THURSDAY, OCTOBER 29, 1908.

FARM ANIMALS.

Cyclopedia of American Agriculture. A Popular Survey of Agricultural Conditions, Practices, and Ideals in the United States and Canada. Edited by L. H. Bailey. Vol. iii., Animals. Pp. xvi+708. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 21s. net.

THE third volume of this important "Cyclopedia of Agriculture"—the volume dealing with animals—reflects in a remarkable manner the varying standards to which agricultural knowledge has attained in individual sections of the subject. In the sections hitherto most amenable to experiment and research a vast amount of information of an accurate and trustworthy character has been accumulated. Much of this information may be beyond the farmer's capacity to utilise; some of it may have been developed on lines which were not always as useful as the experimenters expected and claimed; but time and experience always tend to bring the experimenter in the laboratory and the operator in the field into closer and closer touch, and so to rub off the eccentricities of each. On the other hand, in the sections concerned with breeding and selection, and with the evolution of different types of stock, our knowledge is still in a very nebulous condition, even though in these sections agriculturists have operated with, perhaps, the greatest apparent success. In dealing with such subjects, writers are still too apt to lay the foundations of their work in unquestioned beliefs and unsubstantiated opinions. Such expressions as "it is supposed," "it is believed," "it is said," "it has been thought," appear in this volume, as in most other books upon the same subject, with too great frequency. It is unfortunate that, instead of emulating the patience and thoroughness of such authors as Youatt and Low, our recent writers on live stock have taken to a style that may be descriptively interesting, but is often inaccurate, sometimes even slip-shod, and leads to no abiding result.

The editor of this encyclopædia realises the unsatisfactory nature of this part of the work compared with the other part based upon long-continued experiment and research, and his words are well worth quoting:—

"Contrary to his expectation, the editor has found the compilation of this volume much more difficult than the making of the volume on crops. Animals are less tractable to investigate than plants, and the scientific method does not seem to have been so successfully applied to the study of them as to crops. In the matter of breeds, the expert knowledge is likely to be in possession of advocates or even of partisans, and it is very difficult to arrive at agreement or a common basis of comparison and judgment. Existing writings are largely descriptive and historical. Even on questions of feeding and general management, there are almost irreconcilable differences of opinion. The editor hopes, however, that the compilation has brought together the soundest opinions and practices, and he is sure that the names of the contributors to this volume will make the work authoritative. The articles on breeds are largely from men engaged in practice and from specialists in the breed, whereas the articles on crops in vol. ii. are largely from teachers and investigators; this dissimilarity is representative of the kinds of interest that attach to these two groups of agricultural produce."

It would be almost impossible to overestimate the value of the real scientific part of this volume, such, for instance, as Armsby's chapter on the principles of stock-feeding, the complementary chapters on balancing rations, and the whole section dealing with the manufacture of animal products, in which milk, butter, cheese, meat, and even such things as hides and leather are dealt with. There are very useful and carefully written chapters on the physiology of domestic animals, on infectious diseases of animals, and on the American invention of scoring-cards in stock-judging.

The greater part of the work is taken up with a description of North American farm animals, their breeding, history, rearing, and general treatment towards accomplishing the ends for which they are intended. This part must be useful to a very large number of people, for it treats not only of horses, cattle, sheep, and swine, but of dogs, goats, fish, poultry, reindeer, and bison, and even of pigeons, rabbits, cage-birds, and many other domestic pets.

It is only in the parts of the book dealing with the science of breeding and in the descriptions of individual breeds that we would suggest amendments. In so important a "Cyclopedia" as this, one expects the writers on breeding and heredity to go beyond the Darwinian position and discuss the illumination which the work of such men as Weismann, De Vries, and Mendel has afforded. One also expects doubtful theories to be well sifted. For instance, a reconstructed Urus is labelled "Urus, the source of domestic cattle." The question is no doubt encompassed by many difficulties, but it would be just about as easy to prove that the quagga is the source of domestic horses.

Perhaps the best way to indicate the kind of statement to be found running through the breed descriptions is to throw a few of them into the form of interrogations while retaining the writers' language as far as possible, viz.:—

Did Hugh Watson declare himself for the "Black and all black; the Angus Doddie, and no surrender"? Is Angusshire now a part of Forfarshire? Did Watson's ancestors breed Angus cattle on the Keillor farm for more than two hundred years before 1805? Did Hugh Watson begin to breed Angus cattle in 1805? Are there Devon cattle in Ireland? Is the Galloway the oldest of the pure breeds of Britain? Is the Hereford among the oldest, if not the oldest, established of the English breeds of domestic cattle? Have Suffolk or polled cattle existed in the county of Suffolk, England, from time immemorial, and does the probability seem to be that they were introduced soon after the Roman occupation? Is the supposition correct that a Mr.

Dexter developed the Dexter breed of cattle by crossing the true Kerries on cattle of a beefy sort, possibly Shorthorns? Was the cow called *Red Rose* which produced nearly 10,000 lb. of milk in a year a true Kerry? Is the cow figured on p. 380 as a Dexter-Kerry really a Dexter-Kerry? Is the outcome of the cross of Shorthorn bulls on Galloway cows usually a blue-grey? Did the monks of the Middle Ages have the Cheviot breed of sheep about the pasture-lands of the old monasteries? Did George Washington have Bakewell ewes at Mount Vernon, or is it only "said"? Do black-faced sheep subsist largely on heather?

The answers to some of these questions may be in the affirmative, but they need support before being accepted.

There are two breeds of cattle peculiar to America, viz. the polled Durhams and the polled Herefords, about the origin of which one would like to have definite information. In both these breeds there are what are called "double standards" and "single standards": the "double standard" animals being pure-bred hornless sports and their descendants, and the "single standards," in the case of the Hereford, being animals "not eligible to record in the American Hereford Record," and, in the case of the Shorthorns, animals "got by the use of Shorthorn bulls on the native muley cows." We never hear of hornless sports among pure-bred Herefords or Shorthorns in Britain, and some information as to the circumstances in which these occur in America would be not only interesting, but useful to students of heredity.

JAMES WILSON.

POWER GAS PRODUCTION.

Power Gas Producers, their Design and Application. By Philip W. Robson. Pp. iv+247. (London: E. Arnold, 1908.) Price 10*s.* 6*d.* net.

THE wonderful advance in the production of power made by the suction gas plant combined with the gas engine gives great importance to any trustworthy literature on the subject, and the work on power gas producers by Mr. P. W. Robson is certainly one which will be warmly welcomed, as it sets the subject out in a clear and concise manner, and indicates the theory of the various actions, as well as the means by which the application is carried out.

As the author very fairly admits, it is difficult for one engaged in the manufacture of a particular class of producer to treat thoroughly of the work of other firms, with the result that perhaps full justice has not been done in every case; but as a whole the book is wonderfully free from error, although there are a few points which might be amended.

The statement made on p. 17 that anthracite and gas coke have practically the same proportion of volatile matter is a little loose, as with a good gas coke one does not expect to find more than 1 per cent., whilst the average in anthracite is about 5 per cent. to 6 per cent. On p. 29 the reader is left to infer that, inasmuch as a temperature of 900° C. to 1000° C. favours the formation of carbon monoxide rather than the dioxide, it is the best to employ, whilst practical conditions undoubtedly dictate a lower temperature in order to avoid the tendency to clinker which is so often found with fuels that are not of quite the best quality. Indeed, some of the largest producer makers hold that a temperature between 800° C. and 900° C. is the best for practical working.

In the conclusion to this chapter, also, the statement that an excessive amount of steam lowers the temperature all round and is generally against efficiency, preventing the production of a good gas, is of course modified by the fact that within a fairly wide range increase of carbon dioxide almost invariably means a corresponding increase of hydrogen, and if this were not so it is quite clear that such processes as the Mond would not be possible, whilst the advantage of an excess of steam over the theoretical quantity is in reduction of clinker and ensuring free combustion of that portion of the carbon which otherwise remains in the ash.

In chapter iii. the statement is made that the regulation of the steam is unnecessary, and in producers of the "National" type this may be the case, as it would be very difficult indeed to regulate a water feed which has to distribute over half a dozen places, but with other forms of producer it is certain that if a less saturation of the air is arranged for low loads and is increased in an increasing ratio at full loads, a more uniform temperature is maintained in the generator.

On p. 46 indicator diagrams are shown of the National and Crossley engines as illustrating conclusively that the gas produced with excess of steam could not have been of such high calorific value as that evolved in the National type of producer, but the author has evidently overlooked the fact that in the trial here quoted the National engine was taking full gas, whilst the Crossley engine had the gas charge throttled so as to keep within the limits of power of the trial.

It is stated on p. 71 that the temperature of the gas entering the cooling or coke scrubber should be 600° F., but this temperature would be with ordinary plants far too high, and would be taken as showing that in the form of vapouriser used the heat was not properly extracted.

The author mentions on p. 106 that some French makers have introduced a chemical purifier containing oxide of iron for the purpose of eliminating sulphuretted hydrogen from the gas, but surely it is unnecessary to give credit for what has been done in every gas works for very many years.

On the last line but one of p. 84 "per hour" should be inserted after "7½ gallons," whilst in the table on p. 136 the higher value of the heat efficiency for the whole run should be 80 per cent. instead of 8 per cent., and there is a misprint on the third line from the bottom of p. 221.

The portions of Mr. Robson's work which deal with bituminous gas plants are not nearly so good as those portions that have reference to the use of anthracite and coke, whilst the chapters on work

and management are clearly based on knowledge gained with the National type of producer, and would not in every case be applicable to another form.

The description on p. 56 of the arrangements in the Crossley plant for varying the entering mixture is not very clear, and throughout the book but little is said of the generators produced by this firm, and it is limitations of this kind which are the chief fault that can be urged against an otherwise admirable book.

THE NATIONAL COLLECTION OF FISHES.

Guide to the Gallery of Fishes in the Department of Zoology of the British Museum (Natural History), Cromwell Road, London, S.W. Pp. v+209. (London: Printed for the Trustees, 1908.) Price 1*s*.

THE unique collection described in this guide consists mainly of stuffed specimens, coloured, as far as possible, to resemble the fishes in their natural conditions. "I believe," says the director in the preface, "that there is no other collection of fishes in a public museum in which the specimens are presented without the usual iron supports, with sufficient space around each fish and in natural colours, instead of the oily-brown which all dried fishes tend to acquire." All preserved material is kept in a separate building, where it is accessible only to special applicants. This arrangement is very desirable, since arrays of jars displaying mystifying anatomical details merely serve to distract the general student of fishes who wishes to devote his attention to the external features of as many species as possible, acquiring, at the same time, such information about each as will enable him to understand their natural relationships, their places in the economy of nature, and the special character and variety of fish-life in all its aspects. This is the chief object of the collection, and of the descriptive labels attached to each specimen case. "This guide is a collection of the labels with some additions, arranged systematically so as to show the groups into which fishes are divided, and is illustrated by figures which are to a large extent taken from photographs of the specimens actually seen in the cases."

The variety and interesting character of the information given in this guide is fairly illustrated by the following samples:—

"The Herring, *Clupea harengus*, 255, is found on both European and American sides of the North Atlantic, and is especially abundant in the North Sea and off Norway. It may thus be regarded as a northern and a cold-water fish. The 'Herring' of the North Pacific is of another species, *Clupea pallasi*. The Herring fisheries of the North Sea take place during the spawning season, which reaches its height in June off Shetland, and in November off Lowestoft. The fishing fleets move southwards as the centre of shoaling shifts from point to point. The spawn of the Herring, unlike that of most food fishes, even the allied Pilchard and Sprat, sinks to the bottom; but the fish are mostly caught near the surface in drift-nets, which may be more than a mile in length for each boat. About 8,000,000 cwt. of Herrings, valued at more than 2,000,000*l*., are annually landed in Great Britain. The largest Herrings come from Loch Fyne, in Scotland."

"The Sea-breams and Snappers belong to the family Sparidæ; they are coast fishes, widely distributed, and mostly carnivorous. The spinous and soft portions of the dorsal fin are continuous and nearly equal in extent; the lower rays of the pectoral fin are branched; the lower pharyngeal bones are separate. The genera of the family are distinguished the one from the other chiefly by the characters of the teeth."

In view of the recent rapid growth of our knowledge and increasing public concern regarding our food-fishes, it is not surprising that special attention has lately been devoted by the keepers of the gallery to these fishes. They are distinguished from other fishes by the letters B.F.F. (British Food Fish), while the descriptive labels attached to each specimen give the latest information (repeated in this guide) concerning its economic importance and value, the principal fishing grounds, means of capture, food, and habits.

Altogether, it may safely be said that a student who conscientiously examines the fish series in the national collection and who assimilates the information contained in this guide will acquire an accurate, vivid, and comprehensive knowledge of the world of fishes, a possession not only valuable in itself, but the best possible foundation for more special studies.

W. W.

THE RESISTANCE AND PROPULSION OF SHIPS.

Hydraulics. In two vols. Vol. ii., The Resistance and Propulsion of Ships. By Prof. Dunkerley. Pp. iv+253. (London: Longmans, Green and Co., 1908.) Price 10*s*. 6*d*. net.

THIS is the second volume of a treatise on hydraulics written by the author. Its origin may be traced to his previous service as professor of applied mechanics in the Royal Naval College at Greenwich, where students of naval architecture and marine engineering taking advanced courses receive instruction in the resistance and propulsion of ships. A good text-book on these subjects, bringing information up to date, has been much needed, and this volume (of about 250 pages) will be welcomed. It brings together in a clear and compact form the modern theories of stream-lines and wave-motion, and summarises experimental investigations on resistance and propulsion, thus sparing readers the labour and trouble incidental to personal research in many and scattered publications containing the original papers of Rankine, William Froude, Scott Russell, Cotterill, R. E. Froude, and other authorities. The mathematical parts of the book are well written, and the descriptive sections are interesting; numerous diagrams assist the explanations. Practical applications of scientific methods to the design of steamships and their propellers find a place, although no attempt is made to intrude on the special province of the naval

architect and marine engineer. In these sections of the book considerable use is made of information published in the Transactions of the Institution of Naval Architects and other technical publications, always with due acknowledgment.

There are six chapters. The first deals with "stream-lines," mainly following Rankine's methods, but also discussing Prof. Hele Shaw's interesting experiments on viscous stream-line flow and Sir George Stokes's mathematical investigations thereon. Next an excellent summary is given of the theory of wave-motion; for waves of translation and oscillation, and for capillary waves. Methods of observing ocean waves, and some results of such observations, are also described. In this section reference is made to original work done by Prof. Osborne Reynolds in connection with groups of waves.

Two interesting chapters—making up about one-fourth of the book—are devoted to an epitome of modern methods of determining the resistance of ships, due for the most part to the work of William Froude, whose enunciation of the "law of comparison" between ships and models, and investigations of frictional, eddy-making, and wave-making resistance are described in detail. Since the system of model-experiments was introduced by Froude about forty years ago, great extensions have taken place in the trials made with full-sized ships, and the comparisons of the results of such trials with those obtained with model ships and propellers have yielded much valuable information. This result is illustrated in many ways by the author, in a chapter dealing with the trials of ships. Considerable interest will be taken in the discussion of the influence which *depth of water* has upon the resistance of ships, especially in view of certain extraordinary results obtained on the trials of some recent torpedo-boat destroyers. In a final chapter the characteristics and relative efficiencies of water-jet propellers, paddle wheels, and screw propellers are discussed at length, the work of the two Froudes, Rankine, Cotterill, and Charles Parsons being utilised. No part of the book shows greater labour than this in its assemblage and analysis of facts and theories. A good index completes the volume.

On its merits the book deserves, and will receive, favourable recognition from all interested in the subjects of which it treats. That recognition will not be lessened by the fact that its appearance is coincident with a serious breakdown in health of its gifted author, involving his resignation of the professorship of civil and mechanical engineering in the University of Manchester. To this circumstance may be attributed certain errors in mathematical formulæ occurring in the book, and these should be corrected in future editions. There is evidence, too, that the book was, for the most part, completed some time ago; as it gives no account of valuable experimental investigations made during the last two or three years in this country and the United States. As it stands it may be recommended as a text-book for the use of students, working under the guidance of competent teachers.

STUDIES IN THE STATISTICS OF PRODUCTION.

Kraft: Ökonomische, technische und kulturgeschichtliche Studien über die Machtentfaltung der Staaten. By Prof. E. Reyer. Pp. xvi+380. (Leipzig: W. Engelmann, 1908.) Price 6 marks.

THE subject with which Dr. Reyer deals in this volume is an extremely wide one, viz. "the supply and consumption of human, animal and mechanical and thermal energy for domestic purposes and in agriculture, industry and transport." Practically speaking, the subject, as he interprets it, is coterminous with what is usually understood by the statistics of production, and we cannot help thinking that some such title would have better described the work. Dr. Reyer deals not merely, or even principally, with statistics of power as such, but with the means of obtaining heat and power, the uses to which it is put, and even the organisation of industry. The replacement of handwork by wholesale manufacture, the output of coal, the development in the use of steel, transport by land and sea, agriculture, gas and electric lighting all come under his survey.

The labour that Dr. Reyer must have spent on his work and on the preparation of the numerous illustrative diagrams is immense, and some of his studies serve to emphasise very well the great changes that have taken place of recent years in the industries of the world, and more especially in the relative positions of Germany, Great Britain, and the United States—the three countries to which the author devotes most of his attention. Taking the volume as a whole, however, we do not think that Dr. Reyer can be said to have fulfilled his task very happily, though it will be readily conceded that many difficulties are inherent in the subject. The data are very imperfect, usually incomplete, and nearly always incomparable as between one country and another. Still, there are data, and the volume might, we think, have been made both more readable and more useful to the student.

In the first place, the chapters read as if they were isolated studies, made at different times, and subsequently thrown together with little or no attempt at arrangement. The first three are entitled "The Age of Steel," "Mining and the Importance of Coal," and "The Noble Metals" respectively, and form to some extent a connected series. The reader expects the following chapters to deal with other industries, but chapter iv. treats of the growth of population and development of industry in the case of the Great Powers, chapter v. passes to the industries of a single country—the United States—chapter vi. gives a general discussion on the subject of wholesale manufacture and handwork, and the next chapter deals with economic fluctuations! After this we come to transport and then to agriculture. The book has no obvious structure or plan, and the erratic changes of subject are most distracting to the reader.

In the second place, references are almost entirely lacking. There are few or none in the text, and a hopelessly inadequate bibliography at the end of the volume, a bibliography which suggests that the author must have taken much of his information at second

hand. Data of every degree of untrustworthiness are given in the text, but the student is debarred from verifying the figures or referring to the original for further information as to their meaning; exact references should have been given in every case. Even in the bibliography we would suggest that such citations as "Produktion and consum. of timbre in forein countries, (blue book)," and "Statesman's yearbook, Statist. Abstracts (mit statistischen Tabellen)," are hardly clear.

Finally, while we approve the use of graphic methods, we wish that Dr. Reyer would lay to heart the golden instruction in the Board of Education's "Syllabus of Practical Mathematics":—"In all the work on squared paper a candidate should be made to understand that an exercise is not completed until the scales and the names of the plotted quantities are clearly indicated on the paper."

OUR BOOK SHELF.

Etude sur la Vallée Lorraine de la Meuse. By J. Vidal de la Blache. Pp. 190; with figures and folding maps. (Paris: Armand Colin, 1908.) Price 4 francs.

CAPTAIN VIDAL DE LA BLACHE publishes in this book a memoir on the development of the valley of the Meuse, a subject that has engaged the attention of several previous authors, including M. Cornet and Prof. W. M. Davis. He points out the striking character of this long valley, without any important tributaries, yet carved out in past times by a river more powerful than that which now occupies its bed. He explains its independence as regards the Paris basin by the fact that its waters were led northward into an old sea covering the Ardennes before the westward slope of the Seine system had been determined. The Meuse was originally joined by the Moselle at Pagny-sur-Meuse, through the now deserted gap between that town and Toul, and thus had its primary sources in the Vosges. The author relies much on the distribution of pebbles from the Vosges in the older alluvium of the valley. He denies that the river is decadent, though since the capture of the Moselle it has lost much of its erosive force; it has still an important flow, owing to the supplies gathered from the rains and stored in the deep and saturated gravels of its bed.

The second part of the book relates to the influence of the valley on the occupations of its inhabitants. The population has become reduced (p. 143) to the lowest level compatible with agricultural production, and labourers are even invited from other areas. Hence there is no surplus of workers who might emigrate from it to the neighbouring mining country. The latter has become occupied by Belgians and Italians, and the contrast of peoples and modes of living has become acute. The typical farmstead on the Meuse is figured on p. 151, where we see dwelling-house, barn, and stable under one great roof, as in Friesland; three separate entries, however, are here provided in place of the huge doorway common in the Low Countries. The history of roads along this natural highway or across it is fairly given, but the author stops short of the last great incident of the valley, when the French armies were led northward along it, as if drawn fatally to the Ardennes, while the Bavarians, representing the ancient torrents from the Vosges, poured down after them to Mouzon and Sedan. As Captain de la Blache observes (p. 177), the mineral wealth of Lorraine has led to a convergence of canals and railways independent of the direction of the Meuse; it is as if this valley "avait subi aussi une capture économique."

G. A. J. C.

Chemical Reagents, their Purity and Tests. A New and Improved Text based on the Latest Edition of Krauch's "Die Prüfung der chemischen Reagentien auf Reinheit." By E. Merck. Translated by H. Schenck. Pp. vii+250. (London: A. Constable and Co., Ltd., 1907.) Price 6*s.* net.

EVERY chemist, whether engaged in analytical work or not, will welcome the translation of Krauch's manual into English, for the growing refinements introduced into all chemical operations render a full knowledge of the purity of laboratory reagents increasingly important.

In the present volume the properties of common materials, both inorganic and organic, are given in alphabetical order, the nature of the impurities indicated, and the tests, both qualitative and quantitative, described. It thus becomes a very simple matter to ascertain the purity of any substance, and, as there are something like 250 enumerated, it will be seen that the range is fairly comprehensive. There is little that calls for comment or criticism. The descriptions of the impurities and tests, though short, are usually sufficient for the purpose, not the least valuable part being the references to original papers containing details of the processes not found in the text.

The original of Krauch's manual appeared in German in 1888, and passed through several editions, the above translation being made from a revised edition prepared by E. Merck in 1905. The names of the joint authors are a sufficient guarantee of the trustworthiness of the information, and the translation is all that could be desired. Whilst strongly recommending the book we would direct attention to a few omissions. There is no mention of hydrazine, formaldehyde, toluene, or titanium salts, no quantitative method given for estimating solutions of hydrogen sulphide and ammonium sulphide, and nothing is said about metallic lead, magnesium, and aluminium, all of which may be regarded as not uncommon reagents.

J. B. C.

Notre Flotte aérienne. By Wilfrid de Fonvielle and Georges Besançon. Pp. 234. (Paris: Gauthier-Villars, 1908.) Price 6.50 francs.

THIS little book forms a *résumé* of the steps taken to accomplish the navigation of the air so far as we have at present got. Ordinary ballooning is left out of the question, and the bulk of the book is devoted to the development of the dirigible, especially in France.

Soon after the ascent of the first balloon (1783), Lieutenant Meusnier wrote a memoir discussing the principles on which a dirigible balloon might be constructed. This was remarkable as foreshadowing the airship of to-day, especially as regards the "ballonet," or method by which the envelope can be kept rigid by the internal pressure of air. But at that period no engines existed by which the necessary power for propulsion could be obtained. Later on, when the steam engine had become developed, Giffard built his machine, the prototype of the modern vessel, and made trials in Paris in 1852. Little by little further improvements were made, the siege of Paris especially directing attention to the importance which might attach to such an apparatus in military operations.

Then came the electrically propelled balloons of MM. Tissandier, and *La France*, which latter proved to be the first machine to make long journeys successfully.

Finally we come to the "machines à explosion," or balloons propelled by gas engines. Paul Haenlein in 1865 was the pioneer of this type, although he seems to have had no practical success. The German machines of Woelfert, Schwartz, and the first Zeppelin are in turn described, though each of them proved failures. The various vessels of Santos Dumont next claim attention, especially his much-lauded trip round the Eiffel Tower. More failures and catastrophes followed with Rose, Severo, and De Bradsky, and then came the successful essays of the Lebaudys. The history of this type of airship is fully gone into, from the first trials up to the unfortunate escape of the *Patrie*.

Then follow descriptions of the other French dirigibles, the *Ville de Paris*, and that of Count de la Vaulx.

The modern airships of other countries are disposed of in a few pages. The Zeppelin No. 3 is shortly described, but its better-known successor, which has since made its *début* and taken its *congé*, is referred to in the final pages of the book. Having described the Polar explorations by balloon at some length, the authors give a chapter on aëroplanes. The latter can hardly be called up to date, since progress has been so rapid during the last year or two. It is almost amusing to read of M. Farman's record performance of remaining in the air for 52⅔ seconds when to-day we think nothing of Mr. Wright flying for more than an hour with a passenger. In these circumstances of kaleidoscopic changes it seems impossible to bring out a book on aëronautics which shall be really up-to-date, but the one before us is a good little history which is fairly trustworthy, though it is not detailed enough to be classed as a technical text-book.

An English Holiday with Car and Camera. By James John Hissey. Pp. xviii+426; with 28 full-page illustrations and a map of the route. (London: Macmillan and Co., Ltd., 1908.) Price 10*s*. net.

IT was scarcely necessary for Mr. Hissey to tell us, as he does in his preface, that he travels purely for pleasure and "in search of the picturesque." Those readers who know the author's many pleasant, gossipy books about English by-ways have long been aware, from the optimistic way in which rural England is described, that Mr. Hissey loves exploring his native land. This time the journey taken by the author and his wife was confined to motoring in the country south of a line joining the Wash to the Bristol Channel. The account of the wanderings, with its many glimpses of the home-life of the country people, and the excellent illustrations, combine to make a very interesting volume.

Pearls and Parasites. By A. E. Shipley, F.R.S. Pp. xv+232; with illustrations. (London: John Murray, 1908.) Price 7*s*. 6*d*. net.

THE title of Mr. Shipley's book scarcely serves to indicate the general character of the contents. The volume contains nine essays, which, with one exception, deal with problems of economic zoology. The subjects introduced vary considerably among themselves, as the following titles show:—Pearls and Parasites; the Depths of the Sea; British Sea-fisheries; Zebras, Horses, and Hybrids; Pasteur; Malaria; "Infinite Torment of Flies"; and the Danger of Flies. The concluding essay is an inquiry into the aims and finance of Cambridge University. Most of the essays have appeared previously in periodicals, and have been read by many people interested in science. The subjects discussed are sufficiently important to attract the scientific as well as the general reader.

Architectural Education. By Wilfrid I. Travers. Pp. vii+119. (London: Harrison, Jehring and Co., 1908.) Price 4*s*. net.

THE subtitle of this book indicates its character with fair precision; it runs:—"A history of the past and some criticisms of the present system, upon which are founded some suggestions for the future, with particular reference to the position of the universities." Mr. Travers has collected much information as to the courses of training for architects and the syllabuses of the examinations conducted by the Royal Institute of British Architects and many universities, and also offers useful suggestions for their improvement. Many of the schemes of work here tabulated appear to give little prominence to the training in the principles of science which are necessary for an architect to ensure successful work.

LETTERS TO THE EDITOR.

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

A Suggested Explanation of the High Velocities of Gases observed on the Solar Surface.

THE important discovery by Prof. Hale of the Zeeman effect in sun-spot spectra proves the presence of extensive areas on the solar surface in which ions of one kind largely preponderate. This suggests the solution of one great difficulty which has blocked the way in the attempts that have been made to explain the very high velocities which are not unfrequently observed near the solar surface by spectroscopic and other means. For there is a limit to the velocity of a gas impelled by pressure only, this being the velocity with which it streams from a high pressure into a vacuum, and we may put this limiting velocity to be equal to that of propagation of sound in the gas. Observation shows that the highest velocities observed on the solar surface are about 200 times as great as the velocity of sound in hydrogen at the temperature of freezing water.

If, then, these masses of moving matter are impelled by pressure only, the number expressing their absolute temperature divided by the density must be 40,000 times greater than the corresponding number in the case of hydrogen at 0° C. Taking the absolute temperature of the sun to be forty times as great as that of freezing water (which cannot be far from the truth), the observed velocities would become consistent with our supposition of pressure-motion only if the density of the gas were a thousand times less than that of hydrogen. This brings us down to the mass of the negative electron. As, however, spectroscopic evidence indicates the motion of ponderable matter (principally, if not solely, composed of hydrogen), we must assume that gases are entangled in the rush of electrons, but not to a sufficient degree to alter the average density materially. In the case of matter in which one kind of electrons preponderate, electric forces may, of course, increase the velocities almost to any extent, but the close agreement of the observed high velocities with the limiting velocity in a gas, having a density equal to the thousandth part of that of hydrogen, and being at a temperature agreeing, so far as we can tell, with that of the solar surface, is highly suggestive. I conclude, therefore, that if the observed velocities are real—and there is good ground for believing them to be so—the prominences and other appearances in which velocities of more than about 10 kilometres a second are observed are composed to a preponderating extent of electrons in which gases are entangled to a sufficient degree to give the spectroscopic test, but not sufficiently to alter materially the average density.

In conclusion, I should like to urge a word of caution

with respect to the last paragraph of Prof. Zeeman's article on Prof. Hale's discovery. The magnetic forces indicated by the splitting up of the lines are not sufficient to produce any direct observable magnetic effect at the distance of the earth. ARTHUR SCHUSTER.

Simla, October 6.

The Magnetic Disturbances of September 29 and Aurora Borealis.

SOME details of an unusually bright aurora, seen at Omaha, U.S.A., on the night of September 28, local time, may be of interest to the readers of NATURE in connection with the three-hour magnetic disturbance recorded on our magnetograms between 4 a.m. and 7 a.m. of September 29, Greenwich time.

The details come from Father Rigge, S.J., director of the Creighton University Observatory, Omaha. The sky was perfectly clear throughout the night. The aurora "seemed to commence suddenly at 9.50 p.m.," September 28, local time, *i.e.* at 4.15 a.m., September 29, Greenwich time, when the unifilar magnet at Stonyhurst commenced a rapid westward movement up to 62′ of arc at 4.40 a.m., returning more slowly in three sudden steps backward at 5.5 a.m., 5.35 a.m., and 6 a.m., accompanied by minor rapid oscillations.

The aurora was watched for two hours, up to the local midnight, and during this time alternations of the scene were observed between brilliant streamers of various lengths and breadths from a well-defined arch, and a broken-up arch accompanied by drifting luminous patches as of fiery clouds. It would have been interesting to compare the times of these changes with the halting movements of the magnetic needle, but the time was recorded only of the first appearance of the *streamers*, the smaller lengths of which "seemed to come directly out of the ground," and the noted time agrees closely with that of a single break in the first long and rapid deflection of the needle—a short step-back followed by a rush forward to its greatest elongation. The aurora was again looked for at 5 a.m. of the following morning, when nothing was seen in the still unclouded sky.

It is therefore probable that the auroral display began and ended synchronously with this greater deflection of the needle.

The three-hour wave was, then, followed by the usual rapid oscillations consequent upon a magnetic storm until 2.50 p.m., September 29, G.M.T., when another and a greater storm broke out and lasted until 4.30 of the following morning. At Omaha aurora was again seen at 7.15 p.m., September 29, local time, but in a less favourable sky, which clouded over at 9.15, and showed only by the brightened clouds that the aurora was still active at 10 p.m., when the greater oscillations of the magnets were ending. WALTER SIDGREAVES, S.J.

Stonyhurst College Observatory, October 21.

A Method of Solving Algebraic Equations.

So far as I can ascertain, the method referred to is not known, at least in its complete form. It is a development of a method described by me in a previous paper ("Verb Functions, with Notes on the Solution of Equations by Operative Division," Proceedings of the Royal Irish Academy, vol. xxv., Sec. A, No. 3, April, 1905), which was reviewed in NATURE of April 25, 1905. I give it here as briefly as possible.

Take, for example, the equation used by Newton to illustrate his method of approximation, namely,

$$x^3-2x-5=0,$$

which has one real root, 2·09455. . . . Write the equation in the form $x^3=2x+5$. Select any real number, x_1; substitute it for x in the right-hand member of the equation, and then find x_2 from $x_2=\sqrt[3]{2x_1+5}$. Next substitute x_2 for x_1 in the right-hand side of the equation, and find the value of x_3, and so on. We thus have a series of numbers connected by the equation $x^3_{n+1}=2x_n+5$, and it will be found that whatever number we start with for x_1, x_n constantly approaches the value of the root. Thus, if we begin with 11, we have $x_1=11$, $x_2=3$, $x_3=2\cdot2240$, $x_4=2\cdot1140$, $x_5=2\cdot0975$, $x_6=2\cdot0949$, ... Or, commencing with -100, we obtain $x_1=-100$, $x_2=-5\cdot7989$, $x_3=-1\cdot8756$, $x_4=1\cdot0768$, $x_5=1\cdot9268$, $x_6=2\cdot0688$, $x_7=2\cdot0907$, $x_8=2\cdot0940$, ...

Again, take the equation $x^3-15x-4=0$, which has three real roots, 4 and $-2\pm\sqrt{3}$, that is, 4, $-0\cdot2678$, and $-3\cdot7321$. Write it in the form $x^3=15x+4$, and begin with any number above the limits of the positive roots, say 16. Substitute this for x in the right side of the equation, and proceed as before. Then $x_1=16$, $x_2=6\cdot2488$, $x_3=4\cdot6062$, $x_4=4\cdot0124$, $x_5=4\cdot0039$, ..., which is nearly the first root.

In order to obtain the next lower root take for x_1 a number which is a little less than the first root, say 3·9, and substitute it for x, *not* in the *right* side of the equation, but in the *left* side, so that now $\frac{x_1^3-4}{15}=x_2$. Thus we obtain $x_1=3\cdot9$, $x_2=3\cdot6880$, $x_3=3\cdot0558$, $x_4=1\cdot6356$, $x_5=0\cdot0351$, $x_6=-0\cdot2666$, $x_7=-0\cdot2679$, ..., which is nearly the second root.

For the third root take a number, say $-0\cdot3$, which is a little less (algebraically) than the second root, and substitute it for x in the *right* side of the equation, as done for the first root. We thus obtain $x_1=-0\cdot3$, $x_2=-0\cdot7937$, $x_3=-2\cdot0$, $x_4=-2\cdot9625$, $x_5=-3\cdot4313$, $x_6=-3\cdot6203$, $x_7=-3\cdot6910$, $x_8=-3\cdot7169$, $x_9=-3\cdot7267$, ..., which is nearly the third root.

We can solve the equation in the same manner by beginning with any number, say -5, which is below the limit of the negative roots, and substituting it for x in the right side of the equation; then after finding the lowest root, substitute a greater number for it in the left side of the equation, and so on. We may thus either descend from the highest to the lowest root, or ascend from the lowest to the highest. It is evident that a root is obtained when $x_{n+1}=x_n$, because the equation is then satisfied.

We took the original equations in the forms $x^3=2x+5$ and $x^3=15x+4$, but we may take them also in the forms $x^2=2+5/x$ and $x^2=15+4/x$, or in other forms obtained by ordinary algebraic or operative transformations; and the method of solution is the same.

The rule is most easily explained geometrically. Let $f(x)=0$ be the original equation. Write it in the form $f_2(x)=f_1(x)$, as may usually be done in many ways. Draw the curves $f_2(x)=y$ and $f_1(x)=y$. Then the roots of $f_2(x)=f_1(x)$ are evidently the abscissæ of the points of intersection of the two curves. The procedure adopted above is really as follows. Select any point, x_1, on the axis of x, and draw a straight line from it parallel to the axis of y, either in the positive or in the negative direction, until it meets the *nearer* of the two curves—let us say $f_1(x)=y$. From this second point draw a line parallel to y until it meets $f_2(x)=y$. From the third point draw a line parallel to x until it meets $f_1(x)=y$ again, and from the fourth point one parallel to y until it meets $f_2(x)=y$ again, and so on. Then the abscissa of the first and second points is x_1, of the third and fourth points is x_2, of the fifth and sixth points is x_3, and so on, and x_n must generally approach nearer and nearer to the point of intersection of the two curves—that is, to a root of the original equation.

Fig. 1 represents an intersection where the lines drawn according to the rule all lie within the angles formed by the converging curves. In this case, analytically, x_1, x_2, x_3, ..., are all either greater or all less than x, the abscissa of the point of intersection, although they constantly approach it. Fig. 2 illustrates the case where the lines ultimately approach the intersection spirally. Here, analytically, x_1, x_2, x_3 . . . alternately oscillate above and below x, although they constantly approach it. The former, or "staircase" procession, occurs while the differential coefficients of the two curves have the same sign; the latter, or alternating "spiral" procession, while they are of opposite signs.

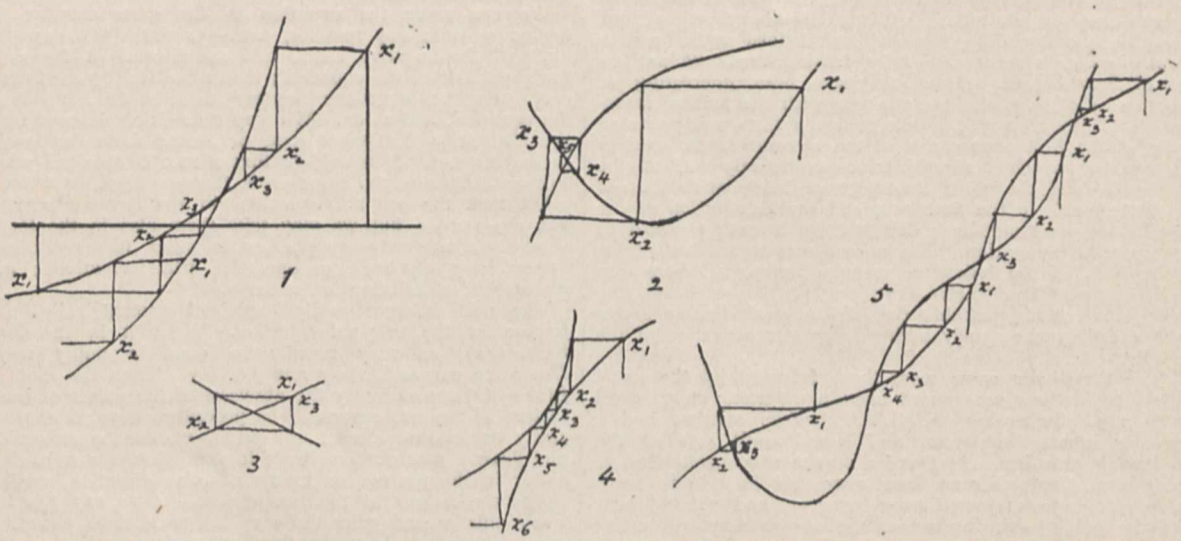
The staircase procession trends in the same direction as the tangent vectors of the curves if x_2-x_1 is positive, and in the opposite direction if x_2-x_1 is negative. A similar law holds for the direction of rotation of the spiral procession. Thus x_1, x_2, x_3 . . . will increase or decrease, either continuously or alternately, according to whether we have taken x_1 on one or the other of the two curves

$f_2(x)=y$ and $f_1(x)=y$. If we have taken it on the wrong curve they will diverge from the required intersection, as will be apparent from Figs. 1 and 2. The rule to ensure ultimate convergency is that at or near the point of intersection x_1 shall be taken upon the curve which has the numerically lesser differential coefficient. If, at the point of intersection, the differential coefficients are numerically exactly equal, the method fails, as $x_{n+2}=x_n$; but the intersection of the curves will then be at the intersection of the tangents, so that $x=\frac{1}{2}(x_{n+1}+x_n)$—Fig. 3. It often happens, if we have taken x_1 at random, that the succeeding terms of the series are at first irregular, but afterwards converge.

If at any stage in the analytical process a term becomes unreal, this means that the corresponding line drawn from one of the curves cannot intersect any branch of the other curve. We must then start again with another value of x_1.

The successive terms may appear to converge for a time and may then diverge. This indicates the position of a pair of imaginary roots (Fig. 4). Compare, for instance, $x^2=13x-42$, of which the roots are 6 and 7, with $x^2=13x-43$, of which the roots are imaginary.

Convergency is slowest when the differential coefficients of the curves at the required intersection are nearly equal, numerically, to each other, especially if both are also nearly equal to ± 1. It is quickest when their numerical difference is greatest. When we have arrived near enough



to the destination, further work may often be abbreviated by assuming that the intersection of the curves nearly coincides with that of the tangents. Thus if x_1 and x_2 are successive convergents on the curves $f_1(x)=y$ and $f_2(x)=y$ respectively, then, approximately,

$$x=\frac{x_1 f_1'(x_1)-x_2 f_2'(x_2)}{f_1'(x_1)-f_2'(x_2)}.$$

In the case of the equation $x^3=15x+4$ the roots were obtained successively by taking x_1 alternately, first on one curve, $15x+4=y$, and then on the other, $x^3=y$. This can be done very frequently, but sometimes one of the curves makes such a bend between two intersections that, by the rule already given to ensure convergency, x_1 may have to be taken on the same curve for two roots in succession. By plotting the curves roughly on paper it is generally easy to see at a glance how best to commence and conduct the process (Fig. 5).

As is evident from the geometrical interpretation, the method is by no means restricted to rational integral equations. The two curves $f_2(x)=y$ and $f_1(x)=y$ may be any we please, provided only that we can obtain $x=f_2^{-1}(y)$, or at least can evaluate it for different values of y, and it is generally easy to put the original equation $f(x)=0$ in such a form that this can be done; but in order to find some of the roots it may be necessary to take x_1 on the other side of the equation, which requires us also to obtain x from $x=f_1^{-1}(y)$, which may be difficult. Generally, however, this can be avoided by finding special roots from other forms of the equation. For example,

$$x^3-3x^2-2x+5=0$$

has three roots, 3·128, 1·202, and −1·330, but they can be calculated more easily from the form $(x-1)^3=5x-6$. One or two of the roots of a complete rational integral equation may frequently be obtained almost at once by dividing the equation by x^{-1}, and putting it in the form $x=a+b/x+c/x^2$. . . . Generally, the first terms of the series x_1, x_2, x_3 . . . may be estimated mentally, exactness being unnecessary until we approach near to a root.

The rule, therefore, has the advantage of being very easily remembered, of giving, theoretically, all the roots in succession, and of leading, almost automatically, to at least one or two solutions. Hitherto it has been considered from the geometric and arithmetric side; I will now try to indicate briefly its operative and algebraic forms.

We have evidently to do with repeated operation, which is best expressed by the algorithm of "verb functions" as described in my paper referred to. This algorithm is based on the fact that ϕ^0, where the index refers to operative and not algebraic involution, cannot possibly be the equivalent of numerical unity (as generally held), but is equal to *operative unity*. I denote this by the symbol β (for base). When substituted for the argument in any expression, β converts that expression into one which denotes an action, not a substantive. Thus $a+b\beta+c\beta^2$ is the action performed on x in order to convert it into $a+bx+cx^2$.

Now let $x^n+ax^{n-1}+bx^{n-1}\ldots=k$, the number of terms being unlimited. Then

$$x=[\sqrt[n]{k-a\beta^{n-1}-b\beta^{n-2}\ldots}]x,$$

where the square brackets denote that the expression contained within them operates on the following matter, and is not multiplied into it. Thus x on the left side of the equation is the result of an operation performed on itself. Similarly, x on the right side of the equation is the result of the same operation performed on itself as many times as we please. Hence we obtain the identity

$$x=[\sqrt[n]{k-a\beta^{n-1}-b\beta^{n-2}\ldots}]^q x,$$

where q denotes operative involution and may be any integer, positive or negative, to infinity. Now the expression on the right can be developed with the aid of the multinomial theorem by successive substitution, according to the common algebra of verb functions, and we obtain

$$x=k^{\frac{1}{n}}-\frac{1}{n}a-\frac{1}{1}\left\{\frac{1}{n}b+\left(\frac{1}{n}\right)^{(2)}\frac{a^2}{2!}\right\}k^{-\frac{2}{n}}-\frac{1}{2}\left\{\frac{2}{n}c+\left(\frac{2}{n}\right)^{(2)}ab+\left(\frac{2}{n}\right)^{(3)}\frac{a^3}{3}\right\}k^{-\frac{3}{n}}\ldots$$

+ terms containing x.

When this series proceeds to infinity the terms containing x, under certain conditions, vanish. So also they vanish if any proximate number is substituted for x in them. We are thus left with x, on the left side, equated to a series containing only k and the coefficients a, b, c . . . . This explains why we may start the process described at the beginning of this paper with *any* number (under certain limitations) for x_1, because, whatever that number may be, it is gradually rendered negligible by the successive operations.

The series has been already studied to some extent in the paper referred to, and has been used for solving equations. Its coefficients are simply those of the multinomial theorem with some modifications. As it has n values depending on the n values of $\sqrt[n]{k}$, we may suppose that these values are the n roots of the original equation, though we may not be able yet to evaluate all of them. This has been proved in the previous paper to be the case, because the sums of the products of the values taken one, two, three . . . times together are equal to the successive coefficients of the original equation with the proper signs. Hence there are some reasons for thinking that the series theoretically constitutes the general *transcendental* solution of the equation of the nth degree. How far this is really the case must be discussed more fully on another occasion, together with details and developments of the method outlined above.

The method is not the same as the methods of approximation of Newton, Lagrange, and Horner. The well-known ascending power series for the reversion of a function, and cases in which certain repeated operations (such as continued fractions) converge to a root of an equation, thus solving certain functional and difference equations, are only particular instances of the above theorem.

RONALD ROSS.

The Nature of X-Rays.

IN a letter to NATURE of July 30 Prof. Bragg tries to show that his neutral-pair theory of X-rays may form the basis of an explanation of the secondary X-ray phenomena which I briefly summarised in an earlier letter (May 7). He, however, neglects the consideration of so much important evidence that I cannot attempt to reply in detail. In reply to his discussion of statements (3), (6), and (5), I need only state that he has confused two distinct types of secondary X-radiation, and that his statement of Mr. Crowther's results is inaccurate when applied, as he applies it, to the scattered radiation alone. (May I also be permitted, in passing, to point out that both the general results attributed to Mr. Crowther had been published by the writer previous to the publication of Mr. Crowther's paper?)

Again, Prof. Bragg has evidently overlooked the work to which I referred in statements (7), (8), and (9). The evidence which I put forward for consideration was not the older work of M. Sagnac, Dr. Walter, and Mr. Adams which Prof. Bragg discusses, but the results of experiments by Mr. Sadler and myself on homogeneous beams of X-rays, which have not yet been published in full, though preliminary notices had appeared in NATURE. The paper giving an account of this work was read before the London Physical Society on June 12. Prof. Bragg, as a consequence, does not discuss the points with full knowledge of experimental facts.

Of the three remaining points, one—the polarisation of a *primary* beam (1)—is not discussed, because Prof. Haga has been unable to verify it by a much cruder method than that originally employed. It is nevertheless a physical fact.

Finally, two results—the polarisation in scattered radiation (4) and the equality in the penetrating powers of primary and secondary (scattered) rays (2)—which appear possible to Prof. Bragg on the neutral-pair theory, require assumptions which, to my mind, are extremely doubtful. On the other hand, many of these results were foretold on the ether pulse theory, and, indeed, they all find an easy explanation on this theory, as I believe Prof. Bragg will readily admit when he has become fully acquainted with the experiments. For a fuller discussion I can, unfortunately, only refer to two unpublished papers, both of which, however, are in the press. These are the one already referred to and one which will appear in the forthcoming number of the "Jahrbuch der Radioaktivität und Elektronik."

In reply to Prof. Bragg's contention, may I add that the phenomena involving radiation of only one kind—X-radiation—to me appeared simpler than those involving two—X and β radiations?

Liverpool, August 8. CHARLES G. BARKLA.

IT is, of course, true that my letter (dated June 5) to which Dr. Barkla refers was written before I had had the opportunity of studying Dr. Barkla's latest results. A portion of my argument was based on his earlier work, and may need a little alteration in consequence. I have myself found by recent experiment that his older statements needed amendment. For example, the emergence and incidence secondary Röntgen radiations differ both in quality and quantity; the former is sometimes far greater than the latter.

May I take this opportunity of correcting a statement in a letter of mine which appeared in NATURE of July 23? As pointed out in an addendum to a recent paper contributed by Dr. Laub to the *Annalen der Physik*, I have been wrong in supposing that Dr. Wien still maintains that the energy of the secondary kathode ray is drawn from the energy of the atom. Had I understood Dr. Wien correctly, I should certainly not have taken so much pains to disprove a theory which he had already abandoned. W. H. BRAGG.

The University of Adelaide, September 17.

The Supposed Inheritance of Acquired Characters.

DR. FRANCIS DARWIN, in his presidential address before the British Association, writes as follows:—

"Fischer showed that when chrysalids of *Arctia caja* are subjected to a low temperature a certain number of them produce dark-coloured insects; and further that these moths mated together yield dark-coloured offspring. This has been held to prove somatic inheritance, but Weismann points out that it is explicable by the low temperature having an identical effect on the colour-determinants existing in the wing-rudiments of the pupa, and on the same determinants occurring in the germ-cells."

It occurs to me that still another explanation is possible to cover at least some such cases. In discussing various types of latency, Dr. Shull (*American Naturalist*, July) has recently defined as "latency due to fluctuation" those cases (of which many are known) in which the special characters of a race do not appear except under suitable conditions. Following this idea, it is possible to think of the dark *Arctia caja* appearing after exposure to cold as representing a variation which possessed an inherent tendency to darkness not exhibited under more ordinary conditions. Indeed, this must have been the case, since only "a certain number" were affected. Given such a variation, it is not unreasonable to suppose that when examples were mated together the tendency would be so emphasised as to appear under normal temperatures, thus producing an apparent case of the inheritance of acquired characters. T. D. A. COCKERELL.

University of Colorado, October 7.

Determination of Sex: a Correction.

MAY I correct a slip in your report of "Zoology at the British Association" (NATURE, October 22, p. 647)? The cinnamon canaries resulting from the mating green hen × cinnamon cock are all *females*, not males, as there accidentally stated. The point is critical in the interpretation of that curious case. W. BATESON.

October 26.

DROPS AND SPLASHES.[1]

THE few who have access to the Transactions of the Royal Society, and who remember the first presentation of Prof. Worthington's beautiful photographs illustrating the successive movements that occur in the phenomenon of the splash of a drop, and some proportion of the many who may have seen his two articles on the subject in *Pearson's Magazine*, will welcome the appearance of the fascinating quarto volume entitled "A Study of Splashes." Not only will their recollection of an interesting research be revived, but the more perfectly executed and more numerous and complete series of photographs here presented will show the phenomena in all their original beauty as displayed on the lantern screens at the Royal Institution and elsewhere.

Besides showing the results and explaining the interesting cooperation of the forces of dynamics and of surface tension which have given rise to the phenomena, Prof. Worthington has given very full details of his method so that many who can extemporise physical apparatus will be able to follow him, and so to investigate the same or analogous movements.

As a series of twelve or twenty successive photographs illustrating the movements of the liquid which occur in a small fraction of a second cannot at present be taken from a single falling drop or splash, but each requires a new drop to be photographed at a different stage, predetermined in time within one or two thousands of a second, it is essential that so far as is possible the phenomena should be exactly repeated, and that the initial conditions should be identical. The method by which liquid is allowed to drop or balls to fall with sufficient exactness is illustrated and described, and to this no further reference need be made in the present notice. The more interesting part of the apparatus is that in which, the ball or drop having been liberated, an illuminating electric spark is formed as many thousandths of a second after the first contact of the splash as may have been determined, as also is the means of utilising the light of the spark for the purpose of obtaining a shaded picture. This is illustrated on p. 7. The action depends upon the equality of speed of two falling bodies, one the drop or ball which will make the splash, and the other a conducting ball which in its fall will pass close to two nobs forming part of an electric circuit. This circuit comprises the two Leyden jars of an electric influence machine, the nobs in question and the illuminating spark gap, the two nobs being connected with the charged insides, and the terminals of the illuminating spark-gap with the uncharged outsides of the jars. The conducting ball as it passes close to the nobs discharges the circuit, and a spark is formed at the illuminating spark-gap. According as an electromagnetic trigger which liberates the conducting ball is set higher or lower, the time which will elapse after the breaking of the magnetic circuit up to the time of the formation of the spark may be made greater or less at will. The drop or ball which makes the splash is liberated in a similar manner, and so it is merely necessary to increase the height of fall of the conducting ball little by little as compared with that of the drop or splashing ball to illuminate the splash at any desired period of its existence; perhaps not merely necessary, as it is also important that the jars should be charged every time to the same potential, otherwise the spark would not be liberated when the conducting ball had in successive falls reached the same place. The spark is in the focus of an illuminating reflector which gives a large field of light as well as a central bright point, and an ordinary camera with a lens to throw an image of the splash upon the plate completes the means by which the phenomenon which exists at the moment of the spark is photographed with all the perfection of light and shade which make the results so beautiful.

Even with all these precautions successive drops are not necessarily exactly alike at their initiation, as very small changes in the electrical conditions of the two circuits and in the form of a liquid drop, if that is used, at its start will make initial differences which the instability of the liquid forms subsequently developed rapidly accentuate. Still, even with these differences in detail the essential characteristics of a series of drops at different stages are, with the precautions mentioned, so nearly identical that the curiously different characters of splashes made in different circumstances can be well followed throughout their existence.

When the under-water phenomena are photographed the field reflector mentioned above is replaced by a lantern condenser, close to which a fine ground sheet of glass is placed so as to give a uniform field of illumination.

It may be interesting to mention that with the apparatus used by Prof. Worthington he was able to obtain sparks the effective duration of which was not more than three millionths (3/1,000,000) of a second. When it is remembered with what extreme rapidity the edge of a liquid film changes its form under capillary forces, it will be seen that a spark of very short duration is essential, and judging by results one sufficiently short has been obtained.

The book is illustrated by eighteen series of photographs, each series representing a succession of events in one type of splash equivalent as nearly as possible to a succession of events in a single splash. The first series is represented by twenty-four successive photographs of a drop of water falling through a space of 40 centimetres into still milk and water, and there is an alternative smaller series. The second shows the fall of water into water, and incidentally the importance of keeping the water into which the drop falls perfectly free from contamination. Two corresponding photographs are shown side by side; in one the water had been skimmed to purify it from the small trace of grease and smoke which the previous falling drop had brought down from the smoked spoon in which it had been supported; in the other the surface was completely renewed by keeping up a gentle supply of pure water so that contamination could be completely removed by gentle overflow. The absence of a multitude of fine ripples in the first contrasts with the closely furrowed surface of the second, as does a patch on the sea into which a sardine tin has been emptied of its oil with the surrounding portions on a day when the surface is black with small ripples.

Succeeding series show the formation of bubbles, the contrast in the splashes formed by smooth and rough spheres, and other phenomena which it is difficult to describe adequately in a notice and without the photographs to refer to. Some of these are illuminated from above only, and some are illuminated by light on a level with the liquid surface, a transparent cell being used in this case so that the under-water phenomena may be seen as well as those above the surface.

The last series illustrates the effect of the fall of a

[1] "A Study of Splashes." By Prof. A. M. Worthington, C.B., F.R.S. Pp. xii+129; illustrated. (London: Longmans, Green and Co., 1908.) Price 6s. 6d. net.

rough sphere into water from a height of 140 centimetres. Figs. 1, 2, 3, 4, and 5 here reproduced are from this series, and they serve well to show the beauty of Prof. Worthington's results, as also the curious formation of a liquid jet within the temporary bubble.

Figs. 1 and 2 show the open cup with the vertically projected cylindrical sheet of water and its breaking edge. In Fig. 3 the capillary tension has pulled in the

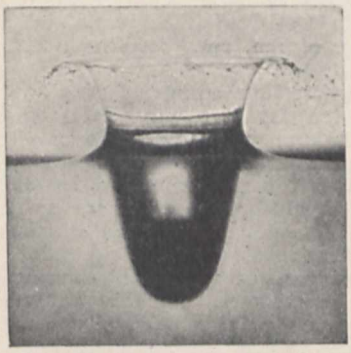


FIG. 1.—0·006s.

sides, and is on the point of completing the bubble. In Fig. 4 the surface of the bubble is being pulled down by the descent of the ball, which reduces the pressure within the bubble. As there is less mass in the film above than in the continuous liquid sides, the roof is at first drawn downwards. At this stage it also thickens from an influx of liquid from the sides, or appears to do so, and this influx, meeting in the centre,

realised unintentionally when a leaking tap allowing drops to fall into a vessel full of water is nevertheless so disposed that either succeeding drops are not almost exactly alike or the water into which the drops fall has not come perfectly to rest so that a musical note is sounded at each fall, the variations in the tone being surprisingly large and erratic. A record of the note,

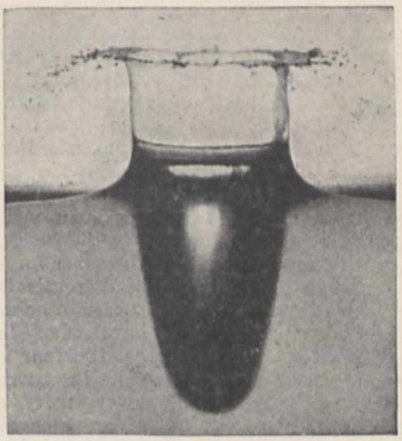


FIG. 2.—0·008s.

if it could be kept audible by acoustically screening off the snap of the spark, and a comparison of this with the alternating periods revealed by the photographs, should, if it were worth while, make clear the source of the musical note and the cause of its variation.

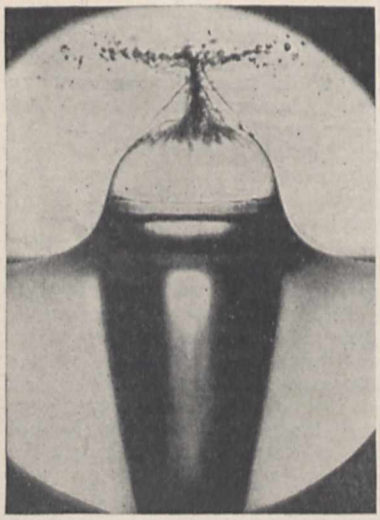


FIG. 3.—0·015s.

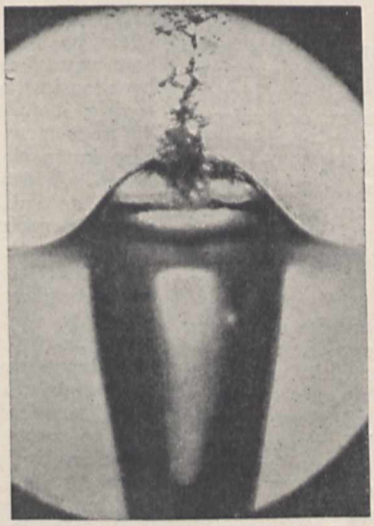


FIG. 4.—0·021s.

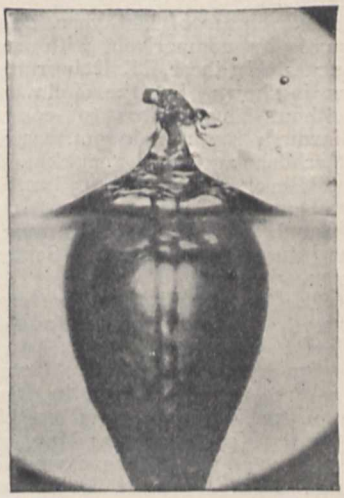


FIG. 5.—0·057s.

Rough sphere falling 140 cm. into water. From "A Study of Splashes."

gives rise to a powerful descending jet seen in Figs. 5 to 11 of the book. The acceleration is greater than that due to gravity, and it appears that the curved path of the inrushing liquid concave downwards enables it to balance the excess of atmospheric pressure above the bubble.

It would be interesting to see a number of photographs of drops falling into water in conditions often

It is not possible in the space available to illustrate or describe more of the results shown in Prof. Worthington's interesting book. It is hoped that enough has been said to excite the interest of experimentalists and others, who will be well repaid by a study of the original, which should find a place in every scientific library.

C. V. BOYS.

PROGRESS IN AVIATION.

APART from the unsuitability of the epithet, such an incident as is suggested by a recent *Daily Mail* poster, "Aëroplane Triumph; Expresses Collide; Passengers Injured," may not occur for some years to come, but the rapid development of aëroplane locomotion within the last year indicates that it may be desirable, at no distant date, to formulate "rules of the road" for aëroplanes crossing each other's path at the same level, and, unless this is done fairly soon, there may be the same difficulty in obtaining international uniformity that has always existed in such other connections as those of language, coinage, and measurement of time.

The records which have been published from day to day in the Press have now, for the first time, placed the problem of flight on a perfectly practical basis, and a great deal that has been written previously to the present year will only be read with interest now insomuch as it enables a comparison to be made between anticipation and realisation. We heard reports of the Wright Brothers' achievements in America in 1904 and 1905, but owing to the inventors' efforts to avoid publicity the feat of Santos Dumont on November 12, 1906, in covering 220 metres in 21·2 seconds has been regarded by many people as the first realisation of an artificially propelled man-carrying machine lifting itself from the ground and performing an actual flight.

M. Delagrange's aëroplane made flights of 164 feet and 196 feet in April, 1907, and by this time the construction of aëroplane machines began to be taken up from the commercial point of view by several firms in France. The present writer visited Captain Ferber in July of that year, and was shown a large building on the outskirts of Paris specially fitted up with the view of manufacturing aëroplanes to order, one being in process of construction. All previous authenticated records were eclipsed by Mr. Farman's flights in November of last year. Yet these records seem small by comparison with recent French achievements. In these, M. Delagrange figures prominently, as is shown by the following examples, selected without any claims to completeness:—March 21, Farman, 4·5 km. in 3m. 29s.; April 11, Delagrange (Archdeacon Cup), 3·925 km. in 6m. 30s.; June 22, at Milan, Delagrange, 15 km. in 16m. 30s.; June 23, at Rome, Delagrange, 17·5 km. in 18⅘m., touching ground once; July 6, Farman (Armengaud Prize), 20·4 km. in 20m. 20s.; September 6, Delagrange, 29m. 53·8s.

The Wright Brothers' performances take us a long way back, and include the following statements of flights:—September, 1905,[1] 17·961 km. in 18m. 9s., 19·570 km. in 19m. 55s.; October, 1905, 24·535 km. in 25m. 5s., 33·456 km. in 33m. 17s., 38·956 km. in 38m. 3s., the causes of stopping being exhaustion of fuel or hot bearings; May, 1908,[2] flights from 22s. up to 7m. 20s., with one man, distance 5 miles, two-man flights,[3] 0·45 mile in 29s., and 2·5 miles in 3m. 40s.; September 6, 1908, at Paris (Wilbur Wright), flight of 19m. 48s., and in America, September 12 (Orville Wright), flight of 74m. 20s. (these last on the authority of the daily Press).

The first "two-man" flight (in Europe, at any rate) would appear to date from March 21, when, after the flight recorded above, Mr. Farman mounted with M. Delagrange on the latter's aërodrome, which flew a considerable distance with the heavy load.[4] This record, it will be observed, is earlier than the Wright records above chronicled. On May 30 Mr. Farman flew 1·241 km., with Mr. Archdeacon as a passenger, on his aëroplane.[1] Finally, we have a flight of more than 1½ hours by Mr. Wilbur Wright in France, shortly after the accident to his brother's machine in America, through which Lieut. Selfridge lost his life.

Simultaneously with these aëroplane experiments we have a series of chronicles of successes with the Zeppelin and other airships. We need only refer to the Zeppelin record of 11h. 50m., and a record by Major Gross of 13h. 2m., covering a distance of 187 miles.

A very interesting summary of progress in aviation up to the day of publication is afforded by M. Armengaud, junior's, book.[2] It is based on a lecture delivered on February 16 at the Conservatoire des Arts et Métiers, and it contains, in addition to an account of recent work, references to the early researches of Penaud, Marey, and others on flight of birds. A feature of special interest is the diagram showing the various systems of aëroplanes used by different experimenters. The illustration accompanying this article is based on the diagram in question, but we have omitted the purely gliding machines of Wright and Archdeacon, and have inserted the Farman "flying fish" type, as well as a figure of the mechanically-propelled Wright model based on the sketch in the *Scientific American*.

On looking at this table the typical Englishman whose education on current topics does not extend beyond the level of the halfpenny paper will ask, "Which is the best flying machine?" As the interrogator usually is under the prevalent delusion that "a straightforward answer to a straightforward question" is all that is necessary to settle, once and for all, the most complex problem of science, and as he probably will forget all that has been told him when he reads about the next football match, the best way of satisfying him is to give a definite answer by choosing one at random from this diagram and saying it is the best. A general discussion of the different types of flying machine, including, not only aëroplanes, but orthopters and helicopters, is given by M. Armengaud, and this probably contains as much as could be embodied in a small handbook. But a complete examination of the conditions required to give the best results involves the discussion of at least two qualities, efficiency and stability, and while engineers have shown themselves fully competent to deal with the first of these qualities, a full discussion of the latter still involves the expenditure of a large number of brain-power hours of work at the hands of a really competent mathematician, and it will be one of the objects of this note to direct attention to some of the most important unanswered questions involved in the theory sketched out some years ago by the present writer, with the assistance of Mr. Williams.

Captain Paul Renard's two papers on dirigibles[5] may at this stage be studied with advantage. The first paper is mainly theoretical, the second descriptive.

Taking the second part first, it contains an illustrated description of all the principal dirigibles that have been constructed, and of a number that have been projected. Captain Renard expresses the opinion that France, which has produced a Montgolfier and a

1 *American Magazine of Aëronautics*, July, 1907.
2 *American Aëronautics*, June, 1908, quoted in *Aëronautics*, supplement to *Knowledge*.
3 Photographs are given in the *Scientific American* for May 30, 1908.
4 *Aëronautics* (*Knowledge*), April, 1908.

1 *Ibid.*
2 "Le Problème de l'Aviation, sa Soluti n par l'Aéroplane" (Paris: Ch. Delagrave.) Price 2,50 francs.
3 "Les Aérostats dirigeables" (*Revue generale des Sciences*, Jun- 15 and 30, 1908).

Col. Renard (whose early experiences with *La France* were greatly in advance of their time), is still to the forefront in aërial navigation by means of airships. He considers, further, that in spite of its interesting details of construction, the Zeppelin aërostat is not to be regarded as a model to be copied. These views we quote, without comment, on the authority of their exponent. The first or theoretical part contains a simple exposition of the elementary principles on which the success or failure of directed aërostats depends. In the first place, the relative velocity of propulsion (*vitesse propre*) must exceed the velocity of the wind if the aërostat is to be completely under control, otherwise the course will be confined within a limited angle. This fact every student of elementary mechanics ought to realise at a glance, but many who succeed in passing examinations fail to do so, and thus Captain Renard's remarks are not so superfluous as they might seem to be to a person who really understood elementary mathematics. As the present writer pointed out, it is mainly the difference in speed between air currents and ocean currents which has rendered aërial navigation less successful hitherto than ocean navigation.[1]

Captain Renard discusses the questions of permanence of form and the relative advantages of large and small screws, and then proceeds to the question of stability. He distinguishes three different kinds of stability, namely, stability in altitude, stability of course, and longitudinal stability. According to the conditions assumed in text-books, when a balloon is in equilibrium at any altitude that equilibrium is stable, so that "instability in altitude" is not a mechanical effect, but consists in the effects of physical causes in disturbing the vertical equilibrium of a balloon; in a dirigible there are many easy methods of maintaining a constant altitude. Instability of course or instability in a horizontal plane occurs when an aërostat tends to turn about a vertical axis so as to set itself at right angles to the direction of motion, like the ellipsoids of our text-books in hydrodynamics. In longitudinal instability the aërostat tends to turn about a horizontal axis, pitching over forwards or backwards. Captain Renard points out (and this is entirely in accordance with the present writer's investigations) that there is a certain limiting or *critical* velocity consistent with stability; in the case of the dirigible the critical velocity is a superior limit, which cannot be exceeded without the motion becoming unstable. He also clearly shows that this fact was known to Col. Renard in 1904, and further that the critical velocity in question in many types of machine, such as the *La France*, *Lebaudy*, and *Patrie*, has fallen considerably below the maximum speed obtainable from suitable motors. For example, "In the *Santos Dumont* the critical velocity is 8·50 m. (per sec.), and a 7 horse-power engine is sufficient to obtain it; if longitudinal stability were assured, the aërostat could be provided with a 22-horse-power engine and attain a speed of 12·10 m. For the *Lebaudy* the critical velocity is 10·80 m. requiring 41 horse-power. If this aërostat were stable it could carry a machine of 95 horse-power, which would give it a proper velocity of 14·20 m."

Yet we find another writer attempting to compare the stability of the *Patrie* and *Zeppelin* in a paper bristling with unnecessary mathematical formulæ, which do not even correctly represent the oscillations of the balloons about a statical state of equilibrium.[2] All that the calculation really does is to treat the balloons as simple pendulums the points of support of which are at the centres of buoyancy, and the masses of which are concentrated in the cars. The use of the word "moment of inertia" tends to conceal the fact that the moment of inertia of the framework about its centre of gravity is completely ignored.

Passing on to the equilibrium and stability of aëroplane systems, we find that not only is there a widespread neglect of even some of the most elementary mathematical principles underlying the subject, but the experimental evidence commonly accessible is insufficient to enable any very definite conclusions to be drawn as to the best form of a flying-machine or as to how far the types which have admittedly given successful results are capable of improvement. The lift and drift of aëroplanes have been carefully measured, and so far as the problem of flight depends on their numerical magnitudes, the theory of the aëroplane is summed up "in a nutshell" on pp. 40, 41 of M. Armengaud's paper.

In the construction of motors the main, if not the only, object to be aimed at is to make the weight as small as possible for a given horse-power, a problem with which engineers have shown themselves sufficiently competent to deal. The best system of aëroplanes from the point of view of general efficiency is that which requires the least horse-power to sustain a given total load in horizontal flight. The actual arrangement of the planes will not affect the efficiency except when one plane is placed in the wake of another. But in connection with equilibrium and stability the conditions are very complex, and a great deal of difficult mathematics is required.

Take the question of propellers. The present critic makes no claim to have examined the literature that has collected around this problem in connection with its more or less closely allied applications to naval architecture, but it is certain that what has been found out regarding the efficiency of a ship's screw should form a starting point for discussions relating to airship propellers, account being taken of necessary modifications. Yet the most crude methods are forming the subject of published papers at the present time. C. M. Woodward's problems[1] would make suitable examples for a conventional text-book on "Dogmatics" (as dynamics should be called) if their working were correct, but the expression for the rate of working in driving an airship "thru" the air involves an error closely resembling that made when the oar is treated as a lever of the second class. The succeeding results regarding the horse-power applied to the "scru" would therefore be incorrect even if the fundamental assumptions were justified. W. B. Parsons[2] deals mainly with experiments, but it may be reasonably doubted whether he has really kept the *power* of his motor constant when the inclination of his blades has been varied. To do so the torque would have to be inversely proportional to the angular velocity. Neither the stated method of regulating the power nor the statement "The consequent variation in velocity is the expression of the air resistance for that inclination and velocity" (whatever this may mean?) appear reconcilable with this assumption.

But to come to the important question of stability, of which longitudinal stability, being the most important, shall alone be considered here. A large proportion of the contributors to aëronautical journals have the vaguest possible ideas as to what stability means. The successful flights of Farman, Delagrange, and Wright do not enable us to infer without further evidence that their machines are automatically stable. The analogous problem of the bicycle illustrates this fact. The lateral stability of the bicycle, like the

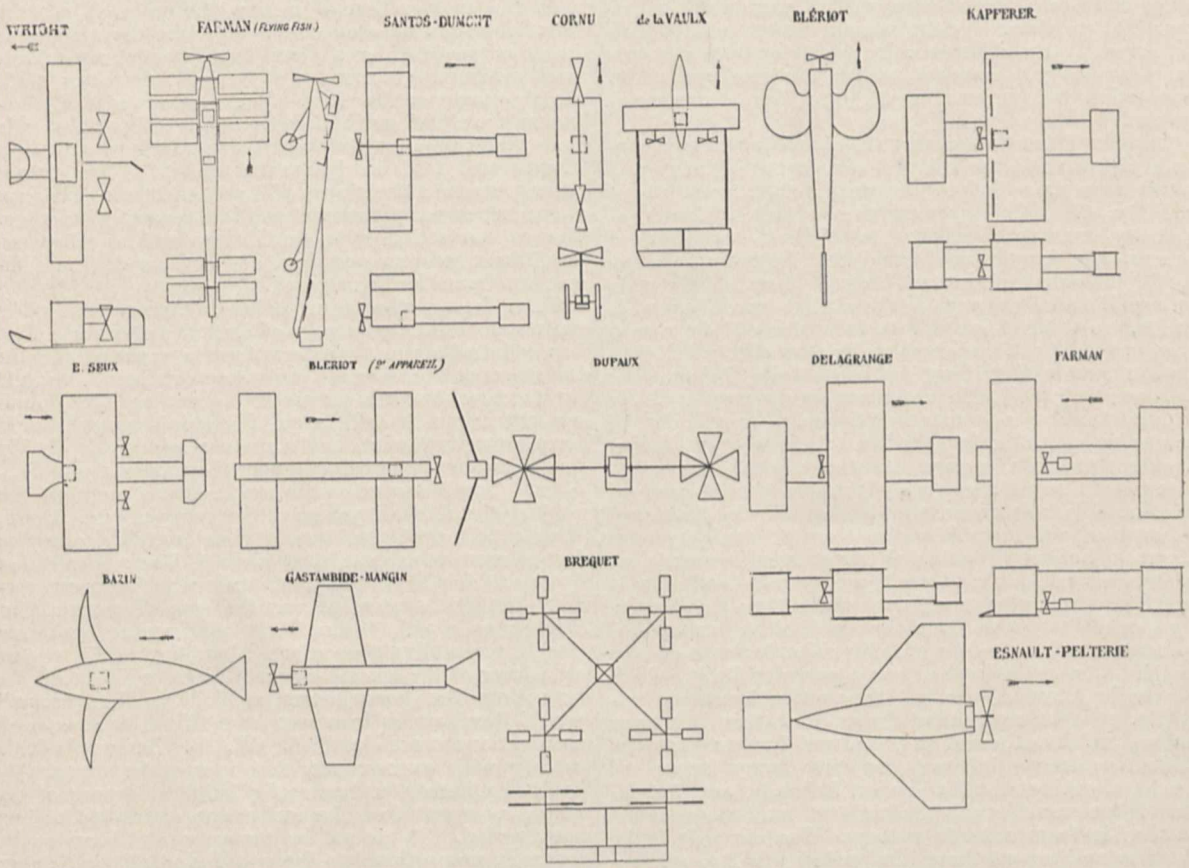
[1] *Cornhill Magazine*, May, 1907.
[2] Capt. Guido Castagneris in the *Aëronautical Journal* for July, 1908.

[1] "Airship Propeller Pr blems," Trans. Acad. Sci., St. Louis, xvii., No. 1.
[2] *Aëronautical Journal*, April, 1908.

longitudinal stability of the aërostat or aëroplane, depends, we believe, on the roots of a biquadratic equation, but in this case there appear to be two critical velocities, one an inferior and the other a superior limit to the speed. Of these the superior limit has been reached in bicycling in the wake of an express train. But bicycles are frequently ridden at speeds below the inferior limit, being kept upright by careful balancing involving no *conscious* effort on the part of the rider. It is highly probable that in many circumstances longitudinal instability may be equally well counteracted by the unconscious efforts of the aviator. Regarding the recent successes, evidence is far too conflicting to enable judgment to be passed in this review as to whether the machines were really stable, though there is equally no evidence to show that they were not.

"Now M. Léon Delagrange, after making quite a number of short flights (the longest about 200 feet) with his motor flying-machine, has found it advisable to go with M. Voisin, the cleverest of the French flying-machine pilots, to experiment with a gliding machine on the sand-hills near Le Touquet." [1]

However probable it may be that a man-carrying machine is automatically stable, the performance of a successful directed flight can never definitely answer the question how far the success is due to automatic stability and how far to the skill of the operator. It may be that with a little experience something short of truly automatic stability is sufficient for all practical purposes; on the other hand, a great many writers who place their views before the public insist on automatic stability as a *sine quâ non*. The evidence derived from uncontrolled aërodromes such as those



Plans of the principal Aëroplanes. From "Le Problème de l'Aviation," with slight modification.

Chanute long ago experimented on automatic stability, and stated that his gliding machines had special appliances for securing it.[1] It is scarcely possible that Chanute's methods have not been utilised by the Wrights. Yet according to the papers the French aviators, while expressing great admiration for the Wright performances, are of opinion that the successful balancing of the Wright machine is mainly a feat of skill on the part of the aviator, and that their object has been to construct machines with which anyone can fly. In support of this view we read that "neither M. Delagrange nor Mr. Farman had ever driven an aëroplane before the last eight months." [2] On the other hand, we were told more than a year ago that used by Langley enables the question of automatic stability to be tested much more definitely. The recent reprint of Langley's researches will always prove a valuable contribution to the literature of aviation.[2] But in employing results of experiments with small models to draw conclusions about larger machines, everything depends on a correct appreciation of the theory of dimensions, and who is there that is sufficient of a mathematician that he can be absolutely trusted not to drop into one of the innumerable pitfalls that beset this elusive but valuable method of generalisation?

Even to make a machine fly steadily in a horizontal

1 See, *e.g.*, *Cassier's Magazine*, June, 1901.
2 *Aëronautics*, August, 1908, p. 61.

1 *American Magazine of Aëronautics*, July, 1907, p. 8.
2 "Researches and Experiments in Aërial Navigation." By S. P. Langley. Reprinted from the Smithsonian Reports. (Washington: Government Printing Office, 1908.)

line at all, three conditions are required. It is not sufficient that the drift should equal the thrust of the propeller (supposed horizontal), and that the lift should equal the weight. There is the third condition that the three forces, weight, propeller thrust, and resultant air resistance, must pass through one point, or an equivalent condition obtained by equating moments. If this condition is satisfied, but not otherwise, the machine is properly *balanced*, and may fly straight. But its flight is not necessarily *stable*, and it may upset at any moment. To find if it is longitudinally stable we must examine what happens if it deviates from its course and begins to pitch. To specify its motion at any instant in this case *three* variables are required, as every student of elementary mechanics ought to know. The resultant air resistance will also be altered, and to specify the new resultant three other variables will be required. The connection between these and the preceding three depends on the laws of aërial resistance. This connection is specified by certain "coefficients of stability" the values of which are necessarily based on experimental knowledge. On the assumption that if these are known, and the weight, position of the centre of gravity and moment of inertia of the flying-machine are known, the oscillations have been worked out and the condition of stability determined. This condition is conveniently expressible in terms of a critical velocity, it being necessary for stability that the velocity of a machine flying in a given manner should not be less than the corresponding critical velocity given by theory. In the case of a balloon we have learnt, on the other hand, that the velocity must not be greater than the critical velocity. The existence of a critical velocity was recently pointed out by Mr. Lanchester in a communication to the British Association, and it is to be hoped that his remarks will carry some weight with the preeminently unpractical "practical men" who abound in this country.

When these results were obtained it still remained to reduce the problem of stability to the form of rules which were not beyond the ken of the ordinary working mechanic, and, further, to show how the necessary data could be obtained from experiments on models. Had the present writer been able to give his whole time to this work the problem of stability would have been thrashed out to the bitter end long ago. Looking at the matter perfectly impartially, and in view of many cases of a similar kind that may occur in almost any branch of science, the question may be asked whether it is desirable that the completion of such investigations should be delayed indefinitely because those who are prepared to undertake them are debarred by their professional duties from giving the necessary time? The cost of a mathematician's time in working out such a problem would probably not exceed the cost of building a single flying-machine, so that the existing method of trial and error is certainly not to be recommended on the ground of *cheapness*.

The critical velocity of a machine moving in air depends on the position of its centre of gravity, the moment of inertia of the machine, the form, dimensions, and position of its supporting surfaces and tail, and the position of its propeller. In some cases stability may be increased by increasing the moment of inertia; in other cases it may be decreased. Our work tended to show that a machine might become unstable if the moment of inertia were *either* too large or too small, other things being kept constant. But when the mathematical theory has been worked out in every detail, the coefficients of stability for any given machine must necessarily depend on experimental data. Now the average mechanic understands the importance of finding the resultant thrust on an aëroplane, but he does not realise the necessity of finding the centre of pressure through which this thrust acts. The result is that experimental data are far from complete on the very points in which they are most wanted. If, however, we were to try and base our stability calculations entirely on the experimental data obtained for the separate aëroplanes, we should not only have a good deal of calculation to perform, but at the end we should have omitted to take account of the resistance of the framework, car, and rider. A simpler plan would be to construct a stabilimeter [1] for experimenting on models as a whole instead of with single aëroplanes. When a machine begins to pitch and rock it has a rotatory as well as a translatory motion, and the rotation may, and certainly does, influence the magnitude and position of the resultant thrust of the air. No calculation of stability can be considered valid which does not take account of this influence. One might just as well neglect the wedges of immersion and emersion in working out the stability of ships. On this turning effect, as it might be called, we have no experimental data whatever. But if a model is to be tested in a stabilimeter, the mechanic will require simple working rules for applying his results, and these must in the end be laid down by mathematicians. In particular he will have to be told whether he can improve the stability of his model by altering the positions of his aëroplanes or the moment of inertia of his machine. A number of questions require answering, and the answers require putting in a simple form. Here is one example: In a dirigible the critical velocity represents the greatest velocity consistent with stability; in an aëroplane system it represents the least velocity. If, starting with a dirigible, we add aëroplanes and reduce the size of the balloon gradually down to nothing, we must come across an intermediate type which is either always stable or always unstable. What is this type?

The recent flights show what can be done in aviation by a person possessed of skill and experience. They are a necessary factor in the development of artificial flight. The problem is quite in a different position from what it was a year ago. But if flying-machines are to be made accessible to the million, the sooner English aëronauts learn mathematics or get someone to do the mathematics the better. At the present time a great deal of rubbish passes off as mathematics which is quite unworthy of the name. We may instance the use of Taylor's expansion in infinite series to prove, not even that the reciprocals of a harmonical progression form an arithmetical progression, but that the general term of this arithmetical progression is of the form written down in elementary text-books on algebra.[2] Or, again, the discussion of the details of an example which would be in a more proper place in a school text-book or examination paper on elementary trigonometry.[3]

Mr. Lanchester's book, of which the first volume has been noticed in NATURE and the second will be reviewed shortly, should open the eyes of many would-be aëronauts as to the complex theoretical investigations which have to be mastered in any attempt to reduce the problem of flight to an exact science. Although the author has purposely avoided, so far as possible, the use of mathematical formulæ, the reader who aspires to revolutionising the flight problem without making actual experiments and without an extended study of mathematical or physical principles will find the book a pretty hard nut to crack.

The time has, however, passed when any useful

[1] *Cornhill Magazine*, May, 1907.
[2] *Aëronautical Journal*, April, 1908, p. 27.
[3] *Aëronautical Journal*, January, 1904, pp. 4, 5.

purpose can be served by merely writing to the effect that the proper way of solving the problem of flight is by means of vertical screws or by imitating the action of birds' wings. When people can fly for an hour by one method they will scarcely be likely to try another. An actual demonstration of either of these alternative methods as applied to a man-carrying machine would, of course, be watched with considerable interest. Whatever may be the best and cheapest way of advancing aëronautical knowledge, it is probable that the human element and the feeling of "every man his own flying-machine" will appeal most to the Englishman, and more scientific methods will appeal more to the German, who has already arranged for translations of Mr. Lanchester's works.

Mr. Herbert Chatley[1] has directed attention to the part played by eddy formation in determining the flow of air in the wake of aëroplanes. This factor may introduce dangers in a flying-machine should the rate of eddy formation coincide with the period of free oscillation. Accidents from a similar cause have frequently occurred in other branches of engineering, and it seems very probable that some day we shall have an object-lesson of the kind in aëronautics. But the study of these eddies affords an interesting recreation for those who like to look into the matter. The side of a ship is a good place for watching eddy formation, but a better place is a dusty road along which motor-cars are passing. Here anyone can see the eddies being thrown off at perfectly regular intervals, each picking up a separate cloud of dust and whirling it high into the air. If the observer cared to carry his researches further he might get a motor-car, and try attaching tails of different sizes and shapes to it until he got one in which the eddy formation was reduced to the smallest possible amount, and the air resistance would probably be also reduced. He would not succeed in abolishing dust altogether, nor would he make a fortune by taking out a patent; but he would discover a more effectual means of reducing the dust nuisance than by writing complaints to the newspapers. G. H. BRYAN.

MARINE BIOLOGY.

THE work of the Danish naturalists on behalf of the International Commission for the Investigation of the Sea is greatly enriching our knowledge of the natural history of important sea-fishes. In "Serie Fiskeri," Bind ii., Nos. 5-8, of the Danish "Meddelelser fra Kommissionen for Havundersøgelser," there are several important papers by Dr. Johs. Schmidt, a naturalist well known for his discovery of the breeding-places of the common eel of European rivers.

In No. 6 Dr. Schmidt records the results of marking experiments with plaice and cod in the waters around Iceland. Of numerous mature plaice caught, labelled, and liberated in the summer of 1905 off the north and east coasts respectively, those re-captured of the former batch were found to have travelled westward, the latter southwards along the east coast and then westwards along the south coast, *taking in each case the shortest route to the warm Atlantic waters.* Here in winter and spring they spawn. The eggs and fry are then carried passively along by the Atlantic stream (Irminger current), which sets eastwards in spring and summer, and the just-transformed young appear successively in the bays and fjords, first on the west, later on the north, and later still on the east coast. Immature cod, caught, labelled, and liberated at the same time as the plaice on the north-east coast, did not migrate, but remained on that coast throughout winter, and even for one to two years after liberation. It was also found that one-year-old cod were much more numerous on the east coast than on the south and west. On the other hand, the eggs of the cod was absent in hauls with pelagic nets made on the north and east coasts, but plentiful on the west and south. From these facts it appears that the peculiar hydrographical conditions round Iceland involve a double migration of considerable extent on the part of cod and plaice, viz. (1) the passive drift with the eastward-setting Atlantic stream of eggs and fry born off the south and west of the island; (2) the active return migration of spawning fishes to the warm water, due to their special sensitiveness to external conditions on the approach of the spawning season.

Another noteworthy result of these marking experiments is to show that Iceland plaice grow at an average annual rate of 2–3 centimetres, much slower, therefore, than in the North Sea. The most obvious cause of this is the low temperature of the water, on the east and north coasts especially, and the short summer. It is also interesting, from the practical fishery standpoint, to note that more than 60 per cent. of the re-captured marked plaice were taken by English steam trawlers.

Hitherto the post-larval stages of those North Atlantic gadoids, viz. the hake (*Merluccius vulgaris*), *Molva elongata*, and *Raniceps raninus*, have not been described or figured in literature. In No. 7 Dr. Schmidt gives descriptions and figures of thirteen different post-larval stages of the hake. All these were carefully identified with the adult by counting the numbers of vertebræ and fin-rays. The paper also contains a summary of the distinctive characters of various gadoids in the post-larval stage.

In No. 8 there are described seven different post-larval stages of *Raniceps raninus*, a remarkable-looking plump form, somewhat resembling a post-larval Liparis species, and differing from other post-larval gadoids in not possessing the usual three post-anal bars of pigment. In this number also are described and figured four different post-larval stages of *Molva elongata* and *Molva byrkelange*. These two forms, in regard to which Holt and Byrne thought "a single species was enough for the reception of both," are shown to have perfectly distinct post-larval forms with characteristically different arrangements of pigment. The geographical distribution of the two forms, as Dr. Schmidt points out, is also quite different, so that there can now be no doubt that we have to deal with two species.

In No. 5 Ove Paulsen describes and figures all the species of Peridiniales so far known to occur in Danish waters. The Peridiniales are a most important group of unicellular organisms from the standpoint of the student of plankton, since certain species of them appear to be characteristic of water of neritic and oceanic origin respectively. The descriptions appear to be adequate, and there are usually figured several different views of each form. There is also a copious list of literature at the end.

NOTES.

AT the general meeting of the Royal Society of Edinburgh, held on October 26, Sir William Turner, K.C.B., F.R.S., was elected president of the society.

THE King has granted his Royal licence and authority to Dr. Ludwig Mond, F.R.S., to wear the decoration of the Grand Cordon of the Crown of Italy conferred upon him.

[1] *Aëronautics*, August, 1908.

THE organising committee of the Anthropological Congress has postponed the date of the fourteenth congress. Instead of being held at Dublin in 1909, it will take place in 1910.

THE opening meeting of the new session of the Institution of Electrical Engineers will be held on Thursday, November 12, when the president, Mr. W. M. Mordey, will deliver his inaugural address.

THE council of the Institution of Civil Engineers has made the following awards for the year 1907–8:—Telford gold medals to W. B. Parsons and Dr. H. Lapworth; a Watt gold medal to Sir Whately Eliot; George Stephenson gold medals to Sir John W. Ottley, K.C.I.E., Dr. A. W. Brightmore, J. S. Wilson, and W. Gore.

PROF. R. H. CHITTENDEN, director of the Sheffield Scientific School of Yale University, has, we learn from *Science*, been appointed the University's representative at the Darwin celebration to be held at the University of Cambridge next June.

THE death is announced, at sixty-two years of age, of M. Gustave Canet, president of the Junior Institution of Engineers. M. Canet was president of the Institution of Civil Engineers of France, and one of the founders of the French Association for the Advancement of Science.

THE death is announced of M. Paul Berger, the eminent French surgeon. M. Berger was a member of the Paris Academy of Medicine, and took an active and authoritative part in the discussions of the society. He also belonged to the French Anatomical Society and to the Société de Chirurgie, of which he was president.

THE *Pioneer Mail* understands that a special pension has been granted by the Government of India to Dr. Eugen Hultzsch, who recently retired from the editorship of *Epigraphia Indica*, the journal of Indian antiquarian research, in recognition of his services to Indian archæology. Dr. Hultzsch went out to the archæological department in India in 1886.

THE death is announced of Dr. Cuthbert Collingwood at the age of eighty-two. Dr. Collingwood was elected a Fellow of the Linnean Society so long ago as 1853, and was a foreign member of the Physico-Economic Society of Königsberg. He was the author of "Rambles of a Naturalist in the China Seas," and of various scientific papers in the Transactions of the Linnean Society and other publications.

THE annual Huxley memorial lecture of the Royal Anthropological Institute will be delivered by Prof. W. Z. Ripley, of Harvard University, on Friday, November 13, at 8.30 p.m., in the theatre of the Civil Service Commission, Burlington Gardens, W. (by permission of the First Commissioner of Works). Prof. Ripley has taken for his subject "The European Inhabitants of the United States." Tickets can be obtained on application to the secretary of the Royal Anthropological Institute, 3 Hanover Square, W.

THE annual general meeting of the Junior Institution of Engineers was held at the Royal United Service Institution, Whitehall, on October 19, the chairman, Mr. Frank R. Durham, presiding. The report of the council referred to the election of Mr. James Swinburne, F.R.S., as president in succession to the late M. Gustave Canet. Special reference was made to the foundation of the Durham bursary, due to the kindness of Mrs. F. R. Durham. The award for the year 1908–9 has gone to Mr. L. M. Jockel, of Edinburgh, his thesis being on the subject of electricity in mining.

WE notice with regret the death, in his seventy-fourth year, of Mr. Henry Chapman, who did notable work in the development of the application of machine tools actuated by hydraulic power, the perfecting of torpedo machinery, and with air compressors. He introduced the Giffard injector into this country, and was one of the pioneers of the principle of distributing high-pressure water. Mr. Chapman was elected vice-president of the Institution of Mechanical Engineers in 1907. He belonged to the Iron and Steel Institute, and was a member of the Institution of Civil Engineers and of the Institution of Naval Architects. He was decorated by the French Government in 1878 as Chevalier of the Legion of Honour, and was promoted to the rank of officer in 1889.

THE International Electrotechnical Commission held its first council meeting at the new home of the Institution of Electrical Engineers, on the Victoria Embankment, on October 19. The Right Hon. A. J. Balfour welcomed the delegates of eighteen countries, and spoke of the intimate relations existing between theory and practice in electricity. From the report of Colonel R. E. Crompton, it appears that electrotechnical committees have been officially constituted in ten countries, while in six other countries committees are to be formed in the near future. The French committee urges the adoption of the metric system, and has also raised the question of a provisional standard of light. The council in committee is also to deal with matters relating to nomenclature, symbols, and regulations for fire insurance for interior electrical wiring.

WRITING to the *Times* of October 24 with reference to the destruction of ancient monuments on Dartmoor, Mr. G. Hubbard states that on Bush Down the sockets may be seen on the side of the hill where an alignment of stones was torn up four years ago, and that portions of another stone alignment on the common land on the same Down have within recent weeks been converted into road metal. It appears to be a common practice with road-makers in the district to collect stones from the moor and to break them up into road metal. One road-maker questioned by Mr. Hubbard said he had no definite instructions as to which stones to use for this purpose, but "he always took those which were handiest." If local authorities and landowners would insist that the stones for road-mending should be obtained from roadside quarries, some check would be placed upon these deeds of vandalism while we are awaiting an Act to render such proceedings illegal.

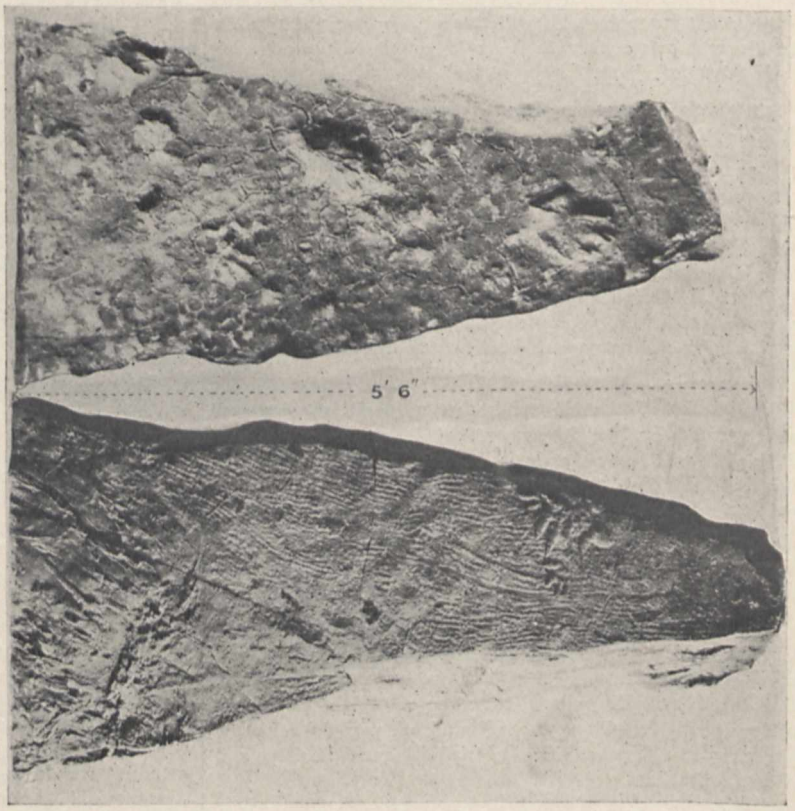
IT will be remembered that on February 29 last Prince Roland Bonaparte placed at the disposal of the Paris Academy of Sciences four yearly sums of 25,000 francs for the encouragement of scientific research among men of science not belonging to the academy. The grants are intended exclusively to encourage discoveries and to assist scientific workers who, having accomplished some successful original research, are unable for want of sufficient funds to undertake or to complete investigations. The first grant was made by the academy last June, in accordance with the report of a special commission. The three next annual grants will be made on July 15 of each of the three years 1909–11. No grant of less than 2000 francs will be made. Men of science desirous of participating in the awards must apply to the academy, either directly or through a member of the academy, before January 1 of each year. A precise statement of the work proposed

to be carried out, and the amount necessary for its completion, must be made. Beneficiaries will be expected to report to the academy within twelve months how the grant has been expended, and the results obtained. Non-compliance with this rule will disqualify for future grants. The first announcement of any results must in all cases be made to the academy.

THE annual dinner of the Institution of Electrical Engineers was held at the Hotel Cecil on October 22, when some of the delegates to the International Conference on Electrical Units and Standards and to the International Electrotechnical Commission were present. Mr. Haldane proposed the toast of "Science and Industries." "A few years ago," he said, "it may have seemed as if the domination of science over what science is applied to had its highest illustration in the application of pure mathematics to physics. But we seem to have got a stage beyond that. There is a topic which is of fascinating interest, and that is the domination which a new generation altogether of pure mathematicians are asserting over the old mathematicians. The conception of number which many people think they are quite familiar with has proved to be quite obscure. In days which are long gone by, people were content to take the motion of a point in space, the line of the curve it described, and accept that as the ultimate standard by which to bring their mathematical theories to the test. On it they based the infinitesimal calculus, just as physicists have been engaged for the last fortnight in seeking standards on which to base and test their electrical practice. But in these days, when everything is questioned, there has arisen a new school which has brushed aside the old notions of space as an exact test to which to refer the mathematical theories of the day. This is a sign of the times and an indication of how men are asserting the necessity of absolute and clear conceptions as the basis of everything. Whether we take a great industry like the telephone, or such things as the science of aërial navigation, it requires a great deal of science to be applied to it before we get it on to a secure basis. Or, if we take the conceptions of the higher mathematics to-day, we are faced with the same tendency which keeps men always busy, always striving after some more general conception to which to refer back what is being worked at. We cannot stand still. In every nation more and more one is impressed with the special excellences which are being developed, with the way in which new men are coming to the front and new truths are being born. And there is this great satisfaction, that there is no real rivalry in the search after truth. Everyone is proud of the contribution of his neighbour, of whatever race. We must bear in mind that all men of science, of whatever nationality, are converging on a common problem when working at the application of science to industry."

THERE has recently been placed on exhibition in the British Palæontological Gallery of the Liverpool Museum a slab of Keuper sandstone taken from a quarry at Storeton, Cheshire, which well illustrates almost all the varied traces of life of the Trias found in the neighbourhood. The slab was quarried about 50 feet from the surface, at the level recognised locally as the "footprint beds." It is about 8 inches in thickness, and exhibits impressions on both surfaces—as indentations on what *in situ* was the upper surface, and in relief on what was the under surface. The impressions consist of well-marked footprints of both fore and hind feet of the labyrinthodont Chirotherium in several well-defined tracks, footprints of the rhynchocephalid Rhynchosaurus, and casts of a group of fragments of stems of the fossil genus of plants Equisetites. The type-specimen of *E. keuperina*, also from Storeton, is exhibited in an adjoining case, and the casts on the slab are either the same species or closely allied to it. The joints or nodes and the grooving of the stem are distinctly seen. The slab also exhibits good examples on one side of "ripple marks" and on the other of "sun cracks," and altogether forms a rather unique museum specimen.

Upper side.



Under side.

Footprints and other markings upon a slab of Keuper Sandstone in the Liverpool Museum.

IN reply to an inquiry as to what hardy flowering plants and shrubs are especially attractive to butterflies, Mr. R. Hooper Pearson has sent us the following information:—

Among plants which are most frequented by butterflies are those following:—*Sedum spectabile, S. Sieboldii, Reseda odorata* (mignonette), *Cistus ladaniferus, Limnanthes Douglasii, Borago officinalis* (Borage), *Pulmonaria officinalis* (lungwort), *Viola odorata* (sweet violet), *Alyssum maritimum* (sweet Alyssum), *Phacelia tanacetifolia, Gilia tricolor, Gilia nivalis, Aster Amellus,* and Helianthus (sun-flowers); but almost all flowers that produce honey or nectar are visited by butterflies as well as bees, though the construction of some flowers prevents the butterflies and bees from reaching the nectar secreted in them. Among "honey" flowers may be mentioned Apple, Apricot, Peach, Pear, Plum, Cherry, Raspberry, Blackberry, *Anchusa italica,* Arabis, Wallflower, Crocus, Snowdrop, Godetia, Lupin, Magnolia, Maple, Salvia, Phlox, Scabious, Sage, Malope, Ivy, *Cercis Siliquastrum* (Judas tree), *Tilia vulgaris* (lime), common Thyme, *Tropaeolums majus* and *minus, Wistaria sinensis, Acer pseudo-platanus* (sycamore), *Vitis vinifera* (grape vine), Fragaria (strawberry), Cytisus, Ribes (currant), Acacia, Clarkia, *Ribes grossularia* (gooseberry), Asparagus, Trifolium (clover), Collinsia, Cucumis (cucumber and melon), Genista, *Nepeta Glechoma* (ground ivy), Erica (heather), Leptosiphon, Allium (onion), and Vicia (vetch). If it be desired to attract butterflies permanently to the garden, means should be taken to prevent sparrows becoming numerous, as these birds have been observed in the act of eating the perfectly developed butterflies.

THE *Philippine Journal of Science* for July (iii., No. 3) contains several important papers, notably one by Assist.-Surg. Garrison on the prevalence and distribution of the animal parasites of man in the Philippines, and another by Dr. Strong on the diagnosis of African tick fever and the differentiation of the species of human spirochætes.

IT has been found by Bail and others that blood serum, and particularly the serum of pathological exudates, may favour infection by micro-organisms. Thus a germ-free exudate, harmless in itself, may, if mixed with a non-harmful dose of a pathogenic bacterium, cause a fatal infection. Bail has supposed that substances derived from the bacteria are present in the exudate, which neutralise or antagonise the natural defences of the body; to such substances the name of "aggressins" has been applied. Cole and Smirnow have found that normal pigeon and rabbit sera exert an "aggressive" effect with the pneumococcus, and suggest that this may therefore be due to the natural toxic action of serum, and not to the hypothetical aggressins derived from bacteria in serum exudates (Bull. Johns Hopkins Hosp., September, 1908, p. 249).

DR. F. A. BATHER was mentioned in a brief note (NATURE, October 15, p. 609) on Mr. A. H. Clark's paper on the nomenclature of crinoids. The note apparently suggested that he had attempted to revise the names of the crinoid genera, which number some 500, and that, in Mr. Clark's opinion, he was only right in two cases. This is not the case. The facts are stated by Dr. Bather as follows:—"In his most useful revision of the nomenclature of the *recent* crinoids, Mr. Clark refers to my essay on 'Pentacrinus: a Name and its History' (1898), which dealt with the numerous names applied at different times to five genera, and apparently he agrees with me as to the names to be applied to four of these genera. As to the fifth, I may have been wrong in adopting Encrinus from C. F. Schulze; but that is a matter of opinion."

MR. F. A. LUCAS, curator-in-chief of the museums of the Brooklyn Institute of Arts and Sciences, in his report for 1907 directs attention to the opening of the new eastern wing of the main building. He adds that, for want of sufficient case-room, he has found it impossible to put the natural exhibits in the condition in which he should like to see them. He hopes, however, that in the course of the next two years it will be possible to do more in this respect than it has been found practicable to accomplish during the past decade. The museum sent a collecting expedition to Venezuela and Trinidad, of which an account will be found in the report, which also contains a history of the rise of the Brooklyn Museum.

WE have received from the publishers—Messrs. Macmillan and Co., Ltd.—two samples of a series of coloured pictures of farm animals, reproduced in chromolithography from paintings by Mr. J. Macfarlane. Each picture measures 30 inches by 20 inches, and the animal occupies nearly the whole length of this space, so that the series is suitable for display in large rooms, such as schools and colleges. The animals depicted are all prize-winners or champions, those shown in the samples received being the shorthorn "Sweetheart" and the Ayrshire "Adamhill Bertha 2nd." The reproductions appear singularly successful, and as the surface is highly glazed, the pictures can be framed and hung without glass. In connection with this subject it may be mentioned that, on the closing of the exhibition at Earl's Court, the Hungarian Minister of Agriculture presented to the natural history branch of the British Museum a number of the beautiful miniature models of domesticated horses, cattle, sheep, pigs, and poultry executed by Mr. Georges Vastagh, of Budapest.

THE female crayfishes of the genus Cambarus inhabiting America east of the Rocky Mountains have long been known to differ from their relatives of other parts of the world by possessing special receptacles for the sperm in the shells; the sperm in other species being deposited on the general surface of the shell. The examination of a Cuban and a Mexican species has now enabled Mr. E. A. Andrews to state (Proceedings of the Washington Academy of Science, vol. x., p. 167) that the presence of sperm-receptacles is common to all the representatives of Cambarus, as it is to the American lobster. These chambers, although occurring in both groups on the under surface of the body, do not, however, correspond structurally, the receptacle in the lobster being an external space roofed over by the annular plate of the seventh thoracic segment, whereas in the crayfishes it is a narrow pocket excavated in the same plate.

IN a supplement to the Journal of the South African Ornithologists' Union for 1908, issued as a separate pamphlet of the Bird Protection Committee of the union, Mr. Alwin Haagner discusses the economic relations of the local birds-of-prey and the treatment they deserve at the hands of the agriculturist and stock-owner. Throughout the world most birds-of-prey, both diurnal and nocturnal, are the subject of suspicion or persecution, and it appears that quite recently the Transvaal Game Protection Association offered a reward for the destruction of hawks of all kinds, a proceeding which gave rise to a protest from the author of the present pamphlet. With the possible exception of Pel's fishing-owl, which may kill guinea-fowls, all the nocturnal species are wholly beneficial, as are also very many of the diurnal group, including all the vultures. A certain number of diurnal birds-of-prey, such as the crested hawk-eagle and the bateleur eagle, are partially beneficial and partially harmful, while a small group, including most of the eagles and a few hawks, is held to be wholly mischievous.

WE have to acknowledge the receipt of a copy of vol. ix. (ser. 3) of the *Anales del Museo Nacional de Buenos Aires*, several of the articles from which have already been noticed in our columns. Among those not so mentioned, reference may be made to two by Mr. F. Lahille on Argentine cetaceans, one relating to a supposed new species or subspecies of dolphin of the genus Tursiops, and the other to the occurrence of *Balaenoptera acutirostrata* (=*rostrata*) in the South American Atlantic. As regards the former, it will suffice to mention that the author appears to be unacquainted with the papers on the dolphins of this group contributed by Mr. Lydekker to the Journal of the Bombay Natural History Society and the Proc. Zool. Soc. In connection with the second, it is remarkable that the author once more resuscitates the (we had heard obsolete) theory of the descent of cetaceans from ichthyosaurs. Here again we note the absence of any reference to Dr. Fraas's proof of the origin of the presumably cetacean zeuglodonts from primitive Eocene land Carnivora.

WE have received two bulletins from the Experiment Station of the Colorado Agricultural College. No. 130 deals with the evergreen trees of Colorado, and describes the native pines, spruces, firs, junipers, and red cedars from the botanical and economic point of view. There are several good illustrations. No. 128 deals with lucerne. Attention is directed to the fact that lucerne, being a deep-rooted leguminous plant, increases the supply of nitrogen and of organic matter in the soil, and thus tends to maintain the fertility of land which is being heavily cropped with sugar beets and other exhausting crops. Numerous varieties are described, and their relative values under the conditions of the trial are indicated.

INCREASING attention is now being devoted to the production of cacao in the West Indies, and some account of the investigations on this crop made by the scientific staff of the Department of Agriculture is given in the West Indian Bulletin, vol. ix., No. 2, and in a recent issue of the *Agricultural News*, the periodical published by the Department. Fertiliser experiments have been made to discover the sort of manuring necessary, and attempts have been made to improve the crop by selecting promising sorts and then propagating them by grafting or budding. The various diseases to which the crop is liable have also been studied, and systematic operations started for coping with them. The whole work furnishes another example of the great benefit conferred on the industries of the West Indies by the scientific staff.

BULLETIN No. 113 of the West Virginia Agricultural Experiment Station gives some interesting notes on the habits of mice, voles and shrews, particularly from the economic standpoint. The short-tailed shrew (*Blarina brevicauda*) is considered to be beneficial to farmers, and is recommended for protection. Brewer's mole (*Parascalops breweri*) may do a certain amount of injury because of the number of earthworms it eats, and, the rather unsightly mounds of earth it throws up, but it destroys so many grubs that on the whole it is classed as useful. On the other hand, the various field mice, of which two are described (*Microtus pennsylvanicus* and *M. pinetorum scalopsoides*) are regarded as wholly injurious, and their destruction by strychnine is urged. The bulletin is well illustrated with photographs.

IN *Symons's Meteorological Magazine*, July–September, the Rev. D. C. Bates describes some recent and costly rain-making experiments by gun firing in the Oamaru district of New Zealand, which may be considered useful in so far as they once more prove their absolute futility. From various causes the district is subject to long droughts; an influential committee was formed to organise the experiments, for which a large sum of money was readily subscribed, and was supplemented by the Government, Mr. Bates being requested to watch and report upon the results. The weight of the charges varied from 50 lb. to 200 lb.; these were primed with dry gun-cotton and fired by a dynamite detonator attached to a slow burning fuse, and in nearly all cases complete detonation took place. The times chosen for the experiments were generally those when atmospheric conditions were considered to be favourable for rain. Although rain occasionally fell within a reasonable time, Mr. Bates could only conclude that it was a mere coincidence, and that "the explosions had apparently no more effect on the vast expanse of the air than would the striking of a match in a room."

IN a short note in the *Annals of Mathematics* for July, Prof. J. L. Coolidge proves a theorem, which he states he has not previously seen, according to which, if a set of ratios between positive integers are equal to one another, then all are equal to the ratio of the greatest common divisor of the numerators to that of the denominators, and also to the corresponding ratio of the lowest common multiples.

MESSRS. B. G. TEUBNER, of Leipzig, have issued an elegantly bound volume, of more than 500 pages, containing a catalogue of their published works on mathematics and allied sciences. To the English reader this list should afford an object-lesson as to the value which is attached to scientific progress and advancement by our German rivals. The book was prepared for the International Mathematical Congress at Rome this spring. It is illustrated by portraits of eminent mathematicians, including a frontispiece of Galileo Galilei, and in addition to alphabetical and subject indices it contains an introductory account of the principal works published by the firm from the middle of last century, and a calendar of births, deaths, and other important events in the mathematical world, by Prof. Felix Müller, of Dresden.

A NEW work is announced for early publication by Mr. Elliot Stock, under the title "Saint Gilbert: the Story of Gilbert White and Selborne," by Mr. J. C. Wright.

PROF. R. W. WOOD has written another amusing set of verses for children, illustrated with quaint drawings. Attention was directed on a previous occasion to the character of the volume "How to Tell the Birds from the Flowers." The present volume is entitled "Animal Analogues," and is published by Messrs. Paul Elder and Company, of San Francisco and New York. Its price is 50 cents net.

THE best form of the mariner's compass card, so described and reproduced in NATURE of September 24 (p. 509), is the registered design of Mr. F. Howard Collins, of Torquay, and has been awarded a diploma for bronze medal at the Franco-British Exhibition. A specimen of Mr. Collins's card was submitted to us two years ago, and was commented upon at that time (vol. lxxiv., p. 594).

WITH reference to the review of "Science and Empiricism" (NATURE, October 15, p. 603), Mr. Daniel writes that cancer must be due to loss of energy in the cell, and not to bacteria. This point was not referred to in the review; in fact, the trend of opinion at present is against the parasitic origin of cancer. The reviewer took exception to the extremely imaginative conception of the cancer process as expressed in the book.

A SIXTH edition of Prof. Strasburger's "Handbook of Practical Botany," translated and edited by Prof. W. Hillhouse, has been published by Messrs. Swan Sonnenschein and Co., Ltd. Considerable textual revision has been effected, some new figures have been introduced, the chapter on cell and nuclear division has been in part rewritten, and Prof. Hillhouse has rearranged the material in such a way as to illustrate grades in cytological technique.

MESSRS. A. E. STALEY AND CO., Thavies Inn, London, E.C., have forwarded us a copy of the September issue of *Prism*, a little magazine published by Messrs. Bausch and Lomb Optical Co., Rochester, N.Y., U.S.A. This issue deals popularly with the manufacture of the microscope. Messrs. A. E. Staley and Co., who are the exclusive agents of the American company in England and the colonies, will send a copy of the magazine to any interested reader on receipt of a stamp for postage.

MESSRS. LONGMANS, GREEN AND CO. have published a second edition of Mr. J. P. Johnson's "The Stone Implements of South Africa," which was reviewed at length on its first appearance in our issue for May 30, 1907 (vol. lxxvi., p. 99). The volume has been revised and enlarged, further discoveries of the author have been incorporated, and a number of new illustrations added. The comprehensive terms adopted in the first edition have been replaced by the current European nomenclature, though most of the data remains the same. The volume possesses neither index nor table of contents. The price of the new edition is 10*s*.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN NOVEMBER:—

Nov. 4. 21h. 10m. Saturn in conjunction with the Moon (Saturn 2° 42′ N.).
,, 11h. 16m. to 13h. 56m. Occultation of 30 Piscium (mag. 4·7).
9. 8h. 16m. to 9h. 14m. Occultation of ϵ Tauri (mag. 3·7).
10. 9h. 45m. to 10h. 29m. Occultation of *o* Tauri (mag. 4·8).
12. 10h. 58m. Neptune in conjunction with the Moon (Neptune 2° 36′ S.).
13. Mercury at greatest elongation, 19° 18′ W. of the Sun.
16. 21h. 42m. Jupiter in conjunction with the Moon (Jupiter 4° 20′ S.).
20. 3h. 42m. Venus in conjunction with the Moon (Venus 3° 6′ S.).
,, 9h. Vesta in conjunction with the Moon (Vesta 0° 40′ N.).
21. 23h. 16m. Mercury in conjunction with the Moon (Mercury 1° 55′ S.).
23. 15h. Ceres in conjunction with the Moon. (Ceres 0° 14′ N.).
26. 14h. 6m. Uranus in conjunction with the Moon (Uranus 1° 17′ N.).
30. 11h. 15m. Venus in conjunction with Mars (Venus 1° 17′ N.).
,, 8h. 46m to 9h. 50m. Occultation of τ^2 Aquarii (mag. 4·3).

MOREHOUSE'S COMET, 1908*c*.—This object has now become visible to the naked eye, and may be picked up, on a clear night, by any keen-sighted observer who has an idea of its approximate position. Photographs taken at the Solar Physics Observatory, South Kensington, with the 6-inch Dallmeyer camera on October 23 show tails nearly 2° in length, whilst those taken with the 36-inch reflector show a complex series of streamers going to the edge of the plate.

Observations recorded in No. 4277 of the *Astronomische Nachrichten* (p. 84, October 20) appear to confirm the suggestion that the comet and tail have suffered some remarkable changes in visibility. Dr. H. Thiele states that both the length and breadth of the tail and the visibility of the comet have varied. According to his observations the length of the tail has varied between 10′ and 2°, and the breadth, within 10′ of the nucleus, from 15° to 40°; the dates of the longest and narrowest tails were September 12?, 15, 20, 23–27, October 4 and 5.

Prof. Hartwig also reports changes from October 2 to October 5 and 6, and suggests a periodic outrush of tail material.

A telegram from Prof. Pickering to the Kiel Centralstelle states that Messrs. Metcalf and Morehouse each announce a remarkable change in tail of Morehouse's comet on October 15, a change which is confirmed by the Harvard observations.

We give below part of the ephemeris published in No. 4276 of the *Astronomische Nachrichten* by Prof. Kobold, and the accompanying chart indicates approximately the

Path of Comet 1908*c*, October 24 to December 2, 1908.

position of the comet, in regard to the brighter stars, according to this ephemeris, for every alternate night from October 24 to December 2.

Ephemeris 12h. M.T. Berlin.

1908	*a* (true) h. m.	*δ* (true) ° ′	log *r*	log Δ	Brightness
Oct. 28	19 1·2	+27 58·6	0·1369	0·0443	5·6
29	19 0·2	+26 27·5			
30	18 59·3	+24 58·4			
31	18 58·5	+23 31·4			
Nov. 1	18 57·7	+22 6·5	0·1222	0·0629	5·5
2	18 57·0	+20 43·7			
3	18 56·3	+19 23·0			
4	18 55·7	+18 4·3			
5	18 55·2	+16 47·7	0·1073	0·0836	5·4
6	18 54·7	+15 33·2			
7	18 54·2	+14 20·6			
8	18 53·8	+13 10·0			
9	18 53·4	+12 1·3	0·0923	0·1054	5·2
10	18 53·1	+10 54·5			
11	18 52·8	+ 9 49·5			

EPHEMERIS FOR COMET TEMPEL$_2$-SWIFT, 1908*d*.—The recent observations of the Tempel$_2$-Swift comet have enabled M. Maubant to re-determine the most probable time for the perihelion passage and to calculate a new ephemeris. He finds that it is necessary to retard the

time of perihelion 3·646 days, and this reduces the mean diurnal motion by 0″·38. As M. Bossert found that, in order to represent the 1891 observations correctly, he had also to diminish this factor by the same amount, it is suggested that this comet is subject to a negative acceleration, such as was found by M. Schulhof for the Tempel$_2$ comet, and by M. Lamp for Brorsen's comet.

In the ephemeris, which covers the period October 20 to December 31, the actual positions for 12h. (Paris M.T.) are given for each day, and observations made on September 29 and October 7 show that the ephemeris was correct for R.A. but required corrections in declination of +1′·7 and +1′·8 respectively. During the period November 1 to December 31 this comet will, according to the ephemeris, apparently travel through the constellations Cancer and Leo, from α=8h. 45·1m., δ=+24° 34′·9, to α=9h. 22·7m., δ=+14° 8′·4 (*Astronomische Nachrichten*, No. 4277, p. 79).

EPHEMERIS FOR JUPITER'S EIGHTH SATELLITE.—An ephemeris showing the position of J viii. in regard to Jupiter has been computed by Messrs. Crawford and Etal, and is published in Circular No. 105 from the Kiel Centralstelle. The following is part of it, and gives the differences :—

J viii. − 1 *for* 12*h. G.M.T.*

	$\Delta\alpha$	$\Delta\delta$
	m. s.	′ ″
Oct. 27 ...	−2 44·8 ...	+26 56
31 ...	−3 3·5 ...	+27 14
Nov. 4 ...	−3 21·9 ...	+27 28

SATURN'S RINGS.—Further particulars of the new dark ring surrounding the bright rings of Saturn are published in a message from Herr Schaer, of the Geneva Observatory, to No. 4277 of the *Astronomische Nachrichten* (p. 81, October 20). On October 8 the white ring was seen to be bordered by two narrow bands of a brownish hue. When the seeing was good both bands were seen beyond the edge of the planet's sphere, and from these observations M. Schaer concludes that there is a dark exterior ring somewhat similar to the interior crape ring. This new feature is difficult to see with the Cassegrain telescope of 40 cm. aperture, using powers of 270, 450, and 660.

Prof. Strömgren, observing Saturn at Copenhagen on October 10, was unable to see any extraordinary feature, nor could Prof. Hartwig, at Bamberg on October 10 and 11, confirm M. Schaer's observation. Similarly, Senor J. Comas Sola, who observed the planet under good conditions during the beginning of the month, states that he saw nothing abnormal.

INTERNATIONAL CONFERENCE ON ELECTRICAL UNITS AND STANDARDS.

INTERNATIONAL agreement on the subject of electrical units was arrived at in Paris at the conferences of 1881 and 1884, and at Chicago in 1893. The results of these conferences have been of considerable value to electrical industries. In recent years, however, differences have occurred, partly in the definitions of the units and partly in their realisation, and the degree of precision in electrical measurements which is now possible rendered it necessary to remove these differences. The committee of delegates at the International Congress at St. Louis in 1905 expressed the desirability of summoning an International Conference on Electrical Units and Standards, and the British Government recently invited representatives from all the civilised countries of the world to discuss these subjects.

The conference was opened by the Right Hon. Winston S. Churchill, M.P., on Monday, October 12, at the rooms of the Royal Society. Delegates from twenty-four different countries, including Australia, Canada, and India, were then present. Mr. Churchill gave, as one of the main objects of the gathering, the establishment of a universal system of electrical standards acceptable to all.

Lord Rayleigh was elected president of the conference, and Dr. Glazebrook chairman of a technical committee, the members of which were nominated by the delegates.

Possibly the best general view of the results of the conference can be given by the reproduction of the first portion of Schedule B containing the resolutions which the conference adopted with the request that the delegates would lay these and the specifications which complete the schedule before their respective Governments with the view of obtaining uniformity in the legislation with regard to electric units.

Resolutions.

(1) The conference agrees that as heretofore the magnitudes of the fundamental electric units shall be determined on the electromagnetic system of measurement with reference to the centimetre as the unit of length, the gram as the unit of mass, and the second as the unit of time.

These fundamental units are (1) the ohm, the unit of electric resistance which has the value of 1,000,000,000 in terms of the centimetre and second; (2) the ampere, the unit of electric current which has the value of one-tenth (0·1) in terms of the centimetre, gram, and second; (3) the volt, the unit of electromotive force which has the value 100,000,000 in terms of the centimetre, the gram, and the second; (4) the watt, the unit of power which has the value 10,000,000 in terms of the centimetre, the gram, and the second.

(2) As a system of units representing the above and sufficiently near to them to be adopted for the purpose of electrical measurements and as a basis for legislation, the conference recommends the adoption of the international ohm, the international ampere, and the international volt defined according to the following definitions.

(3) The ohm is the first primary unit.

(4) The international ohm is defined as the resistance of a specified column of mercury.

(5) The international ohm is the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14·4521 grams in mass, of a constant cross-sectional area, and of a length of 106·300 centimetres.

To determine the resistance of a column of mercury in terms of the international ohm, the procedure to be followed shall be that set out in Specification A attached to these resolutions.

(6) The ampere is the second primary unit.

(7) The international ampere is the unvarying electric current which, when passed through a solution of nitrate of silver in water, in accordance with the Specification B attached to these resolutions, deposits silver at the rate of 0·00111800 of a gram per second.

(8) The international volt is the electrical pressure which, when steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere.

(9) The international watt is the energy expended per second by an unvarying electric current of one international ampere under an electric pressure of one international volt.

A comparison of these resolutions and those of the Chicago Conference will show two main changes.

In the first place there is no reference to the E.M.F. of a standard cell in the definition of the volt, while in the second the definitions of the international ohm, ampere, and volt have been made more precise. As to the first of these changes, after it had been decided that the volt was to remain a derived unit, there was no difference of opinion. The other, as a reference to the account of the proceedings will show, gave rise to much discussion. The increased precision, which it should be noted concerns the definitions of the units, and probably does not affect the concrete standards by which the units are expressed, is arrived at in two ways. In the first place, a distinction is drawn between the ohm—10^9 C.G.S. units of resistance—and the international ohm—the resistance of a definite column of mercury. Previously, some such phrase as that the ohm 10^9 C.G.S. units "is *represented* by the resistance" of a certain column of mercury has been used; in the new resolutions it is stated that the international ohm represents the ohm *sufficiently nearly* for the purpose of electrical measurements and as a basis for legislation, and *is* the resistance of a certain column of mercury of length 106·300 centimetres. Precision is given in the second place by the addition of the 00 after the 3 in the above length, the international ohm being thus defined to one part in a hundred thousand.

It is not to be inferred from this that we know the ohm—10^9 C.G.S. units—to this accuracy in terms of mercury, and the difference between the ohm and the international ohm remains a matter for experiment, but resistances are compared to six or even seven figures, and it is requisite, therefore, for international purposes, that the unit in terms of which they are expressed should be defined with the same precision.

So, too, with the ampere; the definition has been rendered precise by stating that the international ampere is the current which, under certain conditions, deposits 0·00111800 gram of silver per second. In this case decision was rendered much more difficult by the fact that we know that in order to represent the ampere (10^{-1} C.G.S. units) the last two figures should probably be 25 or 20.

The following is a brief *résumé* of the more important proceedings of the meetings.

In discussing the general question of the measurement of resistance by a mercury column, Lord Rayleigh expressed some doubt as to whether the introduction of such a column was not what is called a "fifth wheel to the coach." At the present time there was reason to believe that the ohm, as defined in absolute measure, could be arrived at with a very great degree of precision. He looked forward to the time when the column of mercury might be eliminated from the definition of the international ohm, and when the ohm, 10^9 C.G.S. would be the standard.

Resolution 5, defining the international ohm, was introduced by Dr. Warburg (Germany). In discussing it Dr. Rosa (United States of America) raised the question whether it would not be better to specify the length of the column as 1 metre, and to give the weight accordingly, so that the resistance would be the same. The mass of mercury would then be 12·7898 grams instead of 14·4521. He suggested that if the specification for the international ohm was ever changed, and it probably would be as we came more nearly to the absolute value, it would be necessary to change both figures if the cross-section was to remain about 1 square millimetre. If the length were specified as 1 metre exactly, that would never be changed.

Dr. Rosa's suggestion was referred to the technical committee, and was not approved.

Mr. Trotter thought the resolution proposed by Dr. Warburg was something more than a confirmation of the ohm as established at Chicago. The scientific length was to be set aside and a conventional length declared, like the original Siemens unit. The two zeros after the 106·3 could have no scientific meaning. He thought the mercury column was an ingenious device which would serve a useful purpose, but there was no pressing need for it as a standard. While a useful result of the conference would be an organisation for the comparison of standards of different countries, it was questionable whether the differences which had to be reconciled were of sufficient importance to set aside the C.G.S. system and no longer to look upon it as the ideal. He thought it premature to add the two zeros to the 106·3, because it seemed likely that the Lorenz or some other mode of determination of the ohm would soon be made with an accuracy within a few parts in 100,000. Until that time arrived, mercury columns would be a temporary expedient.

Dr. Rosa, however, doubted whether the time was coming when resistances could be measured absolutely as accurately, and a series of determinations made to agree as closely, as mercury ohms could be set up and measured.

Dr. Warburg thought that the accuracy with which the proposed international ohm approached the true ohm was sufficient, and that an alteration in the international ohm should not take place in the future on account of its difference from the ohm (10^9 C.G.S.). He thought it of the utmost importance to preserve continuity.

In the end the resolution, as proposed by Dr. Warburg, was adopted.

The next matter taken up by the conference was the question whether the ampere or volt should be the second primary unit. In opening it, Dr. Glazebrook moved that the ampere be the second primary unit. The ampere has been defined by all congresses, with the exception of that of 1881, as the second primary unit, and he thought that as a standard the silver voltameter had a greater accuracy of reproduction than any form of standard cell. He directed attention to the following values obtained for the electrochemical equivalent of silver:—

		mgm. per coulomb
1884.	Mascart	1·1156
1884.	F. and W. Kohlrausch	1·1183
1884.	Rayleigh and Sidgwick	1·1179
1890.	Pellat and Potier	1·1192
1899.	Kahle	1·1183
1903.	Pellat and Leduc	1·1193
1904.	van Dijk and Kunst	1·1182
1906.	Guthe	1·1182
1907.	Smith, Mather and Lowry	1·1183
1908.	Janet, Laporte and de la Gorce ..	1·1182

These results showed that the standard could be considered permanent and accurate; and still further confirmation is afforded by the fact that the Board of Trade ampere balance, which was adjusted fourteen years ago on the basis that the unit of current deposits 1·118 mgm. of silver per second, now gives for the equivalent of silver the value 1·11794—an extremely good agreement. A further reason for adopting the ampere as the second primary unit was that the absolute determinations of the ohm and the ampere were independent, and thus conformed more nearly to the theoretical ideal. This was of importance, as he hoped that some day we might arrive at standards which would measure resistance and current in absolute units direct. The chemistry of the silver voltameter had recently been investigated at the National Physical Laboratory; it was of importance to know that only one chemical had to be purified, and this (silver nitrate) one of extreme solubility in water, and therefore capable of purification by repeated crystallisation. No time had to elapse between setting up the voltameter and the attainment of a condition of chemical equilibrium. If secondary reactions took place, they were of very small importance, while it had been shown that the temperature coefficient was certainly not greater than 1 part in 1,000,000, and was probably smaller than this. Dr. Glazebrook did not suggest that the silver voltameter should be generally used for measurement of current; it was intended as an instrument to be used at standardising laboratories. For all ordinary measurements of current a standard cell and a resistance would still be employed. The Weston cell involved the purification of four substances, one of which (mercurous sulphate) was a very insoluble salt and very difficult of purification; moreover, there was a difference of opinion as to the best method for its preparation. If the volt were defined as a fraction of the E.M.F. of the Weston cell, the standard was certainly more concrete, but this was not very important for a standardising laboratory. Of between 300 and 400 cells set up at the National Physical Laboratory 80 per cent. agree within three or four parts in 100,000; but in the remaining 20 per cent. the differences may attain two in 10,000, and we do not know the reason of this. The results obtained by Prof. Janet, at the Laboratoire Central, showed that the permanence of the cell is far from certain, as the mean E.M.F. of one batch of cells dropped six parts in 10,000 in two years, and of another batch seven parts in 100,000 in one year. He agreed that an extraordinary concordance in the E.M.F. of Weston cells had been reached between the Bureau of Standards and the National Physical Laboratory, but it was requisite to obtain agreement with cells made at other places, and this had not yet been done.

Prof. Lippmann (France) was in favour of the volt as the second primary unit. He agreed with Dr. Glazebrook that everybody would use the cell in practical work. He considered that the volt was an independent unit and could be measured absolutely by means of a disc rotating in the earth's magnetic field. Subsequently M. Gerard (Belgium) pointed out that as this method involved the determination of the magnetic field of the earth, it was not comparable with the absolute measurement of current.

Prof. Carhart (U.S.A.) pointed out that the congress of 1881 proposed the volt as the second primary unit. In Germany all measurements of E.M.F. were made by means of a standard cell and resistance, and to all intents and purposes the E.M.F. of the Weston cell had been legalised,

and the silver voltameter was very rarely set up. Lord Kelvin at one time standardised his current balances by means of the silver voltameter, but he abandoned it in favour of a cell and a resistance. He (Prof. Carhart) believed the cell to be a constant and a useful standard. With the absolute balance at the National Physical Laboratory the electrochemical equivalent of silver was not directly determined; it was the E.M.F. of a Weston cell that was first fixed. He considered this was the correct way. At the Board of Trade the balance had only been compared with the silver voltameter once during the past eight years. He did not consider the ageing of cells to be serious; if necessary they might be kept for only a few days or a week. Cells which were set up by unskilled persons should not be considered, as it was a primary standard which was under discussion.

Dr. Rosa contended that the voltage of the Weston cell should be defined and fixed; and that, since some uncertainty must be permitted in the value of its voltage or in the value of the electrochemical equivalent of silver, it should be in the latter, as it was infrequently used, and would therefore be of minor importance. He objected to the silver voltameter because it is not permanent; it only lasts so long as the current flows. It is not a concrete standard like the cell, and it is not portable. It is laborious in practice, and it determines electric quantity and not current. Regarding the choice between Clark and Weston cells, it was possible that the Clark cell was the more stable.

Dr. Warburg thought that mercurous sulphate, which is used as the depolariser in Weston cells, could not be well defined, and that many cells gave abnormal results because of this. In fact, mercurous sulphate had been so much studied during the past three years that the Weston cell of to-day was a new one. He agreed entirely with the views expressed by Dr. Glazebrook.

In the further course of the discussion the following table of results for the E.M.F. of the Weston cell was submitted for consideration [1]:—

E.M.F. of Weston Normal Cell at 20° C.

National Bureau of Standards...	1·01847 *v.* (first batch of cells) 1·01853 *v.* (second ,, ,,)
National Physical Laboratory ...	1·0182 *v.*
Laboratoire Central d'Électricité	1·0187 *v.*
Lippmann and Guillet	1·01825 *v.* (first group) 1·01819 *v.* (second ,,)

Any uncertainty in the value of the resistance in international ohms would, it was pointed out, naturally affect these values. Ultimately the resolution in favour of the ampere was carried by 19 votes to 4.

Considerable discussion took place on resolution 7, the definition of the second primary unit—the ampere. Some of the delegates wished the ampere to be defined as the unvarying current depositing silver at the rate of 0·001118 gram per second; other delegates desired 0·00111800, that is, they wished the ampere to be so defined that comparisons could be made within one part in 100,000. The delegates from the United States, Dr. Weber (Switzerland), and some others desired that the international ampere should agree as closely as possible with the ampere (10^{-1} C.G.S.). The values suggested were 0·00111820 or 0·00111825.

After some preliminary discussion at which this divergence of view was made clear, the question of the exact number to be inserted in resolution 7, defining the ampere, was referred to the Technical Committee, and discussed by them at a long sitting. The suggestion was made that in the resolution the conference should be content to stop at the 8, but that in the specification or in the notes a statement should be made as to the figures to follow the 8 in measurements of precision, and this was at first accepted. When, however, an attempt was made to settle what these figures should be, agreement could not be reached, and ultimately it was arranged to report the various votes which had been taken in committee to the full sitting. Thus, when the conference took up the question again, resolution 7, defining the ampere as the current depositing 0·00111800 gram of silver per second, was still before them. In the discussion which ensued, Dr. Glazebrook, who moved the adoption of resolution 7, urged that as the object of the conference was to secure uniformity of international measurements to a high degree of precision, measurements of current to five or six figures at least were wanted, and that it appeared that our units must be defined to five or six figures. While the value chosen should approach the absolute C.G.S. value closely he did not think it essential to get as close as possible to this value. In the case of the ohm, 00 had been added to the 106·3 cm., and for consistency two more figures must be added after the 8 for the electrochemical equivalent of silver. He would prefer to add 00. If, in the future, it seemed possible to revert to the absolute units, the two standards might be changed together, but so long as the ohm could not be defined closely in terms of the C.G.S. system there was no real necessity to define the ampere closely.

Prof. Lippmann proposed that the international ampere shoud be defined as being equal to the ampere based on the C.G.S. system, but this proposal was not accepted. Mr. Trotter thought that nothing should be added after the 8.

Ultimately resolution 7 was carried in its original form by 21 votes to 3.

The question was again raised when the final report was submitted for approval. Dr. Carhart stated that the chief argument which had been brought forward in favour of the ampere as the second primary unit was the reproducibility of the silver voltameter and the concordant results obtained in determinations of the electrochemical equivalent of silver in different countries. Since that discussion, Dr. Rosa had received a cablegram from Washington stating that the value of the electrochemical equivalent of silver obtained with the aid of a current balance at the Bureau of Standards was 0·00111182, agreeing very closely with the last five determinations. Surely, if anything was to be added after the 8, the figures should be 20.

The majority of the delegates appeared to be, however, of opinion that the change in the equivalent should be made, if at all, at the same time as the change in the length of the mercury column, and in consequence the original decision of the conference was confirmed by a majority of 13 votes to 8, three countries not voting.

Specifications relating to mercury standards of resistance and to the deposition of silver were approved by the conference and included in Schedule B, while the duty of drawing up, as an appendix to the report, a series of notes to the specifications, and planning more fully the methods to be adopted to realise the units, was assigned to a scientific committee nominated by the president.

In cases in which it is not desired to set up the standards provided in the resolutions in Schedule B, the conference recommends the following as working methods for the realisation of the international ohm, the international ampere, and the international volt.

(1) *For the International Ohm.*

The use of copies, constructed of suitable material and of suitable form and verified from time to time, of the international ohm, its multiples and submultiples.

(2) *For the International Ampere.*

(*a*) The measurement of current by the aid of a current balance standardised by comparison with a silver voltameter; or

(*b*) The use of a Weston normal cell whose electromotive force has been determined in terms of the international ohm and international ampere, and of a resistance of known value in international ohms.

(3) *For the International Volt.*

(*a*) A comparison with the difference of electrical potential between the ends of a coil of resistance of known value in international ohms, when carrying a current of known value in international amperes; or

(*b*) The use of a Weston normal cell whose electromotive force has been determined in terms of the international ohm and the international ampere.

Steps necessary to secure Uniformity of Standards in the Future.

The conference expressed a wish that some permanent steps for securing uniformity of standards in the future should be taken, and for such a purpose recommended the

[1] To this table must be added the results just obtained by M. Pellat, which gave the value 1·0184.

establishment of a permanent International Commission for Electrical Standards. Pending the appointment of this commission, Lord Rayleigh nominated a scientific committee of fifteen to advise as to the organisation of the commission and to formulate a plan to direct such work as may be necessary in connection with electrical standards all over the world. In order to facilitate this work, various standardising laboratories will be asked to cooperate with the commission, and to carry out, if possible, such work as it may desire. The question was discussed of enlarging the functions of the International Conference on Weights and Measures, so as to combine with it in future electrical conferences, and the opinion of the conference was favourable to such a combination.

It is hoped that the scientific committee will from time to time modify the notes accompanying the specifications as may be necessary, and that this will conduce to greater uniformity between the standards of the various countries.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

THE meeting of the anthropological section of the British Association was amongst the most successful that has been held in recent years. The address of the president, Prof. Ridgeway, which has been reported in full in NATURE, has already led to considerable discussion and promises to have a good effect, and the meeting, so happily inaugurated, has been fruitful of much good work. As has been noticeable for some time past, papers upon archæological subjects were by far the most numerous. It is to be regretted that the communications in physical anthropology, although of exceptional interest, were hardly so numerous as those interested in the welfare of the section would wish to see. It is to be feared that there is a tendency among physical anthropologists to submit the results of their work to bodies other than the association—a matter for regret in view both of the importance of this branch of the study of man and of the interest in the subject taken by the ordinary members of the association, as shown by the size of the audience usually attracted by such papers.

The papers on physical anthropology included an important communication by Prof. Symington, on certain changes in the lateral wall of the cranium due to muscular development. Observations were made upon the relation of the temporal muscle to the skull and brain from birth until adult life, and it was demonstrated that at birth the muscle was small compared with the brain case, and that consequently the temporal ridge was low at this period of life. After birth the muscle grows more rapidly than the lateral area of the skull, and gradually extends upon it, so that the temporal ridge reaches a much higher level than in the infant. This extension proceeds gradually, and is associated with that of the jaws and teeth, being independent of that of the brain.

In his paper on the significance of the so-called accessory dental masses sometimes found in the upper jaw-bones, Prof. Francis Dixon, from an examination of a series of young Ibo skulls, came to the conclusion that these masses do not represent the rudiments of aborted or vestigial molars, corresponding to the third premolars of the platyrrhine apes, but arise as unabsorbed portions of the second milk molar. It is an interesting question why these fragments are so frequently retained in certain races.

An important contribution to our knowledge of the Egyptian races was made by Prof. Elliot Smith in his paper on anthropological work in Egypt. In his opinion the present population is remarkably uniform, the range of variation being not appreciably greater than that of any other known race. The infusion of negro blood is very small in amount, and its effect is usually slighter than is commonly supposed to be the case. The negro influence is least marked in pre-dynastic times. In Nubia, which was always open to raids from the south, there is a much more marked negro element, and the population of this district may be said to be a hybrid one. There is also evidence of a Levantine element in the Delta as early as the time of the Pyramid builders. The Copts show the least resemblance to the ancient Egyptians, owing to intermarriage with immigrants of their own faith.

Other physical papers were one on the adult brain, by Prof. A. Fraser; the report of the Cretan Committee, which published a preliminary statement on Mr. Hawes's examination of the crania; and that of the Anthropometric Committee, which published a report giving the result of its deliberations for the last seven years.

Another paper, by Prof. Elliot Smith, on the history of mummification in Egypt, may be mentioned here. After showing how in pre-dynastic times the custom of burying bodies in the sand led to their preservation, the author suggested that the idea of preserving their dead by art must have occurred to the Egyptians by observing this phenomenon, more especially as the later custom of burying in coffins or rock-cut chambers led to the bodies' dissolution. The desire was, of course, prompted by religious beliefs. When exactly embalming was first attempted there were no data to show. Although the earliest bodies known to have been embalmed are of the tenth dynasty, there is some evidence to show that the custom was practised by the Pyramid builders. The process of mummification reached its highest development under the New Empire, although under the Middle Empire the general technique was that which was followed for the succeeding two thousand years. Further stages in the art were followed by a period of rapid decline.

An important paper on Rajputs and Mahrattas was contributed by Mr. Crooke, who criticised the views of Sir Herbert Risley on the origin of these peoples. On the evidence of anthropometry, the Rajputs have been classed as Indo-Aryans, but the evidence rather points to the conclusion that they are a status group, compounded from varied elements, and not an ethnical unit. The Mahrattas similarly are a status group, the basis being the Dravidian or indigenous Kunbi tribe. It was suggested that the uniformity which characterises the physical character of the peoples of the Punjab might be due to sexual selection and the influence of environment, which have to some extent been overlooked by ethnologists.

Dr. C. G. Seligmann gave an account of his recent expedition to the Veddas of Ceylon, who may be divided into three divisions, Veddas, village Veddas, and coast Veddas, characterised by different sociological features. The coast Veddas have borrowed largely from the Tamils, and the village Veddas have intermarried with the Sinhalese, but in spite of this the clan organisation of the wild Veddas largely remains. There is hardly any decorative art. Their cult of the dead has given rise to pantomimic dances, which are performed chiefly by men trained to invoke the spirits. In language the Veddas speak Sinhalese or Sinhalese dialects with the addition of a few words not obviously Sinhalese.

A collection of Dinka laws, made by Captain O'Sullivan, was read by Mr. E. Sidney Hartland. The Dinka government is patriarchal with male descent. An interesting custom is the legal fiction by which an heir is provided when the male line has died out.

The archæological papers were of a very varied character, but naturally a considerable part of the section's work consisted in discussing Irish antiquities, and here the section was at the advantage of meeting next door to the National Museum where the Irish collections are displayed, and Mr. Coffey and Mr. Armstrong, the keeper and chief assistant of the Department of Irish Antiquities, were assiduous in their efforts in showing members the magnificent collections which are in their charge. The section, moreover, was fortunate in hearing papers from both these gentlemen on subjects which they have made their own.

Thus Mr. Coffey presented three papers. The first, on the distribution of the gold *lunulae*, showed that whereas in Ireland sixty of these characteristic Irish ornaments had been found, only eighteen had been discovered in Great Britain and the rest of western Europe. This distribution points either to early raids on Ireland from the Continent or to an early trade for gold. The *lunulae* may be dated between 1200 B.C. and 1500 B.C. Another paper by Mr. Coffey was on the survival of La Tène ornament on some Celtic penannular brooches. These brooches may be safely dated at not later than 700 A.D., as there is a complete

absence of any interlaced ornament on them, and many La Tène elements survive in their decoration, some may even be earlier. They are all of bronze, but the enamels on them have disappeared. Finally, Mr. Coffey contributed a note on the Tara brooch which directed attention to a fact hitherto unobserved, namely, that the fine wires of the interlaced patterns, of the central interlacements and of the head of the pin have a minute granulation, which is not apparent to the naked eye.

Mr. Armstrong's paper directed attention to the recent discovery of a leather shield in co. Longford. The shield is made of a solid piece of leather about 20 inches in length and 19 inches across, and has an oblong central boss, which has been pressed out of the leather and furnished with a cap, composed of finer leather, laced on to the boss. The face of the shield is ornamented with three ribs, between which are small bosses arranged in sets of three, the decoration recalling that of the bronze shields. The back of the shield is furnished with a handle. That the specimen is not the leather lining of a bronze shield is clear from the thickness of the leather and the lacing of the boss. It is of the same type as the bronze shields of Western and Upper Europe.

The subject of earthworks was dealt with by Mr. Goddard Orpen in a paper on the origin of Irish motes, which he referred, on documentary and geographical evidence, not to the Celtic or Scandinavian invaders, but to the Normans, thus bringing the date of their erection down to the eleventh century A.D.

Another paper of considerable interest was Dr. Scharff's, on the Irish horse and its early history. The most complete remains of the horse found in Ireland were discovered in the Craigywarren Crannog, in Antrim. The occupation of this crannog dates back to early Christian times, and the horses were doubtless domesticated. These remains bore as striking a resemblance to the Arab type as does the modern Connemara pony. Other remains found indicate that at a more remote period a small race of horse, similar to those found in the Crannog, lived in Ireland, some of which remains probably belonged to a wild breed. It seems clear that the resemblance of the Connemara pony to the eastern and Libyan horse is not entirely due to human introduction of foreign stock, but to the fact that the wild horse of Ireland possessed the same characteristics, which it transmitted to the existing ancient domestic breeds.

In British prehistoric archæology several important papers were submitted. Miss Layard, whose work on the Ipswich Palæolithic site is well known, directed attention to an ancient land surface in that district, where flint implements have been discovered in association with bones of horse, deer, mammoth, *Bos primigenius*, wolf, and bear. The remains were 30 feet below the present surface. She also directed attention to a new Palæolithic site in the valley of the Lark, where rough palæoliths and a large number of flint cores have been found.

Mr. J. Gray, in a paper on Who built the British stone circles? reported the discovery of the remains of a unique race recently discovered associated with short cists in Aberdeenshire. This race, which is of the early Bronze age, is different from any other known prehistoric race in Britain, Sweden, Denmark, and Switzerland, but there are indications of affinity with the ancient peoples of south-west Asia.

In a paper on cup and ring markings, the Rev. H. J. Dukinfield Astley sought to connect these markings with the designs on the churinga of the Arunta, and suggested that they were totemistic.

A paper by Mr. G. Clinch, suggesting a system of classification of Megalithic remains, and the report of the committee appointed to consider this subject, led to an interesting discussion, in which the president, Mr. Acland, and Mr. Swift MacNeill took part. The general consensus of opinion was that the preservation of ancient monuments should be made compulsory and not merely permissive, and that the inspector of ancient monuments should be an active official with wide powers. It was further suggested that a short private Bill might be introduced into Parliament.

The report of the Glastonbury Lake Village Committee directed attention to the discovery of two other villages at Meare, on which tentative excavations had been made with promising results, while that on the age of stone circles reported that excavations had been begun on the ditch at Avebury, in which were discovered a good stratification of pottery, from Mediæval to Bronze-age types, and deer-horn picks, recalling those of Grime's Graves and Cissbury. These relics tend to confirm the theory that the Avebury circle is of the Neolithic or early Bronze-age period, but this can hardly be said to be proved by the present excavation.

Roman remains in Britain again occupied a considerable part of the section's proceedings. Dr. Ashby again gave an account of the excavations at Caerwent which have resulted in the exploration of the basilica and forum, which corresponds closely to that at Silchester. Dr. Newstead described the portion of Roman wall recently found at Chester. It is of ashlar, backed by rubble, with a solid bank of stiff clayey loam behind. The fosse was also excavated in two places. It was not of the usual V-shape, but was broad at the bottom. The finds were numerous, including portions of pottery, fragments of tiles, bones of animals, and coins. A fine flint axe of Palæolithic type was also discovered, as well as the remains of a quern and some spindle whorls.

Prof. J. L. Myres gave a general account of the work of the Liverpool Committee for Excavation and Research in Wales and the Marches. The last season has been occupied with a preliminary survey of a few districts of Wales, and with tentative excavations on sites which seem likely to deserve more thorough examination. Such was the excavation at Caerleon, an account of which was presented by Mr. H. G. Evelyn White. Its chief importance lay in the recovery of the ground plan of the interior arrangements of the camp.

As is usual, many papers dealing with non-British archæology were presented. Among these, one of the most interesting was Mr. J. P. Droop's, on Neolithic culture in north Greece. One of these Neolithic settlements can be roughly dated to 1300 B.C. by the presence of Mycenæan sherds. Subsequently there was a poor Bronze period. The discovery is therefore of the utmost importance, as it shows that, while the bronze culture of the Ægean was being developed, peoples in the north of Greece were still in the Stone age and used bronze comparatively late, and then, presumably, only for a short period before the introduction of iron.

The excavations on the site of the sanctuary of Artemis Orthia at Sparta were described by Mr. M. S. Thompson. The chief find of the year was the remains of a primitive temple of a date contemporary with the great archaic altar. It seems clear that this had a gable roof with a row of pillars supporting the roof tree, similar to the temple of Thermos in Ætolia. In this primitive building may be seen the earliest Dorian style. Many votive offerings were found on the site, as well as a further number of the terra-cotta masks. The so-called Cyrenaic pottery has been proved to be Laconian, as had already been suggested.

An account of the four principal aqueducts of the city of Rome was given by Dr. T. Ashby. Considerable remains of these conduits still exist. Their course between Gallicano and a point seven miles from Rome, where they run upon arches into the city, has hitherto been treated as unknown, but has now been determined accurately, chiefly by making a search for the pieces of calcareous deposit brought down by the water, which was removed from the channels when they were cleaned. Dr. Ashby also gave an account of the work carried out in Sardinia by Dr. Mackenzie and himself. Their researches were devoted to determining the relations between the nuraghi and the so-called tombs of the giants—the latter consisting of long chambers with a circular area, enclosed by upright slabs or by walling in front of them. It seemed clear that the two were in very close relation, the former being the fortified habitation and the latter the family tomb.

The section was peculiarly fortunate in having a paper presented by Dr. Haakon Schetelig, the director of the Bergen Museum. Dr. Schetelig took as his subject the sculptured stones of Norway and their relations to some British monuments. The symbols on these monuments,

for example, the comb, serpent, crescent, and radiated sun-disc, are also found on the early Christian monuments of Scotland, and seem to point to direct communication between Scotland and western Europe about 700 A.D. A sculptured stone from Tu, in Jaederen, with a runic inscription of the peculiar character found on the Norwegian crosses in the Isle of Man, possibly points to an influence from that island.

On non-European archæology four papers were presented. Mr. C. T. Currelly, in a sequence of Egyptian stone implements, considered that the development of the Thebaid palæoliths could be traced from the depth of the patina and from the scratchings. The Neolithic implements of the Thebaid, on the other hand, show little patination, though the length of the Neolithic period may be traced from the fact that unpatinated neoliths have been made by re-working patinated ones.

The Rev. W. A. Adams, in a paper on some ancient stone implement sites in South Africa, recorded the discovery of implements of Palæolithic type from five districts, the hill slope near Bosman's Crossing, Stellenbosch, the Karoo and the Vaal River terraces, near Kimberley, the Rhodesian uplands near Bulawayo, and the headlands of the Victoria Falls.

An interesting paper on prehistoric archæology in Japan was presented by Dr. Gordon Munro, in which considerable light was thrown on the question of the immigrations to the country from the mainland. Many Japanese archæologists deny the fact that the primitive inhabitants of Japan were of the same stock as the existing Ainu, but the discovery of Ainu remains in the shell-heaps proves that this people played a part in the Neolithic culture, and the excavations have revealed a connection between the pottery of this phase and that of the iron culture which accompanied the agricultural invaders from Asia. The progress of these invaders towards the east and north was slow, and may have begun about five centuries B.C., or even earlier. No undoubted Palæolithic remains were found, but the resemblance of the culture to that of other lands agrees with the general verdict of prehistoric intercommunication.

Finally, the Rev. Dr. Bryce, of Winnipeg, read a paper on the mound builders of North America, which was of peculiar interest in view of the association meeting in Winnipeg next year. An examination of a large number of these mounds led the author to conclude that they were built by the Toltecs, and that they mark the course of a Toltec immigration from the south along the Mississippi and Ohio to the Great Lakes and the St. Lawrence; along the Missouri; and along the Mississippi proper to the Rainy and Red rivers. This would make the earliest mound date from about 1100 A.D.

In conclusion, it should be mentioned that the success which attended the meeting was in a very great measure due to the kindness and energy of Mr. Laurence Steele, the section's local secretary.

LOCAL SCIENTIFIC SOCIETIES AT THE BRITISH ASSOCIATION.

DURING the Dublin meeting of the British Association the conference of delegates held two meetings under the chairmanship of Prof. H. A. Miers, F.R.S. At the opening meeting, held on September 3, the chairman read an address on the educational opportunities of local scientific societies. In this he reviewed the growth of such bodies, some of which dated back nearly a hundred years. In these cases they did pioneer work, and helped to create a general scientific atmosphere. With the birth of the British Association, which, he said, might be regarded as a magnified society of the same character changing its yearly habitat, a great stimulus was supplied, as at that time scientific work was supplemented in a very inadequate manner by the publishers and the Press. After this date the growth of local scientific societies and cheap elementary text-books, which stimulated a desire for sound knowledge, was very rapid. Gradually, however, the early manuals, containing perhaps a whole science, have been supplanted by the educational text-book used in schools and the specialist treatise for the advanced student. Thus the amateur nowadays is almost in danger of being placed in the position of his predecessor of sixty-five years ago. He has no time to go through a course of special reading in text-books of various grades, and without that, although perhaps quite learned in one branch of science, can get no adequate insight into modern advances through needless technicalities and their expression in a language which he cannot understand.

The same is the case with the greater scientific societies—they are becoming every day more highly specialised, both in their publications and in their membership. Here is the opening for the local scientific society, but only if it really attempts to meet the wants of the intelligent amateur. It is all very well to make arrangements for sections to take up the local flora and fauna, but what is wanted in addition is some common ground by which all the members can be united by their general interest in science, combined with some educational help to those to whom science is chiefly a hobby and a relaxation. One of the most useful functions of a body like a local society is to encourage a habit of expressing scientific result in simple and intelligible language that will appeal to the whole society. Indeed, nothing can be better or more useful for the scientific specialist himself than to attempt to explain his own work in simple language to a mixed audience. The set lecture is not so much needed, but the description by a speaker of what he has done or seen himself. In a local society no better material for educational improvement should exist where the members have joined it voluntarily, and, in the first instance, because they really wished to learn. In addition to this nothing is more wanted at the present day than books giving simple, untechnical accounts of the living work by the worker himself, and this should be done, not only in the newest fields of science, the popularisation of which is liable to be overdone, but in the more ordinary work of everyday science, which results in discoveries perhaps equally momentous, but at present buried beyond the reach of the amateur.

The educational work that the local societies can best perform through its members, who, though not children, have unprepared minds, is the encouragement of original research. This could be done, first, by inviting the trained and experienced workers to make known to them, through the medium of untechnical language, the beauty and interest of scientific work in the course of its progress, and of scientific discovery in the making; and, secondly, by providing them with followers who will continue to prosecute under their guidance original observation and even experimental research. Enthusiasm has been instilled and sincere students produced by the university extension movements; let the local societies initiate a new science extension movement by which the barrier between the professional man of science and the amateur, between the expert and the layman, will be broken down.

After discussion and votes of thanks, Sir Edward Brabrook proposed that "the conference desires to represent to the committee of recommendations that whenever a committee of the British Association enters upon a local investigation, notice should be given to any local scientific or archæological society so as to enable that society to offer any cooperation that may be desirable." This, having been seconded by the Rev. J. O. Bevan, was carried unanimously.

Mrs. Mary Hobson then read a paper on sanctuaries for our native flora and fauna, in which she discussed various schemes for obtaining, or getting public bodies to set aside, waste land as sanctuaries, instancing that in Ireland already such places existed as Lambay Island, protected by the Hon. Cecil Baring; at Glencar, co. Sligo, on land owned by the Wynne family; at Knocknarae Glen, in the same county, where the hartstongue ferns have the longest fronds in Britain, upwards of a yard in length; and, finally, at Clonbrock Forest, in Galway, where Lord Clonbrock has a sanctuary which has been undisturbed since Elizabethan times. She also animadverted especially on the destructive spirit of collecting rare birds and chance migrants, not to speak of other things. That was not the way to advance knowledge, which was, however, fostered by the study of birds in their native haunts.

In the discussion on this paper several delegates took part. Mr. W. M. Webb, of the Selborne Society, gave some particulars about a sanctuary in which his society was interested. He also agreed that private collecting, if done at all, should be started with the idea of benefiting the many instead of the few. Mr. William Gray, of the Belfast Naturalists' Field Club, spoke as to the destruction by collectors of the eggs of rare birds, which would breed if they were not disturbed, and how last season the club, through providing a watcher, had been successful in the case of a previously much harried species. Mr. J. Hopkinson mentioned that public bodies sometimes were gross offenders in their demands for large numbers of some rare plant from a local habitat, while the Rev. Ashington Bullen spoke as to the scarcity or extinction in certain haunts of species that were formerly plentiful. Mr. Harold Wager thought that the local societies could do much by encouraging a more scientific attitude towards collecting and by inducing a study of the habits and life-histories of the living organism in the field.

The second meeting of the conference of delegates was held on September 8, and was presided over, in the absence of Prof. Miers, by Prof. Grenville A. J. Cole, vice-chairman. At this meeting Prof. G. H. Carpenter introduced the subject of detailed natural-history surveys of restricted areas, an important work suitable for local societies. In his remarks he described the researches lately carried out into the natural history of the island of Lambay, off the coast of co. Dublin, and what was being done at the present time on the North Bull, a grass-covered sandbank in Dublin Bay, known to be less than a century old. Prof. Carpenter urged the importance of the study of such restricted areas as likely to help in the solution of many geographical problems. Several delegates having spoken, Mr. Frederick Long, of the Norfolk and Norwich Naturalists' Society, directed attention to the fact that a few years ago Mr. Robert Gurney established a small laboratory on Sutton Broad, in Norfolk, for the use of anyone wishing to prosecute research work in that area.

Mr. Henry Davey then read his paper on the advisability of re-stocking haunts whence fauna and flora have disappeared. His main contention was that in the case of many of the rarer Lepidoptera, with which alone he was thoroughly familiar, their disappearance or extinction was not so much due to man, but to natural causes, the reason of which in most cases had not yet been discovered. He instanced the case of the large copper, which disappeared in one locality through man, but in the other from no such cause, although he mentioned that a great fen-fire had been blamed. As for the growing rarity of many species, he thought that much destruction was caused by the ease with which the present-day collector was able to get about, but, speaking of the large blue—*Lycaena arion*—which had been killed off in most of its localities, he said that while collectors had caused its extinction at Barnwell Wold, its favourite habitat, it had also disappeared from another resort in Northamptonshire to which the public had no access. Of this insect also he mentioned Mr. Frohawk's discovery in 1903, at its breeding ground in Cornwall, of the caterpillars living on thyme growing on or near ant hills, into which the full-grown larvæ descended so that the ants might remove a secretion which seemed deleterious to their health. As to re-stocking, he considered that it was of little value in the present state of our knowledge. The swallow-tailed butterfly, which in England is now restricted to a small area in the fens, from his observation on the Continent seemed to flourish among or near wooded hills, and never in the flats. However, no success resulted from the attempt to establish it on a large scale in the Peak of Derbyshire and in Devonshire.

Again, an insect which may be far from rare, in certain spots favours such a small area that it may be measured by yards, notably a locality in Sussex, where the marbled white is extremely common in a tract about eighty yards square. Again, in the case of the clouded yellows, in some years the two species may be exceedingly abundant; in the intermediate time not a specimen is to be seen. In such a case re-stocking would be of no use, while the disappearance of the insects has not been caused by man. Finally, Mr. Davey considered that, on the whole, the experiment of re-stocking former haunts was worth the attempt, although from what he had mentioned success was not assured. Such work ought to be undertaken, however, in a scientific spirit, and exact records should be kept. It was also highly desirable that the re-stocking should be tried in two places at the same time a few miles apart, and that individuals should be brought from different localities to avoid, so far as possible, the danger of in-breeding.

Prof. Carpenter during the discussion directed attention to the fact that the species that tended to become extinct were those of commercial value, while Prof. Cole thought that stocking localities with species that had not previously lived there would nullify much of the work on their natural distribution. Under the head of the introduction of insects to localities where they had become extinct or were becoming scarce, Mr. W. P. Stebbing directed attention to what was being done by Mr. Henry Preston, of Grantham. He had collected a large number of the caterpillars of the Peacock butterfly from clumps of nettles, which were always destroyed by the farmers before the insects were full grown, had kept them until they turned into chrysalises, and then on emerging as perfect insects had turned them loose in seemingly suitable spots.

Arising out of the previous papers, the Rev. J. O. Bevan brought forward the following resolution:—"That this Conference of Delegates of Corresponding Societies affirms the desirability of bringing under the notice of local societies the necessity for preserving the fauna and flora of their respective districts as against wanton destruction or careless and needless collecting." This was seconded by Mrs. Hobson, and carried unanimously.

At the close of the meeting Mr. F. A. Bellamy (Ashmolean Natural History Society of Oxfordshire), who had had his notes printed as a paper for distribution to the meeting, exhibited his method for the permanent recording of natural history or other observations by means of the card-catalogue system. In explaining the value to workers of such a catalogue, he said that care was needed when outlining such a scheme so that it would retain its usefulness whatever the size. He also gave an estimate of the cost of one unit (tray, cards, and cover) of the catalogue.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—At the annual general meeting of the Philosophical Society, held on October 26, Prof. Sedgwick was elected president of the society.

It is proposed to confer the degree of Master of Arts, *honoris causa*, upon Prof. W. J. Pope, F.R.S., professor of chemistry, and upon Mr. K. J. J. Mackenzie, lecturer in agriculture.

Mr. R. C. Punnett has been appointed demonstrator of animal morphology for the year ending Michaelmas, 1909, and Mr. F. H. Potts demonstrator of comparative anatomy.

LONDON.—Prof. E. A. Minchin will represent the University at the Darwin centenary celebration at Cambridge next June.

At the meeting of the Senate on October 21 the degree of D.Sc. was granted to David Forsyth, of Guy's Hospital, as an internal student, for a thesis entitled "The Parathyroid Glands"; to Samuel J. M. Auld, of East London College, as an internal student, for a thesis entitled "The Hydrolysis of Amygdalin by Emulsin"; to Henry Bassett, an external student, for a thesis entitled "Contributions to the Study of the Calcium Phosphates"; and the degree of B.Sc. by research to Joseph Yates, Municipal Technical School, Blackburn, an external student, for research work in organic chemistry.

A university course of eight lectures on "Some Problems of General Physiology, more Particularly those Associated with Muscle," was commenced by Dr. F. S. Locke, in the physiology laboratory of the University, on October 20. A university course of three lectures by Mr. R. Lyddeker, F.R.S., on "The Living and Extinct Faunas of Africa and South America," commenced on October 28 at University College. A university course of eight lectures

on "Algal Flagellates," by Dr. F. E. Fritsch, commenced at University College on October 26. Admission to these lectures is free to the public.

OXFORD.—Prof. C. F. Jenkin, professor of engineering in the University, delivered his inaugural address on October 16. No teaching, he said, is sufficient to fit a man for an engineer's various duties. The scientific theory of engineering can be taught, but the no less necessary experience must be gained outside the university. Prof. Jenkin described the teaching of engineering, showing that while the subjects are familiar, the engineering method of teaching differs somewhat from the traditional method. He advocated the use of examples chosen from apparatus which the student can handle rather than from the imaginary astronomical bodies often used to illustrate dynamical principles. In the Oxford laboratory the art of measurement will be taught. It will not be a model shop, but a shop may be used in conjunction with the laboratory for repairing and adjusting apparatus. It is also intended to have surveying classes during the vacation. Prof. Jenkin also explained the details of the scheme which has been prepared for carrying out engineering teaching in Oxford. It is intended that engineering students shall take the science preliminary examination and then proceed to a final honour school in engineering. The necessity for having a final honour school for the student to work for was urged, and there is every reason to believe that the scheme now being prepared will be received favourably, and thus open academic honours to engineers.

The Right Hon. A. J. Balfour, F.R.S., M.P., has been nominated by the Vice-Chancellor to deliver the Romanes lecture next year.

Dr. A. J. Evans, F.R.S., will resign the keepership of the Ashmolean Museum at the end of this year.

WE have received from Prof. W. S. Franklin, of Lehigh University, a copy of the address he delivered at the annual meeting of the New York State Science Teachers' Association last year on the study of science by young people. In it he stigmatises as one of the greatest evils of present-day teaching of science the large proportion of time devoted to problems more or less completely detached from actual physical experience. He believes that the only quantitative physical laboratory work which should be done in a secondary school should relate to things of which the boy has knowledge in his everyday life outside the laboratory, and should be of practical value in that life. Thus, *e.g.*, he would let a boy determine the speed of a runner by observing the time he takes to cover a measured distance, or the power he develops by the time he takes to climb a measured flight of stairs. He would set him to determine the discharge of water along a canal by timing a float from one station to another, and encourage him to measure the rainfall, record temperature, wind and cloud, and get together a great variety of similar data of practical everyday value.

THE Association of Teachers in Technical Institutions has forwarded to the Board of Education a memorandum directing attention to the conditions under which Whitworth scholarships and exhibitions are awarded. The council of the association has, after extensive inquiries, been led to the conclusion that the competitions at present are not in full accord with modern requirements of engineering study and training, and it has, in consequence, drawn up proposals for the modification of the methods of award. The objects of the proposals are to prevent cram and to provide systematic training, to give preference to engineering subjects, to encourage regular workshop practice in engineering over a period of thirty-six months, and to ensure greater prominence for study and practice in electrical engineering. Among other changes suggested are the introduction of a qualifying test, the holding of a special freehand drawing examination, the division of subjects into two groups and a new scale of marks, and the deletion of building construction and drawing and naval architecture from the list of subjects candidates may offer, as not strictly belonging to mechanical engineering. The annual general meeting of the association will be held at the St. Bride's Institute, Bride Lane, Fleet Street, E.C., on Saturday, November 7, commencing at 3 p.m.

THE *Physikalische Zeitschrift* for October 15 contains a list of the lectures in mathematics, physics, and chemistry which are to be delivered during the coming winter session at the various universities and technical high schools of Germany and Austria. At the University of Berlin each of the above subjects is divided into ten or a dozen parts, and each part is placed under the charge of a separate professor or lecturer, who gives four or five lectures per week. Physics, for example, is divided into (*a*) experimental physics: (1) mechanics, sound, and heat; (2) magnetism and electricity; (*b*) theoretical physics: (3) introduction; (4) heat; (5) magnetism and electricity; (6) advanced portions; (7) vector analysis applied to physics; (8) potential theory; (*c*) (9) geophysics; (10) climatology. Under such a system it is possible for each lecturer to present his subject to his students in a much more complete and up-to-date manner than is possible in, let us say, the University of London, the professors of physics of which lecture probably twice as often per week and cover the whole subject in their lectures. Who in these circumstances can blame the post-graduate student who elects to go to Germany to complete his knowledge of his subject? and who can refrain from asking, when will the universities of this country be in a position to attract post-graduate students from Germany in return?

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 19.—M. Bouchard in the chair.—Precipitated silica: Henry **Le Chatelier.** The existence of hydrated forms of silica appears to be generally admitted, but this view does not appear to have any experimental basis. Various experiments with gelatinous silica are described, all tending to prove that silica exists always in the anhydrous state. The passage through filters is not due to the solubility of anhydrous silica or the presence of a soluble hydrate, but is due to its extremely fine state of division. In confirmation of this, it was found that silica jelly could be used for polishing metal sections.—The influence of the heating of urine on urinary toxicity: Ch. **Bouchard,** M. **Balthazard,** and Jean **Camus.** After heating urine to temperatures of 57° C. or above, the toxic power is diminished by one-third, as measured by experiments on rabbits. The freezing point of the urine is not affected by this heating.—The action of Saturn's ring: P. **Stroobant.**—The spectrum of Morehouse's comet, 1908*c*: A de la Baume **Pluvinel** and F. **Baldet.** A comparison of the spectra of the Daniel and Morehouse comets. The latter gives no trace of a continuous spectrum; the photograph shows seven monochromatic images of the comet, the wave-lengths of which are given.—Some properties of curved surfaces: A. **Demoulin.**—Directed waves in wireless telegraphy: A. **Blondel.** Referring to recent papers on this subject by MM. Tosi and Bellini, and by M. Turpain, the author points out that he dealt with this subject in a similar manner in 1903.—The electrolytic soda industry: André **Brochet.** A theoretical discussion of the electrolytic cell through which the electrolyte is flowing in a stream with a velocity equal to or greater than the velocity of the OH ions.—A new method of attacking iron alloys, and, in particular, the ferrosilicons: Paul **Nicolardot.** Chloride of sulphur is the reagent suggested for the solution of ferrosilicons or ferrotitaniums. Details are given of the method proposed, which is specially arranged to avoid loss of silicon.—The phenyl transposition. The migration of the naphthyl group in the iodohydrins of the naphthalene series: MM. **Tiffeneau** and **Daudel.** The migration of groups caused by the addition of hypoiodous acid and subsequent removal of hydriodic acid has been found to occur in the naphthalene series in a manner quite analogous to that previously described for the benzene series. Descriptions are given of the preparation and properties of α-allylnaphthalene, its isomer, propenylnaphthalene, α-naphthyl-α-propanal, methyl-α-naphthylacetic acid, α-pseudoallylnaphthalene, α-vinylnaphthalene, and α-naphthylethanal.—A modification of the preparation of methylamine by means of bromacetamide: Maurice **François.** It has been found advantageous to modify the original Hoffman method in several details.

The yield is increased from 35 per cent. to 72 per cent. of the theoretical, and the methylamine hydrochloride is obtained pure and free from ammonium chloride.—The study of colouring matters in solution: L. **Pelet-Jolivet** and A. **Wild.** Colouring matters exist in a state of electrolytic dissociation; some of them are partly in the colloidal state, as was shown by their behaviour in the ultramicroscope. The properties of colouring matters are intermediate between ordinary saline solutions and colloidal solutions.—Saprophytic cultures of *Cuscuta monogyna*: Marin **Molliard.**—The Secamone of the north-west of Africa: Henri **Jumelle** and H. Perrier **de la Bathie.**—Pigmentary assimilation in Actinia: Georges **Bohn.**—The hereditary chromatic substratum and the nuclear combinations in the crossing of Amphibia: E. **Bataillon.**—The gradation and improvement of the instinct in the solitary wasps of Africa of the genus Synagris: E. **Roubaud.**—The affection known under the name of botryomycosis and its parasite: Gustave **Bureau** and Alphonse **Labbé.** This disease is not a mycosis, but is due to an amœba; the botryomyces observed in previous cases is only a plastogamic stage of this organism.—The protonephridia of the adult polychætal annelids: A. **Malaquin.**—The existing genera of the family of the brachypodides: A. **Menegaux.**—New researches on the radio-activity of springs producing goitre: M. **Répin.** All the goitre-producing waters of the Alps gave on examination a measurable radio-activity, due probably to radio-thorium.—The accelerative influence of magnesia in the transformation of saccharose: J. **Tribot.** Sucrase was prepared from yeast and purified by fractional precipitation with alcohol. It was found that the purer the product from mineral matter the smaller was the activity, as measured by the amount of sugar fermented in a given time. The mineral substance to which the activity would appear to be due is magnesia.—The ferment from the decapod Crustacea: C. **Gerber.** This ferment is distinguished from other animal ferments by its resistance to heat and by the special action of acids. Its properties approach those of the vegetable ferments.—The numerical determination of the urinary excretion of nitrogen in various forms in a normal man: L. C. **Maillard.**—The action of the products of the reaction on the saponification of fats by the pancreatic juice: Mlle. L. **Kalaboukoff** and Émile **Terroine.**—The tonality of the sound of percussion: Gabriel **Arthaud.**—The existence of a new deposit of pre-Pyrenean strata in the middle of the north Pyrenees sheets, in the neighbourhood of Arbas: Léon **Bertrand.**—The seismic disturbance of October 13, 1908: Alfred **Angot.** A discussion of the seismograph record at the Parc Saint-Maur Observatory.—The erosion of the Fontainebleau grits: E. A. **Martel.**—The presence of the genera Salvinia, Nymphæa, and Pontederia in the sparnacian clays of the Montois: P. H. **Fritel.**

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 30.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Repairs, Renewals, Deterioration and Depreciation of Workshop Plant and Machinery (*Resumed discussion*): J. E. Darbishire.

MONDAY, NOVEMBER 2.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Unexplored Western Asia: D. G. Hogarth.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Chemical Industry in Relation to Agriculture: Prof. Adolf Frank.

TUESDAY, NOVEMBER 3.

ZOOLOGICAL SOCIETY, at 8.30.—The Development of the Lesser Black-backed Gull, *Larus fuscus*, L.: Prof. Alexander Meek.—On Mammals from Inkerman, North Queensland, presented to the National Museum by Sir W. Ingram and the Hon John Forrest: Oldfield Thomas, F.R.S., and Guy Dollman.—(1) The Sze-chuen and Bhutan Takins: (2) On an Indian Dolphin and Porpoise: R. Lydekker, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Address by the President, Mr. J. C. Inglis.

WEDNESDAY, NOVEMBER 4.

ENTOMOLOGICAL SOCIETY, at 8.

GEOLOGICAL SOCIETY, at 8.—The Relations of the Nubian Sandstone and the Crystalline Rocks of Egypt: H. J. L. Beadnell.—On the Fossil Plants of the Waldershare and Fredville Series of the Kent Coalfield: E. A. Newell Arber.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Solvent Action of Carbonic Acid on the Carbonates of the Heavy Metals: C. Seyler.—The Analysis of Camphorated Oil for Camphor Substitutes: F. W. Richardson and W. K. Walton.—The Separation and Estimation of Certain Volatile Fatty Acids by Extraction with Benzene or Toluene: T. R. Hodgson.—The Estimation of Cocoanut Oil in Butter: R. Ross.

THURSDAY, NOVEMBER 5.

ROYAL SOCIETY, at 4.30.—*Probable Papers.* (1) Note on Tidal Bores; (2) Vortices in Oscillating Liquid: Lord Rayleigh, O.M., Pres. R.S.—Note on Two recently compiled Calendars of Papers of the period 1606–1806 in the Archives of the Royal Society: Prof. A. H. Church, F.R.S.—On the Osmotic Pressures of Aqueous Solutions of Calcium Ferrocyanide. Part I., Concentrated Solutions: Earl of Berkeley, F.R.S., E. G. J. Hartley, and C. V. Burton.—On the Generation of a Luminous Glow in an Exhausted Receiver moving near an Electrostatic Field, and the Action of a Magnetic Field on the Glow so produced, the Residual Gases being Oxygen, Hydrogen, Neon and Air: Rev. F. J. Jervis-Smith, F.R.S.—The Rate of Production of Helium from Radium: Sir James Dewar, F.R.S.—The Spectrum of Radium Emanation: A. T. Cameron and Sir William Ramsay, K.C.B., F.R.S.—On a Method of Comparing Mutual Inductance and Resistance by the Help of Two-phase Alternating Currents: A. Campbell.—The Effect of Pressure upon Arc Spectra. No. 2, Copper: W. G. Duffield.

CHEMICAL SOCIETY, at 8.30.—The Direct Union of Carbon and Hydrogen: W. A. Bone and H. F. Coward.—The Relation between Absorption Spectra and Chemical Constitution. Part XI., Some Aromatic Hydrocarbons: E. C. C. Baly and W. B. Tuck.—Organic Derivatives of Silicon. Part VII., Synthesis of *dl*-Sulphobenzylethylisobutylsilicyl Oxide: B. D. W. Luff and F. S. Kipping.—(1) Chlorine Derivatives of Pyridine. Part IX., Preparation and Orientation of the Dichlor pyridine, m. p. 66–70°; (2) Chlorine Derivatives of Pyridine. Part X., Orientation of the Trichloropyridine, m. p. 49–50°; (3) Chlorination of Methyl Derivatives of Pyridine. 2-Methyl pyridine. Part II.: W. J. Sell.—(1) The Triazo-group. Part V., Resolution of *a*-Triazopropionic acid; (2) The Triazo-group. Part VI., Triazoethyl Alcohol and Triazoacetaldehyde: M. O. Forster and H. E. Fierz.

LINNEAN SOCIETY, at 8.—Notes on some Parasitic Copepoda, with a Description of a New Species of *Chondracanthus*: May E. Bainbridge.—On some Nemerteans from the Eastern Indian Ocean: R. C. Punnett and C. Forster Cooper.—Report on the Echinoderms other than Holothurians collected by Mr. Stanley Gardiner in the Western Parts of the Indian Ocean: Prof. F. Jeffrey Bell.

RÖNTGEN SOCIETY, at 8.15.—Presidential Address, The Amsterdam Congress.

FRIDAY, NOVEMBER 6.

GEOLOGISTS' ASSOCIATION, at 8.—On some Norwegian Lakes and Rock-Basins: H. W. Monckton.

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