THURSDAY, NOVEMBER 15, 1906.

A CORPUS OF AUSTRALIAN MYTHS.

Mythes et Légendes d'Australie, Études d'Ethnographie et de Sociologie. By A. van Gennep. Pp. cxvi+188. (Paris: E. Guilmoto, 1906.) Price 10 francs.

WITH few exceptions the works on Australian aborigines are in English; the older ones are out of print, the newer ones exceedingly technical, demanding on the part of the reader some enthusiasm and a good deal of preliminary knowledge. M. van Gennep, therefore, has put before the French public a general survey of various controverted questions of Australian ethnography and sociology as a preface to the hundred and six myths and tales translated in the second portion of the volume before us.

The eight chapters of the introduction deal with somatology and culture, kinship and descent, the methods by which social modifications are introduced, aboriginal ideas as to conception and reincarnation, exoteric and esoteric doctrines with regard to the bull-roarer, the idea of magico-religious power, the relations of myth and rite, and the content of the myths. There are additional notes on the subject of Arunta primitiveness and on reincarnation and totemism.

In the somatological section the author emphasises the local differences both as regards indices, pigmentation, and hair character, finally inclining to the views of Spencer and Gillen that a second race with three lines of migration has been superposed on an older stock akin to the Tasmanians. M. van Gennep then passes on to discuss the various attempts to identify the culture of Australia with that of Palæolithic Europe, and to distinguish various cultural cycles corresponding to ethnical differences; he comes to the conclusion that Schoetensack's theories are not proven, the coincidence of cultural elements being rather due to similarity of conditions. The cultural areas of Frobenius and Graebner he dismisses as insufficiently evidenced, and vitiated by neglect of the influence of inter-tribal commerce.

The chapter on filiation is complicated by controversies with M. Durkheim on the one hand, Mr. Andrew Lang on the other; the author holds that modification of the rules of descent is due to the change of view on physiological questions; where the child belongs to the kinship group of the mother, little or no part in producing conception is assigned by the tribe in question to the father, and *vice versâ*. It seems a fatal objection to this view that whereas the Arunta are stated to have no idea of the importance of the male parent in this respect, they reckon descent of the intermarrying class through the father. How could this come about? Does M. van Gennep hold that they originally believed the child to be procreated by the father, and made the class rule fit in with this idea; that they subsequently modified their views on the mechanism of conception, and then adopted a new rule for the totem, retaining the old one for the class? This view seems to land us in considerable difficulties. A criticism of the views of M. Durkheim in this chapter contains an extraordinary misstatement; the Arunta have no rule that two persons of the same totem may not marry, just as they have no tabu of the totem animal; in reply to M. Durkheim's statement of this fact, M. van Gennep replies that the exogamic rule is strict among them. A more unfortunate lapse it is impossible to imagine. Apropos of the Arunta in particular, M. van Gennep propounds a theory of the origin of classes in opposition to the commonly accepted dichotomous hypothesis; he holds that they originated "by convergence"; but unfortunately we do not learn what this means, save that it is in some way connected with the binary system of numeration, which is almost universal in Australia.

A long and important chapter deals with the ideas relative to sexual matters, but space is lacking for an analysis of this and of the chapter on the bull-roarer; the author suggests that the Australian deities associated with the latter are in reality thunder gods, a theory for which there is much to be said. His suggestion, on the other hand, that all other Australian divinities, so-called, are either culture heroes or the body of deified ancestors, to use a somewhat inexact term, which among the Dieri are known as the *mura-mura*, is less acceptable; the only basis for this theory seems to be the fact that the *mura-mura* were originally spoken of by some incorrect writers as a god.

On the subject of magico-religious power, or *mana*, M. van Gennep holds that we must provisionally take the view that the Australians distinguish three kinds—that of the *churinga*, of the *arungquiltha*, and of the *atnongara*—and it is to be hoped that workers in the field, who commonly overlook the wide issues raised by their researches, will not fail to devote especial attention to this problem. As a result of his discussion of myth and rite, M. van Gennep comes to the conclusion that the problem of anteriority is insoluble.

The hundred and six myths which follow are carefully annotated, and should give the reader a good idea of Australian myths and legendary tales. As to the utility of M. van Gennep's work there can be no doubt; but if he were writing for an English public the general impression would be that he had better have relegated controversy to a subordinate place, and have aimed rather at expounding what is known than at putting together an introduction full of technical matter. N. W. T.

THE LIFE AND WORK OF PLANTS.

The Physiology of Plants, a Treatise upon the Metabolism and Sources of Energy in Plants. By Dr. W. Pfeffer. Second fully revised edition, translated and edited by Dr. Alfred J. Ewart. Vol. iii. Pp. viii+451. (Oxford: The Clarendon Press, 1906.) Price 18*s.* net.

THAT Dr. Pfeffer's great work has been issued in a worthy English translation is matter of congratulation to those to whom its treasures are thus rendered accessible, while welcomed by those familiar

with its value in its original form, who will find in it valuable additions, interpolated in brackets and in an appendix, which take account of the recent progress of the science.

The newly issued third (and last) volume deals with the great subjects of movement, the production of heat, light and electricity, and the sources and transformations of energy in plants. As in the former volumes, the width and accuracy of the author's acquaintance with the literature of the subjects under treatment are marvellous, and scarcely less so is the power of arrangement by which it is made available to others. The book demands continuous and close attention from its readers, for it is crowded with information condensed so far as it can be without sacrificing clearness. Dr. Ewart deserves thanks for the excellence of the translation, a task the difficulties of which can be appreciated only by those that have attempted to translate a German scientific work into good English, and have experienced how hard it is to do so. He deserves thanks also for wise reticence as regards the introduction of new technical terms, the employment of which is a very real obstacle to the progress of science unless they are required to ensure accuracy. Most parts of botany have suffered more or less from this evil, and it is thus all the greater a pleasure to mark its absence from so fundamental a work as this.

The treatment of each subject is exhaustive and of much interest. While it demands the reader's undivided attention throughout, there is a noteworthy freedom from obscurity in the language, for which thanks are due to both the author and the translator.

Under movement, the causes and mechanism are first discussed in preparation for the consideration of the varied kinds of movements in detail. These are distinguished into movements of curvature, tropic movements, and locomotory and protoplasmic movements. Under the first head are included autonomic movements, the movements of climbers and twiners, those due to mechanical and chemical stimuli, photonastic, thermonastic, and hydronastic curvatures, and the movements connected with dehiscence and dispersal. Tropic movements are treated in a general way, and thereafter, under the various forms, the conditions for and the mechanism of each are dealt with. The movements of protoplasm and its reactions to stimuli are placed under the third head, whether shown by locomotion of the entire cell or by movements of the protoplasm within the cell wall.

The production of heat, light, and electricity by plants is thereafter discussed, and this is followed by a chapter on the sources and transformations of energy in plants, in which it is stated that, "apart from the locomotory movements which are absent from most plants, as many external manifestations of energy are shown in the vegetable kingdom as among animals." How widely different is such a view from that which regarded plants as little more than inert things, possessed of life and able to grow and to reproduce themselves, but far indeed beneath animals in their powers of response to external stimuli.

A brief but very valuable appendix summarising the more important literature on the subject published since the completion of the German edition and an excellent index conclude the work.

It will be seen from this brief abstract that this volume deals with subjects of extreme interest, in which great progress has been made towards a fuller understanding of plants as living organisms sensitive to influences from without, and adapting themselves to their environments. The modern conception of the study of plants has become very much widened and deepened from that which prevailed when that study appeared to content itself with description and classification. Yet there is a danger lest even advance may lead to narrowness of view through the impossibility of acquiring a personal knowledge of more than a limited part of the science of botany. The disadvantages of too great specialisation are to be dreaded, and the benefits conferred by Dr. Pfeffer's "Physiology of Plants" will be felt by systematists and morphologists not less than by physiologists. From it they can gain a clear view of the plant as a living organism, and can estimate the value of such knowledge in relation to their special fields of study. Such a survey will probably bring to light new problems awaiting solution, and will leave the impression that though much has been accomplished deeper problems of life remain unsolved, and that the field of investigation only widens indefinitely. To what has been gathered in its field no better guide can be obtained than that under review.

STEAM AND HYDRAULIC TURBINES.

(1) *Steam Turbines, with an Appendix on Gas Turbines, and the Future of Heat Engines.* By Dr. A. Stodola. Translated by Dr. Louis C. Loewenstein. Second edition, enlarged and revised. Pp. xix+490. (New York: D. Van Nostrand Co.; London: Archibald Constable and Co., Ltd., 1906.) Price 21*s.* net.

(2) *Steam Turbine Engineering.* By T. Stevens and H. M. Hobart. Pp. x+814. (London and New York: Whittaker and Co., 1906.) Price 21*s.* net.

(3) *Modern Turbine Practice and Water-power Plants.* By John Wolf Thurso. Pp. xxii+244. (London: Archibald Constable and Co., Ltd., 1906.) Price 16*s.* net.

(4) *Hydraulic Motors with Related Subjects, including Centrifugal Pumps, Pipes, and Open Channels.* By Prof. Irving P. Church. Pp. ix+269. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1905.)

(5) *Turbines.* By W. H. Stuart Garnett. Pp. xiv+283. (London: George Bell and Sons, 1906.) Price 8*s.* 6*d.* net.

(6) *Modern Steam Turbines.* Edited by Arthur R. Liddell. Vol. i. The Schulz Steam Turbine. By Max Dietrich. Pp. 73. (London: A. Owen and Co. and T. Fisher Unwin, 1906.) Price 5*s.*

(1) THIS is the second edition of Dr. Loewenstein's authorised translation of the second edition of Dr. Stodola's well-known treatise. The first edition of the translation was recently fully reviewed

in these columns. The only change in the present edition is the incorporation of a supplement, prepared by the translator, giving the derivation, step by step, of the difficult formulæ in Dr. Stodola's treatise; this supplement will be very acceptable to advanced students in our engineering schools. It is a striking proof of the high estimation in which this text-book is held in the English-speaking world that a second edition of the translation should so soon have been called for.

(2) In their preface Messrs. Stevens and Hobart point out that while a number of treatises on the steam turbine has been published, none of them so far has dealt with the subject from the point of view of the purchaser and user, though to them the question of economy, not only in steam consumption, but also in first cost and maintenance, is of the greatest importance. In the second chapter the authors discuss the much vexed question of units; they abandon the well-known B.Th.U., and adopt for their unit, both for heat energy and mechanical energy, the kilowatt hour, or K.W.H., though expressing an abstract preference for the kilogram-calorie as the unit of energy; similarly for the unit of power they have almost exclusively adopted the kilowatt (K.W.) in preference to the older unit, the horse-power (H.P.).

Since in dealing with the economy of steam turbines the authors have reduced all the results to kilograms of steam per kilowatt hour output from the dynamo driven by the turbine, it is inevitable that they should discard the older units. We do not think, however, that the well-known B.Th.U. will be displaced for many years to come; it is still the unit in which most English-speaking engineers think who have to deal with practical problems connected with the generation of steam, and it has certain practical advantages. That some changes in our system of units will come in course of time we have no doubt, and we have equally no doubt that they will be to the advantage of British and American engineers, though we cannot agree with the somewhat far-fetched hypothesis of the authors that "the rapid rate at which Germany and Switzerland are coming to the front as rivals of English-speaking countries in manufacture and commerce" is due to our present system of units.

To each of the types of turbines which have so far been successful on a commercial scale (De Laval, Parsons, Curtis, Rateau, &c.), and to several others still more or less in an experimental stage, a separate chapter is devoted. In each of these chapters the authors follow a definite procedure; they deal with the turbine, which is being considered, under two heads (not always in the same order):—(*a*) its economy as a machine for the conversion of heat energy into mechanical energy; (*b*) its design from the point of view of the user. In the sections devoted to steam economy, the effect of varying the boiler, or admission, pressure, of varying the vacuum, and of superheating the steam is fully treated with the aid of most elaborate and carefully drawn up tables, and curves are plotted from these tables, both at full and half loads, and the thermodynamic losses are analysed; in the portion of each chapter treating of design, the mechanical principles underlying the design of the turbine under discussion are explained with the aid of a number of reproductions of working drawings, unfortunately on such a small scale as often to render it impossible to make out clearly the details.

An interesting point brought out by the elaborate analysis the authors have made of numerous published tests of De Laval and Parsons turbines is that while in the former a considerable reduction in the weight of steam per kilowatt hour is produced by increasing the boiler pressure, there appears to be but little gain in this respect in the case of the latter when condensing, if the pressure is increased beyond 8 atmospheres, assuming, of course, that the same vacuum is maintained in each case. It is only in the case of the De Laval and of the Parsons turbines that the results of sufficiently numerous tests have been published to enable the authors to discuss fully all the factors which make for economy in any given set of conditions, but they have in all cases given all the information which is so far available for each type of turbine.

In connection with the Rateau turbine, full details are given of the regenerative heat accumulators which have been erected at various works, where the steam working the turbines is the exhaust steam from previously existing reciprocating steam engines. In chapter xiii. are a series of steam tables, both in metric and in English units, from pressures of ½ lb. to 200 lb. per square inch, and two other useful tables, one the calorific values of fuel, the other losses in converting the energy of 1 lb. of coal into electrical energy. Two valuable chapters are xv. and xvi., since in these first typical results are given as to steam economy in modern piston engines, and then the authors enter into an elaborate analysis of the respective merits of the piston engine and the turbine from the point of view of working expenses. They point out that forecasting the future is by no means an easy matter; it is certain, however, that the relative positions of these two types of engines as to economy in steam consumption will depend to a large extent upon the amount to which their special characteristics are developed and utilised, such as the fact that a high vacuum is more beneficial to the turbine than to the piston engine from the point of view of economy, while, as regards superheating, apparently the reverse holds.

The next five chapters deal briefly with such problems as the foundations and engine buildings for turbines, and the cost and arrangement of separate condensing plants, all the data collected in regard to each point being grouped into a series of reference tables. In chapter xxii., a very lengthy one, the authors have brought together in the form of very carefully arranged tables all the published details of some twelve of the largest and most modern steam-turbine plants, and in addition there are some hundred illustrations; the many blank lines in these tables show how difficult it is to obtain information on points of great importance in connection with the planning of such plants.

The final chapter is devoted to marine steam tur-

bines, and the authors have certainly succeeded in bringing together in a convenient form for reference a greater mass of information and data than has ever before been published in any one volume; they have almost attempted to be too up-to-date, as shown in the fact that the new giant Cunarder, recently launched on the Clyde, is called throughout *Susitania* instead of *Lusitania*. A valuable bibliography and a complete index conclude a volume which must have involved immense labour in the compilation of the masses of figures with which its pages bristle, and in the preparation of the carefully drawn curves which pictorially represent so many of these elaborate tables; it will undoubtedly for many years be one of the standard works of reference on the steam turbine.

(3) This work does not treat of the design of turbines, but gives such information in regard to modern water turbines and their installation as will be required by an engineer engaged in preparing plans for a proposed water-power plant. In view of the fact that hitherto there have existed so far in hydraulic-power engineering no generally accepted terms, the author explains in an introduction all the terms he uses, gives a careful definition of each, and suggests that the nomenclature he has used might be generally adopted; it would certainly be a great boon to the student if the authors of text-books on turbines would conform to some definite and fixed nomenclature, both in dealing with the theory and also in explaining the mechanical construction of these machines.

The first two chapters are devoted to an account of modern turbine practice in Europe and in America, and Mr. Thurso is of opinion that not only have there been marked differences in the development of the turbine in the two continents, but that, on the whole, development has proceeded on more scientific lines in Europe, and much greater mechanical skill has been shown by the turbine builders of that continent in turning out highly-finished machines. Up to a few years ago the axial-flow machine was the standard type of European builders, but the difficulty of regulating its speed, and the application of the turbine to the generation of electrical energy, which necessitated higher speeds and closer regulation, has led to the almost complete abandonment of this type, and to the adoption of some form of radial-flow turbine, the actual form adopted varying with the head of water available. In America, the author points out, development has been on quite different lines; the modern turbine is a descendant of the radial inward-flow, or vortex, turbine of J. B. Francis; but, since the number of revolutions varies as the square root of the head of water, and since for the same head the revolutions of different machines will vary inversely as their diameter, the tendency has been, owing to the demand for high speed, to reduce the diameter, and thus to reduce the interior space available for the water to turn and escape axially when its work is done. It has thus become necessary to turn the water in an axial direction while still in the runner-bucket, that is, to curve gradually the runner-bucket from a radial to an axial direction, giving these latter a very complicated form, and simultaneously with this there has been a tendency to increase the axial dimensions of the bucket entrances.

Up to a low head, say of 40 feet, the author is of opinion that the American turbine has great advantages over all others in common use, but for high heads he considers it is unsuitable, and that it cannot successfully compete with European types; he is also of opinion that the quality of workmanship and of materials used by American turbine builders is distinctly second-class, due no doubt to the existence of abundant water-power in all parts of the country, and to the belief of the average purchaser that water-power costs little or nothing, and that, therefore, any turbine which will run is good enough for his purpose. He also considers that the practice of testing turbines in the flume at Holyoke, where the head is only 18 feet, has been prejudicial to development, since a good result on the test-bed by no means ensures a similar result when the machine is set up in the place where it is to work, often under heads far greater than those available at Holyoke.

In chapter iii. the various types of turbines are classified, and the general properties and characteristics of each class are briefly discussed; then follows the only chapter devoted to the steam turbine, and, in view of the small amount of space devoted to it, the inclusion of this chapter in the book has been clearly a mistake; it would have been much wiser if the author had omitted the steam turbine altogether, and had devoted the space thus set free to enlarging those portions of the book dealing with the accessories of turbines.

The remainder of the book deals with modern types of water turbines, their construction, and the various accessories attached to them for the purpose of admitting and exhausting the water, governing their speed, &c., and the decided opinion is expressed that, unless there is some definite reason to the contrary, horizontal shafts should always be adopted; a number of illustrations is given of large turbine plants recently erected in America and in Europe, and the essential points in the design of each are clearly set forth.

The chapters on the accessories, &c., are especially valuable, as these details are often either neglected in text-books or treated in a very perfunctory fashion; the data given by the author will be found very valuable by all engineers engaged in planning water-power schemes, and they embody the results of wide experience of various classes of turbines; such important points as the difficulties induced by the formation of ice on a large scale and the means to be adopted to cope with them, and the measurement of water for selling power are fully dealt with.

A paper by Mr. A. V. Garratt on the elements of design favourable to speed regulation in plants driven by water-power is printed in the form of an appendix; the whole book is thoroughly up to date in its information, the facts and data are well marshalled, and it should be consulted by every engineer who may be called upon to deal with the problem of the utilisation of water-power.

(4) The great increase in the utilisation of water-power in all parts of the world, mainly in connection with the electric transmission of energy, has led to much more attention being devoted to this branch of engineering in all technical colleges, and this has naturally brought about a demand for text-books thoroughly up to date, and suited to modern developments of the industry. Prof. Church has attempted both to supply this need on the part of engineering students, and at the same time to write a book which will be of service to practising engineers; the subject has been treated by him, therefore, both from the theoretical and from the practical standpoint.

After dealing with the general considerations which govern the design of all types of hydraulic motors, one chapter is devoted to the various forms of gravity motors—overshot, breast, and undershot wheels—which have been so largely displaced in modern days by the turbine. Before dealing with turbine design the author shows that there are three theorems which lie at the basis of the theory of turbines and centrifugal pumps; these theorems are, in fact, fundamental principles of mechanics, though the third presupposes the existence of "steady flow"; this third theorem may be expressed as follows:—

"Power of a turbine in steady motion = angular velocity × change of angular momentum experienced by the mass of water flowing per unit of time in its passage through the turbine."

These theorems are illustrated by a series of numerical examples worked out in full.

In chapter iv. impulse wheels are considered, and the Pelton and the Girard impulse wheels are taken as illustrations of this type; in the next chapter the turbine proper, or "reaction turbine," is taken up, and as a preliminary to the discussion of the modern turbine the theory of the Barker's mill is deduced; it is then shown that the Fourneyron turbine is a direct descendant of this old and simple form, and the theory of the Fourneyron form is then worked out both when friction is disregarded and when it is taken into account. Prof. Church then classifies turbines under four heads—(1) radial outward-flow, (2) radial inward-flow, (3) axial flow, (4) mixed flow—and deals with each of these classes in detail; he gives descriptions, with excellent illustrations, of well-known makes of each type, and concludes the chapter with the general theory of reaction turbines. The testing and regulating of turbines form the subject-matter of chapter vi., and a description is given of the Holyoke testing flume. The following chapter is devoted to the theory and construction of centrifugal pumps, and the formulæ deduced are illustrated by working out in full numerical examples.

The flow of water over weirs and through pipes and open channels is treated mainly from the point of view of the designer of turbine machinery, and in connection with this portion of the book there is a series of useful diagrams in the appendix for Kutter's coefficient, &c.

The book concludes with a chapter on pressure engines, hydraulic rams and accumulators, the Worthington water-motor pump and the Brotherhood pressure engine being taken as examples. Prof. Church's book will undoubtedly be a recognised text-book for advanced engineering students.

(5) This book, originally intended to give a popular account of the history, construction, and operation both of water and steam turbines, has been extended in its scope, and the author has dealt with the important problem of blade design in such a way as to make it a text-book useful also to the technical student. After giving a brief history of the evolution of the water turbine, the conditions which must be fulfilled if such machines are to be efficient are fully discussed; then follow several chapters in which recent modern types of both impulse and reaction turbines are described with the help of a series of good illustrations; finally, this half of the book concludes with some details of the best methods of erecting water turbines and controlling them by governors.

In part ii. the steam turbine is taken up, and naturally attention is chiefly devoted to the Parsons, De Laval, and Curtis turbines, as these are practically the three types which have so far been commercially successful; a full description is given of the principles underlying the design, and of the methods adopted in manufacturing the various parts of each of these well-known engines, and it is to be hoped that a study of this part of the book may do something to dissipate the extraordinary ignorance and misconception which prevail among men, even of fair mechanical knowledge, in regard to the steam turbine and its possibilities. Special chapters are devoted to the application of the turbine to marine purposes, and a clear account is given of the rapid development in this field of work during the last few years both in the Royal Navy and in the merchant service. Turbo-blowers and rotary pumps are discussed in another chapter, and the advantages of these pumps over reciprocating pumps, where vast volumes of air have to be supplied, as is the case in connection with the blast-furnace industry, are clearly set forth.

A series of appendices dealing briefly with the mathematical and mechanical principles involved in elementary engineering, with fluid motion, and with the behaviour of gas, conclude a book which will do much, it is probable, to make the layman take a more intelligent interest in this the latest and most striking development of the skill of the mechanical engineer.

(6) This is an authorised translation of a book by Herr Dietrich, in which he describes the various patents for steam turbines and their accessories taken out by Mr. R. Schulz, engine-works manager of the Germania Shipyard at Kiel, and also the results of tests of the Schulz turbine, both when used for marine work and for the generation of electrical energy.

The rest of the book is devoted to *ex parte* statements in reference to the controversy between Mr. Parsons and Mr. Schulz in regard to their respective inventions, which was eventually fought out in the Law Courts in an action brought for infringement of

patent rights. It is not our province to enter into the details of this controversy; we need only say that Mr. Schulz claims that he has succeeded better than any other inventor in solving the difficult problem of designing a practical and not too complicated turbine in which the steam consumption per horse-power hour is economical, not only at full power, but also when the engine is working at low loads, and he also claims that he has simplified the arrangements necessary on board ship, where go-astern machines must be provided as well as the go-ahead turbines. The author gives a clear description of the mechanical details by which the inventor has secured the results he claims. This book should be carefully studied by all those interested in the history of the development of the steam turbine. T. H. B.

OUR BOOK SHELF.

Ueber chitinöse Fortbewegungs-Apparate einiger (insbesondere fussloser) Insektenlarven. By Dr. Wilhelm Leisewitz. Pp. iv+143; with 46 illustrations in the text. (Munich: C. Reinhardt, 1906.) Price 4 marks.

THE author commenced his observations with the terminal appendage in the larva of *Xiphydria dromedarius*. This larva, which is almost apterous, lives in galleries in rotten wood, and the appendage is used firstly as a prop and partly to compress the loose substance behind it to give it a firm support as it gradually progresses by gnawing away the wood in front. He then extended his researches to the hairs, bristles, &c., of other internal-feeding larvæ, especially those which are apterous or subapterous, and in this small volume we have the results of his careful investigations.

The chitinous appendages used for locomotion by such larvæ consist chiefly of (1) undifferentiated hairs, (2) spines, (3) warts, and (4) bristles. Where the larvæ live in hard substances, like wood or bark, the appendages consist of short, stiff hairs or spines and warts, but when the larvæ live in soft substances, like rotten wood or mould, they are provided with long, slender hairs or bristles of varying form.

The greater portion of the essay is devoted to larvæ of Coleoptera, though a few others belonging to the orders Neuroptera, Lepidoptera, Diptera, and Hymenoptera are also noticed.

Apart from the physiological interest of the inquiry, it is also of some importance to the systematist, for the author claims to have discovered trustworthy characters in the chitinous appendages, which will allow many species of Coleoptera, hitherto supposed to be indeterminable in the larval state, to be easily recognised. W. F. KIRBY.

Map of the British Isles. Constructed by W. and A. K. Johnston. Size 72 inches × 63 inches. Mounted on cloth with rollers and varnished. (London: W. and A. K. Johnston, 1906.) Price 21*s*.

THE teaching of geography has received much attention in recent years, and the increased importance given to the subjects in schools has led to the production of several new series of excellent wall maps. The present map is a new addition to one of these series. It is boldly printed, and coloured in a manner to make it easily visible in all parts of a large classroom. The scale is 1 : 633,600, or ten miles to an inch. The populations of the different towns are indicated by means of symbols, but it is to be feared that these will be of little use to anybody but the teacher. The map will require to be supplemented by an orographical one if the physical geography of our country is to be studied satisfactorily.

LETTER TO THE EDITOR.

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

The Production of Radium from Actinium.

THE experimental evidence on the growth of radium from uranium has in the past been somewhat conflicting. Both Mr. Soddy and Mr. Whetham have stated that they observed an increase with the time in the amount of radium in solutions of certain uranium salts which were under examination. The writer, however, was able to show that, starting with a solution of uranium nitrate carefully purified by repeated crystallisation, the amount of radium formed in an interval of eighteen months was less than one two-thousandth of the amount which was to be expected from the disintegration theory.

I think that this discrepancy is readily explained by the results of an experiment which I have just made on the growth of radium from actinium. A kilogram of carnotite ore containing about 20 per cent. of uranium was decomposed with an excess of dilute hydrochloric acid, and the solution thus obtained was treated with hydrogen sulphide, the precipitated sulphides being subsequently removed by filtration. To the solution was then added a fraction of a gram of thorium nitrate, followed by a solution of several grams of oxalic acid. After standing for several days, the slight precipitate which formed was completely removed and converted into a soluble nitrate. The nitrate in dilute solution was again treated with an excess of oxalic acid, and this second precipitate was converted into a soluble chloride. I have found from a considerable number of experiments that practically all the actinium contained in a uranium mineral can be separated in this manner.

The solution of the chlorides containing the actinium was sealed up in a glass bulb, and about two months later, on April 25 last, the gases and emanation were boiled out and collected. After standing for some minutes the gas was introduced into an electroscope. The activity of the emanation corresponded to a content of $5{\cdot}7\times10^{-9}$ gram of radium in the actinium solution. The bulb was again sealed, and was allowed to remain undisturbed until to-day, when the radium emanation present was again removed and tested. The amount of radium emanation now found corresponds to $14{\cdot}2\times10^{-9}$ gram of radium, indicating that there has been formed in the solution during this interval of 193 days a quantity of radium equal to $8{\cdot}5\times10^{-9}$ gram. This is equivalent to the production of about $1{\cdot}6\times10^{-8}$ gram of radium in one year, and since the amount of radium in equilibrium with 200 grams of uranium is $7{\cdot}6\times10^{-5}$ gram, the value of $\lambda(\text{year})^{-1}$ for radium can be calculated, and is given as $2{\cdot}2\times10^{-4}$. The indicated half-value period would be about 3100 years. This number can only be regarded as approximate at present, since the original content of uranium in the material used, and the completeness of the separation of the actinium, are both uncertain. I think, however, that another step has been made towards the solution of the somewhat complex problem of the genesis of radium, and, since the amount of actinium in a mineral is apparently always proportional to the amounts of uranium and radium present, that actinium will prove to be the looked-for intermediate product. BERTRAM B. BOLTWOOD.

Sloane Laboratory of Yale College, New Haven, Conn., November 5.

A MODERN PHYSICAL LABORATORY.

IN December of last year were opened at Göttingen a number of fine new buildings to accommodate the different subdivisions of the physical department of the University. An account of these has just been published in a volume issued under the auspices of the Göttingen Association for the Promotion of Applied Physics and Mathematics.[1] This book, a handsome quarto of 200 pages containing numerous illustrations and plans, gives a graphic idea of the elaboration which is now considered necessary for the successful carrying out of work in the different branches of this most rapidly developing science.

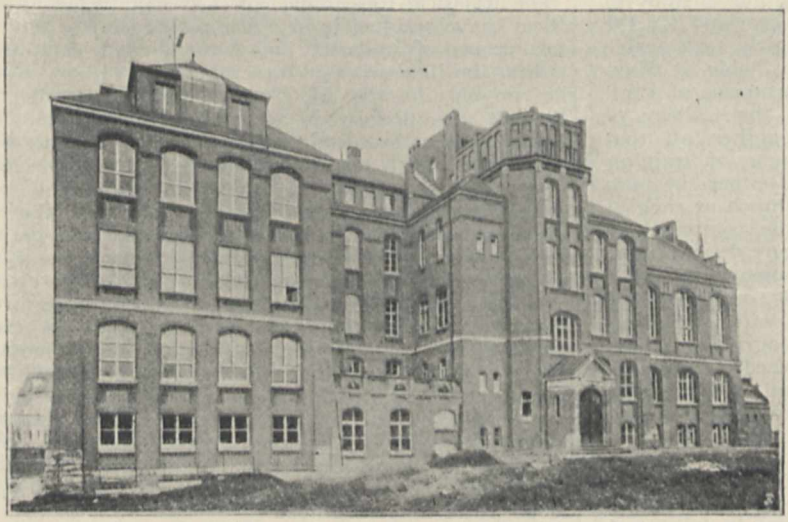

FIG. 1.—North Side of the Physical Institute, University of Göttingen.

Many physicists can remember the time when, even in the most progressive of our universities, where large and well-fitted chemical laboratories had long been established, the accommodation accorded to experimental physics consisted of two or three very ordinary rooms, with perhaps a stone pillar or two for galvanometers or cathetometer, and a wide shelf outside the window for the Grove or Bunsen batteries. By and by came a few accumulators, possibly home-made from jam-pots and roofing lead, the charging arrangements for these consisting of a dynamo of perhaps 25 per cent. efficiency and a gas engine, the obstinacy of which in starting on a winter's morning still calls up recollections. A pressure of 100 volts was to be treated with great respect, and no laboratory resistance-coil was made to carry more than a few amperes. Nowadays it is impossible satisfactorily to house the various subdivisions of experimental physics in a single building, however palatial, and at Göttingen five separate and distinct "institutes" have been provided.

The speeches at the opening ceremony of the directors of each of these institutes sketch in an interesting and eloquent fashion the evolution of the whole from its small beginnings, and review in succession the many honourable names which, from Gauss and Weber down to our own times, have been associated with the progress of physics at Göttingen. Prof. Riecke, speaking as head of the parent laboratory of pure physics, mentions how rapid was the increase, during the closing fifteen years of last century, of work on the borderland between physics and chemistry, of the type in which Ostwald and Victor Meyer were pioneers. This led to the foundation of a separate physical-chemical institute under the direction of Prof. Nernst. Again, the expansion of applied physics and of electrotechnics, particularly in its developments for lighting and power purposes, was so rapid that in 1898, with the aid of the Göttingen Association for the Promotion of Applied Physics and Mathematics, an annexe to the main physics laboratory was erected. This developed later with the help of substantial Government grants into the present institute for applied electricity, and when the new physical laboratory was erected the old building was constituted the institute for applied mathematics and mechanics.

FIG. 2.—Seismological Station, University of Göttingen.

A similar evolution from earlier beginnings has been the history of the department for geophysics, the child of the observatory for the study of terrestrial magnetism founded by Gauss. In a historical *résumé* by Prof. Wiechert is quoted a very interesting letter of Gauss to Olbers in 1833, in which he

[1] "Die physikalischen Institute der Universität Göttingen." Festschrift, 1906. Pp. iv+200. (Leipzig and Berlin: B. G. Teubner, 1906.)

describes his early experiments in telegraphy over a distance of a mile and a half. The equipment of the seismographic department of the geophysical institute is in every way unique, and the new earthquake house built by Prof. Wiechert in 1902 is probably one of the finest in the world.

It is beyond the scope of this article to go into detail on each of these developments, but a study of the volume shows that the facilities provided for the student at Göttingen appear to be fairly comparable in a general way with those now available at Manchester, where the splendid new laboratories of Prof. Schuster at the University, and of the College of Technology in the city, provide together all that could be desired for a complete course of training and research in almost any branch of either the pure or applied science. Though there is much at each of the two universities which cannot be compared to any similar thing at the other, yet many details make the resemblance between the equipments for pure physics distinctly striking; for example, each possesses a large concave Rowland grating, with mounting specially designed for accurate photographic work, made by Krupp and by Sir Howard Grubb respectively. The magnificent equipment at Manchester has already rendered excellent service in the hands of Mr. Duffield in his investigation of the effect of pressure on arc spectra.

The volume under review is well got up, and though considerable space is taken up with purely descriptive detail, there is much matter in it of real interest; for example, many passages in the speeches delivered at the opening ceremony sparkle in a manner not usual in such efforts. We conclude with a translation of some extracts from the address of Prof. Voigt. He says:—

"What is it, then, which fetters the crystallographer so strongly to his science? I will try to explain it by a parable.

"Let us imagine in a large hall a couple of hundred brilliant violin-players, who all play the same piece with instruments faultlessly tuned, but commence simultaneously at all sorts of different places, and perhaps at the conclusion begin over again. The effect is (at least for Europeans) not exactly pleasant, a monotonous jumble of sounds, in which even the finest ear is unable to recognise what is being played. . . . Such music the molecules of gaseous, liquid, and ordinary solid bodies make for us. They may be highly gifted molecules with marvellous internal architecture, but in their activity each disturbs the others. . . . A *crystal* on the contrary corresponds to the orchestra above described, when the same is led by a vigorous conductor, when all eyes intently watch his nod, and all hands follow the exact beat. . . . This picture renders it understandable how crystals can exhibit whole ranges of phenomena, which are absolutely lacking in other bodies. . . . In my opinion the music of physical law sounds forth in no other department in such full and rich accord as in crystal physics."

J. A. HARKER.

THE ETIOLOGY OF SLEEPING SICKNESS.[1]

AMONG the scientific achievements of the last decade, few have been so remarkable as the rapid increase of knowledge with regard to the minute animacules termed by zoologists Protozoa. More especially is this true as concerns the parasitic members of the group and their relation to disease in man and beast. It is now known that protozoan parasites are the cause of many diseases, especially in the tropics, and as a type of such we may refer to malaria, since the etiology of this disease is now so thoroughly known that it may serve as a model, as it were, of diseases due to Protozoa, and at the same time furnishes valuable analogies and suggests the problems to be investigated in other cases.

The classical researches of Laveran, Ross, and others have resulted in establishing clearly the cause and nature of malaria, and have proved definitely (1) that the illness is due to a minute protozoan parasite present in the blood and multiplying there; (2) that the disease is transmitted from sick to healthy persons by certain biting gnats or mosquitoes, a mosquito which has sucked blood from an infected person being capable, after a certain period of time, of inoculating other persons with the malarial parasite at subsequent feeds; and (3) that the parasite is not carried merely passively by the mosquito, but passes through an essential part of its life-cycle within it, since sexual forms of the parasite are developed which conjugate and multiply in the digestive tract of the mosquito in a manner different from the mode of multiplication in the blood of the patient. It is not extraordinary that diseases of this type should be especially prevalent in the tropics, where insect life is so richly developed, and the numerous blood-sucking insects of all kinds furnish the requisite means of transmitting and disseminating the parasitic micro-organisms.

Since Livingstone's time it has been known that horses and cattle in Africa die from a disease produced by the bites of the indigenous tsetse-flies. These flies, of which eight species are now known, belong to the genus Glossina, a genus of Diptera or two-winged flies characteristic of the African fauna, and not found on other continents. The disease which they produce, termed nagana, or tsetse-fly disease, is rapidly fatal to imported cattle or horses, but does not affect human beings. Various suppositions were put forward as to the nature of the malign power exerted by the dreaded tsetse-fly until the discoveries of Bruce solved the problem once and for all. Bruce found that the disease is caused by the presence in the blood of a minute flagellated organism belonging to the genus of parasitic Protozoa already known to zoologists by the name Trypanosoma, and that the parasite is transmitted from sick to healthy animals by the bite of the tsetse-fly, which was thus shown to play a part in the dissemination of nagana analogous to that played by the mosquito in the dissemination of malaria. Bruce's researches established for nagana the first two propositions stated above for malaria, but it remained to be proved whether the parasite did or did not undergo a definite developmental cycle in the tsetse-fly, as the parasite of malaria does in the mosquito. Bruce discovered, however, another fact of great importance, namely, that the "trypanosomes" of nagana are to be found in the blood of indigenous wild game, such as antelopes and buffaloes, to which the parasites appear to be innocuous. These infected wild animals serve, however, as a reservoir for the disease, the trypanosomes being conveyed by the tsetse-fly from the indigenous wild animals to the susceptible domestic animals. No such natural "reservoir" has been proved as yet for the malarial parasite, though its existence has often been suspected.

It had long been known that negroes from the west coast of Africa were liable to a slow but fatal disease, which, from the peculiar comatose symptoms seen in the final stages, was termed the sleeping sickness. Nothing was known as to the nature of this

[1] "*Glossina palpalis* in its Relation to *Trypanosoma gambiense* and other Trypanosomes (Preliminary Report)." By E. A. Minchin, A. C. H. Gray and the late F. M. G. Tulloch. With 3 plates, 1 map and 11 text-figures (Proc. Roy. Soc., 1906.)

mysterious malady until quite recently, when it made its appearance in epidemic form in Uganda, producing an enormous mortality among the natives, and also attacking Europeans. The outbreak of the disease was so serious and threatening that, at the request of the Government, the Royal Society sent out a commission to investigate the nature of the disease, and to discover, if possible, the means of checking the further spread of the epidemic. The commission was not long in obtaining important results. It was discovered that the cause of the disease was a trypanosome which in the early stages of the malady was present in the blood of the patient, but which later penetrated into the cerebro-spinal fluid, and then gave rise to the comatose symptoms characteristic of the disease. It was further proved, once again by Bruce, that the parasite was transmitted from sick to healthy persons by the local species of tsetse-fly, *Glossina palpalis*, and that the sleeping sickness was, in fact, a human tsetse-fly disease comparable to the nagana of cattle, though caused by a different species of trypanosome transmitted by a different species of tsetse-fly, and differing further from nagana in the nature of the symptoms produced. It remained to investigate the exact relation of the parasite to the fly, that is to say, whether the trypanosome went through a developmental cycle in the tsetse-fly or not. It may be added that in the case of sleeping

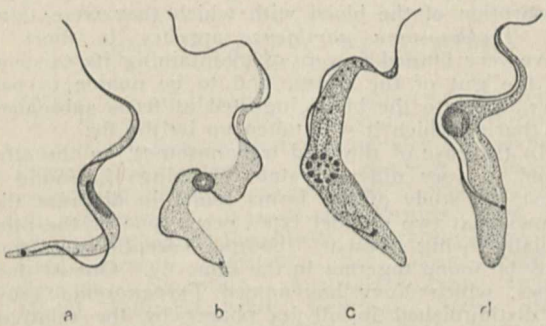

FIG. 1.—*Trypanosoma gambiense* from the intestine of the tsetse-fly, twenty-four hours after feeding upon an infected subject. *a* and *b*, male forms; *c* and *d*, female forms. ×2000 diameters.

sickness no natural "reservoir" has yet been discovered.

Early in 1905 the present writer was sent out to Entebbe by the Royal Society in order to investigate the exact nature of the relationship between the trypanosome of sleeping sickness, *T. gambiense*, Dutton (=*T. castellanii*, Kruse), and the tsetse-fly *Glossina palpalis*. At the time of commencing this work the state of knowledge was as follows:—The experiments of Bruce and Nabarro had proved that the tsetse-fly was capable of transmitting the parasitic micro-organism from an infected animal to one free from the infection if fed on the first, then on the second, with not more than forty-eight hours' interval; and, further, that tsetse-flies freshly caught in localities where sleeping sickness is rife, such as Entebbe, were capable of infecting healthy animals. Trypanosomes had also been observed to be present not infrequently in the digestive tract of freshly-caught flies, occurring in enormous numbers in certain regions of the intestine. Special interest attached, naturally, to these "wild" trypanosomes, as they may be termed briefly, meaning thereby trypanosomes with which the fly had become infected in nature, and not as the result of being fed in the laboratory on infected animals. Lieuts. Gray and Tulloch, of the sleeping sickness commission, had made detailed observations on the wild trypanosomes, and had found them present in about 1.8 per cent. of tsetse-flies caught at Entebbe. The wild trypanosomes differed considerably in appearance and structure from those found in the blood or cerebro-spinal fluid of sleeping-sickness patients, but not more than was capable of being explained as the result of developmental changes.

At that time the late Dr. Fritz Schaudinn had just published his well-known memoir on the life-cycle of the trypanosome of the little owl, *Athene noctua*, a work which created considerable stir among all workers upon Protozoa. We were, therefore, all fully prepared to discover complicated life-cycles involving great morphological changes in these organisms, and had little doubt but that observation would reveal a developmental cycle in the tsetse-fly analogous to that of the malarial parasite in the mosquito. It was, moreover, reasonable to suppose that the trypanosomes found in tsetse-flies caught in Entebbe would be the trypanosomes of sleeping sickness, since, as already stated, it had been proved experimentally that infection could be brought about by the bites of freshly-caught flies. When, therefore, we—that is, the present writer working in collaboration with Messrs. Gray and Tulloch—embarked upon these in-

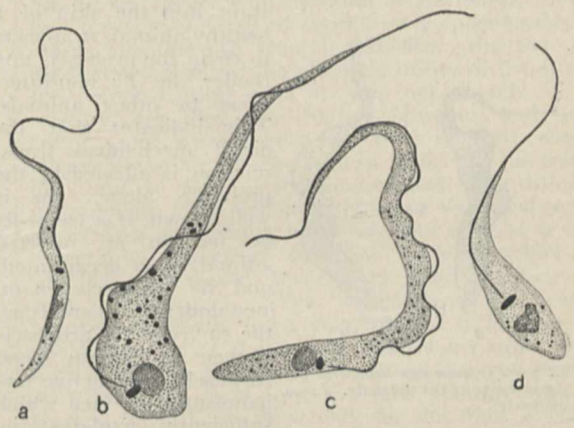

FIG. 2.—*Trypanosoma grayi* from the intestine of the tsetse-fly. *a*, male *b*, female; *c*, indifferent; and *d*, young forms. ×2000 diameters.

vestigations, we were fully convinced that the wild trypanosomes found in the tsetse-fly were nothing more than stages in the developmental cycle of *Trypanosoma gambiense*, and that it remained to work out this cycle in full detail and to refer the various forms of wild trypanosomes to their place in it.

The methods by which this problem was attacked were partly experimental, partly observational. By both alike, all attempts to establish a relationship between *Trypanosoma gambiense* of sleeping sickness and the wild trypanosomes occurring naturally in the tsetse-fly gave absolutely negative results, and forced us gradually and reluctantly, but irresistibly, to the conclusion that the wild trypanosomes of the tsetse-fly have no connection whatever with sleeping sickness, but belong to other species quite distinct from *T. gambiense*, and innocuous to man.

One series of experiments had for its object to determine the exact manner in which the tsetse-fly carries the trypanosome of sleeping sickness from an infected to a healthy animal. If the parasite passed through a developmental cycle in the tsetse-fly, it might be expected that the latter would show a certain periodicity in its infectiveness; that is to say, that

after the fly had taken up the parasites, it would not be ripe, so to speak, to infect a healthy animal until after a certain period of time or a certain number of feeds, as is known to be the case with the mosquito in the transmission of malaria. To test this, and to discover the period necessary for the supposed cycle, batches of flies were fed first on an infected animal and then at regular intervals on a succession of healthy animals (monkeys), using a new healthy animal for each feed. In no case was an infection obtained later than forty-eight hours, although the experiments were extended over three weeks.

On the other hand, conclusive evidence was obtained of the existence of what may be termed direct mechanical infection; that is to say, if a tsetse be allowed to have a partial feed on an infected animal and be then transferred at once to a healthy animal, on which it is allowed to finish its feed, the second animal may become infected. This confirms the results previously obtained by Bruce, both for nagana and sleeping sickness. The experiment was varied by making the fly feed first on an infected animal and then on two healthy animals in rapid succession; it was then found that the first healthy animal became infected, but not the second. If the tsetse dips its proboscis for an instant into the skin of a healthy animal, it appears to clean the proboscis and render the fly non-infectious to other animals. This indicates that the direct mechanical transmission is effected by the proboscis alone. As is well known, if a tsetse-fly be fed on an infected animal, then decapitated, and its proboscis examined under the microscope, the cavity of the proboscis is seen to contain blood corpuscles and active trypanosomes, a fact which sufficiently explains the direct transmission. The experiments suggest that a tsetse which has fed on an infected subject is only infectious to the first healthy subject bitten by it afterwards.

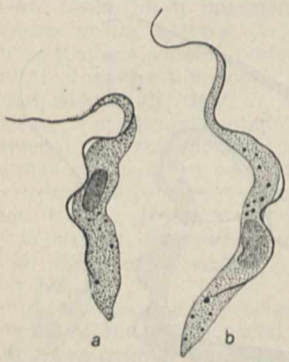

FIG. 3.—*Trypanosoma tullochii* from the intestine of the tsetse-fly. ×2000 diameters.

A second series of experiments had for its object to test the connection, if any, between the wild trypanosomes and sleeping sickness. An island called Kimmi, not far from Entebbe in the Victoria Nyanza, was found to teem with tsetse-flies to a degree almost incredible to anyone who has not been there. Although this island was uninhabited and hardly ever visited by human beings, it was found that the tsetse-flies there were more often infected with trypanosomes than on the mainland, since on the average between 7 per cent. and 8 per cent. of Kimmi flies were found to harbour trypanosomes, as against 1·7 per cent. from the neighbourhood of Entebbe. The island of Nsadzi, adjacent to Kimmi, was found to be free from tsetse except in certain limited spots along the shore, and hence served as convenient ground for a camp and station for experimenting upon the flies of Kimmi. The method was to feed a batch of flies caught at Kimmi upon a given healthy experimental animal daily for a certain length of time, then, by dissection and microscopic examination of every fly in the batch, to find out how many of them contained trypanosomes. In this way it was possible to make certain that animals susceptible to sleeping sickness had been fed upon by one or more tsetse-flies containing trypanosomes. Had these wild trypanosomes been identical with those of sleeping sickness, it might have been expected that some at least of the experimental animals would have become infected; but not in a single case did this occur. Attempts to infect experimental animals by direct inoculation of trypanosomes from the intestine of the fly proved equally futile.

The microscopical observation of the trypanosomes within the tsetse-fly led to similar conclusions. If tsetse-flies were fed on animals infected with *Trypanosoma gambiense*, and subsequently dissected and examined after various intervals, it was found that the trypanosomes flourished and multiplied for the first twenty-four hours, becoming at the same time differentiated into two distinct types, the one slender, transparent, and active, the other bulky, granular, and sluggish in movement. Compared with what is known of developmental phases in other Protozoa, the slender forms may be called male (Fig. 1, *a*, *b*), the bulky forms female (Fig. 1, *c*, *d*). Up to forty-eight hours the multiplication continues, and a more "indifferent" type of individual appears. At seventy-two hours, however, the trypanosomes have become greatly diminished, and by ninety-six hours, or slightly later, the trypanosomes have disappeared completely from the gut of the tsetse-fly, this disappearance coinciding with the complete absorption of the blood with which they were taken in. *Trypanosoma gambiense* appears, in short, to have very limited powers of maintaining its existence in the gut of the tsetse, and to be unable to pass forwards into the blood ingested at feeds subsequent to that at which it was taken up by the fly.

In the case of the wild trypanosomes, on the other hand, a very different state of things is found to exist. A study of the forms found in different flies shows that two distinct types occur, one or the other usually being present, though exceptionally both may be found together in the same fly. One of these types, which Novy has named *Trypanosoma grayi*, is distinguished in all its phases by the relatively large size of the smaller mass of chromatin (micronucleus or blepharoplast), which is elongated in a direction transverse to the axis of the body, and placed almost invariably in front of the nucleus (Fig. 2, *a–d*). The other type, which we have named *T. tullochii*, is more like *T. gambiense* in its characters, having a small rounded blepharoplast placed well behind the nucleus (Fig. 3, *a*, *b*). Both these types are remarkable for their very great activity, whereby they swarm forwards in the gut of the fly into the blood ingested by it at each feed, and by their own exertions penetrate from the hindmost portion of the gut into its most anterior regions.

The conclusion drawn from these observations is that the "wild" trypanosomes, those found occurring naturally in the tsetse-fly at Entebbe, are not stages of the trypanosome of sleeping sickness, but represent at least two entirely distinct species. It remains to be discovered whence the tsetse-fly obtains these trypanosomes. It may be that the tsetse obtains them from the blood of indigenous animals upon which they are parasitic; *Trypanosoma grayi* has some resemblance to certain trypanosomes of birds, while *T. tullochii* is more of the type of a mammalian trypanosome. It may be, on the other hand, that they are parasites of the fly itself, and have no other host of any kind.

With regard to *Trypanosoma gambiense*, experiment and observation alike show that in Uganda it does not pass through a developmental cycle in the tsetse-fly, but is only transferred mechanically by the

fly's proboscis. But the manner in which this trypanosome at first multiplies and develops into male and female forms in the fly's intestine is very remarkable, and suggests the commencement of a life-cycle which is not completed, but which might be so under other conditions. In the case of the trypanosomes of fishes, Brumpt has shown that a given species will go through a complete development in a particular species of leech, but only through a part of the development in another species of leech. There may be conditions, therefore, in which *T. gambiense* would complete the developmental cycle which is seen to begin, but appears to be inhibited, in the tsetse-fly in Uganda. It must be borne in mind that the sleeping sickness is a new thing, apparently, on the Victoria Nyanza, and has broken out there comparatively recently in epidemic form.

In conclusion, there remains only the sad duty of referring to the untimely death of the youngest of the three collaborators in this work, who became himself in some way infected with the trypanosomes which he was studying, and passed away before the results of the investigation were published. Only those who knew Forbes Tulloch can gauge the loss and bereavement occasioned by his tragic end.

ὁ Δαφνὶς ἔβα ῥόον· ἔκλυσε δίνα
Τὸν Μώσαις φίλον ἄνδρα.

E. A. MINCHIN.

THE WIRELESS TELEGRAPHY CONFERENCE.

THE second International Conference on Wireless Telegraphy, which has been sitting during the past few weeks at Berlin, concluded its labours on Saturday, November 3, when the first "Convention radiotélégraphique internationale" was signed by all the representatives of the Powers. The States which have signed the convention are the following:—Great Britain, Germany, the United States of America, Argentina, Austria-Hungary, Belgium, Brazil, Bulgaria, Chili, Denmark, Spain, France, Greece, Italy, Japan, Mexico, Monaco, Norway, the Netherlands, Persia, Portugal, Rumania, Russia, Sweden, Turkey, and Uruguay.

The first conference, which, it will be remembered, was only of a preliminary nature, was held in Berlin in August, 1903, and a summary of the results then attained was given in NATURE at the time (NATURE, vol. lxviii., p. 437). It was there pointed out that by far the most important resolution which the conference had to consider was that making it compulsory on all coastal stations to receive from and transmit to ships at sea all messages irrespective of system, and the hope was expressed that private interests would not be allowed to stand in the way of the development of one of the most beneficial of the recent practical applications of science. Three years have passed since that conference was held, but the correspondence and articles which have lately been so prominent in the daily Press show that this period has served neither to allay private jealousies nor to enlighten public opinion on the true merits of the case; the same appeals to ignorance and prejudice have been made now by both parties to the dispute as were made then.

As the whole question of the justice or injustice of the provisions of the present conference turns on the claims of Signor Marconi, it will not, perhaps, be out of place to recapitulate very briefly the early history of wireless telegraphy. In using the expression "wireless telegraphy," we use it in the sense now almost universally accepted of telegraphy by Hertzian waves, as any consideration of earth conduction or magnetic induction methods has naturally nothing to do with the present conference. The foundations of wireless telegraphy were laid, as everyone knows, by Clerk Maxwell in the theory which gave rise to the experimental researches of Hertz. At the Bath meeting of the British Association in 1888, when the results of Hertz's work were brought to the notice of British men of science by Prof. Fitzgerald, some experiments by Sir Oliver Lodge on the same subject were also described which showed that he was within an ace of making the same discoveries himself. For some time after this experimental work was chiefly devoted to the confirmation and extension of the work of Hertz. It was early recognised that there were possibilities about the new discovery which might render it a useful means of telegraphic communication, and suggestions to this effect appeared in 1891 in *The Electrician*, and in 1892 in the *Fortnightly Review* (from the pen of Sir William Crookes).

The practical application of Hertz waves to telegraphic purposes needed, however, the invention of a delicate detecting mechanism. What Lord Kelvin did for submarine telegraphy by the invention of the syphon recorder, Lodge and Branly did for wireless telegraphy by the invention of the coherer (1889–1891). From this time onward progress was rapid. In 1894 Sir Oliver Lodge demonstrated at the Royal Institution the transmission of signals over considerable distances and through several obstacles. But the credit for first establishing the practical utility of the system, for demonstrating that it was not merely a new scientific toy, lies with Signor Marconi, and to his energy and perseverance we owe it that wireless telegraphy as an art was born in 1896. To his energy, also, and to that of those associated with him, we undoubtedly owe, not only the most extended system of wireless telegraphy of to-day, but also to a large extent the extension of other systems which but for his lead would never have reached their present development. Yet no student of scientific progress can doubt for a moment that if Marconi had not stepped in at the critical point some other would have taken his place. The work of the true pioneers was done, the way into the new country was discovered, and it remained only for the most energetic and resourceful to till the virgin soil and reap the plentiful harvest.

Now that the reaping of the harvest is in sight we are confronted with the rival claims of the sowers. With a wisdom characteristic of the times, the Powers have decided that though each may sow and reap for himself, he shall conduct his operations in the way most advantageous to civilisation. This decision is embodied in the third article of the convention, which provides that "coastal stations and stations on shipboard are bound to interchange telegrams without distinction of the system of wireless telegraphy adopted by them." On behalf of the Marconi Company it has been urged that this provision was devised with the express purpose of obtaining for all systems—and especially the Telefunken system—the immense advantages of the Marconi Company's extended organisation. On the other hand, there could be no other reason for objecting to this clause than a desire on the part of the objector to establish a monopoly. As was pointed out in the article in NATURE to which reference has already been made, the peculiarities of wireless telegraphy render it essential for public utility that there should be either a world monopoly or a perfectly free interchange between competing systems. It is not difficult to choose between these alternatives, and no one, we venture to think, ten years hence will question the correctness of the decision now made.

There is little doubt, also, that once it is reconciled to the inevitable, the Marconi Company will realise the very substantial benefits it will obtain, both financially and otherwise. It is clear that the free and rapid growth of any one system will now tend to the development of all; it is clear, too, that the advantageous positions obtained by the Marconi Company on the coasts of the greatest shipping nation of the world will confer on it an inestimable advantage, of which it would surely have been deprived had a monopoly been allowed. It has been several times pointed out in NATURE that State control—and international control—of wireless telegraphy is a necessity, a fact recognised by all nations, and that this control could not be the control of a privately owned monopoly.

In reference to this clause—the only one of first importance—it should be mentioned that certain Powers, amongst them Great Britain, reserve the right to exempt certain stations from its operation on condition that they provide adequate substitutes for the closed stations.

One other proposal of great importance was that brought forward by the United States, that there should be the same obligation for compulsory intercommunication between ship and ship, and a supplementary agreement to this effect was signed by all the Powers except Great Britain, Japan, Italy, Mexico, and Persia. In view of the onerous nature of this obligation on shipowners in the present state of the art, we are inclined to think that the time is not yet ripe for its adoption, though doubtless it will be adopted by all the Powers at some future conference, and in the meantime individual ships have everything to gain and nothing to lose by carrying out its object whenever possible.

The convention also provides for priority of all messages of distress and answers thereto, for equitable division and regulation of charges, and for the establishment of an international bureau for the transaction of administrative work, publication of information, and so forth, but none of the twenty-three other articles deserves special comment. It may be added, though this naturally goes almost without saying, that the convention imposes no restrictions on the naval or military uses of wireless telegraphy. These never were and never could be a subject for international settlement. The various States are pledged to ratify the provisions as quickly as possible, and it is hoped the convention will become operative on July 1, 1908. Between now and then, we shall probably hear and read a good deal more about it in Parliament and in the Press, and it is to be hoped that those who write on the subject to the daily Press will make some attempt to understand the technicalities and to study the provisions of the convention.

MAURICE SOLOMON.

NOTES.

THE honours conferred by the King on the occasion of his sixty-fifth birthday appear to be mainly for political services, and there is little recognition of the claims of science. Mr. John Tweedy, president of the Royal College of Physicians, has received the honour of knighthood; Colonel R. C. Hellard, director-general of the Ordnance Survey, and Mr. F. G. Ogilvie, principal assistant secretary (Technology and Higher Education in Science and Art) Board of Education, have been appointed Companions of the Order of the Bath; Colonel D. A. Johnston, formerly director-general of the Ordnance Survey, has been appointed a Knight Commander of the Order of Saint Michael and Saint George; Prof. R. W. Boyce, F.R.S., has received the honour of knighthood; and Dr. J. M. Lang, Vice-Chancellor and principal of the University of Aberdeen, has been appointed a Commander of the Royal Victorian Order.

A STATEMENT has recently obtained currency that the French people themselves, after a hundred years' use of the metric system, cannot claim that it has been adopted throughout France, and a free translation of a circular issued to chambers of commerce in France by the French Minister of Commerce has been employed to support the statement. The Decimal Association in this country recently addressed a letter to the French Minister of Commerce with a view to determine what justification existed for the statement referred to. The Minister's reply makes it clear that the circular is directed only against the use of *old names* in certain trades, and that the English translation misinterprets its meaning and conveys a wholly wrong impression. It is satisfactory to find, in view of such endeavours to retard the acceptance of the metric system by this country, that it has recently been adopted in the works of Messrs. Joseph Crosfield and Sons, Ltd., and steadily grows in popularity.

UNDER the chairmanship of Mr. Lawrence Hardy, M.P., a large and representative conference of fruit growers from the fruit-growing counties of England was held at the South-Eastern Agricultural College, Wye, on November 7. Papers were contributed on planting of fruit trees, strawberries, American blight, and fungus diseases. In the latter paper reference was made to the American gooseberry mildew, the appearance of which in England has been noted by the college mycologist (Mr. Salmon), and a resolution calling upon the Board of Agriculture to take immediate steps to prevent further importation of gooseberry bushes and to destroy infected stocks in this country was unanimously passed. The disease appeared in Ireland in 1900, and has made most extensive ravages in that country, and serious alarm is felt by growers that a similar result may ensue in England unless drastic measures are immediately taken.

SHOCKS of earthquake were felt at Akureiri, Iceland, at 10.20 p.m. on November 8, followed by more shocks of less violence between 1 a.m. and 2 a.m. on November 9.

PROF. W. WIEN, professor of physics in the University of Würzburg, has become chief editor of the *Annalen der Physik* (Leipzig: J. A. Barth) in succession to the late Prof. Drude.

THE Bradshaw lecture of the Royal College of Surgeons will be delivered by Mr. Edmund Owen on Wednesday, December 12, upon the subject of "Cancer; its Treatment by Modern Methods."

A CHRISTMAS course of lectures, adapted to a juvenile auditory, will be delivered at the Royal Institution by Mr. W. Duddell, on "Signalling to a Distance; from Primitive Man to Radiotelegraphy" (experimentally illustrated). The lectures will commence on December 27.

IT is proposed, on the occasion of the retirement of Major Craigie, C.B., from the Board of Agriculture and Fisheries, to entertain him at a complimentary dinner on Wednesday, December 12, in recognition of his services to the interests of agriculture and the furtherance of statistical knowledge.

THE balloon *Milano*, of 1000 cubic metres capacity, which started from the exhibition grounds at Milan on Sunday morning, November 11, descended at Aix-les-Bains at

2 p.m. on the same day, having crossed Mont Blanc. The *Milano*, which was piloted by Signori Murillo and Cresti, rose to an altitude of upwards of 6000 metres while crossing the Alps.

THE Board of Agriculture and Fisheries announces that a horticultural exhibition will be held at Mannheim, in the Grand Duchy of Baden, from May to October, 1907. Exhibits from this country will be admitted to the fruit, vegetable, orchid, and cactus shows. Applications for information should be addressed to the office of the exhibition, Friedrichsplatz 14, Mannheim, Germany.

AT the annual general meeting of the Mathematical Society on November 8 the council and officers for the ensuing session were elected. The list is as follows:—*president*, Prof. W. Burnside; *vice-presidents*, Sir Wm. Niven, Prof. A. R. Forsyth; *treasurer*, Prof. J. Larmor; *secretaries*, Prof. A. E. H. Love, Mr. J. H. Grace; *other members of the council*, Dr. H. F. Baker, Mr. A. Berry, Mr. A. L. Dixon, Prof. E. B. Elliott, Dr. J. W. L. Glaisher, Mr. G. H. Hardy, Dr. E. W. Hobson, Prof. H. M. Macdonald, Mr. A. E. Western, Mr. A. Young.

THE *Athenaeum* announces the death, in his sixty-sixth year, of Prof. A. K. Christomanos, professor of general chemistry in the University of Athens. In 1889 Prof. Christomanos became director of the chemical laboratory in the University, and by his efforts it was brought to a high standard of perfection. He was the author of a number of works dealing with his special subjects, and also did good work in geology and mineralogy.

THE Prince of Monaco is, *La Nature* reports, arranging for a first international conference on oceanography and marine meteorology to be held, if possible, at the time of the inauguration of the museum of oceanography. The latter date is not yet fixed, but foreign men of science are being invited to take part in the proposed conference. Inquiries and other communications should be addressed to Dr. Jules Richard, at Monaco.

MR. JOHN DEVONSHIRE ELLIS, who died at his residence at Worksop on Sunday, November 11, was one of the makers of modern Sheffield, and a pioneer in the development of British metallurgy. He was the first to adopt the Bessemer process of steel making, and introduced many important inventions in the manufacture of armour-plates. He was vice-president of the Iron and Steel Institute, and in 1889 received from that body the Bessemer gold medal in recognition of the value of his services to the metallurgy of iron.

CIRCULARS of invitation have just been issued to the ninth International Congress of Geography, to be held at Geneva on July 27–August 6, 1908. The president of the congress will be Dr. A. de Claparède, president of the Geographical Society of Geneva; vice-presidents, Profs. R. Gautier and R. Chodat; and general secretary, M. Fernand Tavel. Most of the sections of the congress will meet in rooms at the University of Geneva. Four languages—German, French, Italian, and English—will be recognised at the congress, and memoirs should be written in one of these languages or in Latin. Papers and abstracts should be sent in by November 30, 1907.

AT the annual general meeting of the Cambridge Philosophical Society on October 29, Dr. Fenton, vice-president, in the chair, the following were elected officers of the society for the ensuing session:—*president*, Dr. Hobson; *vice-presidents*, Dr. Baker, Dr. Fenton, Mr. D. Sharp; *treasurer*, Mr. H. F. Newall; *secretaries*, Mr. A. E. Shipley, Rev. E. W. Barnes, Mr. P. V. Bevan; *new members of the council*, Prof. Larmor, Prof. Thomson, Dr. Duckworth, Mr. W. G. Fearnsides.

A REUTER message from Paris states that M. Santos Dumont made further trials of his airship on Monday in the presence of members of the committee of the Aéro Club and numerous spectators. At the second trial two wheels of the apparatus left the ground, and in five and one-fifth seconds the machine travelled a distance of about 500 metres, in the course of which it rose four times. At another trial the aëroplane started off, followed by a motor-car conveying the members of the committee. It rapidly covered 500 metres, proceeding by successive bounds and soon outpacing the motor-car. The committee, on measuring afterwards the distances traversed, found that the aëroplane, after reaching a height of between four and five metres, had traversed in level flight a distance of 220 metres, without touching the ground, in twenty-one and one-fifth seconds, thus travelling at the rate of about ten metres a second. The best time recorded was seven and one-fifth seconds over a distance of 82·60 metres, representing a speed of about 40 kilometres an hour.

MALARIA in Greece was the subject of a paper read by Major Ronald Ross, F.R.S., before the Oxford Medical Society on November 9. Prof. Ross described the valley of Lake Kopais, in Bœotia, the scene of his recent study of malaria in Greece. The locality was the dried-up bed of a large lake, drained in remote times, but in the Middle Ages reverting to marsh once more owing to the drainage works falling out of repair. Recently, restoration has been taken in hand, and the bed of the ancient lake is now a fertile plain covered with crops of all kinds, but the inhabitants are decimated by malaria, the type of disease being very severe, pernicious attacks common, and blackwater fever extremely common. In five localities the minimum malaria-rate among children was found to range between 25·5 per cent. and 40·9 per cent. Prof. Ross considers that the country is eminently suited to the application of drainage measures for the eradication of the disease. A Grecian malaria society has commenced the work with energy, and an appeal for funds on behalf of the scheme has been issued by the Liverpool School of Tropical Medicine, and is under the patronage of Princess Christian.

THE *Daily Chronicle's* correspondent at Rome reports that Prof. Waldstein's international project for the excavation of Herculaneum has gained the unanimous adhesion of the Royal Commission of Antiquities and Fine Arts in Rome, under the following conditions among others:—(1) Subscriptions are to be of a private character, without the official intervention of foreign States, and the funds are to be administered by an International Committee centred in Rome. (2) An executive commission is to be constituted of foreign members representing the contributing countries and Italian representatives. (3) All scientific material to be published first of all under the supervision and at the expense of the Italian Government, the Minister of Public Instruction being empowered to invite the co-operation of national and foreign publishing houses. (4) All objects excavated to be the absolute property of the Italian Government, which, however, will retain the faculty of conceding to foreign States, according to the measure of their respective generosity as contributors to the exploration fund, duplicates and other finds, where this can be done without prejudice to Italy's national collections.

AT the inaugural meeting of the new session of the Institution of Civil Engineers on November 6, the president, Sir Alexander Kennedy, F.R.S., delivered an address on the relation of the engineer and engineering to the world at large. In relation to science, he pointed out that not a few engineers spend their whole lives in what is really scientific work, while nominally only earning their daily bread in ordinary mechanical pursuits. The paths of the artist and the engineer seem too often to be divergent, but as soon as engineering works are treated on their own merits, and not as if they are mistaken imitations of other things, it will be found that they can possess even artistic as well as other merits. Everyone now recognises that there is a dignity in a *Dreadnought* which is almost majestic, and that a modern liner forms really as fine a subject for a picture as a full-rigged ship. In concluding, the president spoke of the future of engineering and of the possibility—which he thought a very small one—of finding anything in mechanical science corresponding to the "survival of the fittest," or any traceable lines along which mechanical evolution takes place. Invention forms such a disturbing influence in engineering evolution that any prophecy on evolutionary lines is impossible. It is still more useless to attempt to forestall the future by trying to do to-day what it is supposed that other people may try to do twenty years hence. The *Great Eastern*, broken up for scrap almost within hail of the *Carmania*, was a pathetic tragedy, from this point of view, in engineering.

EDUCATIONAL Leaflet No. 22 of the National Association of Audubon Societies is devoted to an account of the blue jay (*Cyanocitta cristata*) by Mr. W. Dutcher, the president of the association. It is accompanied by a coloured plate of the bird.

THE greater part of the September issue of the Proceedings of the Philadelphia Academy is taken up by the description of a large collection of Orthoptera from Montana, Utah, Colorado, and the Yellowstone Park. The authors of the paper are Messrs. J. A. G. Rehn and M. Hebard, of whom the second made the collection. Many new forms are described.

OF two zoological articles included in Nos. 6 and 7 of the fifth volume of the *Boletin de la Sociedad Aragonesa de Ciencias Naturales*, the first, by the Rev. R. P. Longinos Navás, is devoted to abnormal hens' eggs, of which several are figured in a coloured plate. Some of these appear to be of the type not uncommonly met with in the case of old birds about to cease from laying. One, however, is remarkable for its rose-red colour, due, it is supposed, to the parent hen having fed on a particular kind of bulb. In the second, three new Spanish Neuroptera are described, one forming the type of a new genus.

IN an address delivered to the Hull Scientific and Field Naturalists' Club at a conversazione held on October 17, Mr. T. Sheppard, the president, took for his subject the relationship between provincial museums and local scientific societies. The address has been published in the Transactions of the club, and reprinted in pamphlet form as No. 36 of the Hull Museum Publications. Hull, it appears, is very fortunate in respect to the good relations existing between the municipal museum and the local scientific society, this good fellowship, it is stated, being of special value to the museum, and likewise, in a minor degree, conducive to the interests of the ratepayers. In many other towns the relationship is, however, according to Mr. Sheppard, of a less satisfactory nature, the museum officials ignoring the work and disdaining the assistance of the amateurs. Neither is it considered advantageous for the museum to be "run" by the local society, such an arrangement tending, it is urged, to check donations owing to want of security as to the permanency of the former.

ACCORDING to *La Nature* of November 3, Brussels is about to inaugurate a new era in the matter of fresh-water aquariums by the opening of a building in the Avenue Louise. The new institution is not intended to be a merely popular exhibit, with a few tanks in which a certain number of more or less unhealthy-looking fishes are shown. On the contrary, it is purposed to display, as time goes on, the complete fresh-water fauna of Belgium in suitably constructed basins and tanks, including, of course, those distinctive of rivers, lakes, and ponds. Nor will the flora be neglected, the scheme being to show as much of this as is found practicable. The central salon will resemble a winter garden, with a large central basin and tanks let into the walls. In some of these tanks will be shown examples of all the indigenous fresh-water fishes, while others will be devoted to the exhibition of crustaceans, molluscs, batrachians, reptiles, worms, insects, and plankton. It is hoped that the institution will prove, not only an attraction to the general public, but that it will have a definite scientific value, and will also aid in the re-stocking of the depleted Belgian rivers with fish. Acclimatisation is to be a feature of the aquarium, in which a tank will be reserved for the American cat-fish, preparatory to introducing that species into the rivers of the country.

THE history and origin of zoological gardens and natural history museums forms the subject of a long article by Mr. J. von Pleyel in *Naturwissenschaftliche Wochenschrift* for October 28. Menageries, in the author's opinion, owe their origin partly to the cult of sacred animals and partly to the ambition of rulers to possess specimens of rare and valuable creatures from foreign lands or savage ones from their own. In their simplest form zoological gardens were, indeed, one of the earliest developments of culture, and were familiar to the Chinese, Indians, Greeks, Romans, and pre-Spanish Mexicans in very ancient times. The oldest recorded menagerie is, as might be expected, Chinese, dating from 1150 B.C. The den of lions kept by Darius, as described in the Book of Daniel, is an example of one of these primitive menageries, while the cult of sacred white horses by the ancient Greeks and Romans, and that of so-called white elephants in Burma and Siam, are instances of a second type. After a survey of the records of establishments of this nature during the Middle Ages and immediately succeeding periods, the author refers to the typical menageries of modern times, incidentally mentioning that a live giraffe was received at Schönbrunn so early as 1828. The Paris establishment is regarded as the earliest entitled to the designation "zoological gardens," in the modern sense of that term, which owes its origin, however, to the foundation of the menagerie in the Regent's Park. Of German establishments of this nature, the one at Berlin is the earliest.

THE causes producing a cessation of vitality in old trees are imperfectly, if at all, understood. There are various interesting problems concerned with this question, notably the continued propagation of trees by vegetative methods. In this connection Mr. R. S. Hole is contributing an article on pollard-shoots, stool-shoots, and root-suckers to the *Indian Forester* (July and August). It seems probable

that root-suckers play an important part in the regeneration of some Indian trees, and the author instances the production of practically pure woods of *Diospyros tomentosa* and *Ougenia dalbergioides* by this means, so that the subject is worthy of careful inquiry and observation.

THE September number of the Quarterly Journal issued from the Liverpool University Institute of Commercial Research in the Tropics deals mainly with agriculture on the west coast of Africa. Viscount Mountmorres writes a eulogistic article on the results achieved by the Gold Coast Department of Agriculture, comparing the gardens at Aburi very favourably with the gardens at Konakry, in French Guinea. Rubber and cacao are the primary products at Aburi, and the instruction of the natives in their cultivation and preparation is an important branch of the work. An account of the agricultural resources of the Ivory Coast, contributed by Mr. E. Castaing, provides interesting information as to the commercial varieties of the indigenous rubbers, the nature and uses of kola nuts, and the native method of preparing palm-oil.

AN account of the red-rot disease of sugar-cane caused by the fungus *Colletotrichum falcatum* occupies a considerable portion of the third memoir of the Department of Agriculture in India, which deals with fungus diseases of sugar-cane. The author, Dr. E. J. Butler, adduces evidence to show that the disease generally originates in the lower part of the plant, producing eventually characteristic red streaks in the vascular tissues. Amongst other fungal pests, Dr. Butler describes two stem diseases attributed to new species of Cystospora and Sphæronema, and a more serious leaf-spot disease caused by a species of Cercospora also differing from species hitherto recorded.

THE Department of Commerce and Labour, Washington, has issued a report on the blind and deaf (including the deaf and dumb) in the United States, the data having been collected in connection with the twelfth census (1900). At the census itself, however, the work of the enumerators was restricted to a brief preliminary return showing the name, sex, age, post-office address, and nature of the existing defects in all persons alleged to be blind or deaf. More detailed information was then obtained by direct correspondence with the individuals named in the primary returns, or with their parents or guardians, questions being asked as to the total or partial character of the defect, the age at which the defect, if not congenital, was first remarked, the supposed cause, the relationship, if any, between the parents, the relatives who were similarly defective, and the school, if any, at which the defective person had attended. It is from the data contained in these personal returns that the report is compiled. Dr. Alexander Graham Bell is responsible for the scope and conduct of the investigation, and the text of the report relating to the deaf. It may be noted that of the blind whose parents were cousins 25 per cent. were congenitally blind, whilst of the blind whose parents were not so related only 7 per cent. were congenitally blind. Similarly, of the deaf whose parents were cousins 42 per cent. were congenitally deaf, whilst of the deaf whose parents were not so related only 15 per cent. were congenitally deaf. The report is a valuable one, with much more, and more trustworthy, information than has yet been obtained in any similar investigation, but it suffers from a common defect, viz. the lack of comparative information of a similar kind relating to the non-defective, which is essential to a proper interpretation of the results; this especially applies to the statistics relating to defective relatives and to the consanguinity of the parents. The need is only partially met by the comparative figures for congenital and non-congenital defectives.

A NOTE by Signor Alessandro Artom on his system of wireless telegraphy, first invented in 1903, is contributed to the *Atti* of the Lincei Academy, xv. (1), 12. The peculiarity of this system is that by the use of two aërial conductors instead of a single antenna an unsymmetric electromagnetic field is produced, and it is thus possible to send messages in definite directions. Experiments have been made with the cooperation of the Italian naval authorities, chiefly between Monte Mario (Rome), Anzio (distant 55 km.), and the island of Maddalena. By varying the orientation of the aërials, communication could be established or cut off at will.

THE new "Dolomiten Strasse" brings many of the most interesting portions of the Dolomite region within easy access. Leaving Cortina, it rises rapidly over the Col di Falzarego, passing over a shoulder of Monte Nuvolau, and affording a fine distant view of the Marmolata ice fields. It then descends rapidly to Pieve Livinallonga, where it skirts the hill-side at a considerable height above the valley, and it next rises by zigzags to the top of the Pordoi Pass, passing close by some of the most interesting members of the Sella group. From here it descends to Campitello, whence Botzen may be reached *viâ* the Karersee. The new road is completed with the exception of the portion from the Col di Falzerego to Cortina, where the old road is available for vehicular traffic.

A "NATURE-KNOWLEDGE DIARY," compiled by Mr. W. Percival Westell, has been published by Messrs. Blackie and Son, Ltd. Provision is made for plotting the daily barometer readings on a suitably numbered squared paper chart, but it does not seem to have occurred to the compiler that thermometer readings are also worth plotting, and that the same charts can be used for this purpose. The general arrangement of the blank forms for recording observations, of which the diary is almost entirely made up, is likely to prove convenient. The price of the book is 6*d*. net.

THE eighth edition of Prof. R. Hertwig's "Lehrbuch der Zoologie" has just been published by Mr. Gustav Fischer, Jena. The work originally appeared fifteen years ago, and was reviewed in NATURE of June 22, 1893 (vol. xlviii., p. 173).

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A NEW COMET.—A telegram from the Kiel Centralstelle announces the discovery of a new comet at Copenhagen on November 10. Its position at 17h. 3·5m. (Copenhagen M.T.) was

R.A. = 9h. 16m. 3·2s., dec. = 12° 28′ 31″ N.,

and it is travelling in a north-easterly direction. The daily movement is given as +4·2m. in R.A. and +1° 10′ in declination. When discovered, the comet was about 8m. west of ϵ Leonis, and is therefore travelling towards the constellation Leo. Its position rises, at present, at about 11 p.m.

A second telegram from the Centralstelle informs us that this object was observed by Herr Rheden at Vienna on November 11, its position at 16h. 7·5m. (Vienna M.T.) being

R.A. = 9h. 20m. 9s., dec. = +13° 35′ 25″.

Unfortunately no idea of the comet's brightness is given in these telegrams.

THE TELLURIC LINES IN THE SOLAR SPECTRUM.—M. Štefánik is proceeding with his researches on the direct observation of the infra-red portion of the spectrum, and publishes an account of his most recent results in a communication to the Paris Academy of Sciences (*Comptes rendus*, No. 17). After briefly reciting the history of our knowledge of the telluric bands and lines, the author describes the two spectroscopes with which he carried out his researches at Chamonix, at the Grands-Mulets, and on the summit of Mont Blanc. In each case he employed the red screens which he has previously described, and by this means was able to see the region of the spectrum which extends from about B to 1 μ. On July 21, at the Grands-Mulets, he observed the setting sun with his prism spectroscope, and found that as the sun sank lower the group a was unequally strengthened in parts, whilst several feeble bands became visible between a and A. The groups Z, X, and Π were successively reinforced, notably more so as the sun sank into the haze gathered at the horizon. Similar observations made with the grating spectroscope at the summit of Mont Blanc on July 30 gave similar results, and a feeble band appeared between the groups A and Z. The increase in intensity of the groups Z and π was so considerable that their telluric origin was very obvious. Zenith observations revealed changes which in general were of the opposite character. At all three stations M. Štefánik obtained a number of photographs when the sun was highest and at the horizon, respectively, with both spectroscopes.

THE NUMBER OF THE VISIBLE STARS.—The total number of stars usually supposed to be visible in the largest telescopes and on the best photographs is about one hundred million, but according to a computation recently made by Mr. Gore this number must be accepted as the outside maximum. To obtain his results Mr. Gore made a number of counts on the photographic prints given in the late Dr. Roberts's volume of stellar photographs, and found that the average number of stars per square degree was 4137 in the Milky Way, 1782 near the Milky Way, and 408 in the non-galactic regions. Combining these results with the estimated areas of galactic and non-galactic regions published by Prof. E. C. Pickering, he obtained as the grand total of visible stars the number 64,184,757. This is probably smaller than the actual total, as some of the fainter star images would probably be lost in the reproduction of Dr. Roberts's photographs.

Clusters and nebulæ were avoided in making the counts, so that Mr. Gore's total will have to be increased on this account. In another count the average richness of the irregular clusters came out as 5752 stars per square degree, but this is far below the average richness of the globular clusters, one of which, ω Centauri, shows 25,000 stars per square degree (*Observatory*, No. 376).

STARS WITH PECULIAR SPECTRA.—In No. 4129 of the *Astronomische Nachrichten* Dr. H. Ludendorff discusses the spectra of the stars R Coronæ Borealis, 12 Canum Venaticorum, and 72 Ophiuchi, which he and Dr. Eberhard have photographed with the three-prism spectroscope (No. iv.) of the Potsdam Observatory. The remarkable feature in the spectrum of R Coronæ is the non-appearance of the hydrogen lines Hβ, Hγ, and Hδ; as the H and K lines are broad, the absence of Hϵ cannot be affirmed, but on a smaller scale spectrogram the ultra-violet lines of hydrogen do not appear. From the measurement of about thirty or forty lines on each of five spectrograms, Dr. Ludendorff finds the radial velocity of this star to be about +24·6 km. as compared with Prof. Frost's value of +14 km. The present values were, however, obtained during a period when the star was at its normal brightness, whereas Prof. Frost's referred to a period when it was fainter. It thus appears that the radial velocity may vary during the epochs of magnitude changes.

In the spectrum of 12 Canum Venaticorum, Dr. Ludendorff suspects changes in various chromium and iron lines. The magnesium line λ 4481 also appears to vary, and, whilst he can find no reason for the variation, Dr. Ludendorff suggests that this may be analogous to a similar phenomenon which Sir Norman Lockyer has pointed out in the spectrum of α Andromedæ, both stars being of the Markabian type.

AN INTERESTING VARIABLE STAR.—In No. 4126 of the *Astronomische Nachrichten* Prof. Barnard publishes the results of his visual observation of a variable situated in the brightest part of the cluster M3 (N.G.C. 5272).

Observations were made on 112 nights since March, 1899, and from the results the period was found to be 15·77594 days. The maximum magnitude of this object is about 12·0, and it varies through about two magnitudes.

CATALOGUE OF DOUBLE STARS.—Prof. Doberck continues the results of his double-star observations at the Hong Kong Observatory in Nos. 4130–1 of the *Astronomische Nachrichten*. The present list is similar in form to those previously published, and contains the results for about 170 stars.

THE TENTH INTERNATIONAL GEOLOGICAL CONGRESS.

THE tenth International Geological Congress met this year in Mexico, and the proceedings connected with it extended altogether over a period of nearly two months. Elaborate arrangements for the reception and entertainment of the members were made by the Mexican authorities; the President of the Republic, General Porfirio Diaz, himself manifested a lively interest in the work of the congress, and desired that everything possible should be done to make it successful. Over and above this, liberal financial assistance was rendered, the Mexican Government bearing half the cost of the steamer and railway fares of those attending the meeting.

In all, more than six hundred membership tickets were issued; members resident in Mexico of course predominated, and second place was taken by those from the remainder of the North American continent; of European countries, Germany was most strongly represented, which was perhaps natural in view of the large number of Germans who are engaged on the Mexican Geological Survey. It was surprising to find so few British representatives present, considering the great attractions which the country offers both to the geologist and to the mineralogist; all told, there were not more than five members who could reasonably be said to be representative of British science, and not one of these was officially delegated to the congress. This apparent indifference did not pass without comment on the part of the Mexican officials.

Several fairly long excursions, which will be referred to later, were arranged to take place before the meetings, but the formal proceedings of the congress began with the meeting of the council on the morning of Thursday, September 6, when the general arrangements were finally settled, and a programme of papers, &c., was drawn up for approval at the opening session; this took place the same forenoon in the hall of the old Minería (now part of the National School of Engineering). This meeting was presided over by President Diaz, who also, at the conclusion of the business, formally declared the congress open. In addition to the speeches of welcome, and addresses by the retiring president and the president-elect, the only business consisted in the approval of the proposed programme and of the proposed executive committee. The principal offices in the executive were filled by the election of the corresponding officers of the provisional committee in Mexico, as follows:—*president*, José G. Aguilera, director of the National Geological Institute (the Geological Survey); *general secretary*, Ezequiel Ordoñez; and *treasurer*, Juan D. Villarello, both of whom are also on the Survey.

The first of the ordinary meetings (which were held in the newly-completed National Geological Institute) took place on the afternoon of Thursday, September 6, under the presidency of Prof. Credner (Leipzig). A letter was first read from Mr. Karpinski (St. Petersburg), accompanying a copy of his memoir on "Les Trochilisques"—doubtful fossils occurring only in the Devonian—after which Mr. G. H. Heilprin read a communication on "The Occurrence and Interrelation of Volcanic and Seismic Phenomena," in which he maintained the view that shocks of tectonic origin are scarcely to be dis-

tinguished from those of volcanic origin; seismic phenomena are often preceded and accompanied by magnetic disturbances. This view was combated, however, by Prof. Lawson and Dr. Becker, while Mr. H. F. Reid held that the available data are quite insufficient for deciding the point. Dr. K. Renz (Breslau) next read a paper, "Ueber das ältere Mesozoicum Griechenlands," adducing reasons why certain marbles hitherto referred to the Cretaceous might be transferred to the Trias.

Several papers the titles of which appeared on the programme were abandoned or postponed owing to the absence of their authors.

It had been arranged that the meetings of the congress should take place only on alternate days, the intervening days being devoted to sight-seeing and excursions, so the second meeting did not take place until the forenoon of Saturday, September 8, when Prof. Diener (Vienna) occupied the chair. The first business was a statement by Dr. Adams (Montreal) regarding the general geological map of North America, of which copies (each consisting of four large sheets, scale 1 : 5,000,000) had been previously distributed to the members. This map has been prepared in accordance with the instructions of the Geological Society of America, which at its last meeting, in Ottawa, appointed a committee (members:—J. C. Russell (president), J. G. Aguilera, Bailey Willis, F. Adams, C. W. Hayes) to carry the matter through. The expense was borne by the Geological Survey of the United States, the Mexican Government assisting by purchasing a large number of copies for presentation to the members of the present congress. Explanatory notices are provided by Messrs. Bailey Willis and Aguilera. The nomenclature adopted is that of the United States Survey, and at the meeting this called forth a certain amount of criticism from Prof. Lawson (California), especially with reference to the use of the term "Algonkian."

The remainder of the forenoon meeting, and the greater part of the afternoon meeting, were devoted to papers and discussion on "The Climatic Conditions during the Geological Epochs." The first contribution was made by Prof. J. W. E. David (Sydney), who discussed the glacial phenomena more especially of Australia, but also of India, South Africa, and South America. He was followed by Prof. Frech (Breslau), "Ueber die Klimaänderungen der geologischen Vergangenheit." From Palæozoic times up to the present there has always been a correlation between the climatic evolution of the earth and the proportion of carbonic anhydride and of water vapour present in the atmosphere. Increases are due to volcanic exhalations, and diminutions to the formation of organic and, more especially, of inorganic compounds.

At the afternoon meeting of September 8, presided over by Prof. Frech, the general discussion was opened by Dr. E. Philippi (Berlin), and was continued by Messrs. C. Burckhardt (Mexico), Frech, A. Rothpletz (Munich), C. Diener, F. v. Kerner (Vienna), Vorwerg (Herischdorf), A. P. Coleman (Toronto), and M. Allorge (Oxford); it is impossible, however, to give in the space now available even a short review of the discussion. The general results were summed up by the chairman, who considered that the following might apparently be accepted as well-ascertained facts:—the existence of a Permo-Carboniferous Glacial epoch: uniformity of climate during the Triassic and the Jurassic; the existence of zones of climate since the Middle Cretaceous, and a gradual diminution of temperature during the Ternary and the Quaternary.

This was followed by a paper by General L. de Lamothe (Grenoble) on "Le Climat de l'Afrique du Nord pendant les Periodes Pleiocène et Pleistocène," after which Prof. Stefanescu (Bucharest) gave a description of the skeleton of *Dinotherium gigantissimum* (Stefanescu), a new species discovered by him in 1888, and, finally, a study by Mr. Hilgard on "The Causes of the Glacial Epoch" was contributed by Mr. M. Manson.

The discussion on climatic conditions was reopened at the next meeting on Monday, September 10, when Dr. Becker presided. The point chiefly dealt with was the question as to the causes which led to extensive glaciation in parts of the earth's surface where, under present conditions, an extensive snowfall is difficult to explain. The principal speakers were Messrs. W. M. Davis (Harvard), H. L. Fairchild (Rochester), Heilprin (Washington), David, and Frech.

The remainder of the forenoon meeting on September 10, and part of the afternoon meeting (under the presidency of Prof. Tschernyscheff, St. Petersburg), were devoted to the subject of the formation of ore deposits, but many of the papers announced in the programme were abandoned. The first paper was by Mr. H. F. Bain (Illinois), on "Some Relations of Palæography to Ore Deposition in the Mississippi Valley," and led to some discussion as to the possibility of soluble salts of the heavy metals reaching the sea, there to be deposited by secondary action. In his communication "Sur la Relation entre l'État propylitique (Grünstein) des Andesites et la Genèse des Filons liés à cette Roche," Mr. B. v. Inkey (Dömötöri) showed that the formation of the Grünstein which is so characteristic for the metalliferous veins of Hungary (and also, as Prof. Kemp pointed out, for those of the Sierra Nevada) is due chiefly to the chloritisation of the black augite and hornblende of the original andesite, and results from an action quite different from the kaolinisation along the veins themselves. This paper also gave rise to considerable discussion. Prof. J. F. Kemp (New York) read a paper on "Ore Deposits at the Contacts of Intrusive Rocks and Limestones, and their Significance as regards the General Formation of Veins," holding that the evidence indicated that part of the material for the mineral formation must have been brought in by water, which probably came from the intrusive magma. Other papers, which, however, did not give rise to much discussion, were contributed by Mr. Villarello (Mexico), "Sur le Remplissage de quelques Gîtes metallifères"; Mr. W. H. Weed (Washington), "The Origin and Classification of Ore Deposits"; and Mr. Lindgren, "The Relation of Ore Deposits to Depth."

Three papers illustrated by lantern pictures followed; the first, by Mr. G. Andersen, dealing with the Swedish Antarctic Expedition, was contributed by Prof. Sjögren; the second, by Mr. Heilprin, dealt with the eruption at Martinique; whilst the third, by Dr. Tempest Anderson (York), dealt with that of St. Vincent.

At the Wednesday's meeting, September 12, presided over by Prof. Rothpletz, Prof. Königsberger (Freiburg i. B.) read a paper, "Ueber den Verlauf der Geoisothermen in Bergen, und seine Beeinflussung durch Schichtstellung. Wasserläufe und chemische Processe." In the course of this he showed how, by means of a special apparatus devised by him, variations of underground temperature might be measured accurately, and indications obtained by which volcanic eruptions might be foretold. This led to a discussion in which Messrs. Becker, Schmidt (Stuttgart), Günther (Munich), and von Kerner (Vienna) took part. Thereafter Prof. Keilhack (Berlin) discussed the mode of formation of the onyx bed at Etla, Oaxaca (Mexico), and Mr. Diaz (Colima) gave particulars regarding the volcano of Colima, pointing out that there was, apparently, a periodicity in its activity. It was announced that the discussions on "The Nomenclature and Classification of Rocks" and on "The Relations between 'Tectonique' and Eruptive Masses" would not be proceeded with.

Various resolutions of the council were approved, namely, that the new subject for the Spendiaroff prize be "The Description of a Fauna with Reference to its Geological Evolution and its Geographical Distribution"; re-approval of the proposal to create a model institute of geophysics; the institution of a special commission to study the variations of the geothermal degree.

The concluding items were a lecture by Mr. Sabatini (Rome) on "La dernière Éruption du Vésuve," and another by Dr. Tempest Anderson on the same subject; these were accompanied by lantern illustrations.

There was no afternoon session.

The last meetings took place on Friday, September 14. At the forenoon session, Mr. C. W. Hayes (Washington) presiding, the most important matter dealt with was "The Earthquake of San Francisco," introduced by Prof. Lawson, whose paper was followed by a discussion in which Messrs. Frech, T. L. Ransome (Washington), and H. F. Reid (Baltimore) took part. The other papers were on "Interglacial Periods in Canada," by Prof. Coleman; "Geologic Classification in the North-Central

Portion of the United States," by H. N. Darton (Washington)"; "A Meteorite Crater of Arizona," by Prof. Fairchild.

The afternoon meeting was presided over by the president, Mr. Aguilera. Only two papers were communicated, one at the beginning by Prof. David, on "The Occurrence of Diamond in Matrix at Oakey Creek, Inverel, New South Wales," and one at the end by Mr. E. O. Hovey (New York), on "La Sierra Madre Occidentale de l'État de Chihuahua," which was illustrated with lantern views. The intervening period was taken up with reports and general business. Prof. Reid gave a *résumé* of the report of the International Glacier Committee, of which he is president. No report having been received (though asked for) from the committee on the geological map of Europe, a motion was carried regretting the omission. The secretary read a report by Sir Archibald Geikie, president of the committee on cooperation in geological investigation, which was approved. It was announced that the committee of the Spendiaroff prize had awarded this to Prof. Tschernyscheff for his work on "Die obercarbonischen Brachiopoden des Ural und des Timan." Prof. Frech presented the report of the committee on the "Palæontologica Universalis," and its proposal to extend the scope of its publications was unanimously approved; several new American and Mexican members were elected to the committee.

Prof. Sjögren then invited the congress to hold its eleventh session at Stockholm, and in 1910 instead of 1909. The invitation was accepted with acclamation, and it was agreed to leave the date to be fixed by the Swedish committee. (In view of the British Association meeting at Winnipeg in 1909, the later date would be preferable, so far as British geologists are concerned.)

Hearty votes of thanks to the Mexican Government and the organising committee were passed on the motion of Prof. Stefanescu and Mr. Sabatini. They were responded to by Mr. Aguilera, who thanked the foreign geologists for coming so far to make the congress a success, and invited them all to meet again at Stockholm. This closed the formal business of the congress.

A number of very interesting excursions had been arranged in connection with the congress. They were of two kinds—one-day excursions between the meetings, and long excursions of from three to twenty days' duration, which took place before and after the congress proper. The former were free of expense to the members, and for the others an inclusive charge which averaged about fifteen shillings *per diem* was made, the greater part of the expense being borne by the Mexican Government.

The first one-day excursion was devoted to the City of Mexico itself, the members being driven about the town and shown the museums and other public institutions. On the Sunday a long day was devoted to Cuernavaca, and this proved to be probably the most interesting of all. After journeying for some miles over the plain in which Mexico stands at an altitude of nearly 7500 feet, there is a stiff ascent of the range which bounds this plain, the railway reaching an altitude of almost 10,000 feet. Cuernavaca lies nearly 5000 feet down on the other side, and the steep, winding descent is very picturesque. From near the summit magnificent views are obtained over the lower plain, from which rise numerous volcanic cones and ranges apparently but little changed from the time of their formation; the whole stretches out before the observer just like an immense relief map. On the map, the distance from Mexico to Cuernavaca is barely forty miles; by rail it is seventy-five, and the double journey takes more than nine hours. The town itself has one of the finest situations in Mexico, and is a favourite resort. Cortés built his country palace there, and on its terrace the congress was entertained to a banquet by the Municipal Council.

Another day was spent in visiting the Toltec remains at San Juan Teotihuacán. Here there are two pyramids (of the sun and the moon), and the remains of many other interesting structures. After inspecting these, the members lunched in the "Grotto Porfirio Diaz," a large, natural cavity formed under an ancient lava flow in the neighbourhood.

The last of these excursions was to the celebrated silver district of Pachuca, where visits were paid to various mines and works; in these the celebrated "patio process" was seen in operation on a large scale.

Four of the long excursions took place before the congress opened. One, of nine days' duration, was to the south, and visited, in addition to various districts of more purely geological interest, the famous Mitla ruins near Oaxaca. Another, of three days, went east to Vera Cruz, on the coast, returning by Orizaba over the celebrated picturesque route of the Mexican Railway (known as "The Queen's Own" from its British origin), with its difficult engineering and striking scenery. The remaining excursions had special attraction for vulcanologists. On the one, the principal points of interest were Jorulla and Toluca, though the whole excursion lasted for thirteen days; while the last, of twelve days' duration, had Colima as its principal attraction.

In connection with these excursions, the greatest pains had been taken to make the visits as enjoyable and profitable as possible. Special trains, conveyances, and riding horses were provided; detachments of the famous *Rurales* (a kind of military gendarmerie) attended to the safety and comfort of the travellers; where hotels were not available on the cross-country journeys, camp equipment was sent in advance, or the proprietors of *haciendas* were called upon for hospitality. The travellers, therefore, performed their journeyings under exceptionally favourable conditions. It was not possible to carry out the full programme in every case, however, as the excursions took place during the rainy season, which this year has been somewhat exceptional. At the same time, the difficulties or dangers were not nearly so great as, it appears, the sensational accounts in some European papers would lead one to believe was the case.

The principal excursion took place after the congress, from September 15 to October 4. The field covered extended from Mexico City right up to Arizona in the north and down to Tampico in the east, and the distance travelled amounted to three or four thousand miles. The members taking part were accommodated in two special Pullman trains, which served both as means of conveyance and as hotel. The route was arranged so as to include a very wide range of interesting ground, so that all tastes were catered for. Numerous mines were visited—sulphur, silver, copper, lead, and coal—also oil wells; various smelting and separation processes were seen in operation; extinct craters were inspected, and fossiliferous beds were searched for specimens; and, in addition, there was the general interest peculiar to the country itself, to say nothing of the splendid hospitality everywhere encountered. It is impossible to enter into details of the trip, but two striking features may be mentioned. The first is the great stretch of semi-arid region towards the north of the Republic, through which the railway passes for hundreds of miles. This is practically level, and consists of a series of "Bolsons," which at first sight look as if they must have been of lacustrine formation. The evidence is entirely against this, however, and the supposition is that, though the first depositions may have taken place in shallow lakes, these were soon obliterated, and the great bulk of the deposit was levelled out simply by the rush of surface water during the rainy seasons. From the plains thus formed the mountains rise with startling abruptness, as from a sea, sometimes with fantastic outlines, so that the traveller could almost imagine he was sailing some distance off a mountainous coast, like that of Norway. Even more interesting were the opportunities afforded for studying geological structure on a large scale. The mountain ranges are generally bare of vegetation and overlying material, so that the contortion, folding and faulting of strata, formation of anticlinal valleys, &c., can be observed with the greatest ease. This was particularly noticeable along the railways in the neighbourhood of Monterrey, and it was a matter for regret that arrangements had not been made for the train to stop at various points to enable the photographers of the party to make proper exposures; good photographs of many of the structures observed would have possessed all the lucidity of geological diagrams, with the additional advantages which pertain to truthful representations of actual structures.

A special side excursion had been arranged for those members of the party specially interested in mining and metallurgy. These, as the guests of the Copper Queen Co., left the main body at El Paso, on the frontier, and travelled west to Bisbee (Arizona), Cananea (Sonora, Mexico), Douglas (Arizona), and Nacozari (Sonora), visiting the various copper mines and smelting works at these places, and then rejoining the main party.

Although by that time the rainy season was supposed to be nearly over, the members taking part in the northern excursion also had some experience of the difficulties caused by "wash-outs," &c., in a country like Mexico, and at several places the programme had to be curtailed owing to delays to the trains.

The last event of all was an excursion of a week's duration made by a party of sixty or seventy members, who left Mexico City on October 6 to visit the Isthmus of Tehuantepec as the guests of Sir Weetman Pearson, whose firm have constructed the railway and docks which now serve as a means of communication between the Atlantic and Pacific coasts of the Republic at its narrowest part.

As has been indicated, the members of the congress were everywhere received with the greatest hospitality, on the excursions as well as in the capital. One of the many social functions during the meeting may perhaps be allowed special mention; this was the reception of the members by President and Madame Diaz in the famous Palace of Chapultepec ("The Hill of the Grasshopper"). After having been welcomed by their hosts, they spent some time admiring the magnificent views from the upper terraces, including the city and the distant snow-capped peaks of Popocatapetl and Ixtaccihuatl. In the evening they were entertained to a banquet on the lower terrace; they had been invited "to tea," but tea appeared to be the one thing which was not provided.

The meeting of the congress was in all respects a very great success, and for this the Mexican officials, both of the Government and of the congress, deserve the highest praise. While all did well, it is no disparagement to the others to say that thanks are specially due to the general secretary, Mr. Ordoñez, for the admirable manner in which he filled that responsible and trying position.

METEOROLOGICAL NOTES.

THE frequency of thunderstorms in relation to the sun-spot period is discussed by Dr. Aksel S. Steen in a reprint from the "Hann-Band der meteorologischen Zeitschrift." The author has dealt with data from Norway, Sweden, and Denmark, using material from twenty, twenty-eight, and eight stations in each country respectively, extending from the years 1873 to 1903. The result of the inquiry is to show that the curves for the frequency at each of these regions have maxima at about the times of the sun-spot maxima, and minima at about sun-spot minima, but underlying this variation one of half the period is apparent. In combining the results of all the three stations, the curve still shows the eleven-year variation with the change of shorter duration.

Dr. Steen suggests that similar observations covering other regions should be discussed to see if they exhibit similar changes.

Another reprint from the same "Hann-Band" deals with the yearly air movement as determined by registering anemometers over some European stations, and is contributed by Dr. Felix M. Exner. The author discusses, in the first instance, wind observations made at Pola, Vienna, Potsdam, Zurich, Santis, Bremen, Obir, and Sonnblick.

His method of analysis is to calculate the resultant of the sixteen wind directions and to reduce them to north and west components. Thus winds from the west or east were considered as $+W$ and $-W$, while those from the north or south were treated as $+N$ and $-N$. The resulting west and north components were then determined for each year, and expressed in units of hundreds of kilometres.

It is shown that, according to the sign of the west component, with the exception of Pola, all the stations are under the influence of the general air circulation from the west. In the case of the north component, such a general result is not obtained. It is positive in Vienna, Zurich, and on the Sonnblick, sometimes positive in Pola and on the Obir, but generally negative. Local causes are suggested as to the origin of some of these results. At Potsdam, Bremen, and Santis the north component is negative, and these are considered as good undisturbed stations.

The proportion of the north to the west component is generally less than 1 or -1, so that the resulting wind direction is from the S.S.W. The author next investigates the atmospheric pressure values in relation to these variations of wind direction and velocity, and concludes that the yearly northern pressure gradients vary considerably, and that these changes harmonise in a satisfactory manner with those of the air movements. The paper is accompanied by numerous sets of curves showing the similarity of the variations discussed.

Prof. H. Hildebrand Hildebrandsson contributes an important article in the same "Hann-Band" on the circulation of the upper layers of air above the maximum of the North Atlantic Ocean. Prof. Hildebrandsson refers to the recent important researches of Messrs. Rotch, Teisserenc de Bort, Hergesell, Clayton, and Maurice, and, finally, says that "our results concerning the general circulation of the atmosphere are verified by direct observations made by means of kite flying and free balloons."

The article is accompanied by two very instructive maps showing for summer and winter the mean direction of motion of the upper clouds in relation to the isobars. These charts bring out clearly the east-to-west motion throughout the year of the upper currents over the equator and the west-to-east motion in the higher latitudes, indicating an enormous whirl of air round the pole.

In another reprint from the same source we have a discussion of two long series of evaporation measures made at the Kremsmünster Observatory; this discussion was undertaken by Prof. P. Franz Schwab, director of the observatory. The observations divide themselves naturally into two groups, the first series being commenced in 1821 and ending in 1845, while the second began in 1885 and is being continued to-day.

Prof. Schwab in a series of tables brings together the monthly and yearly values, and treats the daily and annual variations at some length, comparing the latter with results obtained at numerous other stations.

Dietrich Reimer (Berlin, 1905) has published an excellent mean rainfall map of Germany, with explanatory notes, which have been prepared by Prof. G. Hellmann. This map, which is on a scale of 1 : 1,800,000, shows the distribution of the mean yearly rainfall over the land from 3000 stations, the observations from which the values were derived extending from 1893 to 1902. To gain some idea of the distribution of these stations, it may be stated that Prussia and the other North German States are represented by 2341 stations, Bayern by 252, Saxony by 166, Württemberg by 90, Baden by 49, Hessen by 32, and Elsass-Lothringen by 70. Thus in North Germany there is one station for every 163 square kilometres, and one for every 295 square kilometres in South Germany. The map gives twelve different shades (ten in blue and two in yellow), and shows at a glance the geographical distribution over this part of Europe.

In the introduction to the meteorological report for the year 1903, published by the Survey Department, Finance Ministry, Cairo, we read that "The meteorology series for Abbassia closes with the end of 1903, and that for Helwan begins from January 1, 1904." In this volume we have in the appendices the first instalment of a few discussions relating to the data collected at Abassia since it was started. These are quite brief, but the discussions will no doubt serve to indicate points for future study. Thus, for instance, the large differences in evaporation recorded at the observatory are well worth careful study, and they will no doubt be found to be closely associated with changes of other meteorological elements when a longer series of observations becomes available. The present report includes all the meteorological data collected at the observatory and various out-stations, together with daily readings of the various river-gauges situated at different parts of the Nile. The reader's attention should, however, be

directed to the rather long list of errata for this volume given at the beginning of the report.

In vol. xx., part i., of the Indian Meteorological Memoirs, we have the first instalment of what we hope will be a series of valuable contributions to the meteorology of the upper air in India.

Up to the present time Indian meteorologists have been considerably hampered in dealing with the air circulation over India, as the only fact which existed from which they could form any idea of the air currents in the upper strata was the movement of clouds.

A systematic investigation of the upper air began, however, last year, and the chief points of the inquiry in the first instance are to determine the distinctive features of the monsoon currents as regards their depths, temperature and velocity gradients, and humidity distributions.

In the present memoir, written by Mr. F. H. Field, deputy meteorologist, and published under the direction of Dr. G. T. Walker, reference is naturally made more to the instruments employed and the methods of using them than to the observations recorded. Advantage has naturally been taken of the experience of other workers in the field, and the English, American, and German systems have all received careful study.

The greatest height as yet reached is 1380 metres, and some details are given as to the records of the self-registering instruments employed during the flights made in August and September last when this elevation was reached.

The importance of this method of investigation will at once be seen when it is noted that accurate measurements can be made of the elevation of the stratum of saturated air day by day. Thus we read that "a nearly saturated stratum of air from the sea extended from the ground surface (about 10 metres above the sea) upwards to a level which rose from 500 metres on August 27 through 800 metres on August 28 to 1130 metres on August 31. From that day onward till September 9, its limiting height was not reached by the kite, but probably exceeded 1000 metres; its upper limit fell again by September 12 to 600 metres."

The reader is referred to the memoir itself for details regarding the apparatus used and the various interesting meteorological curves given relative to the numerous flights made.

FURTHER RESULTS OF THE JESUP NORTH PACIFIC EXPEDITION.

THE recently published memoirs of the Jesup North Pacific Expedition maintain the excellence both as to matter and illustration of the previous volumes. Mr. Swanton[1] gives an account of the religious ideas and social organisation of the Haida Indians, who, to the number of about 600, occupy the towns of Skidegate and Masset, Queen Charlotte Islands. The whole Haida stock is divided into two "clans," the Raven clan and the Eagle clan, the significance of the division being purely social. Each is strictly exogamic, a Raven man being compelled to marry an Eagle woman, and an Eagle man a Raven woman, while the children always belong to their mother's clan. A man of the Raven clan was reckoned in that clan wherever he might go, and the Ravens among whom he settled were his uncles, elder and younger brothers, sisters and nephews. The members of the opposite clan were frequently considered downright enemies. "Even husbands and wives did not hesitate to betray each other to death in the interest of their own families. At times it almost appears as if each marriage were an alliance between opposing tribes; a man begetting offspring rather for his wife than for himself, and being inclined to see his real descendants rather in his sister's children than in his own" (p. 62).

The Raven and the Eagle do not seem to have been deities or deified ancestors. "A West Coast man said that the people sometimes left food for a raven on the beach, and, when it got near them, told it to give them something." Another man, however, said "they did not sacrifice to it or pray to it, because it stole too much as it was." And although Eagle was called "grandfather" by men of the Eagle clan, as Raven was called "grandfather" by the Ravens, this was not because either was regarded as a direct ancestor, "but because they had been prominent heroes of the mythical period, and belonged respectively to the Eagle and Raven clans."

The clans were divided into an indefinite number of "families," and the "family" is the fundamental unit in Haida society. These usually take their names from towns or camping grounds, and are simply local groups. The "family" was divided into households, and there were thus house chiefs, family chiefs, and town chiefs.

The families had certain prerogatives which they guarded jealously, such as the right to use certain personal, house, and canoe names, and the right to wear certain objects or representations of objects, and to carve them upon their houses or property. "These latter I have called 'crests.' They were generally representations of animals; but trees, shells, and figures of objects used in daily life also occur. They were originally obtained from some supernatural being or by purchase from another family." The author is wise in refraining from the use of the word *totem* in this connection, for, as he justly remarks, "they have . . . no proper totemic significance, their use being similar to that of the quarterings in heraldry, to mark the social position of the wearers"; but the name "totem-pole" has crept in beneath the illustrations of the poles, carved with crests, placed on front of the houses (Plates i.–iii.).

The author is of opinion that the "crest system" was "rooted in religion," and that it may have developed from the "personal manitou" (p. 112).

The study of the Haida social organisation is of peculiar interest, since it is possible to view the conflict actually going on between the purely maternal family organisation and the paternal property laws, and the complexities resulting therefrom. It is to be hoped that future observers will apply Dr. Rivers's genealogical methods to the investigation of the sociology of these and other American tribes, as it would be sure to yield important results. This method, however, was not published in time for Mr. Swanton to utilise it.

Turning to religious beliefs, the Haida world is peopled with supernatural beings of the air, sea, and land; the sun is of comparative unimportance, and the moon belongs to the Raven clan. The chief of the Haida deities is Power-of-the-Shining-Heavens, who gives "power" to all things; he is prayed to in sickness or sorrow, and the clouds are his blankets. Owing to the character of the country, the entanglement of land and sea, and the impenetrable nature of the interior, all communication must be by sea, and the supernatural beings of the sea have thus attained an exaggerated importance; but a supernatural being can be destroyed "by cutting its body in two and throwing a whetstone between the severed portions. In their endeavours to coalesce, the two parts then grind themselves to nothing."

The shaman was "possessed" by a supernatural being, and became for the time being the supernatural being himself. The calling was generally hereditary in the family, descending from maternal uncle to nephew, but the youth had to qualify himself by training. "Spirits would come and look around a village to find 'one who was clean' through whom they would act." To become "clean" a man had to abstain from food for a long time. A spirit once, looking through the smoke-hole of a house, saw a youth lying almost dead, "but he was so 'clean' that he looked transparent 'like glass.' So the spirit entered him."

The volume, which is profusely illustrated, deals also with secret societies and potlatches, or the ceremonial giving away of property, and contains nearly 200 Haida stories.

The third and last part of the volume of the Kwakiutl texts[1] collected by Dr. Boas and Mr. Hunt is now published. These folk-tales form a mine of treasures for the folklorist, and are especially valuable as giving unbiased and unconscious evidence concerning custom and belief.

[1] "Contributions to the Ethnology of the Haida." By J. R. Swanton. Jesup North Pacific Expedition, vol. v. part i., 1905.

[1] "Kwakiutl Texts." By Franz Boas and George Hunt. Jesup North Pacific Expedition, vol. iii. part iii., 1905.

Numerous songs are given, many being songs of cannibals. The volume concludes with a *précis* of each tale. The authors are to be congratulated on the termination of what must have been a laborious piece of work.

The study of the religion and myths of the Koryak[1] is of particular interest, since these people are very little known, and they seem to have been successful in resisting the efforts of the Russians to convert them to Christianity, and to have preserved their primitive religion to a considerable extent.

The Supreme Being occupies an important position in the religious life of the Koryak, but the conception of him is vague. Nothing is known of his world-creating activity, except that he sent down Big Raven to our earth to establish order, and Big Raven is the founder of the world. The One-on-High plays no active part in the myths which occupy more than one-half of the volume; these deal almost exclusively with the life, travels, adventures, and tricks of Big Raven, his children, and other relatives. The value of this record is greatly increased by a comparison of the Koryak myths with Kamchadal, Chukchee, Yukaghir, Mongol-Turk, and American mythologies.

Descriptions are given of the festivals and sacrifices, and customs at birth, death, and funerals; many of the charms and sacred implements, and some of the ceremonies, are illustrated from photographs and drawings.

A. C. HADDON.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The electors to the Isaac Newton studentships give notice that in accordance with the regulations an election to a studentship will be held in the Lent term, 1907. These studentships are for the encouragement of study and research in astronomy (especially gravitational astronomy, but including other branches of astronomy and astronomical physics) and physical optics. The studentship will be tenable for the term of three years from April 15, 1907. The emolument of the student will be 200*l*. per annum, provided that the income of the fund is capable of bearing such charge. Candidates for the studentship are invited to send in their applications to the Vice-Chancellor between January 16 and 26, 1907, together with testimonials and such other evidence as to their qualifications and their proposed course of study or research as they may think fit.

The State medicine syndicate reports that it has held two examinations in tropical medicine and hygiene during the past year. At the January examination six candidates presented themselves, three of whom passed and received diplomas. At the August examination eleven candidates presented themselves, of whom ten passed and received diplomas. The syndicate proposes to contribute out of the funds in its hands the sum of 150*l*. annually as part of the stipend of the reader in hygiene.

Mr. Ernest Gardner, M.P., has been appointed a member of the board of electors to the professorship of agriculture, and Sir Walter Gilbey, Bart., an additional member of the board of agricultural studies.

The following have been appointed examiners for the natural sciences tripos:—physics, Mr. C. T. R. Wilson and Mr. J. A. McClelland; chemistry, Dr. Fenton and Mr. H. B. Baker (Oxford); mineralogy, Mr. A. Hutchinson and Mr. H. L. Bowman (Oxford); geology, Mr. P. Lake and Mr. E. J. Garwood; botany, Mr. F. F. Blackman and Mr. A. G. Tansley; zoology, Prof. E. W. MacBride and Mr. R. C. Punnett; physiology, Mr. F. G. Hopkins and Dr. T. G. Brodie (London); and human anatomy, Mr. T. Manners-Smith and Dr. A. Robinson (Victoria).

The Mark Quested exhibition of 60*l*. a year for three years ending Christmas, 1909, has been awarded to F. A. Potts, of Trinity Hall, assistant to the superintendent of the museum of zoology.

THE honorary degree of LL.D. has been conferred upon Sir W. H. Perkin, F.R.S., by the Johns Hopkins University, Baltimore.

[1] "The Koryak, Religion and Myths." By Waldemar Jochelson. Jesup North Pacific Expedition, vol. vi. part i., 1905.

A NEW building for the engineering department of the University of Pennsylvania was formally dedicated on October 19, and is said to be the largest and best equipped structure devoted to engineering education in the United States. The cost, including equipment, was 200,000*l*.

THE council of University College, London, has received from the committee and subscribers of the Carey Foster Testimonial Fund the sum of 143*l*. to be applied in the award of an annual prize in physics, to be known as the Carey Foster research prize. This fund is the balance of that raised for the portrait of Dr. Carey Foster which was presented to the council in July last.

WE learn from *Science* that the Georgia Legislature has appropriated 20,000*l*. to erect and equip a building for the Agricultural College, and that the New York State College of Agriculture at Cornell University has received a gift of 6000*l*. for the foundation of six agricultural scholarships. Our contemporary also states that the University of Florida has been removed during the summer from its former position at Lake City to new grounds and new buildings at Gainsville, Fla. The new grounds comprise a tract of five hundred acres just outside the city limits of Gainsville.

IN his report for 1906 on secondary education in Scotland, Dr. J. Struthers, the secretary to the Scotch Education Department, devotes a section to the teaching of science. After directing attention to the satisfactory progress made in the secondary schools of Scotland in developing a sound and well-considered course of experimental science, the secretary remarks on a common mistake in the practice of science teachers in allowing inadequate time for the discussion of experimental exercises. As one of the inspectors reported to the Department, "unless frequent occasions are afforded for conference on class results, divergences, and conclusions, the work is apt to degenerate into a series of more or less isolated operations in which the pupils are found, not only lacking in their grasp of the subjects of study, but deficient in their knowledge of the units they are using and in their understanding of the constants they have determined." This failing is not confined to Scottish schools, and teachers would do well to take every precaution that the experiments do not degenerate into mere recipes unintelligently worked through by the pupils. Unless the pupils acquire a comprehensive idea of the meaning of series of connected experiments, they are obtaining little help in learning how to employ scientific methods.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 21.—"Experimental Evidence of Ionic Migration in the Natural Diffusion of Acids and of Salts.—Phenomena in the Diffusion of Electrolytes." By R. G. **Durrant**. Communicated by W. A. Shenstone, F.R.S.

Conclusions.—The results as given in the present paper appear to afford a considerable body of data tending to support the theory of Nernst and Planck.

So far as the author is aware, the method of studying band boundaries has been almost entirely confined to experiments in which batteries have been employed, as in the work of Orme Masson and of Steele.

The earlier experiments in jellies and the later experiments with silver nitrate and calcium chloride show that very fairly sharp bands are obtainable without batteries.

The evidence goes to show that hydrogen ions move in advance of the diffusion front, whereas other ions produce their various "effects" in the rear of the diffusion front.

Entomological Society, October 3.—Mr. F. Merrifield, president, in the chair.—*Exhibitions.*—Commander J. J. **Walker**: A specimen of *Calosoma sycophanta* taken in Denny Wood, New Forest, June 16; *Lygaeus equestris*, L., found in the Isle of Sheppey on September 22; *Sitaris muralis*, taken near Oxford in August by Mr. A. H. Hamm; varieties of *Vanessa urticae*, *Argynnis adippe*, *Lycaena icarus*, ♂, and of an almost black form of *Strenia clathrata* occurring at Streatley, Berks, in August—all

taken this year.—G. T. **Porritt**: A series of *Abraxas grossulariata*, var. *varleyata*, bred this year from a pairing of the variety, all the brood being of the variety: none showing the least tendency to revert to the ordinary form.—C. P. **Pickett**: A gynandromorphous specimen of *Angerona prunaria* bred by him, and a ♂ specimen of *Fidonia atomaria*, caught at Folkestone, with six wings.—F. W. and H. **Campion**: Specimens of the rare dragon-fly *Sympetrum flaveolum*, taken near Epping in August last. It was suggested that these were part of a migration of the species such as occasionally takes place.—Dr. F. A. **Dixey**: Specimens of *Nychitona medusa*, Cram., *Pseudopontia paradoxa*, Feld., *Terias senegalensis*, Boisd., *Leuceronia pharis*, Boisd., and *L. argia*, Fabr. Although there does not exist any direct evidence that the members of the genus Nychitona are distasteful, their habits are such as to suggest this mode of protection, and there is little doubt that they have served as models for other insects.—H. St. J. **Donisthorpe**: Examples of *Dinarda pygmaea*, Wasm., with our other three species, *D. hagensi*, Wasm., *D. dentata*, Gr., and *D. märkeli*, Kies., with their respective hosts.—Dr. N. **Joy**: Species of Coleoptera first recognised as British in 1906; a variety of *Lathrobium elongatum*, L., from South Devon, with entirely black elytra, and which he proposed to call var. *nigrum*; a curious dull aberration of *Apteropeda globosa*, Ill.; *Heterothops nigra*, Kr., taken in moles' nests; and a species of Gnathoncus differing in certain characters from *G. rotundatus*, Kugel, and which occurs almost exclusively in birds' nests.—G. B. **Oliver**: A melanic ♀ of *Acidalia marginepunctata*, Goeze, and a melanic ♂ of *A. subsericeata*, Haw., both taken in North Cornwall this summer, together with the typical forms for comparison; also a dark aberration of *Coenonympha pamphilus*, Linn., taken in the same district.—**President**: A series of *Selenia bilunaria*, illustrating the remarkable angulation of the wings in these examples.—*Papers.*—The formation of a new nest by *Lasius niger*, the common black ant: H. W. **Southcombe.**—Some notes on the dominant Müllerian group of butterflies from the Potaro River district of British Guiana: W. J. **Kaye.**—A contribution to the classification of the coleopterous family Passalidæ: G. J. **Arrow.**

October 17.—Mr. F. Merrifield, president, in the chair.—*Exhibitions.*—H. St. J. **Donisthorpe**: Living specimens of the beetle *Mononychus pseudacori* found in plants of *Iris foetidissima* found at Niton, Isle of Wight.—A. H. **Jones**: A collection of butterflies from Arosa, Switzerland, at 6000 feet, and varieties of *Melanargia galatea* and *Argynnis niobe*, ♀, taken on the Splugen Pass in July; also specimens from other localities for comparison.—W. J. **Kaye**: A fine example of the remarkable moth *Dracenta rusina*, Druce, from Trinidad. The species bears a wonderful resemblance to a decayed dead leaf, the patches on the wings suggesting the work of some leaf-mining insect.—E. M. **Dadd** showed a number of Noctuids common to the British Isles and Germany, and directed attention to the constant differences between the prevalent forms occurring in England and the prevailing forms of the same species on the Continent.—Dr. F. A. **Dixey**: Specimens of *Ixias baliensis*, Frühst, and *Huphina nerissa*, Fabr., remarking that the association between the two species must necessarily be Müllerian, and not Batesian.—S. A. **Neave**: A number of Lepidoptera selected from the collection made by him in N.E. Rhodesia, in 1904 and 1905, comprising the following rare and remarkable species:—*Melanitis libya*, Distant; *Liptena homeyeri*, Dewitz; *Pentila peucetia*, Hew.; *Catochrysops gigantea*, Trim.; *Crenis pechueli*, Dewitz, and *Crenis rosa*, Hew., which are evidently two distinct species; and *Crenidomimas concordia*, Hopff., the mimic of the last two species. Also two remarkable species of the genus Aphnæus—including the female, so rarely taken in this genus—*Acraea natalica*, Boisd., and *Acraea anemosa*, Hew., with two remarkable moths showing a close mimetic resemblance to them. The exhibitor further stated that his collection should prove interesting as regards seasonal forms, especially in the Acræinæ and Pierinæ, of which he showed additional examples.

Royal Microscopical Society, October 17.—Mr. A. N. Disney, vice-president, in the chair.—*Cornuvia serpula*, a species of Mycetozoa new to Britain: J. M. **Coon.** For the first time a complete description was given of all the stages of this organism, previous descriptions being limited to the mature plasmodicarp and its contents.

Physical Society, October 26.—Prof. J. Perry, F.R.S., president, in the chair.—The strength and behaviour of ductile materials under combined stress: W. A. **Scoble.** In former tests of materials under combined stress either the ultimate strength or elastic limit stress has been considered, and the tensions have been applied either directly, or by internal pressure in the case of thin tubes, so that the distribution of stress was approximately uniform. The present experiments were made on bars $\frac{3}{4}$-inch diameter, subjected to bending and twisting to reproduce the irregular distribution of stress occurring in practice. The yield-point was selected as the criterion of strength, but it is open to more than one specification. Here the stress corresponding to the first sign of yield was not taken, but that given by the intersection of the two parts of the stress-strain diagram corresponding to perfect elasticity and complete yield, so that the intermediate state was neglected. The critical bending moment was found to be greater than the yield torque, 2660 and 2400 lbs. ins., and plotting the corresponding bending and twisting moments the ellipse gave the closest approximation to the results.—The behaviour of iron under weak periodic magnetising forces: J. M. **Baldwin.** The behaviour of iron in strong alternating fields has been studied by many observers, and the induction in iron when placed in both strong and weak fields has been thoroughly examined by static methods, but up to the present no results have been published of the induction in weak alternating fields. The author has now, however, succeeded, by means of Lyle's wave-tracer (for description of which see *Phil. Mag.*, vol. vi., p. 549), in examining the induction in periodically varying fields down to extremely low amplitudes. The principal points brought out are as follows:—(1) the permeability satisfies a linear law through a considerable range for weak fields, diminishing to a minimum about 150 as the amplitude of the field diminishes; (2) as the field diminishes the difference in phase between the induction and the magnetising force tends to disappear, and (3) at the same time the hysteresis losses become very small; (4) frequency at these low values of the field has practically no influence on the results obtained.—Fluorescence and magnetic rotation spectra of sodium vapour and their analysis: Prof. R. W. **Wood.** After recapitulating the descriptions of the experimental arrangements given in previous papers, the author describes the work done during the present year in photographing magnetic rotation and fluorescent spectra. A 12-feet grating, a specially constructed three-prism spectrograph, and a monochromatic illuminator were used.

Challenger Society, October 31.—Prof. d'A. W. Thompson in the chair.—Preliminary note on a method of detecting successive moults of the same species among Crustacea: Dr. **Fowler.** The uncertainty of connecting together in series the successive stages of larvæ captured in tow-net hauls is great, especially if the general form and appendages differ at different moults. Brooks noticed, twenty years ago, a curious numerical relation between the lengths of four specimens of stomatopod larvæ, which appears to be capable of expansion into a regular law, and if the larvæ captured be sorted at first by general morphological similarity and by constant association in the same hauls, it seems probable that this law will give the key to their relationship. The author had measured and sexed more than 400 specimens of *Conchoecia subarcuata*, Claus=*macrocheira*, Müller. The males and females each fell into three groups when arranged by lengths; when the frequency of the lengths occurring in each group was plotted, each formed a small "curve of frequency," and the mean length of each group when multiplied by a certain factor (found experimentally) yielded the mean of the next highest group; the extremes, similarly multiplied, yielded, approximately, the extremes of the next highest curve. The factor is different for males and for females, and seems to be an expression of

the percentage of its total length by which the animal increases between two moults; this is apparently constant for every moult. This law is also very clearly observable when applied to the measurements of lobster larvæ recorded by Herrick.—Three graphic methods of recording temperature observations in use in the section of the International Investigations of the North Sea conducted by the Scottish Fishery Board: Prof. d'A. **Thompson.** One method recorded the surface temperatures at any date and any position along a given line, another the temperature at any date and depth at a given position; the third showed the daily sequence of temperatures for the year at any given position in the form of sine curves.

Linnean Society, November 1.—Prof. W. A. Herdman, F.R.S., president, in the chair.—The structure of bamboo leaves: Sir Dietrich **Brandis.** While the leaves of other grasses exhibit a great variety of structure, those of bamboos are exceedingly uniform. In bud they are always convolute; they all have in the upper epidermis, alternating with the longitudinal nerves, bands of large bulliform cells known as motor-cells. In most species these motor-cells are filled, entirely or partially, with solid bodies of silica. Between the bands of bulliform cells and the longitudinal nerves, bamboos (with one exception so far as known, *Chusquea pinifolia*, of south-east Brazil) have large apparent cavities, which are completely filled by large flat thin-walled cells, lying one over the other, like the leaves of a book. This tissue is entirely different from that which, in a young state, fills the cavities in the leaves of *Glyceria aquatica*, *G. fluitans*, and other aquatic grasses. The species placed by Dr. Stapf in "Flora Capensis" in the new tribe Phareæ have, so far as known, leaves with a structure similar to bamboo.—Crustacea from the Inland Sea of Japan: Dr. J. G. **De Man.** Thirty-nine species were fully described, and ambiguities in previous authors cleared up.—The systematic position of *Hectorella caespitosa*, Hook. f.: Prof. A. J. **Ewart.** This plant has been regarded as belonging to the Portulaceæ, but the author suggested it might be transferred to the Caryophyllaceæ.

Mathematical Society, November 8.—Annual general meeting.—Prof. A. R. Forsyth, president, in the chair.—Partial differential equations: some criticisms and some suggestions. Presidential address by Prof. **Forsyth.** The address dealt chiefly with the present state of the methods of practical integration; a number of exceptional cases, in regard either to method or classification, were pointed out, and various gaps in the theory were indicated. Some suggestions as to hopeful lines of advance were made.—Harmonic expansions of functions of two variables: Prof. A. C. **Dixon.** A function of two real variables, having a considerable degree of generality, is expanded in a double series each term of which is the product of two functions containing the two variables separately, and also containing parameters which differ from term to term of the series. The series is transformed into a multiple integral. The series that are founded on this expansion are found to be equally complete with double Fourier's series.—The inversion of a definite integral: H. **Bateman.** The paper contains a classification of integral equations of the first kind, two practical methods of proceeding to a solution, and a number of illustrative examples.—Partial differential coefficients and repeated limits in general: Dr. E. W. **Hobson.** Among the matters treated is the formulation of the most general conditions in which the equation

$$\frac{\partial}{\partial x}\left(\frac{\partial u}{\partial y}\right)=\frac{\partial}{\partial y}\left(\frac{\partial u}{\partial x}\right)$$

holds good.—Bäcklund's transformation and the partial differential equation $s=F(x, y, z)$: J. E. **Campbell.** The form of differential equation in the title includes the differential equation of all pseudospheres, or surfaces of constant negative curvature. In this case the equation admits of being transformed into itself by a transformation due to Bäcklund. The transformation succeeds also in one other case.—Subgroups of a finite Abelian group: H. **Hilton.**—The general solution of Laplace's equation in n dimensions: G. N. **Watson.**

MANCHESTER.

Literary and Philosophical Society, October 26.—Sir William H. Bailey, president, in the chair.—A development of the atomic theory which correlates chemical and crystalline structure and leads to a demonstration of the nature of valency: Prof. W. J. **Pope** and W. **Barlow.**

October 30.—Mr. Charles Bailey in the chair.—(1) A journey to North-East Rhodesia during 1904 and 1905; (2) a collection of birds from North-East Rhodesia: S. A. **Neave.**

PARIS.

Academy of Sciences, November 5.—M. H. Poincaré in the chair.—The alcoholysis of fatty bodies: A. **Haller.** The hydrolysis of fatty substances by an aqueous solution of various acids is well known. The author has found that if the acids are employed in alcoholic instead of aqueous solution the glycerol is split off as before, but the alkyl ester of the acid is formed, and hence the process may be fitly called alcoholysis. All fatty bodies, whatever their constitution or consistency, undergo this change with more or less facility. Full details are given of the methods used in carrying out this reaction, which has been applied to a large number of glycerides. Owing to the low temperature at which the reaction can be completed, the replacement of water by alcohol possesses certain advantages.—The transformation of volcanic rocks into phosphate of alumina under the influence of products of physiological origin: A. **Lacroix.** The change takes place under the influence of the excrement of sea birds.—The seeds and flowers of Callipteris: M. **Grand'Eury.** The frequent presence, along with Callipteris, in the neighbourhood of Autun, of seeds catalogued thirty years ago under the name of *Carpolithes variabilis*, found with an intimate mixture of the same seeds with *Call. conferta* in the coal deposits of Bert, formed exclusively of this fossil, led the author to the view that these belonged to the same plants. In the present paper an account is given of a study of the flora of the Autun boghead which confirms this view.—The perturbations of Vesta depending on the product of the masses of Jupiter and Mars: M. **Leveau.**—Certain linear groups: Léon **Autonne.**—The potentials of an attracting volume the density of which satisfies the equation of Laplace: A. **Korn.**—Certain kathode rays: P. **Villard.** Some remarks on the nature of the non-deviable rays observed in a Crookes's bulb by J. J. Thomson.—The establishment of an exclusive correspondence, independent of syntonisation, between a transmitting post and one of the receiving posts of a wireless telemechanical installation: Édouard **Branly.**—The conditions of precipitation and re-dissolution of metallic sulphides: H. **Baubigny.** Remarks on a paper by M. G. Bruni and Padoa, the author referring to papers by himself on the same subject published in 1882 and 1889.—The gases observed in the attack of tantalite by potash: C. **Chabrié** and F. **Levallois.** Experiments on tantalite and the corresponding ferrous titanate show that the hydrogen observed in the reaction with potash is not present in the mineral, but is due to a chemical reaction between ferrous oxide and the alkali.—Contribution to the study of selenium: Œchsner **de Coninck.** By the reduction of selenious oxide by glucose, an amorphous, brick-red selenium is produced. This dissolves gradually in concentrated sulphuric acid, forming $SeSO_3$. This latter substance in contact with water deposits a new stable variety of selenium, the properties of which are detailed.—The chlorination of paraldehyde and on butyric chloral: P. **Freundler.**—Phenyl migration; the structure of the intermediate compounds: M. **Tiffeneau.**—Study of the constitutional formulæ of some dimethylanthracenes: James **Lavaux.**—The toxicity of some rare earths: their action on various fermentations: Alexandre **Hébert.** The sulphates of thorium, cerium, lanthanum, and zirconium possess certain toxic powers. Experiments on frogs, fish, the seeds of plants, Aspergillus, yeast, diastase, and emulsin are described.—An albumin extracted from the eggs of fish: comparison with the vitelline from hens' eggs: L. **Hugounenq.** By hydrolysis with dilute sulphuric acid the albumin from the egg of *Clupea Harengus* (clupeovine) gave arginine, histidine, lysine, aminovaleric acid, tyrosine, leucine, alanine, serine, phenylalanine, and aspartic acid. These correspond closely

with the products of hydrolysis of egg-albumin, but the ratios in which the various substances are produced differ in the two cases.—The liquid crystals of ammonium oleate: Fred. **Wallerant.**—The indirect actions of electricity on germination: Pierre **Lesage.**—The histological structure and development of the osseous tissue in ectromelian monsters: J. **Salmon.**—Cytology and pathogeny of spermatic cysts: J. **Sabrazès.**—The development of polygenesis and the theory of concrescence: Jan **Tur.**—The dislocations of the edge of the Central Plateau between Voulte and Vans (Ardèche): Émile **Haug.**—The Jurassic strata in Greece: Carl **Renz.**—The archæan substratum of the globe and the mechanism of geodynamical actions: E. **Jourdy.**—The circumzenithal rainbow: Louis **Besson.**

NEW SOUTH WALES.

Linnean Society, September 26.—Mr. T. Steel, president, in the chair.—The sound (and lake) basins of New Zealand and the cañons of Eastern Australia in their bearing on the theory of the peneplain: E. C. **Andrews.** An attempt, from an examination of Eastern Australian and New Zealand geographical types, to prove Prof. Davis's contention that the greater number of plateaus of erosion are elevated *peneplains* formed at or near sea-level. Streams speedily cut profound cañons, the bases of which, even prior to the passing away of the individuality of the central plateau, approximate closely to the level of the main water body into which they are discharging. Large floods determine these channel grades, the normal stream being functional in aggrading the holes formed *below* main or temporary base-level by the storm waters. The lake and sound basins of New Zealand represent holes ploughed out below base-level by swiftly converging glaciers, and are analogous to the deep flood holes found in river beds.—A correlation of contour, climate, and coal: a contribution to the physiography of New South Wales: T. Griffith **Taylor.** It is submitted that the rivers of the Murray-Darling system show evidence of the influence of Ferrel's law on their courses. The gap in the Great Divide situated near Cassilis is due to the shifting of the Divide by the Goulburn River. The cutting action of this river has been determined by the lower "coefficient of resistance" of the Permo-Carboniferous Coal-measures. The relation of the temperature lines and of the lines of rainfall is shown to be influenced by this Geocol.—The stinging property of the giant nettle-tree (*Laportea gigas*, Wedd.): Dr. J. M. **Petrie.** The physiological action is shown to be due to the free acid existing in a concentrated form in the hairs, which are hollow siliceous tubes, and it differs from the sting of the common nettle only in degree. Laportea contains ninety times more free acid than the common nettle.—A striking example of river-capture in the coastal districts of New South Wales: Dr. W. G. **Woolnough** and T. Griffith **Taylor.** The authors have examined the topographical relations of the bend in the Shoalhaven River near Marulan. Field evidence shows the existence of a fairly well-defined ancient river-channel connecting the Shoalhaven and Wollondilly watersheds. Along this line are well-defined coarse river-gravels derived from the southward. The structure of this former river-channel is described. It is pointed out that other instances of capture of Wollondilly water by branches of the Shoalhaven are imminent, for instance, in the neighbourhood of Bundanoon.—Supplement to the "Revision of the Cicindelidæ of Australia": Dr. T. G. **Sloane.**—Descriptions of new species of Lomaptera (Coleoptera: Scarabæidæ, subfamily Cetonides): A. M. **Lea.** Two species are described, from specimens obtained by Mr. H. Hacker at Coen, N.Q., a district which appears to be rich in showy beetles, especially in Cetonids and Longicorns.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 15.

ROYAL SOCIETY, at 4.30.—Calcium as an Absorbent of Gases, and its Applications in the Production of High Vacua and for Spectroscopic Research: F. Soddy.—A Method of Gauging by Evaporation the Degree of High Vacua (Addendum to Mr. F. Soddy's Paper): A. J. Berry.—The Effect of Temperature on the Activity of Radium and its Transformation Products: Dr. H. L. Bronson.—On the Refractive Indices of Gaseous Potassium, Zinc, Cadmium, Mercury, Arsenic, Selenium and Tellurium: C. Cuthbertson and E. P. Metcalfe.—The Photo-electric Fatigue of Zinc: H. S. Allen.

CHEMICAL SOCIETY, at 8.30.—On the Determination of the Rate of Chemical Change by Measurement of Gases Evolved: F. E. E. Lamplough.—Xanthoxalanil and its Analogues: S. Ruhemann.

LINNEAN SOCIETY, at 8.—Recent Researches in Norway: Horace W. Monckton.

FRIDAY, NOVEMBER 16.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Steam as a Motive Power for Public Service Vehicles: T. Clarkson.

MONDAY, NOVEMBER 19.

LONDON INSTITUTION, at 5.—Musical Sands: Cecil Carus-Wilson.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Seychelle Islands: J. Stanley Gardiner.

SOCIOLOGICAL SOCIETY, at 8.—Japanese Character: Prof. Motora.

SOCIETY OF ARTS, at 8.—The Nutrition of the Plant: A. D. Hall.

TUESDAY, NOVEMBER 20.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Single-phase Electric Traction (Discussion): C. F. Jenkin

ROYAL STATISTICAL SOCIETY, at 5.—Presidential Address: Sir Richard B. Martin, Bart.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—A Visit to the Hopi Indians of Oraibi: W. Crewdson.—On the Relative Statures of Men with Long Heads, Short Heads, and those with Intermediate Heads, in the Museum, Driffield: J. R. Mortimer.

WEDNESDAY, NOVEMBER 21.

ENTOMOLOGICAL SOCIETY, at 8.—Studies of the Blattidæ (ii.): R. Shelford.—Notes on the Life-history of *Trochilium andrenaeforme*, Lasp.: Hon. N. Charles Rothschild.

ROYAL MICROSCOPICAL SOCIETY, at 8.—The Use of a Top Stop for Developing Latent Powers of the Microscope: J. W. Gordon.

SOCIETY OF ARTS, at 8.—Opening Address by Sir Steuart Colvin Bayley, K.C.S.I.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The International Congress on Polar Exploration at Brussels, September, 1906: Dr. H. R. Mill.—The Abnormal Weather of the Past Summer, and some of its Effects: W. Marriott.

GEOLOGICAL SOCIETY, at 8.—On the Skull and Greater Portion of the Skeleton of *Goniopholis crassidens*, from the Wealden Shales of Atterfield (Isle of Wight): Reginald W. Hooley.—The Kimeridge Clay and Corallian Rocks of the Neighbourhood of Brill (Buckinghamshire): A. Morley Davies.

THURSDAY, NOVEMBER 22.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Studies on the Development of Larval Nephridia; Part ii., Polygordius: Dr. Cresswell Shearer.—The Structure of Nerve Fibres: Prof. J. S. Macdonald.—On Opsonins in Relation to Red Blood Cells: Dr. J. O. Wakelin-Barratt.—On the Inheritance of Certain Invisible Characters in Peas: R. H. Lock.—The Influence of Increased Barometric Pressure on Man, No. 2: Leonard Hill, F.R.S., and M. G. Greenwood.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Selection and Testing of Materials for Construction of Electric Machinery: Prof. J. Epstein.

FRIDAY, NOVEMBER 23.

PHYSICAL SOCIETY, at 5.—On the Electrical Radiation from Bent Antennæ: Prof. J. A. Fleming.—Auroral and Sun-spot Frequencies contrasted: Dr. C. Chree.—The Electrical Resistance of Alloys: Dr. R. S. Willows.

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