or presented by an enthusiast, yet it is a fact that this kind of spasmodic and unconsidered foundation of museums is inconvenient at the present day. We have now had some experience of museums, and a little reflection will show us what is the good and what is the bad of these miscellaneous collections, and what any public body should aim at when accepting or taking charge of a museum.

As distinguished from a library or a picture gallery, a museum, as we understand the term at the present day, is a repository in which are partly exhibited, partly stored, objects, tangible things, which are neither books nor pictures, but are actual relics of antiquity or samples of animal, vegetable or mineral structure of such a nature as to extend or to illustrate our knowledge of the history of man or of the natural world.

It seems to me—if I may go at once to the point without further preface—that a public museum, whether it be that belonging to a municipality such as ours here in Ipswich, or one belonging to the State, such as the British Museum, should have two distinct and recognised objects, the germ of which we can trace in the old collectors' cabinets of rarities of nature and of art. In the first place, such a museum must aim at collecting and preserving for the study and information of all men, but especially of those who live near it, the records of antiquity and of natural history in the locality of which it is the centre. A great part, even a half of the space of a museum building, should not be occupied by exhibition cases, but contain cabinets and cases in which precious things are preserved ready for the study of those who are willing to give time and skill to their study. But the second great object of a museum (present also in the old collectors' minds) is to exhibit in the most perfect and attractive way, in public show galleries, to all who choose to come and see, the most interesting, beautiful and instructive of the things in its possession, and especially to show such things as will readily excite an interest in the study of archæology and natural history amongst the inhabitants of the town or city in which the museum is situated.

There is a third use of museums, and the collections in them, which ought, I think, to be very carefully separated from the two I have just mentioned. A student of text-books, preparing for examination and carefully pursuing his educational studies, requires specimens to handle and to manipulate closely. A collection suited for his purposes is quite different from the exhibition-collection addressed to the larger public, and ought never to be confused with it or with the record-collection of a local museum. These strictly collegiate and technical collections ought to be placed in colleges and schools, and kept apart from the more striking and generally interesting collections. When the public is admitted to such students' collections a great mistake is made. The ordinary man is bewildered and wearied by such minute details as are fit for the academic student, and becomes so bored and exhausted that the word "museum" has ever after an evil sound in his ears. You cannot appeal artistically and effectively to the casual well-meaning visitor to a museum if you show him endless rows of obscure objects, which nevertheless have value for the special student. My opinion is very strong that these two kinds of

[1] Abridgment of an address delivered at the opening of a new wing of the Ipswich Museum on November 8, by Prof. E. Ray Lankester, F.R.S., president of the Museum.

collections should be kept far apart, and I doubt very much whether the State or the municipality should undertake to set out and exhibit students' collections. They inferfere, in my judgment, with the two great combined objects of a "public museum," namely, first to preserve objects of permanent interest and value, especially those of the locality; and, secondly, to excite in the general public—the ratepayers who pay for the whole affair—a pleasurable and intelligent interest in the purposes of the museum by the exhibition of a limited number of fine specimens, not crowded together, but well set out and beautifully housed and cared for.

Nothing is so hostile to the true spirit and purpose of a public museum as to exhibit in it dirty, ill-mounted, mean and contemptible specimens. Next to this, nothing is so bad for a public museum as to crowd specimens in the cases, so that none produces its due effect. After this, in order of harmfulness, come illegible and careless labelling and bad classification. Local museums suffer from want of funds to pay for good cases and good setting out of specimens, and for the printing of good labels. Still more, perhaps, do they suffer for want of funds to pay for the intelligent services of a curator. But in regard to this, I believe that when there is a great deal of voluntary service and personal help given in a town, with the object of making the museum a worthy show of which the town can be proud, there need not be much difficulty in paying the salary of a curator. I must, however, tell you that he ought not to have other work to do, if you wish him to keep your museum in a state of efficiency and beauty.

Perhaps one of the greatest difficulties which local museums suffer from is the ill-considered generosity of local collectors. I know of several museums which are rendered more or less ridiculous by the worthless collections of ill-stuffed birds or other such objects, presented and, I regret to say, accepted by well-meaning committees or trustees. No collection should ever be accepted with conditions attached to it unless money is also given for carrying out those conditions, and, as a rule, no collection whatever should be accepted *en bloc* from a private donor. The friends or relatives of a deceased collector very often seem to think that a public museum is a place where rubbish may be shot. This should not be allowed. The managers of a museum, with the advice of their curator, should have definite purpose and intention, and should know what they want and try to obtain it by gift or purchase. But they should not allow themselves to be the instruments of vanity or sentiment, and should never allow their museum to become a receptacle for rubbish, no matter by whom it is offered.

If I might venture to apply some of these remarks to the Ipswich Museum, I should say the Museum ought first of all to provide an absolutely safe repository for objects of antiquity found in the neighbourhood, extending from flint implements and Roman pots to old china, brass-work and wood-carving; also for the skins of rare birds and mammals taken in Suffolk, and for the fossils of the wonderful Red Crag, which is unique as a geological phenomenon in England. Such things should be cared for, labelled, and preserved with the greatest care. The best of these things should be exhibited in the best possible cases, with ample space, and in your best rooms, fully labelled and explained. It forms *the* local collection. But besides these, and as illustrating them and the sciences with which they are connected, you should have as many really fine examples of birds and mammals, of fishes, shells, starfish and corals as your space and your funds allow you to show in a really beautiful and attractive way. These also should be fully labelled and explained. That is a *sine qua non*. They should comprise such things as the skeleton of the horse and the man, side by side; of the lion and the cat; and a few other perfect and well-chosen examples of the skeletons of animals. Then you should have the whole or parts of recent elephants to illustrate the Mastodon of the Crag and the Mammoth of the river-bed of the Orwell. The skeleton of the recent bull should be compared with the extinct ones whose bones are dug up in the local gravels. Then a glimpse should be given of some of the utterly strange extinct monsters whose skeletons are preserved in larger museums, from which you can obtain complete casts, scarcely distinguishable from the original specimens.

I do not think there is any advantage in setting out on perches in the glare of daylight, which soon destroys their colour, a complete set of British birds. If you have these and their eggs, they should, excepting a few of the more striking, be unmounted and kept in drawers.

In such a Museum as this, plants, of course, will not be neglected. A herbarium can readily be formed and kept for reference and record. But for your exhibition cases there are many most interesting features concerning the seedlings, early and later growth, and changes of our native trees, which form most striking and instructive exhibits. In an agricultural county a set of models illustrating the life-history of wheat, such as has lately been set up in the Natural History Museum, would be greatly appreciated. Further, let me say that there is a no more beautiful and interesting class of objects for a public museum than really fine crystals and minerals of various kinds. The history of agates, and of the carnelians and other pebbles from the Felixstowe beach would form a delightful and most attractive case in the Ipswich Museum. But in no instance should there be a mean or dirty or ill-considered specimen in any one of your glass cases.

I think that the whole of one of the larger rooms in such a museum should be kept shut up and used for placing cabinets and for storing those specimens in glass cases with which it is not desirable to try the patience of the general public. They should be accessible on proper application; but why show all your doubtful specimens, your obscure though important fragments, your faded skins of birds and mammals to the public? It is not always right to destroy unsightly specimens, but it is never right to offend and disappoint the innocent visitor to a museum by thrusting them under his eyes. He wishes to be pleased, to learn something—not too much—but still something of natural history. You may lead him on by judicious exhibition to enthusiasm and serious interest in science: then he will be able to tolerate the sight of your sick specimens, but you gain a bad reputation for museums if you let your visitor be disgusted at the very first by incongruity and neglect.

A county museum is not a place for children or school-teaching: it is not Noah's Ark or Madame Tussaud's waxworks, but a place for the delight of grown-up men and women. It should be full of the things which are the pride of those who care for the history and natural life of their countryside, and just as you do not use a picture gallery to teach the elements of drawing, but for the enjoyment of fine pictures, so your county museum must be for the enjoyment by your grown-up, educated people of the rarities of nature and of art, and not for the cramming of schoolboys and schoolgirls.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The curators of the University chest have been authorised to spend 1050*l.* in erecting a new chemical laboratory over some of the existing rooms.

Prof. E. B. Tylor delivered a public lecture on November 22 upon totems and totemism, with special reference to the magnificent totem-post from British Columbia which he has recently presented to the Pitt-Rivers Museum.

Brasenose College has elected the keeper of the Ashmolean Museum to an *ex-officio* fellowship, which will have the effect of increasing his stipend by 100*l.* a year and augmenting the income of the Ashmolean Museum and the University Galleries by the same sum.

The 229th meeting of the Junior Scientific Club was held on November 20; a paper was read by Dr. Collier on "Health and Athletics," and Mr. A. T. V. Sidgwick read a paper on "Acetone Di-propionic Acid."

MR. E. H. GRIFFITHS, F.R.S., Fellow of the Sidney Sussex College, Cambridge, has been appointed Principal of the University College of South Wales and Monmouthshire in succession to the late Mr. Viriamu Jones.

THE first number of the *London University Gazette* has appeared, and is largely taken up with a statement of the constitution of the reorganised University and the conditions under which the work is now being carried on. The text is given of an address sent to Prof. Virchow on his eightieth birthday, and of one to Yale University upon the occasion of the recent bicentennial celebrations.

A COMMENDABLE characteristic of the Calendar of University College, London, is the list of original papers contributed by members of the scientific departments of the College to various

societies and publications. The list contains nearly one hundred papers as the record of activity during the College year 1900–1901, and it is a better testimony to the work carried on than many successes at examinations. A similar statement of investigations made in the laboratories of the Royal College of Science and the Solar Physics Observatory during the session 1899–1900 will be found in the recently-published report of the Board of Education, vol. iii.

SCIENTIFIC SERIAL.

American Journal of Science, November.—On the effect of temperature and moisture on the emanation of phosphorus, and on a distinction in the behaviour of nuclei and of ions, by C. Barus.—On the determination of the heat of dissociation and combustion of acetylene, ethylene and methane, by W. G. Mixter. Acetylene was exploded alone and with oxygen and the amount of heat evolved measured. If acetylene is exploded without oxygen in presence of a small quantity of ethylene, the latter is completely decomposed, and in this way the heat of dissociation can be more accurately determined than by the usual combustion method.—The geological relations and the age of the St. Joseph and Potosi limestones of St. Francois County, Missouri, by F. S. Nason.—Note on the Cambrian fossils of the Francois County, Missouri, by C. E. Beecher. From the fossils found an extensive area and thickness of sedimentary rocks are definitely placed in the Cambrian. Palæontological evidence as to the nature of these rocks had hitherto been largely wanting.—Discovery of Eurypterid remains in the Cambrian of Missouri, by C. E. Beecher. Description and drawing of *Strabops Thacheri*.—The determination of persulphates, by C. A. Peters and S. E. Moody. An experimental examination of the methods proposed by Mondolpho, Namias, Le Blanc and Eckhardt, Grutzner and the author. The process of Le Blanc and Eckhardt, the oxidation of ammonio-ferrous sulphate in sulphuric acid solution, is recommended as being simple, rapid and convenient.—Studies of Eocene mammalia in the Marsh collection, Peabody Museum, by J. L. Wortman. A continuation of previous papers on the same subject.—The Carboniferous and Permian age of the red beds of Eastern Oklahoma from stratigraphic evidence, by G. I. Adam.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 22.—Prof. S. P. Thompson, president, in the chair.—Prof. W. Cassie read a paper on multiple transmission fixed arm spectroscopes. The simplest form of spectroscope shown consisted of two half prisms silvered on the back, between which a beam of light goes backwards and forwards with a slight upward inclination. The result in dispersing and resolving power is equivalent to direct transmission through a long train of prisms. The collimator and observing telescope are fixed and adjustment is made by a double tangent screw which moves both the prisms. Two other types constructed on a similar principle were described, of which one had one prism and two speculum mirrors, and the other had two refracting prisms and a reflecting right-angled prism. The adjustments of these instruments are simple and their power great. By a small movement of an adjusting screw the observer can produce great changes of dispersion by passing from one to another of the series of spectra which are produced. The author in reply to questions said that with an ordinary Bunsen burner sodium flame a series of about five spectra is easily observed with dispersion equivalent to direct transmission through ten full-sized prisms. The loss of light at the reflections limits the number of transmissions that can be used; but he believed that no other spectroscope with only two prisms would give dispersing power and resolving power in any way approaching the instrument described.—Prof. W. Cassie then read a paper on the measurement of Young's modulus. The apparatus described consisted of a horizontal needle (a bar of large moment of inertia) supported by a bifilar suspension made of the wire of which the stretch modulus is to be measured. The periods of the pitching, rolling and bifilar oscillations of this system are observed, and an expression for the stretch modulus is obtained which involves no measurements except the weight of the needle and the periods of oscillations. The necessary adjustments, and the means of eliminating residual errors of adjustment, were described for two forms of the apparatus. One form also affords a simple means of statical measurement by hanging a small weight on the needle at measured distances from the centre, calculating the difference of tension produced in the wires, and observing with a mirror and scale the consequent dip of the needle.—A paper entitled "Notes on Gas-Thermometry, Part ii.," by Dr. P. Chappuis, was read by Dr. Harker. Messrs. Holborn and Day have published recently in a research on the air thermometer the results of a new determination of the expansion of Berlin porcelain between 0° and 1000°. The author has already drawn attention in a former note to the fact that part of the divergence found between the results of Callendar and Griffiths and of Harker and himself for the boiling-point of sulphur may be attributed to the uncertainty in the values assumed for the expansion of porcelain. In the present paper the author examines the way in which their results would be modified by the introduction of the dilatation deduced from the experiments of Messrs. Holborn and Day. It follows from the introduction of the new values that the boiling-point of sulphur deduced from experiments with a porcelain reservoir thermometer would be lowered from 445°·2 to 444°·7, a number very close to that obtained by Callendar and Griffiths. In a second part of the paper Dr. Chappuis has recalculated the divergences between the uncorrected nitrogen scale and the theoretical scale, and finds that the difference between these values and those given previously is too small to be of any practical importance. Prof. H. L. Callendar said that he was highly gratified to see that the application of the correction for the expansion of the bulb of Dr. Chappuis' gas-thermometer, deduced from Holborn and Day's results, gave a value, 444°·7, for the boiling-point of sulphur in such close agreement with the value 444°·5 deduced by Mr. Griffiths and himself in 1890. The agreement was really much closer than appeared at first sight, because the remaining difference of two-tenths of a degree in the results was almost exactly accounted for by the scale difference of the constant pressure and constant volume thermometers according to the theory of Joule and Thomson. It was also interesting to remark that the corrected result found by Dr. Chappuis was in very close agreement with that deduced from their own observations by Messrs. Holborn and Day. Dr. Chappuis had not referred in the present note to the work of Bedford on the expansion of Bayeux porcelain, which he had criticised in a previous paper. A comparison of results would show that Bedford's results agreed very fairly, allowing for the difference of material, with Holborn and Day's from 200° to 600° C.; and that both differed from those of Dr. Chappuis between 0° and 80°, when extrapolated, in a precisely similar manner. It was quite possible, as he (Prof. Callendar) had previously suggested, that the expansion of porcelain between 0° and 100° was anomalous. It appeared certain that some anomaly in the expansion at 800° was indicated both in the experiments of Bedford and also in those of Holborn and Day. It was also clear that Dr. Chappuis' results for Bayeux porcelain when extrapolated would agree with Bedford's at a temperature a little above 100° C., or very nearly at the same point at which his results for Berlin porcelain agreed with those of Holborn and Day.

Mathematical Society, November 14.—Dr. Hobson, F.R.S., president, in the chair.—After the ballot had been taken the president announced that the gentlemen whose names were published in NATURE (October 17) were duly elected for the current session. Dr. J. Larmor, F.R.S., propounded a query regarding the recent behaviour of Nova Persei which gave rise to remarks by the president, Dr. Glaisher, F.R.S., and Messrs. Hargreaves, Hough and Lieut.-Colonel Cunningham, R.E.—Prof. Love, F.R.S., communicated two papers by Mr. J. H. Michell, (1) on the inversion of plane stress, and (2) on the theory of Hele-Shaw's experiments on fluid motion, dwelling specially on the latter paper, which also evoked some discussion.—Mr. E. T. Whittaker read a paper on the solution of dynamical problems in terms of trigonometrical series. The president spoke at some length upon the subject and other members joined in a discussion.—The following papers were communicated by the reading of their titles:—Linear groups in an infinite field, Dr. L. E. Dickson; note on the algebraic properties of Pfaffians, Mr. J. Brill; on Burmann's theorem, Prof. A. C. Dixon; the Puiseux diagram and differential equations, Mr. R. W. H. T.

Hudson; determination of all the groups of order 168; Dr. G. A. Miller; an outline of a theory of divergent integrals, Mr. G. H. Hardy; limits of logical statements, Mr. H. MacColl; addition theorems for hyperelliptic integrals, Mr. A. L. Dixon; on the representation of a group of finite order as a permutation group, and on the composition of permutation groups, Prof. W. Burnside, F.R.S.; note on Clebsch's transformation of the equations of hydrodynamics, Mr. T. Stuart, and linear null systems of binary forms, Mr. J. H. Grace.

Geological Society, November 6.—Mr. J. J. H. Teall, V.P.R.S., president, in the chair.—Note on a submerged and glaciated rock-valley recently exposed to view in Caermarthenshire, by Mr. Thomas Codrington. This valley was brought to light in building a bridge across the River Towy at Dryslwyn, nine miles above Caermarthen, to which the tide now flows. At the bridge the valley is narrowed to about half a mile. Near the water-edge the rock sloped down gradually to 23 feet below summer water-level, and was glaciated in large furrows a foot or more across, and striated blocks of grit rested upon it. About 60 feet farther out into the river rock was not met with till depths of from 34 to 42 feet below summer level were reached, and the rock-surface was found to be sloping towards the south at an angle of from 28° to 18° with a vertical line; it was followed down to between 45 and 56 feet below summer water-level. Scratched stones were again met with in the clay near the rock. The glaciated surface on the northern bank is only 25 feet above sea-level; and the rock-surface is sloping down at a precipitous angle at 8 feet below sea-level at a distance of eighteen miles from the mouth of the river.—On the Clarke collection of fossil plants from New South Wales, by Mr. Edward Alexander Newell Arber. This collection, numbering nearly 2600 specimens of all kinds, including some 80 fossil plant-remains, was presented to the Woodwardian Museum, Cambridge, in November 1844. Among other points discussed is the age of the beds. Such evidence as the few plants in the Clarke collection afford supports Feistmantel's conclusion that the Wianamatta beds are of Triassic age. *Thinnfeldia odontopteroides* occurs in Rhætic beds in South America, and the identification of Rattee's *Salisburia palmata* with the American *Baiera multifida*, and a comparison with the Rhætic *Baiera Steinmanni* of Chile, is a new point in favour of this conclusion. The plants also support Feistmantel's opinion that the Newcastle beds are equivalent to the Permian of Europe. The exact origin and age of the Arowa beds must for the present remain doubtful. In the discussion that followed Dr. Blanford expressed his satisfaction at hearing a paper read before the Geological Society in which the Palæozoic age of the Australian Coal-Measures was fully accepted on palæontological evidence. For many years the question had been debated between McCoy, backed by all the European palæontologists, Schimper among others, who declared that the Newcastle beds of Australia were Jurassic, on the one side; and on the other, by the geologists of New South Wales, among whom none did more valuable work in proving the Palæozoic age of the Coal-Measures than the Rev. W. B. Clarke, the collector of the specimens described by the author.—On an altered siliceous sinter from Builth (Brecknockshire), by Mr. Frank Rutley.

Zoological Society, November 19.—Mr. William Bateson, F.R.S., vice-president, in the chair.—Prof. E. Ray Lankester, F.R.S., read a memoir on the new African mammal, *Okapia johnstoni*. After an account of the history of the discovery of this remarkable animal by Sir Harry Johnston, Prof. Lankester gave a description of its skull and skin, based upon the specimens forwarded to the British Museum by the discoverer, and compared its structure with that of the giraffe and the extinct member of the same family, Helladotherium. The nearest living ally of the okapi was undoubtedly the giraffe.—Mr. Oldfield Thomas read a paper on the five-horned giraffe obtained by Sir Harry Johnston near Mount Elgon. It was shown that, although the horns were unusually developed, the animal could not be specifically separated from the ordinary North-African giraffe, *Giraffa camelopardalis*. This latter was believed to grade uniformly in the development of the horns and other characters into the South-African form, which would therefore be only a subspecies, *G. c. capensis*. On the other hand, de Winton's *G. c. reticulata* (from Somaliland) seemed to be sharply separated, and therefore to be worthy of recognition as a distinct species, *G. reticulata*. With regard to the accessory horns, it was shown that they, or rudiments of them, existed in all male giraffes, even in the southern subspecies. Mr. Thomas believed that these rudimentary horns corresponded, not only to the somewhat similar projections found in Samotherium and the okapi, but also to the large posterior horns of Bramotherium, and perhaps of Sivotherium. If this were the case, it seemed probable that they were the degenerate rudiments of horns which had been large and functional in the giraffe's ancestors.—Mr. J. Graham Kerr read some notes on the genito-urinary system in the male Lepidosiren and Protopterus, in which he gave an illustrated account of the more important anatomical features of the organs. Mr. Kerr dwelt particularly on the presence in both Lepidosiren and Protopterus of very definite remains of a testicular network, and pointed out that the presence in all three Dipnoi of the connection between the testis and the kidney gave greatly increased probability to the view that this connection is a very ancient and primitive feature of gnathostomatous vertebrates. Mr. Kerr also pointed out that the conditions in the Dipnoi shed considerable light upon the relations of testis and testis-duct in the Crossopterygians and the Teleosts.—A communication was read from Mr. Alfred E. Pease, M.P., containing some field-notes on the antelopes obtained during his expedition to Somaliland and Southern Abyssinia in 1900–1901.

Mineralogical Society, November 12.—Dr. Hugo Müller, F.R.S., president, in the chair.—Mr. R. H. Solly, in continuation of his investigations on minerals from the Binnenthal, described baumhauerite, a new sulph-arsenite of lead, $4PbS.3As_2S_3$, which crystallises in the oblique system ($\beta = 82° 42'\frac{3}{4}$); the crystallographic examination of good recently-acquired crystals of dufrenoysite led him to refer this mineral also to the oblique system with $\beta = 90° 33'\frac{1}{2}$; twin crystals of hyalophane from the Legenbach Binnenthal were also described.—Dr. H. Warth contributed a note on the occurrence of gibbsite in the Palni Hills in southern India.—Prof. H. A. Miers gave an account of a visit to the Klondike which he had made last August at the invitation of the Canadian Minister of the Interior. He described the various methods of mining which are in operation this year, and showed a number of photographs illustrating the great changes which have taken place in the mining camp. An account was given of the various conditions under which the gold occurs.

EDINBURGH.

Royal Society, November 4.—The Hon. Lord M'Laren in the chair.—The chairman read an opening statement describing the work done during the preceding session and enumerating the losses the Society had sustained, with special reference to the great loss occasioned by the death of Prof. Tait, who had for many years acted as general secretary.—A paper on variable stars of the Algol type was communicated by Dr. A. W. Roberts. It dealt with the star C.P.D. 41°·4511, whose period of variation of brightness is 1 day 20 hours 30 minutes. The light curve has one well-marked minimum lasting 4 hours 30 minutes, with a diminution 0·85 from the normal brightness, which is steady for the remainder of the period with the exception of a short drop of 0·1 dividing it into two symmetrical parts. These variations of brightness are due to the two stars which form the double system eclipsing one another wholly or partially as viewed by an observer on the earth. From them Dr. Roberts deduces the following elements for the double-star system:—Diameter of each (probably the same), 0·325, the distance between them being unity; inclination of orbit, 6° 43'; ratio of the brightnesses of the two components, 6 : 1; and mean density 0·44 of the sun's density, or about two-thirds that of water. The theoretical light curve calculated from these data agreed exactly with the observed light curve.—Prof. MacGregor read a note on the relation of the density of electrolytes to ionisation, chiefly with reference to certain discrepancies which appeared when the densities were measured and calculated to six significant figures.—Prof. Chrystal communicated a paper, by Mr. J. N. Miller, on an instrument for the mechanical trisection of an angle. A rod OAB is rotatable about the fixed point O; and a second rod PAX pivots on A, and PA is made equal to OA. From M, the middle point of AB, a perpendicular is constructed of convenient length. If O is placed at the vertex of the angle to be trisected, the trisection is accomplished by adjusting the instrument until the point P lies on one side of the angle and the other side of the angle passes through the intersection of AX with the perpendicular to the middle point of AB. The curve

on which the properties of the instrument depend is a unicursal curve of the sixth degree, and Prof. Chrystal showed how, by making a templet in the form of part of the curve, the trisection of a given angle could be easily effected with the use of a pair of compasses.

CAMBRIDGE.

Philosophical Society, November 11.—Mr. W. Bateson, vice-president, in the chair.—The unit of classification in systematic biology, by Mr. H. M. Bernard. The writer described the difficulties he had experienced in grouping the stony corals into genetic groups, and maintained that the time had come when for such unstable groups a new technique was urgently required. The present unit of classification, the only one we had at our disposal, was the species. Hence if these are not discoverable the work is brought to a standstill. His work with the stony corals had suggested to him a geographical method of designating the varying *forms* as the units for work. These forms he proposed to arrange in geographical lines. Upon the chart of each genus thus obtained he proposed to arrange the different structural variations exhibited within the genus, and hoped to find in this way a powerful and searching instrument for morphological study by means of which in time a natural classification may be built up.—An exhibition of fishes and amphibians to illustrate new methods of mounting specimens for museums, by Mr. J. S. Budgett.—Notes on the development of Sagitta, by Mr. L. Doncaster. The paper confirmed O. Hertwig's account of the development in most points, but showed that Bütschli's account of the formation of the head-cœlom was correct. Sections were described showing the temporary obliteration of the cœlom and the origin of the muscles. The genital cells were described, and the origin of the posterior septum between them during larval life. The development of the genital ducts was discussed, and this, together with the mode of origin of the transverse septa and absence of nephridia, led to the rejection of the view that the Chætognatha are connected with Annelids.

DUBLIN.

Royal Irish Academy, November 11.—Prof. R. Atkinson, president, in the chair.—Prof. Charles J. Joly read a paper on the interpretation of quaternions as point-symbols. The author explained a convention by means of which a quaternion may be interpreted as the symbol of a weighted point. He assumes an arbitrary origin, and writing

$$q=(1+\mathrm{OQ})\mathrm{S}q,\quad \mathrm{OQ}=\mathrm{V}q/\mathrm{S}q,$$

he interprets the quaternion q as denoting the point Q at the extremity of the vector $\mathrm{V}q/\mathrm{S}q$ drawn from the origin. The weight attributable to this point is $\mathrm{S}q$—the scalar part of the quaternion—so that multiplication by a scalar leaves the representative point unchanged and merely alters the weight. He gave some examples of applications to projective geometry, and pointed out that the equations

$$\mathrm{S}q(f+f^1)q=0,\quad \mathrm{S}q(f-f^1)p=0$$

represent respectively the equation of the general quadric surface and the equation of the general linear complex, f being a linear quaternion function and f^1 being its conjugate. The equations of the reciprocals of these loci are simply

$$\mathrm{S}q(f+f^1)^{-1}q=0,\quad \mathrm{S}q(f-f^1)^{-1}p=0.$$

The principle of duality presents itself with perfect naturalness, and a quaternion may also be regarded as the symbol of a plane. Thus two objections to the calculus of quaternions have been removed—the want of a point symbol and of a concrete interpretation for a quaternion—and, what is in the author's opinion of much greater importance, the whole field of projective geometry is rendered easily tractable by quaternion methods.—Prof. Joly also read a paper on quaternion arrays. In the previous paper the author employed and extended a most useful but neglected notation of Hamilton's ("Elements," art. 365 [6]) in order to define lines, planes and volumes in terms of two, three and four quaternions or points. In this paper the notation is further extended, and the vanishing of the array with quaternion constituents

$$\left\{\begin{matrix} a_1, & a_2, & a_3 & \ldots\ldots & a_n \\ b_1, & b_2, & b_3 & \ldots\ldots & b_n \\ \ldots\ldots & & \ldots\ldots & & \ldots\ldots \\ p_1, & p_2, & p_3 & \ldots\ldots & p_n \end{matrix}\right\} \quad (n \text{ columns}, m \text{ rows}),$$

expresses the possibility of determining n scalars $t_1, t_2, \ldots\ldots t_n$, so that

$$\Sigma t_1 a_1=0,\quad \Sigma t_1 b_1=0,\quad \ldots\ldots\quad \Sigma t\text{-}p_1=0.$$

The laws of expansion and of manipulation of these quaternion arrays are explained, and it is pointed out that the quotient of a two-row and a one-row array

$$\left\{\begin{matrix} fa, & fb, & fc, & fd \\ a, & b, & c, & d, \end{matrix}\right\} \div \{a, b, c, d\}$$

comprises all the Hamiltonian invariants of the linear quaternion function f—a result easily extended to the case of any number of functions by increasing the number of rows in the first array. As another example of the use of these arrays, if μ is the couple and λ the force of a wrench, the origin being base-point, the invariants of an n-system of screws are at once deducible from the array,

$$\left\{\begin{matrix} \mu_1, & \mu_2, & \mu_3 & \ldots\ldots & \mu_n \\ \lambda_1, & \lambda_2, & \lambda_3 & \ldots\ldots & \lambda_n \end{matrix}\right\}.$$

—Mr. Frederick Purser read a paper on the application of Bessel's functions in the theory of elasticity. This paper attempts to use Bessel's functions in the discussion of the elastic equilibrium of a right circular cylinder. It is shown that the elastic forces and displacements at any point when no bodily forces act can be expressed as the sum of two series, one of which proceeds by products of exponential functions of z and ordinary Besselians in r, the other by products of trigonometrical functions of z with Besselians in r of imaginary argument. The method is also applied to certain cases of applied bodily force, and various practical problems are considered both with a view to approximate solution and as illustrating the St. Vénant theory of equipollence, on which it is conceived the present method throws some light.

PARIS.

Academy of Sciences, Nov. 18.—M. Fouqué in the chair.—On the periods of double integrals in the theory of algebraic functions of two variables, by M. Emile Picard.—On a modification in the mode of use of an electrical thermometer, for the determination of subterranean temperatures at the Museum of Natural History, by M. Henri Becquerel. A description of a new method of applying the thermocouple to the determination of temperature at a distance. A d'Arsonval galvanometer, the deviations of which are proportional to the intensities of the currents, is used, and the scale of this galvanometer is calibrated in degress by direct comparison with the thermocouple and a mercury thermometer. One junction of the thermocouple is then placed in the point the temperature of which is required, and the other in mercury along with a thermometer. Since the deflection of the d'Arsonval is now proportional to the difference of these temperatures, the graduated scale is displaced parallel to itself in such a manner that the zero of the galvanometer coincides with the line indicating the temperature of the junction in the mercury. On closing the circuit the reading on the scale now indicates the temperature of the distant junction.—The study of ammonium amalgam, by M. Henri Moissan (see p. 89).—On the Perseids of 1901, by M. Perrotin. There has been an increase in the number of meteors from the Perseids during the present year. The observations at Nice were somewhat incomplete on account of the weather. On August 10 there was an average of 10 stars per hour, on the 11th, 25 to 30 per hour, on the 12th, 32 were counted during the 40 minutes observations were possible, and only 24 were seen on the two following nights.—Observations of the Perseids made at Athens, by M. D. Eginitis. These stars were seen on the four nights commencing on August 9, and were counted up to the sixth order. About 500 meteors were observed in all, the maximum display being on the 11th, when on the average 31 per hour were seen.—On a manometric differential log, by MM. Emile Raverot and Pierre Belly. The two sides of a manometer are connected to two tubes under the water in the same horizontal plane, one tube opening in the direction of motion of the vessel, the other being at right angles. In the case of the tube in the direction of motion, the pressure depends partly upon the velocity of the vessel and partly upon the variable static pressure due to its depth below the surface of the water. The latter effect is completely compensated by the second tube, and by the introduction of a suitable damping arrangement the readings of the manometer are a function of the speed of the vessel alone. The scale is graduated empirically by runs over a measured distance.—The law of radiation at low temperatures, by M. Compan. A series of experiments were carried out on the rate

of cooling of a blackened ball, the temperatures being measured by means of a thermocouple. The rate of cooling was taken over the ranges 302° to 0° C., 174°·3 to −79°·2 C. and 15° to −182°·5 C., and the experimental values compared with those calculated from the formulæ of Dulong and Petit, Stefan and Weber. The formula of Dulong and Petit was found to apply roughly only between 0° and 200°, that of Stefan covered the whole range from the boiling-point of liquid air to 302°, whilst the formula of Weber does not apply at low temperatures, but for the range 100° to 302° it has the advantage over Stefan's formula.—On the combinations of gold and chlorine, by M. Fernand Meyer. Gold was converted completely into the chloride $AuCl_3$ by the action of liquid chlorine in a sealed tube at 70° C. The dissociation of this pure chloride into AuCl and Cl_2 was then studied, and also the dissociation of AuCl into chlorine and gold. No indication was obtained of the existence of a chloride of gold intermediate between $AuCl_3$ and AuCl.—On dioxyisopropylhypophosphorous acid, by M. C. Marie. A study of one of the three acids obtained by the action of hypophosphorous acid upon acetone. The acid is monobasic, and from its analysis and the fact that it forms diacetyl and dibenzoyl derivatives it is assumed to have the constitution $[(CH_3)_2(OH).C]_2PO(OH)$.—The action of some acid chlorides upon the sodium derivatives of methyl and ethyl acetoacetates, by M. Bongert. Details of the compounds obtained by the action of propionyl chloride and butyryl chloride upon ethyl acetoacetate, and of isovaleryl chloride and caproyl chloride upon methyl acetoacetate.—The oxidation of unsaturated alcohols by contact action; the preparation of vanillin, by M. A. Trillat. The vapours of the alcohols mixed with air are submitted to the action of a hot platinum spiral. Allyl alcohol gave 5 per cent. of its weight of acrolein, cinnamic alcohol gave the corresponding aldehyde and isoeugenol gave vanillin. Eugenol gave the same product.—The spermatocyte divisions and chromosome special to the Orthoptera, by M. R. de Sinety.—The blue and green colorations in the skin of the vertebrates, by MM. Camichel and Mandoul. It has been known for some time that the blue coloration of the skin in certain vertebrates is not due to a blue but a black pigment; green skins contain two pigments, black and yellow. A study of these coloured skins with the spectrophotometer shows that there is a complete analogy between these and the phenomena exhibited by turbid media, the curves obtained from skin and from artificial turbid media such as lamp-black and Chinese ink being absolutely similar.—The relation between the liver, skin and hair from the point of view of the pigments and iron, by M. B. Floresco.—The influence of the ingestion of wine on the development of tuberculosis, by M. L. Roos. From experiments made with guinea-pigs the author concludes that there is no reason to suppose that the ingestion of alcohol in the form of wine accelerates the course of tuberculosis.—The formation of pearls and their "diseases," by M. S. Jourdain.—The measurement of the blood pressure in lunatics, by MM. Ed. Toulouse and N. Vaschide. It is shown that there is a distinct connection between the blood pressure and mental troubles; there is also a change in the blood pressure corresponding to different states of the same patient.—A mechanical theory of vision, by M. Antoine Pizon.—An anatomical comparison between grafting, the removal of the heads of buds and annular decortication, by M. L. Daniel.—On chlorophyll assimilation in autumn, by M. Jean Friedel.—On the mica schists, gneiss, amphibolites and green rocks of the schists of the western Alps, by M. Pierre Termier.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 28.

ROYAL SOCIETY, at 4.30.—Micro-crystalline Structure of Platinum: T. Andrews, F.R.S.—A Comparative Study of the Spectra, Densities and Melting Points of some Groups of Elements, and of the Relation of Properties to Atomic Mass: H. Ramage.—On the Properties of the Arterial and Venous Walls: Prof. J. A. MacWilliam.—The Development of *Echinus esculentus*: Prof. E. W. MacBride.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

MONDAY, DECEMBER 2.

SOCIETY OF ARTS, at 8.—The Chemistry of Confectioners' Materials and Processes: William Jago.

IMPERIAL INSTITUTE, at 8.30.—Planters and Planting in Tropical Greater Britain: R. Hedger Wallace.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Lemon Oil Industry: Herbert E. Burgess and J. F. Child.—The Separation of Materials of Different Specific Gravity: J. W. Hinchley.

TUESDAY, DECEMBER 3.

ZOOLOGICAL SOCIETY, at 8.30.—On the Myriapoda collected during the "Skeat Expedition" to the Malay Peninsula, 1899–1900: F. G. Sinclair.—On the Crustacea collected during the "Skeat Expedition" to the Malay Peninsula, 1899–1900: W. F. Lanchester.—On the Anatomy and Systematic Position of Rhynchæa: F. E. Beddard, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Paper to be further discussed*: Train Resistance: J. A. F. Aspinall.

AERONAUTICAL SOCIETY, at 8.—Aërial Navigation by the Body heavier than Air: Sir Hiram Maxim.—Atmospheric Currents: William Marriott.—Navigable Balloons, and the Scientific Aspects of M. Santos Dumont's Experiments: Eric Stuart Bruce.

WEDNESDAY, DECEMBER 4.

SOCIETY OF ARTS, at 8.—The Identification of Wood and its Application to Scientific and Commercial Purposes: Herbert Stone.

GEOLOGICAL SOCIETY, at 8.—On a New Genus belonging to the Leperditidæ, from the Cambrian Shales of Malvern: Prof. T. T. Groom.—The Sequence of the Cambrian and Associated Beds of the Malvern Hills: Prof. T. T. Groom, with an Appendix by C. A. Matley.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.

THURSDAY, DECEMBER 5.

ROYAL SOCIETY, at 4.30.

SOCIETY OF ARTS, at 4.30.—The New Trade Route to Persia by Nushk and Seistan: Edward Penton.

LINNEAN SOCIETY, at 8.—On the Foraminifera collected round the Funafuti Atoll from Shallow and Moderately Deep Water, with Notes on New Species from the Sands of the Reef Slope: F. Chapman.—Protoplasmic Connections in the Lichens: Dr. J. H. Salter.—Exhibition: Ten Abnormal Sacra of the Frog: Dr. A. G. Ridewood.

CHEMICAL SOCIETY, at 8.—Influence of Substitution on the Formation of Diazoamines and amino-azo-compounds: G. T. Morgan.—The Determination of Available Plant Food in Soils by the Use of Dilute Solvents: A. D. Hall and E. J. Plymen.—Some New Derivatives of Gallic Acid: E. B. Power and E. Shedden.

FRIDAY, DECEMBER 6.

GEOLOGISTS' ASSOCIATION, at 8.—Notes on a Recent Visit to Egypt: Dr. C. W. Andrews.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Gas-Engine Construction: R. W. A. Brewer.

CONTENTS.