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GYMNOSPERMS.

Morphology of Gymnosperms. By Prof. J. M. Coulter and Prof. C. J. Chamberlain. Pp. xi+458. (Chicago: The University of Chicago Press; London: Cambridge University Press, 1910.) Price 16*s.* net.

IN 1901 Profs. Coulter and Chamberlain published a short treatise on the Gymnosperms, forming the first volume of their "Morphology of Spermatophyta." Their present work takes the place of this volume, and is practically a new book, designed on a far more liberal scale than its predecessor. The number of pages has grown from 188 to 458, and the illustrations have increased in an even greater proportion. The extension of the book is in no small degree due to the original researches of the authors and their pupils; the special contributions from the Chicago laboratory have amounted to twenty-six since 1901.

"The present account, therefore, is based upon our own work, supplemented by the work of other investigators, rather than a compilation from literature, supplemented by occasional personal observations" (preface).

A striking feature of the book is the prominence now given to palæobotanical evidence.

The book is an invaluable record, admirably illustrated, of our present knowledge of the older type of seed-plants; on reading it one is enabled to realise in what respects essential progress has been made, and where, in spite of the accumulation of detail, there has been little real advance. The latter, less favourable position exists, in the reviewer's opinion, in respect of the Conifers, in which the most fundamental points of morphology and affinity still remain obscure.

The book begins with an account of the Palæozoic class, Cycadofilicales, a name which the authors prefer to the more modern designation, Pteridospermeæ, now generally adopted in England and France. The authors are certainly well advised to include a description of the Pteridosperms in their book, though some botanists have thought it best to keep these fern-like seed-plants of the Palæozoic apart from the Gymnosperms, on the ground of their manifestly primitive characters. In this book there is a tendency to minimise the peculiar features of the Pteridosperms, which mark them off as an archaic group. The entire absence of anything approaching to a strobilus separates them, among other characters, from all Gymnosperms except the female plant of Cycas. In any case, however, the close relations between the seed-ferns and the true Gymnosperms are undisputed and of fundamental importance.

The Cycadofilices were recognised as a distinct group before their reproductive organs were discovered. The authors scarcely do justice to this rather impressive instance of the successful use of anatomical characters in determining systematic position; they say:—

"The striking anatomical feature of the Cycadofilices is the association of secondary wood with a fern-like vascular system. There was no occasion, on this account, to remove Cycadofilices from Pteridophytes" (p. 2).

No one who knew Williamson's work was likely to found a new group on such a basis; other considerations, as, for example, the close agreement between the leaf-trace strands of Lyginodendreæ and those of Cycads carried much more weight; the authors appear in this instance not to have consulted adequately the original memoirs. They do full justice, however, to the importance of the work done in recent years on morphological anatomy, especially that of the vascular system:—

"Vascular anatomy has emerged as a subject organised upon a morphological basis, and its value in supplementing the older morphology cannot be overestimated" (p. 4).

Though open to some criticism in detail, the account given of the Pteridosperms is on the whole an excellent summary, and will be welcomed by readers who are not familiar with special works on palæobotany.

The interesting question of the constant absence of an embryo in all Palæozoic seeds hitherto investigated is discussed. This has been regarded as the normal condition, the development of the embryo not having begun until after the seeds were shed, and then having passed over at once into germination. The authors, on the other hand, incline to the view that all Palæozoic seeds investigated were abortive, having been shed prematurely. The fact that nearly all the seeds observed are at the same stage of development, and the usual presence of normal pollen in the pollen-chamber scarcely seem consistent with this view.

The remark that the seeds of Pteridosperms

"are very far from being primitive in structure, and are no more suggestive of the origin of seeds in general than are the seeds of existing seed-plants" (p. 34),

appears just, and indicates how much remains to be learnt in this field.

In discussing the relations of the Pteridosperms to the ferns it is pointed out that "Filicales are probably so ancient that all of our evidence is relatively modern" (p. 55).

"The gap between the homosporous Primofilices (or their unknown ancestors) and the seed-bearing Cycadofilicales is an enormous one, including the evolution of both heterospory and the seed" (p. 57).

The authors divide Gymnosperms into Cycadophytes and Coniferophytes (the latter name too glaringly hybrid to be acceptable). They include the Cycadofilicales in the former, which is not Nathorst's arrangement, as erroneously stated on p. 59. The two great phyla are regarded as "both differentiating from the Cycadofilicales or each arising independently from the progenitors of the Cycadofilicales" (p. 59). This is a little confusing, for on the former alternative the Cycadofilicales would have differentiated from themselves. It would have been better to leave the Cycadofilicales (Pteridosperms) as an independent ancestral group, lying at the root of all the other branches.

Chapter ii. is devoted to the Bennettitales, the characteristic Mesozoic Cycadophytes, remarkable for their anticipation of the angiospermous flower.

The authors have been misled by the synonymy in one instance, for they describe *Williamsonia angustifolia* and Wielandiella as distinct plants, whereas they are merely two names for the same thing (pp. 66 and 86). A more serious error is the statement that Nathorst confirms the view that the flowers of the Yorkshire Williamsonias are *bisporangiate* strobili (p. 76). Nathorst's conclusion is that these flowers were monosporangiate (unisexual).

The derivation of the Mesozoic Bennettitales from the Palæozoic Cycadofilicales will be generally accepted, but the statement that "the bisporangiate character of the strobilus is probably to be explained by the bisporangiate character of the fronds of those Cycadofilicales which gave rise to Bennettitales" (p. 87) is more open to question. We have at present no evidence of the existence of bisporangiate fronds in the Palæozoic group; neither is it necessary to assume their existence in order to explain the association of stamens and carpels in the same flower.

Chapter iii., on the Cycadales, is no doubt the best account we have of this important and fascinating family. A large number of original observations, by members of the Chicago School of Research, are embodied, and there are some very fine new figures.

Dioon edule, a Mexican Cycad, said to attain an age of 1000 years, has now been added to the list of species in which fertilisation by motile spermatozoids has been observed.

The statement that the Cycadales are "probably not so old as either the Ginkgoales or the Coniferales" may need revision. Our records are scanty, but carpels scarcely distinguishable from those of recent species of Cycas are known as far back as the Lias.

In the chapter on the Palæozoic Cordaitales there is not much room for novelty, for here our knowledge has advanced but slowly of late. The current views of their affinities are adopted. The related phylum of the Ginkgoales (chapter v.), of which there is only one survivor, the maidenhair tree, is regarded as retaining certain primitive features in common with the Cycadophytes, while it has advanced more in the direction of the Coniferales, and has developed certain peculiarities of its own (p. 217).

Chapters vi. and vii. are on the Coniferales, which, from their extent and variety, naturally demand a fuller treatment than any other group. The account given is excellent, and contains much of interest, but one realises that the Conifer problem still remains to be solved.

The class is divided into Pinaceæ and Taxaceæ, but it is very doubtful whether even this first grouping is natural, for the Podocarps among the Taxaceæ seem to have little to do with the Yews, while they have much in common with the Araucarians among Pinaceæ.

Perhaps too much is made of the supposed special antiquity of the Abietineæ (firs). The arguments in support of the primitive nature of this tribe are not altogether convincing.

In stating that the Taxaceæ have not been recognised further back than the Cretaceous (p. 349), the authors ignore Nathorst's suggestion that the Rhætic genera Stachyotaxus and Palissya may be early representations of the Podocarps.

The heterogeneous group of the Gnetales forms the subject of chapter viii. We think that more stress might have been laid on the possible affinity, originally suggested by Wieland, between Welwitschia and the Mesozoic Bennettitales. The hermaphrodite flowers and monadelphous stamens occurring in Welwitschia are striking points of agreement with the extinct group.

The account of the three extremely diverse genera which make up the Gnetales is of much interest, and contains various details hitherto not readily accessible to the student. The relationship of such isolated types, with no known fossil history, necessarily remains obscure.

The final chapter, on "Evolutionary Tendencies among Gymnosperms," previously published in part as a separate paper, sums up the main results. The diagram on p. 409 gives a good idea of the probable evolutionary connections of the various groups, though in one or two points it is not quite consistent with the statements in the text. Though the reviewer does not agree with quite all the authors' conclusions, he is in entire sympathy with their principle that

"the relative position of any form in a scheme of classification can be determined only by averaging all its characters; and its relative age in a scheme of phylogeny can be determined only by the sure testimony of history" (p. 425). D. H. S.

THE EVOLUTION OF OUR ISLANDS.

The Building of the British Isles, being a History of the Construction and Geographical Evolution of the British Region. By A. J. Jukes-Browne, F.R.S. Third edition, rewritten and enlarged. Pp. xv+470. (London: E. Stanford, 1911.) Price 12*s.* net.

THIS new edition of Mr. Jukes-Browne's well-known book makes it virtually a manual of the geology of the British Isles. The photographic illustrations bring the relations of the rocks clearly home to us, and many of them are works of art, such as Prof. Reynolds's view of chalk and lavas at Garron Point (Fig. 61), and Mr. R. F. Gwinnell's Miocene folding at Lulworth (Fig. 63). The numerous maps, suggesting the relations of land and water at various epochs, suffer, as all such maps must do, from our ignorance of details. The sweeping boundaries of continents and the generalised forms of firths and sounds are perforce unlike anything that we now know upon the earth. Printed explanations on the maps would greatly aid the reader, such as "area of Bunter pebble-beds," "Lake-basin," and so forth. There is a mysterious dotted line on Fig. 19, for which one must search the text, while much guidance is required for the lines and colours on Fig. 57. The result may, however, be regarded as happy, if the casual reader is sent through a lengthy chapter, to find there a summary of the latest researches, and evidence of a critical mind that looks eastward across Europe. Mr. Jukes-Browne does not hope to

satisfy everyone. He gives us a marine Lower Devonian series across south-west Ireland (Fig. 19), the Glengarriff Grits being supposed to represent the deposits of a land-locked bay. He carries the Upper Senonian sea (Fig. 53 and p. 333) boldly into Scotland, Wales, and central Ireland, though flints are scarce in the surface-deposits of some of the areas thus invaded, and though they are not likely to have been carried away by subsequent marine action (compare p. 426). The rapidity of the oscillatory movements in Cretaceous times is properly insisted on, if we are to regard the chalk as a deep-water rather than merely as a pure-water deposit.

The consideration given by the author to the conditions under which successive series were formed is well seen in his comparison of the Bunter pebble-beds with the alluvium of the Helmand River (p. 234), or in his very interesting discussion of the Pliocene and Pleistocene deposits (pp. 404–61). The references to recent literature show how keenly he has watched the progress of research. We thus have Mr. Hickling's views on the Permian affinities of the outliers of sandstone near Dumfries, which are often supposed to be of Triassic age (p. 208); Prof. Watts's suggestion (p. 379) of the Eocene age of igneous rocks in the English Midlands; and Mr. Bernard Smith (p. 237) on the "skerries" of the Keuper marls. Anyone who has become attracted by the varied surface of our islands, or even by the scenery of a single county, will find his views enlarged when he follows Mr. Jukes-Browne into the past. He will at once feel the complexity of the subject, and the vast range of the events that have determined the present forms of hill and dale. After reading a few pages, a healthy reaction sets in against the superficial physical descriptions in which we all are liable to indulge. No one can read "The Building of the British Isles" without becoming again a student. The author's expressions of personal opinion will stimulate inquiry rather than remove all doubt. This is the manner of the true scientific teacher, and we feel that Mr. Jukes-Browne has made new claims on our regard.

To enjoy a book so full of detail, one must see and remember the country it describes. In ten years, in holidays of a few days at a time, the geologist may learn a great deal of the aspect of our islands. To anyone who has happily crossed the open country, from the rocky coves of Cornwall to the heather-covered slopes above the Moray Firth, or from the sunlit dunes of Donegal to the grey mud-flats near the Nore, these pages will make a singular appeal. Perhaps we may read into the book a good deal obtained from other sources, since it presupposes a general knowledge of the great tectonic movements that have affected the European area. In spite of what we have said, it is intended primarily for the geologist.

Every British or Irish geologist, moreover, will find points that he will like to criticise. Why, for instance, should stratified gravels be difficult to understand (p. 440) on the hypothesis that they result from the washing of boulder-clay? Does not the melting ice supply the very agent for their stratification? A "very deep basin" would not be required (p. 128) for the accumulation of the Cornstone series in Wales, but only a continuously subsiding floor. The omission of the Snowdon area from the description of the Ordovician rocks of North Wales seems surprising (pp. 68 and 69), and no stranger would suspect the immense part played by volcanic action in originating the scenery between the Conwy and Llanberis. Other geologists, however, must now enjoy the book, and discover their particular grievances to the author, who has done so much to help them. G. A. J. C.

TECHNICAL THERMODYNAMICS.

Applied Thermodynamics for Engineers. By Prof. W. D. Ennis. Pp. viii+438. (London: Constable and Co., Ltd., 1910.) Price 24*s.* net.

THIS is by far the most comprehensive book published in the English language on the subject of technical thermodynamics. It contains an account, brief but lucid, of the transformations of heat and mechanical energy which occur in almost every conceivable industrial process. As evidence of this widespread treatment, it is only necessary to mention that among the processes discussed are the development of power in the internal combustion engine, in the steam engine, in the hot-air engine, air and gas compressors, distillation plant, mechanical refrigeration, fusion and liquefaction of gases. To the discussion of these various topics Prof. Ennis brings experience gained in the mechanical engineering side of the Polytechnic Institute of Brooklyn, and it is clear that in his study of these problems he has made a digest of recent work on the subject of gases and vapours. His style of writing is graphic, forceful—but eccentric in so far as he seems actually to seek opportunities for splitting the infinitive; in fact, he does so no fewer than four times in the first five pages of the book, and after that we gave up counting.

A useful feature is the appendage to each chapter of a brief synopsis of its contents, together with a bibliography of the authorities quoted. Problems are added for the use of students, but the author does not commit himself to their solution, a cautious step in a first edition.

Prof. Ennis's immediate aim is expressed in the following words:—

"Thermodynamics is physics, not mathematics or logic. This book takes a middle ground between those text-books which replace all theory by empiricism and that of the other class of treatises which are too apt to ignore the engineering significance of their vocabulary of differential equations. We here aim to present ideal operations, to show how they are modified in practice, to amplify underlying principles, and to stop when the further application of those principles becomes a matter of machine design."

The author may fairly be said to have carried out these intentions successfully, in spite of the necessarily considerable labour which must have gone to the compilation of so compressed a treatise.

It is not possible to discuss at length the methods followed by the author even in a section of the subjects he deals with, but some call for passing notice. Thus, he introduces early the idea of increasing specific heats of gases, and uses a formula

of the form $k=a+b\,T$, which he applies to the calculation of entropy. He shows that when expansion follows the path (called a "polytropic" path) $p\,v^n=$ constant, the rate of heat absorption or emission is directly proportional to the temperature change, and the author therefore deduces that the "specific heat" *must* be constant along any such path. This seems confusing when it is realised that this particular proof rests on the hypothesis of a constant specific heat, but investigation shows the confusion to be due to a somewhat loose use of the term "specific heat." This may prove a stumbling-block to some readers. After a careful and necessarily compressed account of the basic thermodynamic laws, the author gives an account of the properties of entropy, and of the limitations to be observed when non-reversible cycles are being studied. He rightly points out that many of the most important engineering processes are not even "cyclic," to say nothing of their not being "reversible." He remarks—

"A careful distinction should be made at this point between the expression $\int\frac{d\mathrm{H}}{\mathrm{T}}$ and the term 'entropy.' The former is merely an expression for the latter under specific conditions . . . perhaps the most general statement possible for the second law of thermodynamics is that all actual processes tend to increase the entropy; as we have seen, this keeps possible efficiencies below those of the perfect reversible engine." He concludes, however, that "most operations in power machinery may, without serious error, be analysed as if reversible; unrestricted expansions must always be excepted. The entropy diagram to this extent ceases to have an automatic meaning."

We seem here to be getting nearer to the desired harmony between the various views, as to the nature of entropy and its utilisation, which have been expressed in the past. Brief as the author has found it necessary to make his description of the action in a gas producer, he has been able, we are glad to see, to consider the important case where exhaust products are employed instead of steam as a "heat reservoir," and he gives on p. 153 an interesting diagram comparing the two alternatives, which should prove very useful in practice.

It may be a surprise to some readers to find that, contrary to the usual custom, the internal combustion engine is dealt with before the steam engine; but since the study of gases is easier than that of vapours, it is in reality a rational sequence to adopt. The section on the steam engine is very complete, and includes an account of wire-drawing, condensation, steam-jacketing, superheating, compounding, the use of turbines, boilers, drafts, fans, chimneys, stokers, economisers, pumps, and injectors. It would have seemed rash to forecast that so many subjects could be treated in one book, but the author has succeeded in including all this, and more, in his four hundred and forty pages.

In conclusion, we have no hesitation in welcoming the book as a valuable addition to the literature of the subject. It will be of special use to scientific engineers, to practical physicists, and to that growing student class which aspires to become the one or the other.

THE SOURCES OF EDUCATIONAL THEORY.

The Child's Inheritance: its Scientific and Imaginative Meaning. By Dr. G. Macdonald. Pp. xii+339. (London: Smith, Elder and Co., 1910.) Price 12*s.* 6*d.* net.

THIS book, which some readers will find prolix and whimsical, but all must acknowledge to be eloquent and sincere, seeks the ideal form of the educational process as a development of the child's racial inheritance.

"In the understanding of the child's inheritance both the poet and the biologist are worth deep and close study, not because they are necessarily antagonistic, but because, if they understood each other better, the gain to education would be incalculable."

For this reason the author directs us to Wordsworth's "Prelude" and Weismann's theory of the continuity of germ-plasm as the best sources of educational doctrine. The synthesis is original, and Dr. Macdonald is probably right in thinking that Weismann "would find his place somewhat unexpected while standing as the poet's squire." He would possibly be still more astonished at his proximity to William Blake, who is also repeatedly quoted.

Dr. Macdonald has published elsewhere a lecture on "The Sanity of William Blake." The citations in the present work certainly indicate that a teacher with the right temperament may learn much professional wisdom from the mystical poet. With the aid of these oddly consorted authorities the author discusses the nature and interaction of the child's endowment and environment. The former is "the old world within"—the epitome, as Haeckel taught, of phylogenesis. The latter is "the new world without," which, by imitation, by suggestion, and in other ways, moulds the plastic substance of the child's mind. Examining in further detail the interplay between these fundamental factors, the author finds two processes or aspects of mental growth to be of the first importance—expression and imagination. The chief means of expression is "the service of the hand." The discussion of this topic is rather one-sided, but is nevertheless an interesting and valuable contribution to a subject of much present importance.

The chapter on imagination—described as "that something in the child which recognises the shining light in all things living"—gives occasion for some not ill-founded criticisms of existing views of man's nature and of educational practices based on them. The chapter headed "Faith and Recreation" contains an admirable doctrine of the functions and value of play. In an intermediate chapter "On Specialisation," the author is led by his favourite thesis that mental life is more than "an assembly of various functions" to combat vigorously any form of specificity in education. It is perhaps unfortunate that a criticism of education, which, though ill-balanced and occasionally extravagant, must on the whole command respect, should lead to this position. For many of us feel that vocational education, properly understood, is the most hopeful means of giving the child effective possession of his inheritance.

T. P. N.

SPECULATIVE COSMOGONY.

Essai de Cosmogonie tourbillonnaire. By E. Belot. Pp. xi+280. (Paris: Gauthier and Villars, 1911.) Price 10 francs.

THE preface to this volume of speculative cosmogony will not raise much hope in the mind of the orthodox or sceptical man of science. "Faisant table rase de toutes les méthodes actuelles de la mécanique céleste spécialement créées pour des astres isolés . . . il doit chercher par la pure logique appuyée sur l'expérience comment ces corps ont pu réaliser *tous* leurs mouvements actuels. . . ." The advice is too sweeping to be readily accepted. The phenomena which the one new theory is to explain are so varied and numerous that suspicion is at once aroused against the arguments employed.

A hypothesis that, in a short chapter of twenty-seven pages, is to account for "les alignements d'étoiles, les étoiles doubles, multiples; les amas d'étoiles; les nébuleuses amorphes, planétaires, annulaires, elliptiques, les étoiles nébuleuses, les nébuleuses spirales, les courants d'étoiles" must be well grounded to stand any reasonable chance of general acceptance. And when this hypothesis is also to explain the solar periodicity and equatorial acceleration and the masses, mean distances, and inclinations of the planets, even the most credulous mind must pause before giving adhesion to the new views. It is true that in the law of gravitation an explanation of a vast number of diverse phenomena was sought. But gravitation could be and has been triumphantly put to the supreme test of prophecy. The alternative law put forward by M. Belot as replacing gravitation in an earlier stage in the evolution of the present cosmos can be put to no such test. At the best it can be shown more or less satisfactorily to lead to the present condition of affairs and to suggest views about some phenomena other than those commonly held.

The suggestion that a spiral nebula is revolving in the direction of the increasing radius of its arms may be verified by the spectroscope, but such a discovery would not in any real sense prove the truth of the theories of M. Belot. Neither facts nor arguments of sufficient weight have been brought forward to call for very serious consideration of his views.

Put very briefly, M. Belot's account of the evolution of our solar system amounts to this. Some 90,000,000 years ago a vortex-tube, moving through space at a speed of about 75,000 kilometres per second, encountered a slowly moving mass of nebulous gas. In the subsequent disturbance huge vibrations were set up in the vortex which led to the throwing off of successive portions forming the planets of the system. In a matter of two years the nova formed by the collision had expanded into the solar system, and in the manner of this expansion, coupled with a one-sided development of the planetary portions, lies the meaning of the present constants of our system.

M. Belot seeks by ingenious methods to justify certain curious empirical laws which he has found to fit the rotation-periods, inclinations, and mean distances of most of the planets. In these empirical laws and the many facts about different parts of the solar system which M. Belot has gathered together will probably lie the chief interest of the book to serious students of cosmogony.

For those who are unable to read the book as a whole but desire to gather the views of the author, a very complete account is given in the last chapter of the book. M. Belot, in his insistence on the importance of the energy of initial translatory motion upon the evolution of our system, may have brought into deserved prominence a factor which other cosmogonists have overlooked. It is true that it hardly seems to fit in with the fact that increasing stellar velocity generally accompanies increase in age, while the extremely high velocities required by M. Belot seem out of the question. Still, the idea may prove a useful addition to cosmological speculations. The second great point of the book—the need and use of a universal *dualisme* to explain the phenomena of the heavens—does not seem likely to be fertile of useful results. It leads the author to the following fantastic comparison between the celestial and the organic world:—

"Le tourbillon qui pénètre dans la nébuleuse se met à vibrer dans le choc; à chacune de ces vibrations correspond une émission de matière, qui se mélangeant à celle de la nébuleuse, va constituer l'embryon planétaire. Puis dans la nébuleuse se dessine un vaste ovoïde à l'intérieur duquel se trouvent enfermés tous les noyaux de planètes directes; pendant leur croissance ces noyaux sont reliés à la nébuleuse par de longs filaments tourbillonnaires, véritables cordons ombilicaux amenant les aliments cosmiques aux deux pôles de chaque œuf planétaire"!

BRITISH LICHEN FLORA.

A Monograph of the British Lichens: a Descriptive Catalogue of the Species in the Department of Botany, British Museum. Part ii. By Anne L. Smith. Pp. v+409+59 plates. (London: Printed by order of the Trustees of the British Museum, and sold by Longmans and Co., B. Quaritch, Dulau and Co., Ltd., and at the British Museum (Natural History), 1911.) Price 20*s*.

THE appearance of the second volume of the "British Museum Catalogue of British Lichens" has been looked forward to eagerly by lichenologists for some time. This fact will be realised when it is recalled that the first volume, written by Crombie, was reviewed in these columns so long ago as 1894. Crombie was one of the last of the more prominent lichenologists to protest against the dual nature of the lichen thallus. The author of the new volume, however, belongs to the modern school, and we therefore find the algal constituents of the lichens given their correct names. The gonidia are thus more accurately defined, and the determination of the genera is greatly facilitated.

The descriptions of the species are given in terms which will be more easily understood than the very technical words used in the previous volume, and it is clear that they have been compiled with very great care, for as a rule they are very much to the point.

The introduction of keys here and there is also of great use. The first volume was illustrated by a number of drawings in the text, all of which, with the exception of the last six, were made by Nylander. The new volume has at the end fifty-nine plates which form a very valuable part of this catalogue. The figures of the lichen habits and the sections of the apothecia are really excellent, but the sections of the thallus are in most cases too diagrammatic to be of any use. In the glossary we miss any reference to the very important and not uncommon soredia.

The ecological study of the lichens is of the greatest interest, but until now it has been hampered by the absence of a complete and modern flora. It is to be hoped that botanists will now attempt more thoroughly to study the physiology of the distribution of lichens. Everywhere, on trees, on solitary rocks, on the tops of hills and mountains, towards the Arctic and Antarctic limits of plant life, the lichens form practically the only vegetation present. But this vegetation shows, though on a small scale, of course, all the gradations, from the small tree-like Cladonias of the "lichen-forest" to the minute crustaceous lichens which occur on the bare rock faces, there forming very often a typical interrupted "desert-vegetation." Numerous xerophil and hygrophil, and even hydrophil formations, can be distinguished, which are characterised by the regular association of certain definite species. But all ecological work must be based on an accurate knowledge of the species under examination, and we must therefore be glad that this lichen flora is now complete. The author is to be congratulated on having successfully carried out a very arduous bit of work.

O. V. D.

MODERN CUBA.

Cuba. By Irene A. Wright. Pp. xiv+512. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 10*s.* 6*d.* net.

IT is a somewhat thankless task to write a book upon an island like Cuba, which, although large and tropical, is devoid of really grand scenery, and the original natives of which have vanished without a trace, whilst the colonial population has made no history in comparison with other Latin-American countries. The conquests of Mexico and of Peru were dramatic; they and the rest have retained a large native population full of interesting problems; they all had their wars of independence; they combined or split, and kept themselves in evidence by countless revolutions or wars of mutual conquest; and not a few of them have attained an important position among the nations of the world. Cuba, from the time of its discovery until a few years ago, was a Spanish colony, the usual unhappy condition of which concerned none but the mother-country. It is the "Pearl of the Antilles" simply because it is so large and marvellously fertile. Its history means recent politics, and such are difficult to write upon.

The author has resided for ten years in Cuba as a journalist, either on the staff of some local newspaper, or as agent of the Cuban Department of Agriculture, or lastly as editor of a magazine devoted to the commercial industries of the island, in which capacities she travelled largely through its provinces to write up, or down, as the case may be, some mine, plantation, or other concern.

After the overthrow of the Spanish *régime* in 1898 followed the four years' military administration by the U.S.A. Thanks to the vigorous cleaning-up of the devastated country and enforced quietude, everything assumed a brighter outlook until the American Government withdrew, leaving Palma as the first president of the new republic. Then followed the inevitable internal strife, those who were out wanting the jobs enjoyed by those who were in. It was no longer Cubans against Spain, but Cubans against each other. The prevailing condition is perplexing. Of the two million inhabitants, more than 11 per cent. are foreigners. This foreign-born element consists mainly of Spaniards (80 per cent.), the rest of Chinese, former African slaves, Americans, and various other nations in much diminished proportion. The Cubans themselves are for the most part the island-born descendants of white stock, but inextricably mixed with black and brown.

The foreigners hold at least three-fourths of all the valuable lands, and the commerce also is in their hands, but as uitlanders they have no voice in the government, although they pay most of the property taxes and, at least directly, the Customs duties, whilst the Cubans represent the governing class, or rather they fill the Government offices. As usual in these Latin republics, the numbers of the politically active natives are small, the overwhelming mass being petty traders and labourers, who take no interest in a strife which they do not understand. They prefer being left in peace, but they take up arms and become patriots merely because as men in arms they may forage.

The staple industries are sugar and tobacco, and as these pay best other agricultural pursuits are rather neglected, so that in parts this fertile island can scarcely feed itself. There is a chapter on tobacco, interesting for its history, but this is culled from some other work; and the reader will learn nothing about the working of such a plantation, or, let us say, the life-history of a Havana cigar, from seed to finish, a story which would be more attractive, even to non-smokers, than the information that "modern implements, intelligent and scientific irrigation are bound to increase quantity, without impairing quality in the least."

The bulk of the book, illustrated with some seventy well-executed photographs of scenery, building, town and country life, is devoted to the description of several journeys, interspersed with remarks upon commerce, industries, and local history. A long residence in the island, and the active interest taken in its politics during stirring times, entitle the writer to take sides in her expressed opinions. The chapters on home life, days in Habana, rice with beans, foreigners in Cuba are vividly true of Hispano-American life, and sketched by one who has not merely peeped but lived behind the curtain.

NEW TEXT-BOOKS OF CHEMISTRY.

(1) *A Course in Qualitative Chemical Analysis.* By Prof. C. Baskerville and Dr. L. J. Curtman. Pp. ix+200. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 6*s.* net.

(2) *Elementary Chemical Theory.* By J. M. Wadmore. Pp. xi+275. (London: Methuen and Co., Ltd., n.d.) Price 3*s.* 6*d.*

(3) *Physikalisch-Chemische Praktikumsaufgaben.* By Prof. G. Kümmell. Pp. vii+71. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 1.60 marks.

(4) *Inorganic Chemistry.* By Prof. F. S. Kipping, F.R.S., and Prof. W. H. Perkin, F.R.S. Pp. xiv+750. (London and Edinburgh: W. R. Chambers, Ltd., 1911.) Price 7*s.* 6*d.*

(5) *Outlines of Experimental Chemistry.* By Dr. E. B. Ludlam and H. Preston. Pp. iv+95. (London: Edward Arnold, 1910.) Price 2*s.*

(1) AT first sight the volume on qualitative analysis by Messrs. Baskerville and Curtman appears to follow the old, familiar arrangement, in which individual tests are followed by simple schemes of separation. But on closer inspection one comes across at the end of each scheme a series of notes in small print, which seem to us to be the really valuable part of the book. These notes, whilst they destroy to some extent the apparent simplicity of the analytical tables, acquaint the student with facts which he usually has to learn from experience, viz. that reactions are modified by their environment and that few separations are quite complete. Anomalous results are thus anticipated, and the pitfalls, into which a belief in the infallibility of tables often leads, are avoided. Importance is attached to careful manipulation, and to the use of solutions of known strength for examination, so that the student may become accustomed to forming a rough estimate of the composition of a mixture. It should be added that the book does not profess to teach manipulation, and there are no detailed descriptions of apparatus or laboratory operations.

(2) This is a book on chemical theory for use in schools, that is, one dealing with laws and hypotheses in an elementary way. Such a study naturally implies a fairly extensive quantitative as well as qualitative knowledge of chemical facts. Assuming that the schoolboy knows his facts, such a book as Mr. Wadmore's should be of real assistance to him in systematising his information. Moreover, the emphasis laid on quantitative results and the method of plotting them as curves is a process which should be early assimilated. On the other hand, such a book as this will have to be used with the utmost discrimination, for it is not every schoolboy, even in the higher forms, who will be in a position to grasp the real significance of Pasteur's work on asymmetry, the meaning of optical activity, the use of the phase rule or the nature of osmotic pressure.

The subjects on the whole are well selected, and the material is put together in a simple and attractive form. We have one criticism to offer. Some of the historical references are so curtailed as to be quite valueless, and might, for any purpose they serve, be omitted. "He [Marignac] was misled by the erroneous hypothesis of an English doctor, Prout"; but what the erroneous hypothesis was is not stated. "It occurred to no one, however, to make a special investigation of this point [constancy of composition] till . . . Berthollet denied it"; but what Berthollet's views were, or why he denied it, is left untold. "Attention was originally directed to this [diffusion] by the chance observation that hydrogen could escape through a fine crack in a gas jar." This was certainly not the chance observation, and it would have been remarkable if anything else had happened. It may be true that Dalton's quantitative results were inaccurate; but it is a novelty to read that he "cooked" them (p. 12).

(3) This small volume of seventy pages is intended, as its name indicates, to serve as a practical guide to physical chemistry. It contains exercises in chemical statics and dynamics, thermo-, photo-, and electrochemistry, the latter forming nearly half the volume. No fault can be found with the arrangement or character of the exercises; but it may be doubted if the meagre descriptions of the operations would enable any student to carry out a single determination without either previous experience or the constant supervision and help of the demonstrator. In short, the descriptions afford little more than might be found in any ordinary text-book in which these subjects are discussed. A comparison with such a book as Dr. Findlay's at once reveals its shortcomings in the all-important matter of descriptive detail.

(4) This is practically two books, an elementary and a more advanced text-book, which are published separately, and also in one volume. The first, or elementary part, covers the subject-matter required by the matriculation examination of London University; the second part is intended for students who are working for a pass degree. The object, so the authors state in the preface, of thus combining two stages of a student's chemical course, is to avoid the necessity in which a student entering a college finds himself of procuring a different and much larger text-book. For the advanced book usually takes him back to the beginning of the subject in which "some of the new matter which he requires is scattered here and there in the earlier chapters dealing with the non-metals, most of it is contained in the chapters on the metals, but in both cases there is generally the further difficulty that it is not differentiated from the more advanced matter required in his third year."

It is no doubt true that the schoolboy has to go to some expense in stocking his library with more advanced text-books when he enters on a university course. This seems almost inevitable, and the process necessitates a certain discontinuity of treatment, and, to some extent, a repetition of previous information. It has obvious disadvantages no doubt, but also perhaps less obvious advantages. It is with the object of avoiding the former that the authors have developed their method, and it may be admitted at once that it is extremely well done. To give examples: the subject of solution is discussed in a simple elementary manner in an early chapter of part i., in which the

meaning of the term, determination of solubility, and the plotting of curves is explained. The subject is taken up again at the beginning of part ii., when equilibrium between solids and liquids is discussed, and such topics as supersaturation and eutectics are considered. Again, the effect of the electric current in effecting chemical change described in part i. serves as an introdution to the theory of ionic dissociation presented in part ii. In this way there is little or no overlapping, and the subjects are systematically developed. Also, a zealous beginner who wishes to learn something more of a subject may, if he chooses, turn to part ii., and satisfy his curiosity, although unfortunately no reference is given in the text to the continuation in the advanced section. The possible disadvantage of such treatment is that it limits the scope of part ii. through want of space, and consequently restricts the range of some of the subjects which might otherwise have been expanded with advantage. This criticism may, of course, be met by the different view of the authors as to the standard of knowledge demanded for the pass degree.

Putting this point on one side, the book, we feel sure, will commend itself to teachers and students by its logical arrangement, clear descriptions, excellent illustrations (with the exception of Fig. 51), and convenient size. It may also be pointed out that, unlike some of its predecessors, it is not overloaded with facts. There are some omissions in the index. Thus "the law or rule of Le Chatelier" is twice referred to in the text, but is left out of the index, and so is "vapour pressure." Charcoal stoves (p. 121) are said to yield carbon monoxide, which is true enough, but so do coke stoves, which are much more common, at least in this country, and a frequent source of danger.

(5) Every teacher sooner or later will probably consider that his peculiar experience will afford him special advantages for producing a book on practical chemistry. Indeed, it seems a natural and proper feeling in anyone devoted to the subject. Whether the results obtained by different methods are essentially different is another question. One is inclined to think that it is the teacher rather than the book that counts in the long run. Here at least is a book produced by two teachers whose hearts are in their work, and who possess the additional advantage of being "untrammelled by examination requirements of any kind." Through their laboratory 300 boys pass weekly and are instructed by the methods described in their book. This, along with the traditions of the school, on its scientific side, are strong recommendations in themselves, and are further emphasised by a study of the character and arrangement of the exercises. The latter are clearly described and illustrated, and follow in a natural and logical sequence. The apparatus is simple and easily made and set up, and the number of quantitative operations sufficient to ensure exact manipulation. One feels that school chemistry is here dignified as a rational study rather than imposed as a compulsory acquirement of "the dirty part of physics." It is a book that may be warmly recommended for use in any well-equipped school laboratory.

J. B. C.

OUR BOOK SHELF.

Factor-table for the First Ten Millions containing the Smallest Factor of every Number not Divisible by 2, 3, 5, or 7 *between the Limits* 0 *and* 10,017,000. By Derrick N. Lehmer. Pp. xvi+476. (Washington: Carnegie Institution, 1909.)

THE condensation of a ten-million factor-table into a single volume of fewer than 500 pages is a remarkable feat, and it is interesting to learn how it has been done. The author's manuscript was first typewritten in duplicate, and these sheets, after correction, were photographed on glass. The photographs were inspected and corrected and then transferred to zinc plates, so that no movable types were employed in the printing. It is difficult to imagine a more effective way of preventing errors after passing for the press. The result is very compact and quite legible; auxiliary tables are provided for finding the proper entries in the main table: these may, however, be dispensed with, if desired. Multiples of 2, 3, 5, 7 are omitted, so the arrangement is really that of residues prime to 210.

There is an interesting introduction, giving accounts of previous tables and the method of sifting out successive primes; it also contains a valuable list of errors in former tables. More interesting still is the account of the MS. tables by Kulik, preserved by the Vienna Royal Academy. They are in six volumes, and profess to give the smallest factors of all numbers not divisible by 2, 3, or 5 up to a hundred millions. Kulik uses a special notation, and, judging by his tenth million, his work is not very trustworthy (not nearly so good as Dase's, for example); but the existence of such an enormous calculation by one man is very remarkable. He appears to have worked at it for twenty years.

The author makes due acknowledgments for help received; one of these is of international interest. The funds for preparing the manuscript and publishing the tables were furnished by the Carnegie Institution of Washington. Such a contribution to abstract science deserves cordial recognition and gratitude; and we hope that colleges that can afford to do so will promptly buy copies of this work. For although a factor-table is not often wanted, it is in certain circumstances indispensable, and it is very convenient to have one at a reasonable distance that can be personally consulted.

G. B. M.

Didaktische Handbücher für den realistischen Unterricht an höheren Schulen. Edited by Prof. A. Höfler and Prof. F. Poske. Band vii., Didaktik des botanischen Unterrichts. By Prof. B. Landsberg. Pp. xiii+303. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 8 marks.

A CONSIDERATION of the title gives rise to the reflection, how far this series of didactic handbooks owes its inception to the German educational system controlled to a great extent by official regulations; yet the present volume affords proof that changes in teaching methods can be, and are, effected by individual efforts. The main idea, advocated by Prof. Lindenberg, of instruction based on practical observation and experiment, has already received general approval, but the proposed sequence of procedure, explicitly scheduled under three stages, does not appear to be entirely realisable or acceptable. During the first stage, that extends over two years, the governing principle, expressed briefly, is to induce the study of single organisms in their environment with regard to form and working of the different members. The collation of individuals into groups, both ecological and classificatory, is relegated to the second stage, when it is proposed that a course of anatomy and

physiology, as also an introductory survey of cryptogamic life, should be taken.

The chief aims during the advanced stage are to amplify the earlier courses of anatomy and physiology, to expound the theory of development and other working hypotheses, to correlate botany with other sciences, and to indicate the nature of biological investigation. It is manifest that from the elementary stage, when the author considers it necessary to offer a word of warning lest impatience on the part of the teacher should discourage the youthful inquirer, to the summit of the advanced course is an exceedingly long journey, too long to be traversable during school life. However, if the scheme is not workable in its entirety, various sections are practicable, and one can confidently bring the volume to the notice of teachers.

It will be found that the book is not overweighted with philosophic discussion, and that the greater part of it is devoted to illustrative examples and hints for various substages of the course. The precise paragraphing of the subject-matter under chapter contents affords a ready means of reference and a useful bibliography is appended.

Treherne's Nature Series.—(1) *British Butterflies and Moths.* Arranged by W. F. Kirby. Pp. vii+26+xii plates.
(2) *Animals: Wild and Tame.* Arranged by W. F. Kirby. Pp. ii+22+xii plates.
(4) *Minerals.* Arranged by W. F. Kirby. Pp. ii+24+xii plates.
(London: A. Treherne and Co., Ltd., n.d.) Price 8*d.* net each.

The Nature-lover's Handbook. By Richard Kearton and others. Pp. viii+265. (London, New York, Toronto, and Melbourne: Cassell and Co., Ltd., 1911.) Price 2*s.* 6*d.* net.

THE fox is "a destructive animal in hen-roosts, but still common in Britain, being preserved for the fashionable sport of fox-hunting"; and, again, the female of the black arches moth "is furnished with a very sharp projecting ovipositor, an organ not usually very conspicuous in moths." Such are the main items in the notices of two species in a couple of the volumes in Treherne's Nature Series; and it will be perfectly manifest that the reader who wants the first (which, by the way, is not true for Britain as a whole) can have no possible use for the second. Again, in the volume on minerals, we find, to take one example only, under the heading of cerusite, a statement to the effect that carbonate of lead is common in most parts of the world, but nothing to show that cerusite and lead carbonate are one and the same. If little is to be said in favour of the text of these volumes, in the case of the one on animals it is difficult to give much praise to the illustrations. The case is, however, quite different with the volume on butterflies and moths, in which the coloured plates are really excellent; and, in a somewhat modified degree, commendation may be bestowed on those in the mineral volume. The low price of these "booklets" renders them accessible to all, and if they serve to awaken an interest in natural history, their issue is no doubt justified.

"The Nature-lover's Handbook" is on an altogether different platform from that of the other volumes, and cannot fail to be useful to the young student, giving, as it does, interesting notes on the animals and plants specially noticeable in each month, followed by lists of birds, butterflies and moths, and wild flowers, with the respective "station," or season of appearance of each species, in our islands. The only alteration we can suggest is that the species in the lists should be arranged alphabetically, as they are now difficult to find; and that if it is necessary to use names like "barn swallow," the dominant term should come first. R. L.

Introduction to Chemistry. By William Ostwald. Authorised translation by W. T. Hall and R. S. Williams. Pp. ix+368. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1911.) Price 6*s.* 6*d.* net.

IN this volume the contents of Prof. Ostwald's "Schule der Chemie" are reproduced in narrative form, in place of the conversational method previously adopted. From the point of view of the average reader the change is a great advantage, and the book is now written in such a form as to be readily available for use in the teaching of classes of elementary students. As might be expected, much attention is directed to physical and physico-chemical properties; it is quite refreshing in an elementary book to find crystals classified according to their axes of symmetry, in contrast with the emphasis which is usually laid exclusively upon the planes of symmetry.

The most surprising fault of a book, which is in nearly every respect an admirable introduction to the study of chemistry, is found in its treatment of equivalents, atomic weights and molecular weights. After a discussion of the laws of simple, multiple, and reciprocal proportions, Dalton's atomic theory is introduced, but is followed by a table of "Combining Weights of the Most Important Elements," which represent, not the equivalents—which alone can be deduced from this theory—but the modern system of atomic weights, as firmly based by Cannizzaro upon Avogadro's hypothesis. This hypothesis is not mentioned by name, either in the text or in the index, and the latter contains no reference to gas-densities or vapour-densities; these important matters are smuggled into a chapter on carbon, and the theory which is really the basis of all determinations of atomic weights is merely used to provide a few exercises on the combining volumes of gases. A pupil who had the curiosity to inquire why the atomic or "combining" weight of oxygen relatively to hydrogen is taken as sixteen, and not as eight, would find it very difficult, if not impossible, to find a satisfactory answer in the book now under review.

This is, however, the only serious fault that has been noticed in a volume that in other respects displays the admirable quality of lucid exposition, which is characteristic of the author. The translation has been so well done that the book gives the impression of having been written first in English and then translated into German. T. M. L.

Milk Testing, a Simple, Practical Handbook for Dairy Farmers, Estate Agents, Creamery Managers, Milk Distributors, and Consumers. By C. W. Walker-Tisdale. Revised edition. Pp. 86. (London: *Dairy World* Office, 98 Fetter Lane, 1911.) Price 1*s.* net.

THIS useful little book has so commended itself to those for whom it was intended that it is now for the second time revised and enlarged. The new matter includes such recent developments of the dairy industry as the testing of sour milk and the description of portable appliances for use by travelling inspectors. It is a happy circumstance that Mr. Walker-Tisdale, who is himself the manager and a director of a large milk company, should thus place his experience at the disposal of other dairy managers, and it is equally fortunate that the British dairy manager and farmer, so far from abusing the monopoly he possesses (for there is practically no importation of milk from abroad) should show himself so ready to apply chemical tests in order satisfactorily to establish the purity of his milk.

LETTERS TO THE EDITOR.

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

The "Stomatograph."

THE recent controversy regarding the causes which had depreciated the yield of Egypt's cotton crop, terminating in the Egyptian Government's Cotton Commission of 1910, showed very clearly how little accurate knowledge of the physiology of the cotton plant was available, more especially in regard to field conditions. This ignorance was most striking in respect to the water relationships, which —Egypt being dependent on the Nile for its water—are very largely within human control.

One point of interest in this respect is the action of the stomata, especially since I showed that growth is completely arrested by direct sun, from the first emergence of the seedling until late in the summer, the heavy water loss involved by the high sun temperature (160° C. in May to August) and the low day humidity being the limiting factor.

Investigation of plant physiology in the field, however, usually requires special and automatic apparatus, and no suitable appliances were available for investigation of the stomata. After several trials I succeeded in constructing a self-recording form of Mr. Francis Darwin's "porometer," which will work without appreciable errors under any variation of wind, sun, temperature, or barometric pressure, in rain or in dust-storms.

Briefly described, the apparatus consists of an electrical air-pump expelling 3 c.c. of air at each stroke under a constant pressure of 1 millimetre of mercury. The outflow tube is closed by a definite area of leaf, so that the air in escaping has to pass through the leaf tissues. The resistance to this escape depends almost entirely on the aperture of the stomata, of which there are some seventy on the upper leaf surface and two hundred on the lower in adult leaves of Egyptian cotton. The rate of escape is a direct measure of the porosity of the leaf, as in the "porometer." A relay circuit is operated when one stroke of the pump has been completed, and this telegraphs the signal to an electromagnet carrying a pen on its armature; this pen writes on a spiral drum which revolves once every hour.

The complete appliance is very convenient in use, being composed of a box like a microscope case, which is placed on the ground under the plant to be examined; from this box issues the air-tube leading to the leaf and the telegraph wire to the recorder. The number of adjustments which have to be made in the field is thus reduced to a minimum, which is no unimportant consideration under the field conditions obtaining during an Egyptian summer.

The trace of five consecutive days recorded from the same leaf without adjustment shows the stomata slowly closing as the hottest part of the day approaches, then closing when the sun goes behind the trees at 1.40 p.m., and remaining closed all night, opening slowly after sunrise, more rapidly when the direct sun strikes the leaf about 7 a.m., attaining a maximum at 9 a.m., and thenceforward closing steadily, in spite of the brilliant illumination, since the soil around the roots is being dried up by the heavy transpiration.

A side-issue from such records as this, which promises to give further unexpected results, deals with the effect of such stomatal closure on assimilation of CO_2. I have already mentioned that the stem of an Egyptian cotton plant does not grow in sunshine, and it appears that the growth of the root is also checked; it now seems not unlikely that photosynthesis may also be arrested or reduced after a certain hour of the day through stomatal closure, this closure being dependent on the development of the root system and on the water content of the soil.

The beneficial effects of Egyptian sunshine seem to be rather indirect. W. LAWRENCE BALLS.

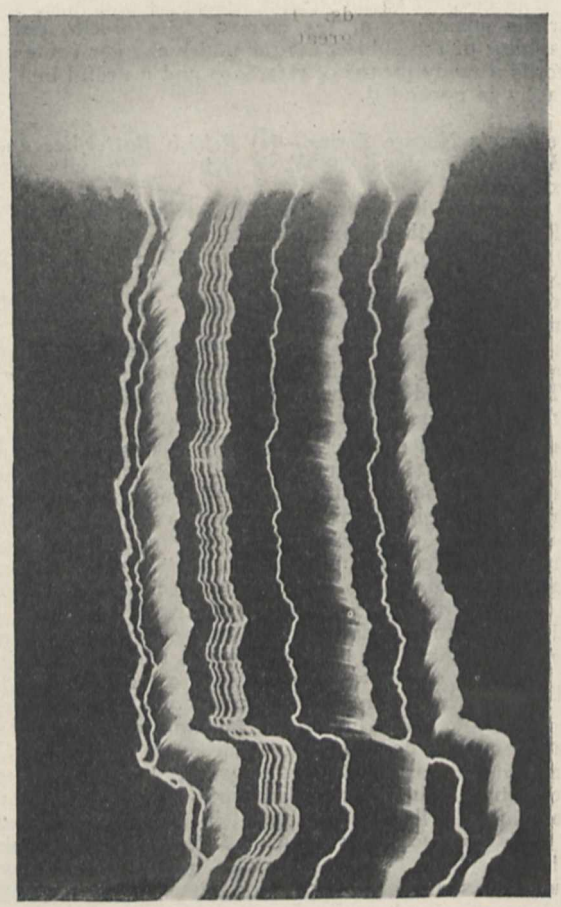
Ghezireh House, Cairo, July 10.

Photograph of Multiple Lightning Flash.

I BEG to enclose a copy of a remarkable flash of lightning which I took some years ago in Uruguay, South America, and which, so far as I know, has never been published—with my knowledge or permission, at any rate.

This copy is an enlargement from a small negative about 1½ inches square, and shows the curious curl-like form in some of the streaks. One noteworthy point about this photograph is that I "snapshotted" it. I had wasted many plates in the usual way, and obtained nothing of any value, but noticed that before every big flash there was a slight flicker in the clouds where the flash came from; I waited for this, let the shutter go just as I saw the flicker, and obtained the enclosed result.

Uruguay is noted for its severe thunderstorms, and animals, fences, trees, and houses are constantly struck. Some years before this photo was taken a powder-house was blown up by lightning not far from where this flash occurred, and in the sand a few miles off



I found a fulgurite—a glass tube about 2½ inches in diameter made by the lightning striking and fusing the sand. These fulgurites are mentioned by Darwin in "The Cruise of the *Beagle*"; he found some near Monte Video, also in Uruguay. A. E. WALBY.

67 Lansdowne Street, Hove, Brighton, July 27.

The Rearing of Sea Urchins.

I HAVE read with much interest in NATURE of July 27 a short letter from Prof. Stanley Gardiner in which he communicates the fact that a hybrid of the species *Echinus esculentus* and *E. miliaris* was successfully reared from the egg through all the larval period until after the completion of metamorphosis in the zoological laboratory at Cambridge. It may interest your readers to learn that by means of salt-water aquaria established last year in the zoological laboratory of the Imperial College of Science in

London we have reared very considerable numbers of *E. miliaris* from the egg through the metamorphosis. The eggs were fertilised in the beginning of April, and when I left London in the middle of June there were many young Echini creeping about. The details of the methods adopted will be described in a paper shortly to appear in *The Quarterly Journal of Microscopical Science*. Last year we reared the eggs of the Serpulid *Pomatoceros* until the larvæ had attained the adult condition and had formed tubes, which were attached to the sides of the vessel in which they were. E. W. MACBRIDE.

Marine Biological Association of the West of Scotland, July 28.

FLIGHT, NATURAL AND ARTIFICIAL.[1]

IN the words of the introduction, "The object of this report is to place at the disposal of the members of the society some of the information now available regarding the physical characteristics, powers of flight, &c., of birds. It must be clearly understood that, owing to the great difficulty experienced in collecting the details of weights, wing area, &c., the report is of a temporary nature only, and does not profess to give the fullest possible information regarding the subject dealt with. The details given, however, have been taken from the best available sources, and it is hoped that the report as a whole will be found a useful introduction to the study of bird flight." It will be seen that original observation and experiment did not fall within the scope of the committee, but, subject to this and the other limitations mentioned above, the results of their labours cannot fail to be of value.

The first section deals with the classification of birds from (*a*) the ornithological and (*b*) the aëronautical point of view. Under (*a*) table i. gives a classification after Finn into twelve main groups, further subdivided into families. The aëronautical classification presents difficulties. In table iii., column 17, are given the values of $S^{\frac{1}{2}}/W^{\frac{1}{3}}$, S being the surface and W the weight, together with other particulars for a large number of birds.

Section ii. is devoted to a description of the principal sorts of flight and of various manœuvres, such as turning in the air. Under the first head are mentioned gliding flight, flapping flight, and soaring flight, of which, however, the first does not differ essentially from the third. Instructive photographs after Marey and Milla are reproduced. Soaring has been the subject of much discussion at various times, no small part of it being hopelessly confused by misunderstanding of mechanical principles. Even in the present section paragraph 12 is not above reproach. The comparison of soaring with the normal performance of a sailing ship is certainly misleading.

When a bird maintains or increases his elevation without working his wings, the explanation is to be sought in a special movement of the air. It cannot be too much emphasised that for this purpose a uniform horizontal wind is of no avail. The larger soaring birds, such as condors and pelicans, probably find their support on ascending currents. Such currents must exist, though we on the ground perceive little of them. Even though the wind be strictly horizontal in the space where the bird is flying, advantage may be taken of variation with height or with time. As a matter of fact, the wind, near the ground at any rate, is always more or less gusty.

Travellers at sea have frequent opportunity of making interesting observations. In these latitudes one may see gulls following the ship and taking advantage of upward currents deflected from the sails or hull. From other parts of the world the albatross is often reported to follow the ship, maintaining his position for minutes or hours together without flapping of wings. Since in this case the distance from the ship may be considerable, one must appeal to upward currents deflected from the waves or to the other specialities of wind already mentioned. But is it certain that a flapping of the wings could not escape attentive observation? One would have supposed so; but the evidence is not free from ambiguity. Following upon a lecture upon the mechanical principles of flight, given in 1900,[1] a correspondent sent me an instantaneous photograph of an albatross flying "very near indeed" to the ship. In the picture the wings appear elevated as if near the top of a stroke, but to the observers at the time "the wings were fully extended in a line with the body." In answer to further inquiries my correspondent wrote: "*Without question* none of the many passengers who were watching the albatross (which was *exceptionally* near the side of the ship) saw the slightest movement of the wings when I took my snap-shot. To all appearance they were fully extended and immovable—certainly 10 to 12 feet from tip to tip." Here, indeed, is a question worthy of further attention from travellers in the southern seas.

Section iii. of the present report deals with weight, wing area, &c. The heaviest bird in the table is the Californian vulture, weighing 13·6 kilog. (30 lb.). The bird carrying the greatest weight per sq. m. is the whooper swan (21·3 kilog. per sq. m.). In section iv. we find observations and calculations regarding the velocity of birds, the power expended, &c. It appears that the maximum speed in ordinary flight does not much exceed 50 miles per hour, and that no bird moving near the earth's surface attains the enormous speed with which flying creatures are sometimes credited. These speeds are, of course, relative to the air. At considerable heights migrating birds may easily experience winds of like amount, so that 100 miles per hour, or more, relative to the ground may well be admissible.

The opinion is expressed that the power required for flapping flight has been much exaggerated. This may be true as regards regular horizontal flight, but it remains a fact that the power exerted by some birds, *e.g.* pigeons, in rising nearly vertically is very great. The question was discussed by Penaud in 1876. "In the ascent the total work developed by the bird is divided into two parts, the one fixed, that is, the work of elevation; the other variable and increasing with the time, that is, the work dispensed in finding a support in the air."

"It is thus to the interest of the bird to rise as quickly as possible, which it generally does, even when under no sense of fear. Their velocity of direct ascent is always several yards per second." And, further: "Thus, and apart from all theory, it is certain that birds are capable of developing momentarily a force corresponding at least: for the peacock, to 1 horse-power for every 66 lb., and for the pigeon and ring-dove, 57 lb."; and, as before mentioned, the work of elevation is not the whole.

In these days there is a natural tendency to overlook the work of the early pioneers. In principle not much has been added to the conclusions of Wenham and Penaud, and the latter constructed actual flying-machines. What was wanted to make flight practical was the advent of the light motor, as developed for the motor-car. When this became available, the skill and courage of such men as the brothers Wright soon led to successful human flight. Further progress is assured, but how far it will go would require a bold man to prophesy. RAYLEIGH.

[1] Aëronautical Society of Great Britain. First Report of the Bird Construction Committee. Compiled by Col. J. D. Fullerton. Pp. 61. (London: Aëronautical Society of Great Britain, 1911.) Price 10*s.* 6*d.* net.

[1] Manchester Memoirs, xliv., p. 1; Scientific Papers, iv., p. 462

SOME SCIENTIFIC CENTRES.

No. XVI.—Prof. Weismann's Zoological Institute at Freiburg-im-Breisgau.

MOST students of zoology arrive at some period or other of their Wanderjahre at Freiburg, that quaint and beautiful old town on the edge of the Black Forest. To some the chief interest will lie in the Münster, in the university buildings, old and new, and in the numerous statues and fountains that are scattered through the town; yet the majority of the students will not consider the visit satisfactorily ended if they omit to call at that institute in Katherinen-strasse, which Prof. August Weismann has made famous.

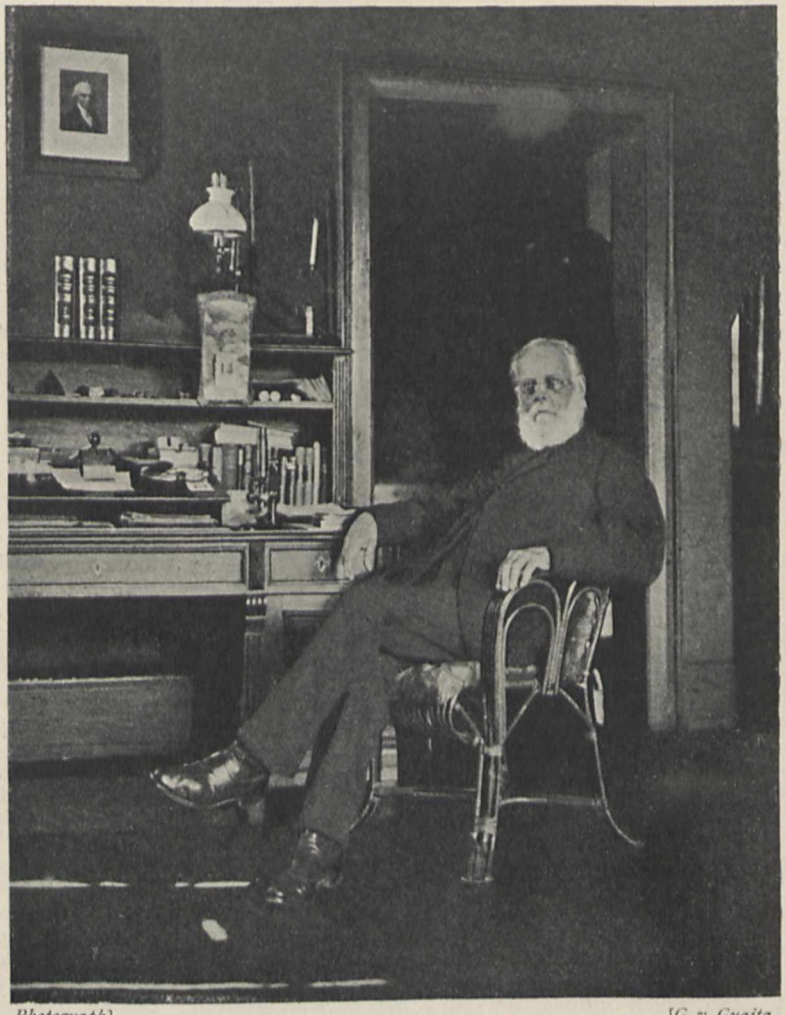
The institute itself stands in a small garden close beside the Chemical and Physiological Institutes, and is built in the shape of an L, with the laboratory windows facing north. It stands gable on to the street, and its exterior presents no striking features, so that by anyone going there for the first time it could easily be passed unnoticed, as it was by the writer on his first visit. The interior, however, presents quite a different appearance: everything necessary for research is there, and the work-benches are splendidly equipped with gas and water and the necessary electric plugs and switches.

In addition to the senior and junior laboratories, rooms are set aside for the students at different stages in their course. There are special rooms for diagrams, apparatus, &c., and in the basement a large tank room. The lecture theatre, from which a small tramway runs to the museum, is large, has plenty of wall space for diagrams, and is fitted with a large Zeiss epidiascope. Finally, there is a fine suite of rooms for the members of the staff, a large and representative museum, and an extensive library, and, further, through the kindness of Prof. Weismann, his private library is placed at the disposal of those engaged in research.

A typical day's work may be of more interest than a mere detailed description of the buildings. In summer by 8 a.m., and in winter by 9 a.m., the senior students are at work. The morning's work usually starts with a short discussion. it may be on some points that have arisen in someone's "Arbeit," but very often the discussions are on any subject under the sun but zoology. As a rule this discussion soon finishes, and each student seats himself at his bench to collect the knotty points in his research for the professor's consideration, or to get some passage in a book or journal ready to lay before the professor as soon as he appears in order to get his own interpretation confirmed or utterly quashed.

Sometimes the morning's discussion is disturbed when near its height by the whisper, "Der Chef," which is always followed by a general and hurried scamper to get ready for the morning's visit. This whisper of "Der Chef" has been used on more than one occasion as a means of getting out of a tight place in an argument.

Prof. Weismann begins his day by visiting each student, going over the interesting points in his work, comparing them with other results, or by a series of questions getting the student on to the right track. During the remainder of the day the laboratories are in charge of the senior assistant, and students may either spend all their time there, or attend one or more of the courses of lectures delivered at the institute, either by Prof. Weismann on some general subject, or by one or other of the assistants on some special subject.



Photograph] [*G. v. Guaita.*

Prof. August Weismann in his Study.

On one afternoon weekly there is the seminar, which is attended by the professors, the other members of the staff, and the senior students. Some time previously recent books or articles from the scientific journals are distributed to the students and members of the staff, and at the seminar each student must criticise the book or paper given to him. As soon as the criticism is finished, the other students and the members of the staff give their opinions, and then Prof. Weismann sums up the discussion. The work in the seminar is not restricted to recent literature, nor to works published in German. Frequently a student is requested to give a review of the present state of knowledge in some biological problem, or to

give a summary of the results achieved in some particular group.

The day's work is arranged and carried out in such a way as to give the student opportunity of observing, forming opinions of his own, and gaining confidence in his own judgment. There also the student is taught to get at the root of things, and, without knowing it, gradually copies the example and is imbued with the earnestness of the director.

The general routine differs very little from that followed in most German universities, and yet year after year every Arbeitsplatz in the institute is occupied, and that by a very cosmopolitan group of zoologists and of zoologists in the making.

Why is it that students from all quarters flock there? It is certainly not due to the equipment, for many of the newer zoological institutes in Germany are more lavishly equipped; nor is it due to the fact that the institute is situated in a very pleasant town. On the contrary, it is due to the reputation, but still more to the personality of the director.

Prof. Weismann's research has covered a wide field, and the resulting articles are all marked by a thoroughness and a mastery of detail which shows that he, at any rate, has just that power, often lacking in German men of science, of not allowing the details, while giving them their full value, to obscure the main issue.

Of his original investigations, that on the origin of the germ-cells in the Hydrozoa is specially interesting, as it led him from the facts there observed to formulate his greatest doctrine—the continuity of the germ-plasm, and to found thereon a theory of heredity. This doctrine had a much wider significance than was at first thought. If it be accepted, the only conclusion possible is that all variations—by this is meant inherited variations—must be congenital, and that as the direct result of this there can be no transmission of acquired characters, that is to say, of such characters as are acquired during the lifetime of the individual. Needless to say, the publication of this doctrine caused an enormous sensation everywhere, but particularly so among men of science and breeders. In spite of all the jibes and sneers hurled at it, its effect on the natural sciences has been deep and permanent, and, however much modified, however much tampered with, it forms the one firm basis of all modern views of heredity.

His thorough knowledge of both animal and vegetable cytology helped him to place his theory of heredity on a surer basis, one might well venture to say on a firmer foundation of fact than was possible for most of his predecessors and many of his contemporaries.

In the development of Darwinism Prof. Weismann has taken a leading part, not only in gaining for it in Germany an almost universal acceptance, but also in explaining its real meaning to the world at large and in freeing it from such traces of Lamarckism as still existed.

Moreover, a style which is beautiful and at the same time lucid, a persuasiveness which is equalled by few, and a capacity for following a hypothesis to its logical end, has made Prof. Weismann one of the foremost, if not the foremost, exponent of all that is best in Darwinism and in the teaching of Wallace.

His views have exercised on evolution a far-reaching influence, for they have been the direct cause, and this must be peculiarly gratifying to Prof. Weismann, of much of the recent research undertaken in this subject.

But a record brilliant as his has been is not sufficient to fill the institute to overflowing, or to rouse such enthusiasm and affection for the director as is seen there. This is purely due to the personality of Prof. Weismann, to his geniality, and to the kindness with which he guides the faltering steps, especially of strangers within his gates. In fact, his Gemüthlichkeit soon overcomes the diffidence of his students, and at the same time rouses in them a regard and affection which it is given to few teachers to gain.

No student can work through a course in zoology at Freiburg without being influenced by the enthusiasm, the earnestness, and the profound thoroughness he finds there, and gaining and retaining a feeling of the deepest admiration for that veteran in science, the director of the institute, Prof. Weismann.

No better tribute can be paid to Prof. Weismann than the affection in which he is held by his former students, to whom the phrase, "Der Chef," calls up so many pleasant memories, and no better proof of this exists than the longing with which they look back to the time spent within his halls.

W. D. H.

PREHISTORIC SOUTH AFRICA.[1]

MR. J. P. JOHNSON continues to make good use of the opportunities his mining practice gives him for the careful study of South African geology and archæology. The latest addition to his series of short books is, like its predecessors, valuable from its record of carefully observed facts and instructive illustrations. The subjects included range from the period of the Zimbabwe ruins back to the oldest of the stone implements, and perhaps even older. Occasional remarks show that Mr. Johnson had been a diligent collector of stone implements in the south of England, so that he went to South Africa as a trained observer. He has found in the rich implement-bearing gravels there abundant scope for his energies. He classifies the South African implements into three groups—Eolithic and two divisions of Palæolithic. No Neolithic implements have as yet been found. He identifies as Eolithic a series of implements collected from a gravel at Leijfontein, in the Campbell Rand. He compares them with the eoliths of Kent, which he accepts as probably of artificial origin, though he admits that this conclusion is still open to doubt.

He gives two pages of sketches of these eoliths, and though they resemble some of the characteristic Kent types, the illustrations are inadequate for any independent opinion as to their relations with the English "eoliths."

The Palæolithic implements are divided into two groups—the Acheulic, which are generally of the type which he has called amygdaliths, and the Solutric, which are generally scrapers. He regards the implements which he refers to the Solutric type as of later date than the Acheulic. Some authorities, however, hold that both belong to the same period. Mr. Johnson regards them as of different dates from the evidence of their distribution. The Acheulic implements must, he thinks, be the earlier, as they are found in older deposits, and none of the Solutric sites have yielded any of the typical Acheulic forms. He has collected Acheulic implements from seven or more feet below the surface, and found some in gravel that has been cemented to a hard conglomerate. Many of the Acheulic implements must be of considerable antiquity. They are abundantly distributed over the plateau around the Victoria Falls, and Colonel Fielden, who collected many there, is of the opinion that they were deposited before the erosion of the

1 "The Prehistoric Period in South Africa." By J. P. Johnson. Pp. iv+89. (London: Longmans, Green, and Co., 1910.) Price 10s.

great Zambezi gorge. Mr. Johnson, however, agrees with Mr. Codrington that these implement-bearing gravels are later than the gorge, and were washed to their present position from slightly higher ground.

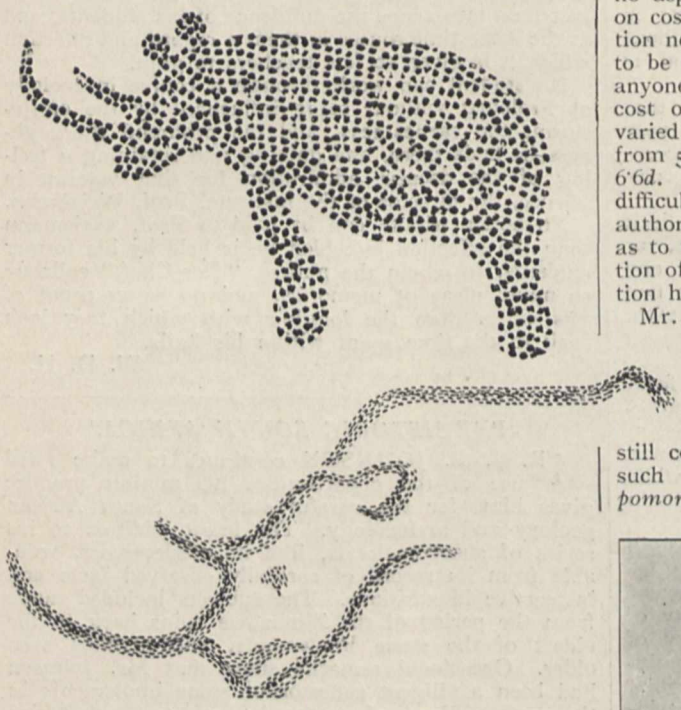


Figure of rhinoceros coarsely pecked in full, and of head of rhinoceros pecked in outline, Wolmaransstad. From "The Prehistoric Period in South Africa."

They are of a considerable, though not of the enormous antiquity, demanded by the other hypothesis.

The author adds many new examples of the rock drawings to those issued in his previous works, including some formed by pecking rock surfaces. Some of these drawings he regards as made by men of the Solutric period; and, as the men of Solutré, though skilled artists, did not use the rock-pecking process, Mr. Johnson concludes that the European and South African makers of Solutric implements were derived by separate migrations from a common eastern ancestor.

Mr. Johnson accepts the view that the Zimbabwe was made by a Bantu people. He records (p. 80) an interesting tradition in the northern Transvaal of a race of miners who were not Kaffirs, and whom he suggests were Arabs; but as these miners had guns they belonged to comparatively modern times.

J. W. G.

THE ADVISORY WORK OF AN AGRICULTURAL COLLEGE.[1]

WHEN county councils make grants to agricultural colleges they expect to get in return for their money a certain amount of instruction for students at the college and for farmers at market-day lectures, and a good deal of advisory work for rate-paying agriculturists. The volume before us represents the output of the Wye College staff in advisory work during the year 1910.

In view of the great importance of milk production in Surrey, and to a smaller extent in the suburban districts of Kent, it is natural to find a large part of the farm report taken up by the preliminary results of an inquiry into the cost of milk production. On no aspect of farming have we less information than on costs of production, and on none is more information needed at the present time, when economies have to be introduced at every turn. It will not astonish anyone acquainted with farmers to learn that the cost of food required to produce a gallon of milk varied from 3·8*d*. to 10·5*d*. The usual variation was from 5*d*. to 8*d*., the average on fifty-nine farms being 6·6*d*. An inquiry of this nature is beset with many difficulties and pitfalls, and it would be well for the authors to obtain advice from an expert statistician as to the methods to be employed and the interpretation of the results; a more useful subject for investigation has rarely been attacked by dairy workers.

Mr. Theobald's report on economic zoology covers 130 pages, and is, as usual, well illustrated. Among new fruit-tree pests are noted the pale brindled beauty (*Phigalia pilosaria*, Hb.) and the light emerald moth (*Metrocampa margaritaria*, Linn.). Many of the old pests still continue to baffle all the efforts of the grower, such as the apple blossom weevil (*Anthonomus pomorum*, Linn.) and the raspberry beetle (*Byturus tomentosus*, Fab.), but there is put forward for consideration an interesting statement from "an old book" to the effect that woolly aphis may be cured by planting a nasturtium against the infested tree. But the two

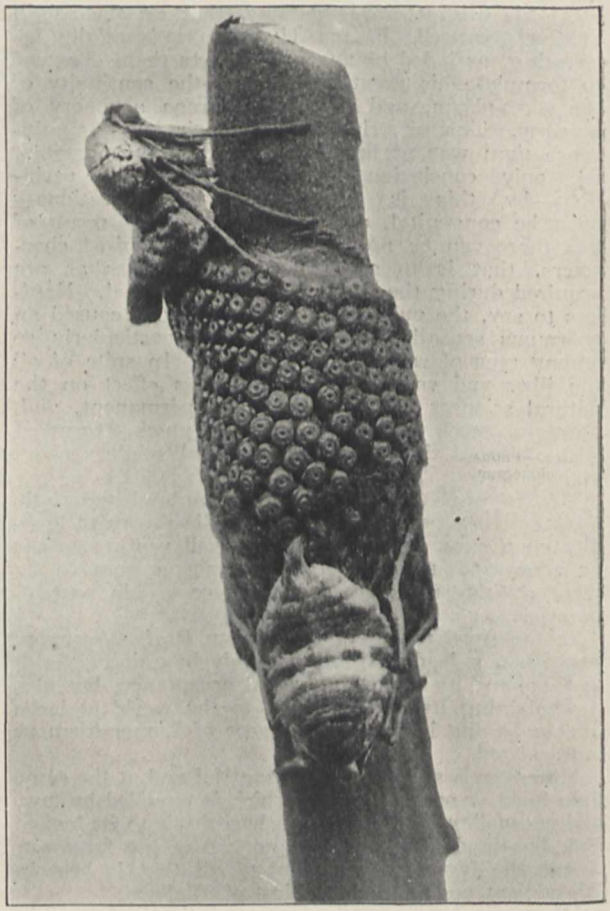


FIG. 1.—Female March Moths. The lower moth laying on her egg-band beneath one of the Lackey moth (×4). From the Journal of the South-Eastern Agricultural College.

[1] The Journal of the South-Eastern Agricultural College, Wye, Kent. No. 19. Pp. 426. (London and Ashford: Headley Bros., 1910.) Price 7*s*. 6*d*. (Residents in Kent and Surrey, 3*s*. 6*d*.)

problems Mr. Theobald considers of most pressing importance are the bionomics of nematodes and the study of Strongylidæ. Nematodes are responsible for considerable losses to the hop-grower, the market-gardener, the strawberry-grower, and the farmer; they have long been known to damage cereal crops, and are now recognised as potato pests. The Strongylidæ are serious parasites of sheep and other animals, yet nothing is known of the life-history of the commonest form.

We reproduce a very good photograph of a female March moth (*Anisopteryx aescularia*, Schiff.) laying her "egg band" on a twig.

The report from the Analytical Laboratory deals with the more interesting of the 377 samples sent in for analysis.

In the report from the Botanical Department, Mr. S. T. Parkinson describes some interesting experiments that will be new to many people in this country. It will be remembered that, in 1909, Prof. Molisch, of Prague, published a paper in which he advocated that perennial plants, while still in their resting stage, should be dipped in hot water prior to forcing. In the resting period he distinguishes between the "unfreiwillig" and the "freiwillig" rest; the former, being inherent in the nature of the plant, cannot be altered; the latter, being dependent on the external circumstances, can be shortened. By steeping the plant in hot water at the proper time the "freiwillig" period is therefore cut out, and its cells spring into activity, thus it has such a start over the untreated plants that it comes to maturity well before they do.

FIG. 2.—Photograph of "Dipped" (D) and Control (C) plants of Spirea. "Dipped" November 25; photographed December 13. From the Journal of the South-Eastern Agricultural College.

Without committing himself to this particular hypothesis, Mr. Parkinson has carried out numerous experiments, and finds that an exposure of about twelve hours to a temperature of 95° F., or, in the case of soft plants, such as seakale, to 85° F., just after the period of "deepest rest," *i.e.* the end of November or beginning of December, led to very rapid growth. Numerous photographs are given, one of which is reproduced in Fig. 2. Further studies of this interesting problem will be awaited with interest.

Experiments are recorded by Mr. Garrad on the growth of tobacco for nicotine extraction. Nicotine makes an excellent wash for fruit-trees and hops, but its price (12*s.* per lb.) is too high. Mr. Garrad shows that he produced it at 6*s.* per lb., which, if it turned out a normal cost of production, would make a profitable industry. Mr. Garrad's Indian experience has stood him in good stead, and a continuation of the work would be very useful.

Mr. E. S. Salmon's report makes very sad reading. It seems but a few years ago since he announced that a gooseberry disease had appeared in Ireland and must inevitably spread to this country, with alarming results, unless certain precautions were adopted. Unfortunately his words fell on deaf ears, and it is a matter of history that no steps were taken to exclude the disease; trouble that had not yet appeared could not rouse the authorities to action. When the disease finally came over its seriousness was at first denied, and now that many hundred acres are affected and the disease is rapidly spreading, a plan of campaign has been organised in some, *but not in all*, districts. Thus Kent is efficiently inspected by trained inspectors, while Surrey and Sussex are not.

If the serious losses now being incurred could teach all concerned a few elementary facts about plant diseases, the lesson would still be worth having, however dearly bought, but we seem to be in for equal or greater losses from a potato disease known as the Wart Disease or Black Scab. The disease is here and is spreading, yet nothing adequate is being done. It is not surprising that the Pests Committee of the Central and Associated Chambers of Agriculture should, in a communication to the Board of Agriculture, "earnestly recall your attention to the last paragraph of their report, dated December 1st, 1908, in which they suggested that the Board should appoint an advisory committee of experts to assist the Board in dealing with plant diseases generally, as recommended by the Departmental Committee on the Fruit Industry."

A JUNGLE FOLK.[1]

THE Veddas of Ceylon have long been regarded as one of the most interesting of the varieties of mankind, and one way and another a good deal has been written about them in various journals and books, but the information was usually scrappy and not always trustworthy. An exception must, however, be made to the careful work of John Bailey in 1863, and the sympathetic investigations of Hugh Nevill, whose valuable notes are to be found in a scarce journal, *The Taprobanian*. In "Ancient Ceylon" (1909), Mr. H. Parker gives a useful summary of our knowledge of the Veddas, together with the results of his own observations on the village Veddas. For the physical anthropology we are mainly indebted to Virchow (1881), who studied the craniology of the Veddas, and to the magnificent memoir, "Die Weddas von Ceylon," by the cousins Sarsin; this monograph deals also with their material culture, but the account of Vedda sociology is much less satisfactory. It was evident to ethnologists that the sociology and religion of the Veddas needed to be studied carefully by modern methods of sociological field research, as these people undoubtedly are little-modified representatives of a very ancient human stock, and there was a danger, owing to the very small number of the wilder bands and their gradual

[1] "The Veddas." By Dr. C. G. Seligmann and Brenda Z. Seligmann. With a chapter by Dr. C. S. Myers and an appendix by A. Mendis Gunasekara. Pp. xx+463+map. (Cambridge: The University Press, 1911.) Price 15*s.* net.

adoption of a more civilised mode of life, that their customs and beliefs might become obsolete. On being approached on the subject, the Ceylon Government, with their customary public spirit, voted a liberal grant for this purpose, and Dr. C. G. Seligmann was selected to undertake the research. He was accompanied by Mrs. Seligmann, and to her in no small measure must be credited the success of the expedition. The Veddas are a shy and intensely jealous people, but the presence of a woman in the party led to very friendly relations being established, and Mrs. Seligmann proved herself to be a first-class investigator in the field. Their results are now published as one of the Cambridge Archæological and Ethnological Series of the Cambridge University Press.

FIG. 1.—Kirikoraha ceremony. The shaman tracking the sambar (Henebedda). From "The Veddas."

Mr. Parker is inclined to believe that the forebears of the present few hunting Veddas were more civilised, and that the existing condition is a reversion to the forest life of their remote forefathers; the Seligmanns, however, regard the hunting Veddas as direct survivals of the primitive Veddas, and the traditions of a higher state of culture as mainly due to confusion between the Veddas and Kandayans of mixed Vedda descent, who until recently called themselves Veddas, or were known as such to their neighbours. A brief account is given of the various Vedda communities; the Danigala Veddas are the show "wild Veddas" described by so many travellers; although really well-off, they pose as poor, morose, wild men of the jungle—they are, in fact, professional savages.

The Vedda system of relationship is a late form of the kind known as classificatory; the working basis is the marriage of the children of brother and sister, but not of two brothers or sisters. Before marriage a man pays at least as much regard to his future father-in-law as to his own father, but after marriage the association between father-in-law and son-in-law becomes very intimate. The social system is an exogamic clan organisation with female descent. Two clans are regarded as socially superior to the others, and their members do not marry into the inferior clans. The Veddas greatly prefer living in rock-shelters to huts, but they shift their home two or three times a year as the season demands. Most of the caves shelter several families, but each family keeps strictly within its own limits. There are no puberty ceremonies for either sex, except among certain Veddas who have been much influenced by Tamils or Sinhalese. The Veddas marry young, and are strictly monogamous. A rigid sexual morality prevails, but at present, among the more sophisticated groups, an unmarried girl is allowed considerable liberty with regard to the youth allotted to her. The country is divided into hunting lands for the different groups, within which each individual has the exclusive hunting rights of a particular area or areas; when dying, a man generally gives his land to his sons, and not to his sons-in-law, but no landed property passes without the consent of the grown men of the group. Trespass is almost unknown. The religion of the Veddas is essentially a cult of the dead; with this is associated the cult of spirits, *yaku*, of certain long-dead Veddas who may be regarded as legendary heroes. The chapters dealing with the magico-religious practices and beliefs are of great interest and importance. The ceremonial dances are described and illustrated with great detail; the majority are pantomimic, and are performed with the object of becoming possessed by a *yaku*; the Seligmanns believe that there is no considerable element of pretence in the performance of the shaman.

Dr. C. S. Myers has a chapter on music, based on thirty-four phonographic records. In the Vedda music we seem to meet with the very beginnings of melody-

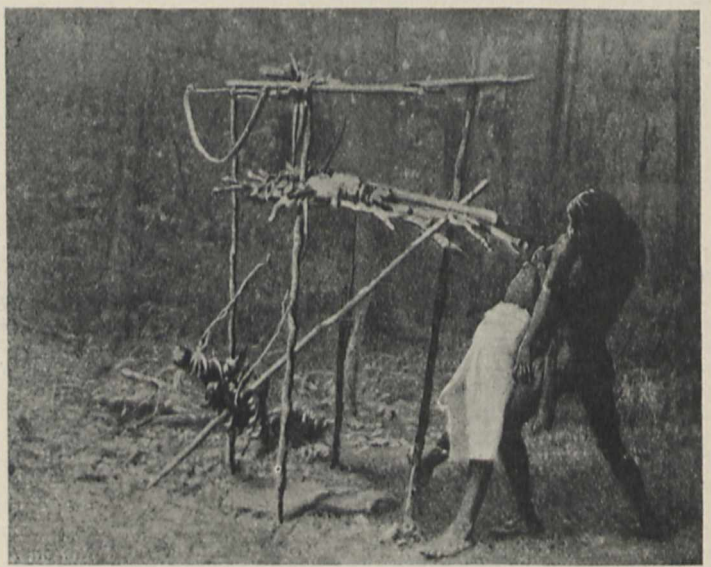


FIG. 2.—Bambura Yaka ceremony. The boar is at length killed; the possessed shaman collapsing into the arms of a supporter (Sitala Wanniya). From "The Veddas."

music; there is no other people in whose music the gradual construction of music on such simple lines can be discerned. A number of Vedda songs have been transliterated and translated by Mr. A. M. Gunasekara, and Mr. Parker has done the same for the invocations. The senses of the Veddas were also tested. Enough has been said to show that this book

is of first importance, and it may be considered as the final word on the subject, as it is improbable that we shall ever learn much more about the Veddas. The Ceylon Government is to be congratulated in having secured the services of Dr. and Mrs. Seligmann for this important research. A final word of praise is due to the number and excellence of the photographs; those illustrating various ceremonies are of exceptional interest. A. C. HADDON.

THE COAST EROSION COMMISSION.

IN July, 1906, a Royal Commission was appointed to inquire and report as to the encroachment of the sea on the coasts of this country, and as to what means are desirable for the prevention of such damage; also as to the reclamation of tidal lands as affecting the subject of unemployment. Two years later the duties of the Commission were extended to an inquiry as to whether it is desirable to make an experiment in afforestation as a means of increasing employment during periods of depression.

The Commission consisted of thirteen members, representing landowners, experts in coast defence works, geologists, lawyers, the Board of Trade and other Government departments. The Hon Ivor Guest was appointed chairman. The first report, containing the minutes of evidence heard in the earlier part of the inquiry, was issued in 1907; the second report on the subject of afforestation in January, 1909; that now issued being the final report containing the findings of the Commission.[1]

The witnesses who appeared before the Commission represented all branches of the subject, including representatives of the Board of Trade, local authorities and their officers having charge of the sea coast in England, Ireland, and Scotland, owners of land abutting on the coast, engineers having expert knowledge of sea defence works, and geologists. Committees of the Commissioners made inspections of various parts of the coasts where erosion was going on, and where reclamations had been made; and also of the works of sea defence in Holland and Belgium.

As the subject of coast erosion had not been dealt with by any previous Commission, the Commissioners thought it necessary to make an ample and thorough examination of the whole subject. The report is divided into an inquiry into the physiographical and geological conditions affecting the coast-line; an estimate of the extent of erosion and accretion of land; and where artificial reclamation has been carried out on the coasts and in tidal estuaries; engineering questions as to the type of work which has been adopted for sea defences; the central and local administration of the foreshore; and whether it is desirable to promote facilities for reclaiming tidal land; and also as to whether the defence of the coast is a national duty towards which grants of public funds ought to be made.

The inquiries of the Commission extended over five years, and the resulting report gives a very clear and able digest of the large amount of evidence taken. It deals with the subject in an exhaustive and comprehensive manner, and contains an able account of the technical considerations which should govern the design of works of defence. The finding of the Commissioners appears to be a fair exposition of the evidence brought before them, and it deals in an even-handed way with the rights of the owners of land abutting on the coast, on one hand, and of the State, as representing the other tax-paying members of the community, on the other.

The recommendations of the Commissioners are practically unanimous. There are reservations as to some of the subjects dealt with, the most important relating to the subject of the obligation of the State to protect the sea coasts.

The findings of the Commissioners may be summarised as follows:—

That there is a considerable amount of erosion and consequent loss of land taking place on certain parts of the coast; on the other hand, land is being reclaimed from the sea. Taking the last thirty-five years, it was shown by the evidence of the Ordnance Department that 6640 acres have been lost, while 48,000 acres have been gained by reclaiming tidal lands. This reclaimed land is due principally to the accretion of material brought down in suspension by the rivers. The amount and rate of erosion along the coast is governed by the nature and form of the coast. The natural protection of the coast is afforded by accumulations of sand and shingle derived almost entirely from the material eroded from the cliffs. The amount of beach material therefore depends on the amount of erosion going on, and the quantity is limited, and is not inexhaustible.

The material eroded travels along the coast in definite directions, due to the action of the tides, the wind and the waves. Its travel may be arrested by projecting headlands and river mouths.

Much damage to the coast has been incurred by the removal of this beach material in some places for road-making and constructional purposes.

The evidence shows that if works of protection are carried out with due regard to the local peculiarities of the district to be dealt with, and on sound engineering lines, erosion of the coast may be prevented. The fact also is disclosed that a very large amount of money has been wasted on groynes, sea-walls, and other defence works, owing to a want of knowledge of the conditions prevailing in the neighbourhood where the works were carried out; also that works designed solely with regard to the protection of a particular line of coast may lead to increased erosion on the coast to the leeward side, owing to the stoppage of the travel of the beach material. If the land to be protected is ordinary agricultural land, the cost of protection may be greater than the value of the land to be protected.

The Commissioners advise that the whole care of the coast should be placed under the administration of the Board of Trade, who should be constituted the central authority of the United Kingdom for the purpose of sea defence. That the Board should be invested with power to enable it to control the removal of materials from the shore, making it illegal to remove any sand, shingle, or stone without their previous consent being obtained; the approving of works of construction on the shore; the supervision of existing local authorities concerned with sea defences, and, where required, the creation of new authorities for the purposes of supervision of the coast to employ a staff of scientific experts to secure systematic observation of the movement of beach material and for watching the coast in order to prevent removal of such material where doing this would be injurious; also to sanction the borrowing of money by local authorities for defence works, and to determine the period over which repayment should be made. At present this duty rests with the Local Government Board, which only allow a period of ten years for groynes and twenty years for more solid works. This limit appears

[1] Third and Final Report of the Royal Commission on Coast Erosion. The Reclamation of Tidal Lands and Afforestation. (London: Published by his Majesty's Stationery Office, 1911.) Price 3s.

to the Commissioners to operate detrimentally in the case of local authorities.

With regard to the alleged obligation of the Crown to defend the coasts from the inroad of the sea, the Commissioners, with one exception, consider that the evidence laid before them does not warrant this conclusion, and that there is not any settled principle of the Crown or statute law to support the contention that there is a responsibility for sea defence resting primarily upon the nation at large; the fact that there is erosion in some places does not affect the nation generally, and there is not any ground for the contention that sea defence is a national service.

SEASONAL VARIATIONS OF MARINE ORGANISMS.

THE present short article has been written, not for the plankton specialist, but for readers who may have had their interest aroused by some reference in purely technical papers to seasonal variations. Aquatic organisms (vegetable and animal) may be divided into two groups, those which are fixed to the bottom or cannot leave the substratum, and those which are independent of it, and live swimming or floating in the water.

Of the latter, the pelagic organisms, some, such as fishes, swim about actively, whilst others are passive organisms, with but feeble organs of locomotion or none. They float about almost like inanimate objects, at the mercy of tides and currents, and they vary in size from microscopic flagellates up to large medusæ. These more or less passive pelagic organisms (both vegetable and animal) are what Hensen in 1887 characterised under the term plankton. The study of the plankton has advanced by leaps and bounds in the last few years, and fresh discoveries (often the results of new methods and ingeniously devised apparatus) have acted as stimuli to the work.

From being a qualitative science, planktology has become quantitative, and is becoming as exact in its methods as biometrics. Formerly the investigations were considered sufficiently intense and accurate if a net made of fine silk was pulled horizontally through the water, so that the planktonic organisms were filtered out and captured. Now, it is necessary to use other methods, to pass the water through special filters, and to centrifuge measured quantities in order to catch those exceedingly small creatures which pass quite easily through the finest silk cloth. These very small organisms are of supreme importance, for what they lack in size they make up for in numbers, and some of the most keenly discussed theories in marine biology of the last few years may have to be seriously modified when more detailed observations have been made on their occurrence.

Serial investigations have shown that the plankton varies both qualitatively and quantitatively through the different seasons. It is never absent even under an ice cover in fresh-water lakes, and just as the opening of the buds serves as an indication of spring, so the appearance of certain organisms tells of the approach of the same season in the waters. Summer and autumn are both equally well marked in the aquatic world, and this applies to the seas as well as to lakes and ponds.

Some organisms are always present, but most planktonic animals and plants appear at certain seasons, and then disappear, whilst others take their places. In fact, it is quite impossible to write an account of the plankton of any waters from a series of catches made in a period of a few weeks only. A plankton investigation must extend through at least one year, so that catches may be examined representative of all seasons. If such a research be carried out it becomes at once obvious that the plankton varies according to certain external conditions, amongst which might be enumerated, sunlight and temperature of the water, chemical constitution of the medium, and, finally, the motion of the latter, particularly as regards vertical currents.

The application of quantitative methods to the study of the marine plankton has shown that, contrary to all expectation, the colder waters of the globe are more productive than those of the tropics. Compared with temperate and Arctic seas, the open ocean of the tropics is a desert so far as the plankton is concerned, with occasional oases. In our own waters the quantity of plankton present varies enormously during the year. Catches made with a net hauled vertically under the same conditions average perhaps about 1 c.c. in volume during the early months of the year. In the short space of a week in March or April, this volume may rise to 40 c.c., or even more, and remain constant for a period of some weeks, falling eventually to about 1 or 2 c.c. again during the summer. It is of the utmost importance that the causes of these variations in the quantity of the plankton should be discovered. What determines the productivity of any particular region? Why is there an extraordinary increase in quantity during certain weeks of the spring and autumn? These are amongst the most fundamental questions in the biology of the sea.

If every year was the same so far as meteorological conditions were concerned, and the plankton variations of successive years were absolutely identical, we should never be able to do more than make speculations as to the causes of such variations. Nature, however, varies the meteorological and hydrographical conditions for us, and we find that there are also corresponding annual variations in the plankton. Thus the spring and autumn maxima of the latter may be earlier one year than another, or may extend over a longer period. It is the work of the planktologist to analyse these changes and endeavour to correlate plankton variations with hydrographical and meteorological conditions.

In the Irish Sea, for example, an attempt has been made by Prof. Herdman and others to arrive at some of the causes of the seasonal variations by taking serial plankton catches through a period of several years, the hydrographic conditions prevailing being also observed. It ought to be possible in this way to correlate certain biological and physical variations. It was found in the first years of this plankton investigation that the spring and autumn maxima were due to a large extent to an enormous increase in diatoms, an increase followed by the appearance of dinoflagellates. The copepods followed these spring dinoflagellates, and attained their greatest development in the early summer. This order of succession has held good throughout all the years of this investigation (1907–11). Whilst, however, the highest monthly averages were in April in 1907 and 1910, they occurred in May in 1908 and 1909. The two years, 1907 and 1910, resembled one another so far as meteorological conditions are concerned in having a larger amount of sunshine during the early months than was the case in 1908 and 1909; and the question arises whether this early sunshine was a determining factor in the early appearance of the vernal maximum.

It was expected that this year, 1911, would perhaps throw some light on the question, and whatever the result may be when the hydrographic and meteorological conditions are worked out, the plankton maximum has certainly been very different from that of any of the previous years.

Up to the present the cause of the vernal phyto-

plankton maximum still seems to be wrapped in mystery, and the same may be said of the greater productivity of the cooler waters.

Several theories have been proposed from time to time by Brandt and others to explain the vernal maximum, and of these Nathanson's appears to be the most fundamental. This author believes that vertical currents, which aid in the circulation of food materials, are responsible for the productivity of the sea in plankton. These currents are always present at certain places, and there one can always rely on finding a rich plankton. They are also present at certain seasons in other larger areas of the sea, and in lakes, and these seasons correspond to the times of maxima.

It is most probable that this explanation is not sufficient alone, and that the sunlight, the temperature of the water, and the chemical constitution are also determining factors.

The conditions surrounding the plankton are very complex, and it will probably require many years of investigation before the predominant factors in the problem can be discovered.

The work is slow and laborious, but still it aims at the solution of one of the most important problems in the metabolism of the ocean. This is the point of view from which the planktonic work at the Port Erin Biological Station is being carried out under Herdman's direction, and similar work is being prosecuted by planktologists elsewhere. It has lately been asserted that the most important part of the food of aquatic organisms is derived from organic compounds in solution in the medium in which they are living. At the present time it is impossible to say with any certainty how far this thesis may be correct, but whether it be the case or not, the plankton still retains its importance as either the immediate or the ultimate source of those organic substances upon which all marine and fresh-water animals depend.

WM. J. DAKIN.

NOTES.

IT is announced in the July issue of *The Popular Science Monthly* that during his visit to Washington at the time of the annual meeting of the National Academy of Sciences Sir John Murray, K.C.B., F.R.S., presented a fund of 1200*l.* to the academy for the purpose of founding an Alexander Agassiz gold medal, which is to be awarded to men of science in any part of the world for original contributions to the science of oceanography.

WE regret to announce that Mr. W. I. Last, director of the Science Museum, South Kensington, died on August 7 at his residence, 11 Onslow Crescent, S.W., in his fifty-fourth year. Mr. Last was apprenticed in 1873 with Messrs. Hayward Tyler and Co., and when barely twenty years of age won the Senior Whitworth Scholarship; he held his scholarship at the works of Sir Joseph Whitworth, and at the same time he followed a course of study at the Owens College, Manchester, gaining numerous prizes during this period. In 1886 he was elected an Associate Member of the Institution of Civil Engineers, and in the following year the council awarded him a Watt medal and a Telford premium for his paper on setting out the curves of wheel teeth. In 1890, after some years spent in practical work at home and abroad, he was appointed to the post of keeper of the machinery and inventions division of the South Kensington Museum; shortly afterwards the naval division was also entrusted to his care. Recognising that objects which involved mechanical movement are most intelligible as well as most attractive, both to students and to the public, when shown in motion, he arranged numerous ways of effecting this under museum conditions. One of the best methods which he devised and introduced for this purpose was the supply of compressed air for working the objects by their own driving mechanism. The plan of sectioning objects to show the working parts of machines and details of construction was carried out by Mr. Last with much success. The collections have been very widely extended under his supervision. Mr. Last received his appointment as director of the whole Science Museum in 1904. The excellence of his work on the collections was the subject of comment in connection with the recent inquiry as to the museum.

THE death at Nice is announced, at the age of seventy years, of Dr. Louis C. De Coppet, distinguished by his researches on the solubilities of salts and the lowering of the freezing point of water by the presence of salts in solution.

WE are informed by the National Association for the Prevention of Consumption that it has been decided by the Rome authorities to postpone the International Congress on Tuberculosis, which was to have been held in Rome on September 24–30, to next April.

THE London County Council, on the recommendation of the Local Government Records and Museums Committee, has resolved that the whole of the objects of London interest collected by the Council from time to time, including the boat of the Roman period discovered on the site of the new County Hall, be offered on permanent loan to the trustees of the London Museum. The museum will be accommodated in the State apartments of Kensington Palace, which was placed by the King at the disposal of trustees for the exhibition of the collections. The accommodation at Kensington Palace is understood to be of a temporary nature, the intention being eventually to house the objects in a building worthy of London.

IT is announced in *The Times* that an experiment in the direction of utilising aëroplanes in the postal service of the country is likely to be undertaken shortly by the General Post Office. The proposal is for a regular aërial service for a limited period between London and Windsor. Arrangements have been made with a number of large firms for the fixing in their establishments of special "aërial" letter-boxes, in which letters intended for the aërial service must be posted. Daily clearances will be made by postmen, and the collections will be dispatched to the central clearing house. Here the letters will be placed in sealed bags and conveyed by motor-van to the aërodrome at Hendon, where the bags will be securely fixed to the machines. The airmen will then start on the journey to Windsor, covering the distance of 21 miles in, it is estimated, half an hour. At Windsor the aëroplane staff will be responsible for the conveyance from the aërodrome by road of all the letters to the town post-office, where they will be dealt with in the usual way.

THE annual autumn meeting of the Institute of Metals will be held at Newcastle-on-Tyne on September 20–22. Sir C. A. Parsons, K.C.B., F.R.S., is acting as chairman of the local committee, and Dr. J. T. Dunn as honorary secretary. The meeting will open at 10 a.m. on Wednesday, September 20, when the members will be welcomed at Armstrong College by the Lord Mayor of the city, Sir W. H. Stephenson, and the local committee, after which a series of papers will be read and discussed, Sir Gerard A. Muntz, Bart, president, being in the chair. In the afternoon members will have the opportunity of visiting

shipbuilding, engineering, metallurgical, and electrical works in the neighbourhood. In the evening there will be a reception of the members and their ladies, followed by a conversazione, in the Laing Art Gallery, by invitation of the Lord Mayor. On Thursday, September 21, papers will be read and discussed at a morning session of the institute, and in the afternoon there will be further visits to works. For September 22 the Tyne Improvement Commissioners have placed a steamer at the disposal of the local committee for a voyage to the mouth of the river and back.

THE ninth annual meeting of the South African Association for the Advancement of Science was held at Bulawayo on July 3–8, under the presidency of Prof. P. D. Hahn. The meeting was attended by members from Cape Town, Johannesburg, Salisbury, &c. The sectional presidents were as follows:—Section A, Rev. Father Goetz, S.J.; Section B, A. J. C. Molyneux; Section C, F. Eyles (Rhodesia); Section D, G. Duthie. In addition to the presidential addresses, numerous papers were read before the various sections. In particular, Mr. R. N. Hall's papers dealing with the Zimbabwe ruins gave rise to considerable discussion. Papers were read before Section A on electric clocks, by Prof. H. Bohle; aviation in South Africa from a meteorological point of view, by R. T. A. Innes; atmospheric electricity observations, by Prof. W. A. D. Rudge. Many interesting excursions were arranged by the local Bulawayo committee. The Khami ruins and various Bushman haunts were visited under the guidance of Mr. R. N. Hall. A pilgrimage was made to Rhodes's lonely grave in the Matopos, and after the conclusion of the meeting several days were spent at the Victoria Falls.

IN the July issue of *The Quarterly Review* Mr. E. Clodd contributes a useful criticism of totemistic theories under the title of "Primitive Man on his Origin." While cordially welcoming Dr. Frazer's monumental treatise on totemism and exogamy, he is unable to accept his explanation of the origin of totemism from the Arunta theory of conception, mainly on the ground that it does not account for the clan totemism, which is admittedly of primary importance, and because, so far from being the most primitive, the Arunta are probably the most advanced of the Central Australian tribes. He is inclined to prefer Mr. A. Lang's solution that at the earliest period the groups were nameless; that later on they obtained soubriquets chosen from their fancied resemblance to this or that object; "no more than three things—a group animal name of unknown origin; belief in a transcendental connection between all bearers, human and bestial, of the same name; and belief in the blood superstitions—was needed to give rise to all the totemic creeds and practices, including exogamy." Needless to say, this solution involves certain special difficulties, of which Mr. Clodd is fully aware. The result of the discussion is to increase the feeling of doubt if any single solution hitherto advanced of the complex group of facts labelled as totemistic offers a reasonable explanation of them.

THE Journal of the Gypsy Lore Society continues its useful task of studying the eastern European groups of this interesting race. We have two articles of special importance, one an account of the Gypsies of Central Russia by Mr. D. F. de l'Hoste Ranking, the second of the organisation of the South German Gypsies by Mr. E. Wittich. The predatory habits of the Russian group amply account for the fear and hatred felt towards them by the rural population. On the other hand, in Germany their moral standard seems to be decidedly higher, and their tribal organisation provides for the control of social order by the trial of offences committed by members under the superintendence of their chief at an annual assemblage held in Elsass, where the proceedings are conducted in secret session. This festival, however, often ends in a general free fight between rival members of the tribe, who take this opportunity of gratifying their feelings of revenge for bloodshed or other injuries. If a reconciliation of such quarrels is effected it is done by the exchange of glasses charged with their favourite liquor. The tribal code of social morality, with its curious system of taboos, one being that a man who eats or drinks out of a vessel which a Gypsy woman has touched with her dress or stepped over becomes an outcast, will be of much interest to students of primitive usages.

IN the same issue of the Gypsy Lore Journal Mr. J. Teutsch describes a curious form of primitive lathe, revolved by a string, which is used by Gypsy spoon-makers at their settlement in Kutusch, north of Kronstadt. The bowl of the spoon is first shaped with a set of knives and scrapers. The handles are then turned in this rude lathe, the woman worker decorating them with a series of circular stripes and bands by pressing against the wood as it revolves a rag soaked in a green dye and moistened in saliva. The method furnishes some analogies to that used by the Indian makers of so-called "Benares toys," in which, by means of a similar rude lathe, pieces of lac of various colours are pressed against the toy as it is revolved, the heat produced by this friction causing the lac to become partially melted, and leading to the deposit on the wood of thin streaks of colour.

DR. DANIEL STARET communicates to the current number of *The Psychological Review* an interesting experiment upon the influence of suggestion, or unconscious imitation, on handwriting. More than a hundred persons were investigated by the following method. Each person was provided with a set of five sheets, on the first of which was written the instruction: "We desire records of your handwriting. Will you accordingly write out the words and sentences presented on the pages given you. Kindly do this without further questioning or reflection." The second sheet contained a short paragraph of typewritten material, the subject's written copy of which provided an illustration of his (or her) normal handwriting. The third sheet was of vertical, the fourth of slanting, script; the fifth contained unusually large script, all taken from American "copy-books," and written out by the subjects of the experiment. The measurements of the slope of the subjects' handwriting were subsequently made by means of a scale of variously inclined lines drawn on transparent paper, which was superimposed on the handwriting; three letters, *l*, *f*, *p*, were selected for measurement. The size of the letters was determined by measuring their horizontal width, the lengths of entire words being measured and divided by the number of letters. All the subjects who were investigated appeared to be (unconsciously) susceptible to this form of imitation, women showing a greater tendency towards imitation than men, and those persons who showed a large amount of change in slope also showing a large increase in the size of the letters. The more "vertical" writers were, of course, influenced more by the sloping than by the vertical copy; the opposite relation obtained with the more "slanting" writers.

THE composition of Indian yams, as furnished by chemical analysis, is discussed by Mr. D. Hooper in a short note published in the Journal and Proceedings,

Asiatic Society of Bengal (vol. vii., No. 3). Compared with potatoes, yams contain a larger proportion of fat and a smaller proportion of carbohydrates. The alkaloid dioscorine was detected in the tubers of several species, notably *Dioscorea daemona*; it appears that cultivation tends to reduce the amount of alkaloid.

UNDER the title of "Album général des Cryptogames," a new and elaborate iconograph arranged by Dr. H. Coupin is being published by the Librairie générale de l'Enseignement, Paris. It is announced that the work will deal with algæ, fungi and lichens, and that every genus and most of the species will be illustrated. A beginning is made with the lowest organisms, and the first volume, containing fifteen plates, illustrates eighty-three species under thirty-seven genera representing the family Chrysomonadineæ and part of the family Dinoflagellatæ; under the genus Gymnodinium seven species are illustrated in thirteen figures. The text is limited to a brief description of the figures, habitat, generic synonyms, and a reference under each species to the literature where fuller information can be found. The price of each part is 2.50 francs, but no estimate of the number of parts is offered.

AN article on the formation of anthocyanin in plants, communicated by Miss M. Wheldale to *The Journal of Genetics* (vol. i., No. 2), provides a carefully reasoned discussion of the chemical processes involved with the view of substantiating a proposed hypothesis explanatory of the mechanism underlying the phenomenon of soluble pigment formation. The arguments are based upon data derived from observations upon the general distribution of pigment, its formation, the conditions which lead to its appearance, and the enzymes detected at the time of its production. According to the hypothesis formulated, the soluble pigments of flowering plants, collectively termed anthocyanin, are oxidation products of colourless chromogens of an aromatic nature which occur in combination with sugar as glucosides; the process of formation of glucoside and water from chromogen and sugar is reversible; the chromogen can only be oxidised to anthocyanin after liberation from the glucoside, and the process is controlled by one or more oxidising enzymes.

FROM the report recently to hand on the work of the Edinburgh and East of Scotland Agricultural College, it appears that all the classes are overcrowded, and the lack of accommodation is now causing serious inconvenience. The fact that the number of students last season exceeded all previous records shows that useful work is being done, and is taken as an indication that, with better accommodation and with a college farm, even better work could be turned out. Bulletins are also issued by Mr. Bruce on potatoes and on grass land, demonstrating the kind of return that may be expected from applications of artificial manures.

AN interesting bulletin issued by the Nyasaland Department of Agriculture shows the great progress that has been made in the development of the cotton industry. The total export of cotton from the Protectorate is valued as follows:—

	£	
1903	3	
1904–5	5,914	
1907–8	13,999	
1908–9	28,355	
1910–11	52,853	(eleven months only).

According to Mr. McCall, the director, there is still the possibility of much further growth. Some of the problems connected with the extension of the crop are discussed in the bulletin.

IN making provisional estimates of the yields of crops, it is customary in the United States and in Canada to express the condition in terms of a hypothetical "normal" or "standard" crop. Mr. H. D. Vigor discusses the method in a recent issue of the Journal of the Royal Statistical Society, and shows that it has no sound statistical basis, since the standard for measurement is largely constructed in the imagination of the individual reporter. The various difficulties that arise when statisticians attempt to make deductions from the results are dealt with, and it is shown that a sounder method would be to express the probable yield as a percentage of the average yield during some convenient preceding period.

WE have received from Mr. J. B. Rorer, mycologist to the Board of Agriculture, Trinidad, his report for the year ended March, 1911, in which it is stated that the cause of two troublesome cacao diseases, the canker and black rot, has been successfully traced. It appears that both diseases are caused by one and the same fungus, *Phytophthora faberi*. A bacterial disease of bananas and plaintains is also described by him, and the organisms have been isolated; they are similar to *B. solanacearum*, and are provisionally being called *B. musae*. Much attention is given to the mycological problems of the West Indies in *The Agricultural News*, the official organ of the West Indian Agricultural Department. Descriptions are given in several of the recent issues of miscellaneous fungi found during the past few months, some of which have not yet been identified.

ONE of the most promising methods of effecting improvements in agriculture is to bring to the notice of experts and of farmers those practices that are found useful elsewhere. It does not follow that a plan must necessarily succeed in any one place because it has been found beneficial in another, but a discussion of the factors cannot fail to be fruitful. The *Bulletin de la Société d'Encouragement pour l'industrie nationale* periodically publishes very interesting accounts of the agriculture of particular countries or districts, several of which have been referred to in these columns. In the current volume a good description of Canadian agriculture has appeared, and also of the agriculture of the Saint Brieuc district of Brittany. The method is one that might usefully be adopted more widely, and has in the past been used with great advantage in this country.

PUBLIC opinion in Australia is awakening to the harm done—to put it on no higher level—by the ruthless extermination of birds which modern millinery seems to demand, and to which heedless sportsmen contribute in no small degree. The matter is now being taken up by *The Journal of Agriculture of South Australia*, and in recent issues coloured pictures of protected birds and their eggs are given, with brief notes on description, habitat, food, &c. "The killing of our wading birds each year," it is stated, "not only renders South Australia ever more prone to plagues of grasshoppers, but is most certainly a prime cause of the decline of our fish resources. . . . In a day one ibis was found responsible for the destruction of 2410 grasshoppers, or so-called locusts. Yet each season this lovely and useful bird, together with numbers of cranes, spoonbills, and egrets fall victims. . . . It is the decimation of such birds which leads to the ever-increasing multitudes of crustaceans that destroy fish-spawn and young fish hatching out." We wish our contemporary success in its crusade.

In *The Agricultural Journal of India* (vol. vi., part ii.) Mr. Keatinge continues his account of the rural economy of the Bombay Deccan, dealing now more particularly with capital. A high rate of interest prevails for several reasons: capital is scarce in the country, and there is no organisation enabling the cultivator to get into touch with the money markets of the towns; security is not always good, and the money-lender incurs some social odium. In consequence, a man raising a mortgage on good land has even in favourable circumstances to pay 9 per cent. interest, while in less favourable circumstances he may have to pay up to 24 per cent., and on personal security the rates go up to 100 per cent. There are two papers on cotton, one by Mr. G. S. Henderson on the exotic cottons in Sind, and one by Mr. P. Venkayya on the Cambodia cotton, a hardy long-stapled annual, yielding lint of a superior white colour. An interesting summary of the cotton investigations now in hand by the United Provinces Department of Agriculture is given by Messrs. H. M. Leake and A. E. Parr in part i. of the same journal; these fall under two headings, the production of an improved type or types suited to the conditions of the Provinces, and their introduction into general cultivation.

The growing importance of the Suez Canal is shown by a Parliamentary paper recently issued, which gives the return of the shipping passing through the canal for the years 1908, 1909, and 1910. The net tonnage of the past year shows an increase of nearly three million tons as compared with 1908. The gross receipts in 1910 were the largest reached. The percentage of the British vessels amounted to 62·9 as compared to those of all other nations, Germany being second with 15·5 per cent., both showing an increase over previous years, while the remaining 21·6 per cent., representing all other nations, remain practically at the same rate.

The annual report of the conservator of the River Mersey shows that since the commencement of the dredging and deepening of the bar at the mouth of the river upwards of 161 million tons of sand have been removed, the quantity for last year being 18¼ million tons. The minimum depth of water maintained in the centre of the dredged channel is 30 feet 3 inches. Dredgers are now being employed in deepening the channel off the Askew Spit, the revetment on the south side of Taylor's Bank having been completed in November last. The report also states that during 1910 nearly two million tons of silt were dredged from the channel of the Manchester Ship Canal, the whole of which would have found its way into the estuary of the Mersey had not the canal works interposed.

Four years ago a scheme of irrigation was inaugurated for supplying water for agricultural purposes in a district in Canada near Calgary. The area of the district to be irrigated covers three million acres, and involves the construction of 4500 miles of canal, of which 1500 miles have now been completed. The main canal is 17 miles in length and 120 feet wide at the water-level, and is supplied from the Bow River. Storage is provided by a reservoir 3 miles long by half a mile wide, with a depth of 40 feet. The total cost of the whole work is estimated at three million pounds. In other parts of Canada also extensive irrigation works are in progress, notably in the fruit districts of Columbia. In this district the rainfall ranges only from 9 to 10 inches as a maximum, falling to as little as 2 inches in dry seasons. Without irrigation the land in this dry district would be worthless. The area of Canada which is being opened up for fruit farming by irrigation extends over 30,000 acres.

Communication No. 122 from the physical laboratory of the University of Leyden contains a paper by Prof. Kamerlingh Onnes on the disappearance of the electrical resistance of mercury at the very low temperatures obtained when liquid helium boils under reduced pressure. The resistance of the mercury filament in the liquid state at 0° C. was 173 ohms; in the solid state at the same temperature it would, if its temperature coefficient of resistance remained constant, have a resistance of 40 ohms. At 3° absolute its resistance had sunk below 3×10^{-6} ohms, that is to say, one ten-millionth of its resistance at 0° C. The resistance of constantin (eureka) remained nearly constant over the same range of temperature. In a second paper Prof. Onnes and Mr. A. Perrier show that paramagnetic and diamagnetic substances the magnetic susceptibilities of which at ordinary temperatures vary inversely as the absolute temperature at these very low temperatures, deviate considerably from Curie's law.

In the Bulletin for 1910 of the International Association for Promoting the Study of Quaternions and Allied Systems of Mathematics, in addition to the usual list of members and the additions to the bibliography during the preceding year, there are some reviews by Prof. J. Birnie Shaw, the secretary. The most important is the critical examination of Burali-Forti and Marcolongo's books on their new notation for vector analysis. Prof. A. Macfarlane, the president, communicates a short address, followed by a paper on the unification and development of the principles of the algebra of space. Here the author gives a well-arranged argument in favour of his system of what might be called versorial analysis. He corrects Hamilton's view of the quaternion exponential, and develops what is undoubtedly a self-consistent system, in which the square of the vector is kept positive, and associative flexibility is obtained by the introduction of the imaginary. Complexities of an unexpected kind seem to spring out of his method, but as a piece of analytical reasoning it is of great interest. No illustrations are given of the practical value of the method.

A small self-contained machine for the grinding and polishing of metal specimens for microscopic examination has been brought out by Messrs. R. and J. Beck, Ltd., and the apparatus possesses certain advantages which should render it particularly useful to metallurgists. The whole machine is carried on a small iron bed-plate, and consists essentially of a small enclosed electric motor of a substantial type and the polishing spindle proper; the motor drives a counter-shaft, and from this the drive is by a range of three-speed pulleys to the polishing spindle. The polishing discs themselves are detachable from the spindle, and run in a carefully designed casing, which not only serves to catch the spent polishing materials, water, &c., but also serves as a rest to the hand of the operator, and in an emergency saves the specimen from injury if it should accidentally escape from the operator's fingers. The attachment of the polishing cloth to the discs takes the somewhat novel form of a fairly stiff steel spiral spring acting as a species of garter, and, provided that the spring is strong enough to resist the centrifugal action at high speeds, this forms a most convenient form of attachment for both cloths and papers. With the addition of a suitable rheostat for controlling the speed of the motor, the machine should prove equal to all requirements for metallurgical polishing, although the use of separate machines

—in separate rooms, if possible—for grinding and polishing, respectively, is to be advocated.

Two years ago it was shown by Ramsay and Usher that a solution of thorium nitrate, left to itself for some months, gave off a certain quantity of carbon dioxide, and that under the action of the radium emanation the thorium solution gave off this gas much more rapidly. The view was put forward that the carbon of the carbon dioxide might have been produced during a transformation of the atoms of thorium by the action of the radium emanation. In the *Comptes rendus* of the Paris Academy of Sciences for July 24 M. Herschfinkel gives a description of a repetition of these experiments. The production of a trace of carbon dioxide by the solution of thorium nitrate left to itself, and the increase of this amount under the influence of the radium emanation, were confirmed. It was, however, found that oxidation of the thorium nitrate with a solution of potassium permanganate also gave rise to the production of carbon dioxide, and this in spite of the great care taken in preparing a pure salt. The conclusion is drawn that the appearance of carbon dioxide under the conditions of this experiment cannot be taken as any evidence of the production of carbon from atomic transformation of the thorium.

An article on scientific management and efficiency in the United States Navy, by Walter B. Tardy, appears in *The Engineering Magazine* for July. Less than 3 per cent. of all the shells fired in the battle of Santiago by the American fleet hit the enemy. There is no record that a single 12-inch or 13-inch shell took effect. The ranges were less than 3000 yards. Recently the *New Hampshire* used the old *Texas* as a target, firing at ranges from 10,000 to 11,500 yards, and landed whole salvos on the *Texas* whenever she wished. The *Michigan*, an all-big-gun ship, recently made twenty-two 12-inch hits at ranges of 10,000 yards while steaming at 15 knots, the target being only 60 feet long by 30 feet high. She fired forty-eight 12-inch shells, the percentage of hits being about 45; the shots were fired at the rate of about two per minute per gun. Organisation and strict attention to details are responsible primarily for the great improvement shown. Among other matters, coaling has received considerable attention, and the rate has been improved from 30 or 40 tons per hour to 200 tons per hour for the entire coaling period; some ships have taken on and trimmed as much as 350 tons per hour for the entire coaling period, with a record of about 550 tons for the best hour.

OUR ASTRONOMICAL COLUMN.

Rediscovery of Encke's Comet, 1911*d*.—A telegram from the Kiel Centralstelle announces that Encke's comet was discovered by Dr. Gonnessiat at the Algiers Observatory on July 31. Its position at 15h. 54·5m. (Algiers M.T.) was R.A.=7h. 27m. 54·5s., dec.=26° 54′ 6″ N., and its brightness was estimated as being about equal to the tenth magnitude; this position lies in Gemini very little south of Castor and Pollux.

Owing to its faintness and unfavourable position, it was not expected that this famous comet would be easily detected at this return; only under the most favourable conditions has it ever become a naked-eye object. The comet is famous as being the first short-period (3·3 years) comet for which the periodicity was established, and also for its very slow but persistent acceleration, which was held to be a demonstration of the existence of a luminiferous æther. According to M. Bosler and others, its brightness varies with the sun-spot activity through the eleven-year period.

Stellar Parallaxes.—Dr. Schlesinger's discussion and summary of his parallax results obtained with the Yerkes 40-inch refractor—the seventh paper of the series—appears in No. 1, vol. xxxiv., of *The Astrophysical Journal*; only a few of the more interesting points can be noticed here. The results for four helium stars included in the programme confirms the proper-motion results in pointing to the fact that this class of stars is situated at an enormous distance from the earth, so much so that, taking averages, a fourth-magnitude helium star is probably as distant as the ninth-magnitude stars in the same region of the sky. Of these four, three give negative and one slightly positive parallaxes; no other star measured gave a negative value.

A practical point elucidated is that with such an instrument as the Yerkes telescope the number of parallaxes that may be determined per annum, with an average probable error of ±0·013″, is about the same as the number of fine nights.

Of the twenty-six stars given in the tabular summary, three, Groombridge 34, P.M. 2164, and Krüger 60, have parallaxes greater than 0·2″; the mean values for these three are 0·266″, 0·282″, and 0·252″ respectively.

During the minute examination of sources of error it was shown that measuring the plates in duplicate adds only 10 per cent. to their weights; such measurements were early discontinued. In some cases a rotating disc was employed to reduce the brightness of the parallax star, and the final probable errors show that no increased error was thereby produced.

Prominences in 1909.—Prof. Ricco's valuable summary of the Catania prominence observations for 1909 appears in No. 6, vol. xl., of the *Memorie di Astrofisica ed Astronomia* (June, p. 83). Compared with 1908, especially with the latter part of that year, the frequency and dimensions of the prominences showed an increase in 1909. Slight differences are seen in the mean latitudes, and the maximum frequencies—in 10° zones—occurred in 20°–29° N. and the 30°–39° S. latitudes. This was the only maximum in the southern hemisphere, but in the northern there was a minor maximum in the zone 50°–59° N. The mean daily frequencies were 1·84 for the northern and 1·81 for the southern hemisphere, while the respective mean heliographic latitudes were 31·9° N. and 27·5° S. On 8 per cent. of the days of observation no prominences were seen during the first half of the year, while only two days (2 per cent.) yielded no prominences during the second half.

The Algol System RT Persei.—Contribution No. 1 from the Princeton University Observatory is a monograph, by Mr. R. S. Dugan, dealing with the observations of the Algol variable RT Persei made at the Halsted Observatory with the 23-inch telescope during 1905–8. After describing and discussing the observations, Mr. Dugan concludes that there is undoubtedly a secondary eclipse, that the two stars are practically equal in size, and that the reality of the light-changes between eclipses is fully guaranteed by the probable error.

Jupiter's Faint Satellites.—Observations of the fainter satellites of Jupiter are being kept up at the Transvaal Observatory. Four good exposures were made during April and May, but on one plate only is J viii to be found. Images of J vi appear on all the plates, and it is estimated that this object is at least two magnitudes brighter than J viii. The places given as yet are not final, but, brought up to the equinox of date, they show good agreement with those given by Dr. Crommelin's ephemeris. Observations of twelve minor planets, five of which are suspected to be new, were made during the satellite observations; temporarily the new ones have been designated T_1–T_5, and their positions are given with the above in Circular No. 8 of the Transvaal Observatory.

The Brightness of Comets 1908 III. and 1910*a*.—The variations in the brightness of Morehouse's comet and in that of comet 1910*a* have been investigated in detail by M. Orlow, who publishes the results in No. 4513 of the *Astronomische Nachrichten*. Eliminating the terrestrial distance, he finds confirmation of the result that a comet's brightness varies more than is expressed by the formula $1/r^2\Delta^2$. The ratio $1/\Delta^2/r^4$ is nearer the observed results, the index of r in the case of comet 1910*a* being 4·6.

PROBLEMS IN SEISMOLOGY.

A GENERAL report of the recent meeting of the International Association of Seismology was given in NATURE of July 27, including Prof. Schuster's presidential address, which touched illuminatively upon the broad problems of the physics of the earth's crust. The following supplementary notes are intended to give a fuller account of the many subjects which were discussed by the seismologists.

Particularly interesting was the report presented by Dr. Hecker, formerly of Potsdam, now of Strassburg, on the tidal strains produced in the crust of the earth. Hecker's well-known results have been supplemented by similar work carried out at Dorpat by A. Orloff, who also gave an account of his measurements of the deformation of the earth's crust under the action of the moon. The method of both sets of experiments is to search for a lunar periodicity in the movements of sensitive horizontal pendulums. If the earth were rigid, these movements, in so far as they are due to the influence of the moon on the vertical at any locality, can be calculated. The experimental results give, however, a deflection of the vertical which is only two-thirds of the calculated value. This is explained on the assumption that the earth's crust yields to the tidal action of the moon. Hecker's and Orloff's results show, moreover, that the force acting on the pendulum is a larger fraction of the moon's force when it acts towards the east or west than when it acts towards the north or south. In other words, the earth seems to be more rigid towards forces acting east or west than towards forces acting north or south. Sir George Darwin suggested that this might be due to the effect of the earth's rotation; and the problem thus presented has been worked out with great skill by Prof. Love in his Adams prize "On some Problems of Geodynamics." He finds that Hecker's result cannot be explained in terms of the earth's rotation, and proceeds to invoke the direct gravitational influence of the tidal wave in the Atlantic Ocean upon the vertical at any neighbouring locality or the pressure effect of the same wave on the bed of the ocean. The International Association propose to follow up the inquiry by establishing new stations in suitably chosen localities, such as Paris, because of its contiguity to the ocean, and a station in the Russian Empire far removed from the Atlantic. The installation of instruments in South Africa, say at Johannesburg, and at some place on the American continent, would also provide results which, in conjunction with the others, might lead to the complete solution of the problem. In carrying out this work the Seismological Association is to be associated with the International Geodetic Association, and funds have been voted for the purpose.

It has thus been established beyond a doubt that the earth's crust yields appreciably to the tidal action of the moon. The measurement of this yielding demands the use of delicate instruments of a type familiar to seismologists, and used by them in the investigation of earthquake movements. Every large earthquake starts tremors through the earth, and these are caught and recorded at a large number of stations in many parts of the globe. Prof. Milne, working through the Seismological Committee of the British Association, was the first to show the value of such a seismological survey; and now it may safely be said that no observatory is complete without a self-recording seismograph. Within the last few years great advances have been made in the perfecting of instruments for registering movements of the ground, and among those who have increased the precision of these instruments Prof. Wiechert and Prince Galitzin are worthy of special mention. Prince Galitzin exhibited at the congress his form of vertical motion seismograph, which utilises the same method of magnetic damping which is characteristic of his horizontal pendulum. The instrument is thus made aperiodic, so that the relative motion of the ground is faithfully recorded. The record is obtained by the action on a delicate galvanometer of induced currents set up in a coil which moves with the boom of the seismograph relatively to a strong magnetic field. The galvanometer is also made aperiodic. Prince Galitzin explained his method of finding the epicentre of an earthquake from records obtained at one place on his two horizontal pendulums. The interval between the arrival of the first and second phases of the preliminary tremors gives, as Milne and Oldham showed years ago, the *distance* of the epicentre. Galitzin has now shown how we may get the *azimuth* from the first indications of the seismograms obtained with aperiodic horizontal pendulums. The ratio of these first displacements in the east-west and north-south records gives the tangent of the azimuth angle referred to the meridian. There is an ambiguity as to the direction along which the epicentre lies, whether, for example, it is N.N.E. or S.S.W.; but this ambiguity is quite removed when the vertical component is obtained. The precision of the method depends upon the fact that the instruments are damped accurately so as just to be in the aperiodic state. By a large number of examples Prince Galitzin showed that the estimation of the position of the epicentre in cases in which the method is applicable was as satisfactory as by the usual method of comparison of times from two or more stations.

The interpretation of the times of transmission of earthquake tremors to places at various distances from the epicentre is one of considerable importance in seismological studies. The curve which shows the relation between distance and time—the hodograph, as many now call it—is not yet known so accurately as one would wish, a fact which was emphasised by Prof. Reid, of Baltimore. Prof. Wiechert's ingenious discussion of inferences to be drawn from the form of this curve has led him to a theory of the constitution of the earth which differs in some respects from other similar theories. To take into account the peculiarities of the hodograph, and especially the flattening of it at mid-stations, which has already engaged the attention of Milne and Oldham, Wiechert finds it necessary to construct the earth of three layers differing in elastic properties, the central core being, in his opinion, made of nickel-iron. A special feature of Wiechert's discussion is the account he takes of the intermingling of disturbances which have travelled to the same station, the one directly, the other after one reflection at the surface of the earth. The theory is admittedly approximate, and may require correction as our knowledge of the hodograph becomes more certain; but the mathematical reasoning by which Wiechert attacks the problem will always have its value apart from the details of any conclusion to which we may be temporarily led.

These three lines of research—tides in the earth's crust, determination of epicentres from observations at one station, and inferences as to the structure and physical properties of the inner parts of the earth—probably bulked most largely in the discussions of the congress. But many other points of interest were touched upon, such, for example, as the elastic properties of rocks, for the measurement of which Dr. Oddone gave a remarkably simple experiment and calculation based on Hertz's expression for the compression of a sphere during impact. Again, in connection with the cause of the microseismic movements of the earth's surface, Prof. Schuster and Mr. Morris Airey exhibited an instrument designed to count the number of waves which beat on the shore. The increase of pressure due to the passing of a wave was transmitted by means of a hydrostatic and electric arrangement, so as to make the recording pen move always with a slight definite motion in one direction at right angles to the motion of the strip of paper on which the record was taken. After 120 minute and individually imperceptible movements were made, the pen moved back automatically to the original position. The record was therefore a series of diagonal lines the inclination of which to the motion of the paper was greater according as the waves came faster. In the records which were shown the period indicated was about six or seven seconds for each wave. This is one of the commonly recurring periods in microseisms.

The idea of measuring the intensity of an earthquake shock by the overturning of blocks is an old one, and engaged the attention of Milne and West in the early 'eighties. Omori also constructed from these indications a dynamic scale. Prince Galitzin showed how the indications might be greatly improved by providing the blocks with edges like the projecting covers of a book. When

set oscillating the block executes movements the amplitudes and periods of which diminish in such a way that resonance effects are prevented. By experimenting on a movable platform, Galitzin found that the acceleration of the enforced movement was the determining factor in the overthrow of each block.

Prof. Reid, of Baltimore, described a new method of estimating the intensity of an earthquake, the fundamental proposition being that the energy associated with an earthquake was proportional to the square of the area within a given isoseismal line.

Mr. Napier Denison, of Victoria, Vancouver, gave an account of his observations of secular movements of the horizontal pendulum, and made a strong claim for Victoria as a place well fitted for seismological work.

Prof. Omori, of Tokyo, described some of the recent volcanic and seismic phenomena of Japan, the most interesting being the rise of a new hill during the eruption of Usu-san in Hokkaido, and the increasing activity of Asama Yama, a volcano in the centre of Japan which rises to a height of 8000 feet. The dull red contents of the crater have been steadily rising in level for some time, and fairly large blocks of stone have been projected from it. A station has been built on the flank of the mountain, and seismographs installed in it. The character of the tremors is markedly different according as they do or do not accompany a volcanic eruption.

In their less strenuous moments the delegates and their friends enjoyed to the full the hospitality of Manchester, more especially the Lord Mayor's reception in the Town Hall; Prof. Schuster's garden-party at Kent House, when a remarkably good photograph was taken of all attending the congress; and the closing dinner given by the University Council, when Prince Galitzin, in a humorous impromptu speech, proposed the health of Prof. John Milne, whose characteristic reply was a fitting close to a great conference.

THE MIGRATION OF A RACE.[1]

THE theory of a relationship between the numerous languages spoken in the islands of the Indo-Pacific Ocean from Madagascar and Sumatra to the Philippines, and thence far eastward to Melanesia and Polynesia, is almost universally accepted. But the connection of these languages with the Asiatic Continent, their origin, and the means by which they reached their present settlements, are still uncertain.

In the volume before us Mr. Churchill essays to trace the migration of the Polynesian people from their first home on the borders of Indonesia, through Melanesia, to Nuclear Polynesia, that is, to the region round about Samoa, Tonga, and Niue. Dealing with the languages only, he recognises two streams of voyagers who have left traces of their passage in the loan words adopted from their speech by the Melanesians with whom they came in contact; these words being most numerous in the languages of the islands along the coasts of which the Polynesians passed, and less frequent in the languages more remote from their route.

One stream of these primitive Polynesians, or Proto-Samoans, passed north of New Guinea, by way of the Admiralty, Bismarck, Solomon, and Santa Cruz Archipelagoes to Samoa. Another stream came southward through Torres Straits, by the south-eastern shores of Papua, through the New Hebrides to Fiji. In Nuclear Polynesia the two streams resumed their ancient fellowship, and thence despatched colonies to Hawaii, New Zealand, and the Far Eastern Pacific.

Later, there came upon these Proto-Samoans a swarm of kindred people whose origin and migrations Mr. Churchill regards as indefinite and obscure, and to whom he gives the name—Tongafiti—by which they are known in Samoan history. The Tongafiti are considered to have left no definite trace of a passage through Melanesia, though their presence in Nuclear Polynesia is clearly evident. The origin and migrations of the Tongafiti are not discussed in the present volume.

In his earlier chapters the author devotes some attention to the two most prominent theories yet put forth as to the settlement of the Oceanic peoples, namely, those of Dr. Macdonald and Dr. Thilenius. The former refers the island races to an immigration from Arabia, and affirms their languages to be modern representatives of a Semitic tongue (*cf.* NATURE, March 19, 1908, p. 460). The latter regards the Polynesians as entrants into the Pacific by way of the Micronesian Islands, and sees in the Melanesian Islands, and the Polynesian settlements bordering them, the meshes of a net which has caught the drift of castaways blown westward from their homes in Eastern Polynesia. In his second chapter and elsewhere in his book Mr. Churchill utterly demolishes the Semitic theory of Macdonald, mainly on the grounds of illogical and forced etymologies, and perverted definitions of words. Mr. Churchill finds difficulties and fallacies in the argument of Thilenius, chiefly with regard to the ascription of feeble navigating powers to the Polynesians, and to the unlikely survival of castaways among an anthropophagous people.

Mr. Churchill regards the Proto-Samoans as a seafaring race, who, driven by some expulsive force, set out from Indonesia in double canoes. The principal difficulty in their navigation was the victualling of their vessels, and this led to coasting voyages wherever there were coasts to follow. When supplies ran short, a food colony was established on a suitable island until a sufficient crop was raised to carry the voyagers farther on. For these food colonies there were three requisites—a sufficient water supply, an encouraging area of soil for tilth, and an autochthonous population insufficient in number, or too weak, to prevent the settlement of strangers. Mr. Churchill considers the eastward impulse to have ceased in Bismarck Archipelago and Torres Straits, so that the crop settlements tended to become, in suitable places, permanent colonies. Also, as the fleet kept to windward in the seas along which they passed, the lands which became fixed settlements (as, *e.g.* Nuguria, Liueniua, Sikayana, Aniwa, and Futuna) would be found on the windward side of the archipelago with which they are associated. The apparent exceptions, Rennel and Bellona, though leeward of the Solomons, are, however, on the weather side of the voyagers in the southern stream.

Mr. Churchill bases his evidence of this migration upon an examination of the Polynesian words contained in the languages of the Solomon and New Hebrides islands. From comparisons of the material available to him, which are given in an appendix on data and notes, and the Polynesian content therein, set forth in a series of elaborate tables, the author deduces the amount of likeness shown by the individual languages to Polynesia. His method in the comparisons is sound and accurate, and a very welcome contrast to the wild guesses of some writers on the subject. But the deficiencies and imperfections of his material are a source of serious error. For a proper estimate of Polynesian likeness the vocabularies compared should be of equal size and range of signification, else the presence or absence of certain words would unduly exaggerate or diminish the likeness. Mr. Churchill's tables show this. He gives the coefficient of likeness to Polynesian of Belaga as 100, whilst Nggela, of which Belaga is a dialect, is given only 80. So also the likeness of Nguna to Polynesian is expressed by 93, whilst that of Sesake (the same language, Sesake being a colony from Nguna) is only 76.

Mr. Churchill makes no comparisons of grammar. All the Polynesian words present in Melanesia are regarded as loans, but if this is so, it is remarkable that many of the languages have borrowed 80 or 90 per cent. of Polynesian vocables without borrowing a single grammatical form. In some cases, not pointed out by Mr. Churchill, grammatical forms which survive in Polynesian have been preserved more fully in Melanesian languages which are not on the supposed migration route.

The backward track deduced by Mr. Churchill breaks off short at Moanus (Admiralty Island) in the north, and at Motu (New Guinea) in the south, and he leaves the starting point of the Proto-Samoans in a waste of empty sea, where non-Polynesian and non-Melanesian languages occupy the whole seaboard. He states that "only a few of

[1] "The Polynesian Wanderings." Tracks of the Migration deduced from an Examination of the Proto-Samoan Content of Efaté and other Languages of Melanesia. By W. Churchill. Pp. ix+516. (Washington: Carnegie Institution, 1911.)

the vocables in Melanesia for which we have discovered Polynesian affinities are found to carry that affinity back to Indonesia." He is "ready to pronounce the decree of Divorce upon Malay and Polynesian." Other judges of Indonesian will scarcely concur in this judgment.

It is impossible in the limits of this notice to give an adequate exposition of the value of Mr. Churchill's book to the student of Oceanic linguistics and ethnology. It is not only suggestive of points for discussion, but provides also material upon which the argument may be based. There is a bibliographical appendix, two maps, and a useful index.

SIDNEY H. RAY.

SCIENTIFIC PROGRESS IN THE UNIVERSITY OF OXFORD.

THE annual report of the delegates of the University Museum, lately published, contains a very complete record of the scientific work done in the several departments of the museum during the year 1910. In the department of physiology, special attention is directed to the establishment of an advanced practical course in physiological optics, under the direction of Prof. Gotch and Dr. Burch. A considerable amount of the requisite apparatus was made in the laboratory workshop. Prof. Arthur Thomson (human anatomy) announces that instruction in physical anthropology has now been systematically organised. The report of the Linacre professor of comparative anatomy (Prof. Bourne) also shows much evidence of steady progress. The list of additions to the collection is a long one, and numerous important memoirs have been published by members of the department during the past year.

Prof. Poulton submits a lengthy and interesting account of the work done in the rooms assigned to the Hope professor of zoology. A very fine collection and library of Oriental and British entomology, chiefly Hymenoptera, was presented by Mr. G. A. James Rothney; and other important accessions were received from numerous donors, among whom were Mr. Herbert Druce, Commander J. J. Walker, Mr. J. H. Watson, Mr. S. A. Neave, Mr. W. A. Lamborn, and the Hon. Walter Rothschild. Special attention is directed to bred specimens received from Mr. A. D. Millar, of Durban, which prove that the conclusion tentatively arrived at by Mr. G. A. K. Marshall in 1902, that *Euralia mima* and *E. wahlbergi* are dimorphic forms of the same species, is in accordance with the fact. The collection of British Rhynchota, Hemiptera, and Homoptera belonging to the late Edward Saunders, and presented by the professor and Dr. G. B. Longstaff, is described as one of the most important additions ever made to the British collection in the department. Among the original memoirs published by workers in the department are Mr. H. Eltringham's important monograph on African mimetic butterflies and Mr. R. Shelford's contributions to the Genera Insectorum.

Noteworthy additions have been made to the anthropological collections contained in the Pitt-Rivers Museum. The energy of the curator, Mr. H. Balfour, who has paid three special visits to the Victoria Falls of the Zambezi, has resulted in the acquisition of a far more complete collection representing the archæology of that region than exists anywhere else. Other important accessions have come in from the Belgian Congo, British East Africa, West Africa, the Dordogne, and the Isle of Wight. In the department of experimental philosophy, Prof. Clifton reports that an extension of the laboratory is absolutely necessary, the only alternative being to restrict the number of students.

The report of the Wykeham professor of physics (Prof. Townsend) records the transference of the laboratory furniture and apparatus from the temporary quarters in the old museum to the fine new building provided by the generosity of the Drapers' Company. The new premises have been found to be excellently adapted for giving practical instruction, and also for research work. In the department of chemistry, Prof. Odling notes the starting of a new course of advanced practical organic chemistry under Dr. Chattaway, and the publication of several important memoirs dealing with researches conducted in the chemical laboratory. These include Dr. Chattaway's work on chlorine, Mr. Marsh's on the solution of haloid double salts in organic solvents and on the halogen derivatives of camphor, and also the investigations by Mr. Lambert and his pupils on the wet oxidation of metals. The report mentions that as a result of the work still in progress, it is hoped later to establish sufficient facts to warrant putting forward a modification of the present views on the subject of the corrosion of metallic iron.

A valuable consignment of rocks and fossils has been sent to the geological department from Peru, where Mr. J. A. Douglas is engaged in using the excellent opportunities for geological study now being afforded by several important railway cuttings. The expenses of the investigation are being borne by Mr. W. E. Balston, University College, and the consignment that has been already received is the first of many that may be expected as a result of Mr. Douglas's labours. Besides the usual field-work conducted by Prof. Sollas in the country about Oxford, an excursion, attended by sixteen students, was made to the Siebengebirge and the Eifel. Much work has been done by Miss Byrne and others on the rearrangement of the collections. A long series of specimens illustrating the history of the pleistocene epoch is in course of arrangement, and the work is rapidly approaching completion.

Like other heads of departments, the professor of rural economy (Prof. Somerville) finds himself somewhat embarrassed for want of room. The laboratories of botany and chemistry included in his department have been taxed to their utmost capacity to provide accommodation for the students. For the needs of the department of mineralogy, provision has been made by the allotment of a portion of the northern room of the old Radcliffe library, lately occupied by the Wykeham professor of physics. Many additions are recorded to the collections of specimens and the stock of apparatus, and some important researches have been carried on by Prof. Bowman, his pupils, and assistants.

A remarkable feature in many of the departmental reports that have now been briefly noticed, is the great and growing need of still further accommodation if the requirements of both teachers and students are to be satisfactorily met. Much has already been done; all departments alike tell the same tale of great and increasing activity in scientific work. Much still remains to do; but the document before us gives good hope for the future, for it contains abundant evidence that the ancient University of Oxford is becoming more and more alive to its responsibilities in the matter of scientific progress, as regards both teaching and research.

ADVANCES IN REPTILIAN PALÆONTOLOGY.

IN the July number of *The American Naturalist* Dr. O. P. Hay reopens the discussion with regard to the position of the limbs in Diplodocus and other sauropod dinosaurs, criticising the views of those who assert that these reptiles carried themselves in elephantine fashion, and maintaining his own opinion that the general pose was more after the crocodilian style. In regard to what may be called the elephant pose, it is pointed out that since a straight femur appears to have characterised the Proboscidea from the beginning, its occurrence in the modern representatives of the group may be regarded as a primitive feature, rather than an adaptation to the support of great bodily weight. At the conclusion of his arguments with regard to the pose of the sauropods, Mr. Hay expresses doubts as to whether the erect bird-like posture attributed to the carnivorous dinosaurs of the Jurassic is really true to nature. "The extraordinary development of the pubic bones of Aristosaurus, the expanded and ankylosed distal ends of which reached nearly half-way to the forelegs, seems to me to indicate that these animals, when in repose, had a prone position, resting much of the weight on the pubes, and that when running their legs straddled considerably."

In reference to the opinion of Dr. Matthew that Sauropods were too bulky to have lived on land, it is added that "the law to which he gives expression does, of course, prescribe a limit to the size an animal can attain, but who has yet determined what that limit is?"

To vol. vii., part 4, of the Annals of the S. African

Museum, Dr. Broom contributes an illustrated article on the dinosaurs of the Stormberg beds. Seven generic types, namely, Euskelesaurus, Hortalotarsus, Gyposaurus, Gryponyx, Massospondylus, Ætonyx, and Geranosaurus, are recognised, of which the third, fourth, sixth, and seventh are described for the first time. The first six are referable to the carnivorous group, but the last is characterised by the presence of a predentary bone to the mandible. This feature suggests that the horizon of the Stormberg beds from which it was obtained is of Lower Jurassic, in place of Triassic, age; and, even so, Geranosaurus will be the oldest known type with a predentary.

The angulated outer and rounded inner surface of the terminal segment of the second hind toe in Gryponyx, Massospondylus, and Ætonyx indicates that the investing horny claw had an edge adapted for combing or scraping; and it is suggested that it was employed for cleaning the skin and scales. If this be so, the dermal covering was probably unlike that of crocodiles or lizards; and it may be that the scales were long and narrow with intervals of soft bare skin between them. Such a skin would certainly require cleansing with the claw after the reptiles had been hunting on the muddy banks of lakes.

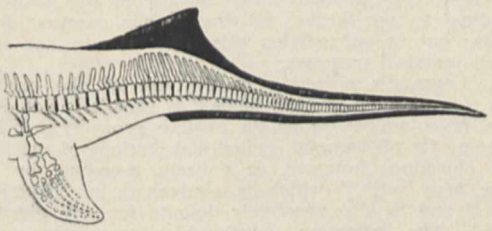


Fig. 1

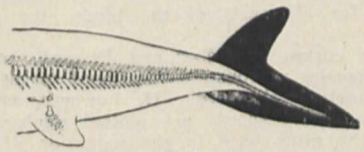


Fig. 2.

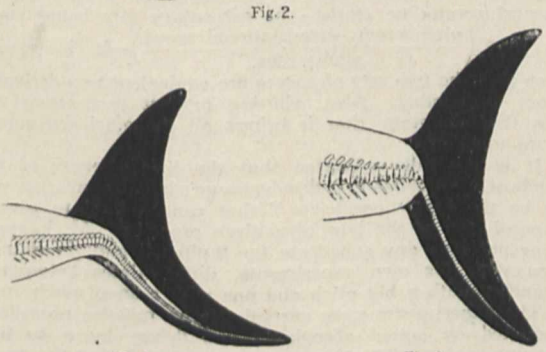


Fig. 3. Fig. 4.

Tail-fins of Ichthyosauria.

FIG. 1.—*Mixosaurus nordenskjoeldi.*
FIG. 2.—*Ichthyosaurus quadriscissus* (young).
FIG. 3.—*Ichthyosaurus quadriscissus* (adult).
FIG. 4.—*Ichthyosaurus trigonus posthumus.*

In the same issue Dr. C. W. Andrews describes portions of the skeleton of a plesiosaur (*Plesiosaurus capensis*) from the Uitenhage beds of Cape Colony. The species, which belongs to the group of small forms represented in the European Wealden by *P. degenhardti* and *P. valdensis*, is the first plesiosaur known from South Africa. The occurrence of a member of the group in that country is of special interest, in view of the possibility that the Sauropterygia may have taken origin from a form related to the therocephalous anomodonts of the South African Permian.

In this connection reference may be made to the identification by Mr. H. Fuchs (*Anat. Anz.*, vol. xxxviii.) of a septomaxillary bone in the skull of the peba armadillo. In a review of this discovery by Mr. F. Müller in *Naturwissenschaftliche Wochenschrift* for July 9, 1911, it is pointed out that a septomaxillary has been hitherto known in amphibians and certain reptiles, in which it forms an ossicle on the side of the nasal capsule. Recently it has been identified in certain fossil reptiles—notably the Theriocephala and Theriodontia. Among mammals, it occurs not only in the peba, but likewise in the hairy armadillo (*Dasypus villosus*), where it is represented by an undetermined bone described by Dr. Broom. It has not yet been definitely identified as a separate ossification in other mammals; but Gaup considers that it is represented by the so-called extra nasal process of the maxilla, although Fuchs considers that in the aforesaid armadillo both this process and the septomaxillary are present. Be this as it may, the identification in armadillos of an element common to amphibians, anomodonts, and certain other reptiles is a feature of prime importance in regard to the anomodont ancestry of mammals.

The description of an embryonic, or newly born, specimen of *Ichthyosaurus quadriscissus* from the Lias of Holzmaden, Württemberg, in which the outline of the body and fins is preserved, has led Dr. E. Fraas, in *Mitt. aus dem kgl. Naturalienkabinett, Stuttgart*, to give an interesting account of the evolution of the tail-fin in the ichthyosaurs. That the specimen on which the investigation was based is extremely young is rendered evident by the great relative size of the head, which is equal to one-third the entire length, whereas in the adult it is less than one-fifth. The earliest known type of tail-fin in the ichthyosaurs occurs in *Mixosaurus nordenskjoeldi* from the Muschelkalk of Spitsbergen, in which, according to Mr. H. Wiman's figure in Bull. Geol. Inst. Upsala, vol. x., 1910, it takes the form of a low falcate fin in the basal third of the tail, continued as a marginal expansion along the whole of the rest of the tail, both above and below. In the young of *I. quadriscissus* the falcate portion and the marginal fringe are increased in height so as to form a fin approximating to the heterocercal type, with the extremity of the vertebral column bent down into the lower lobe. In the adult of the same species the increase in the size of the fin and the degree of flexure of the vertebral column are intensified, thus producing an approximation to the homocercal type. A further stage is displayed by *I. trigonus posthumus*, of the Upper Jurassic Limestone of Solenhofen, in which the fin is almost completely like that of a homocercal fish, while the flexed terminal portion of the vertebral column has diminished in relative size, with a marked increase of the angle of flexure. One step more and it would have vanished. A somewhat similar grade is presented by Opthalmosaurus of the Oxford and Kimeridge Clays. It should be added that in the hind paddle of Mixosaurus the metatarsal and phalangeal bones retain an elongated contour, and do not form a mosaic-like structure. R. L.

LONG-DISTANCE RADIO-TELEGRAPHY.

A VERY interesting paper by Mr. L. W. Austin, entitled "Some Quantitative Experiments in Long-distance Radio-telegraphy," has recently been published in the Bulletin of the Bureau of Standards (Reprint No. 159). The paper describes a complete investigation of the relationship between the current in the receiving aërial and the distance between the transmitter and receiver, the observations being mainly by the shunted telephone method. Although this method is not so accurate as the direct method, it is probably the only one available for use on board ship at long distances. Some years ago Mr. J. E. Taylor and the present writer carried out similar experiments over short distances up to 60 miles, using a thermo-galvanometer directly in the aërial. Mr. Austin has greatly extended the range, and has carried on the experiments up to a distance of 1200 miles between the two stations. The results confirm the proposition put forward by Mr. Taylor and the writer that the current in the receiving aërial varies inversely with the distance except for one important particular, namely, Mr. Austin finds, with much longer distances that he has worked

over, that it is necessary to take into account the absorption, and therefore his formula contains an exponential term to allow for this.

A perhaps still more important discovery mentioned in the paper is that of Dr. Louis Cohen, that if the reduction in the strength of the received current due to absorption be written e^{-Ad} then A is inversely proportional to the square root of the wave-length within the limits of accuracy of the experiments.

Mr. Austin again checks Mr. Marconi's statement that the received signals are proportional to the height of the two antennæ, and adding to this the observation that they also vary inversely as the wave-length, he obtains a complete formula giving the received current I_R in terms of the transmitted current I_S the heights of the two antennæ h_1h_2, the wave-length λ, and the distance d. The formula is

$$I_R = 4{\cdot}25\frac{I_S h_1 h_2}{\lambda d}e^{-\frac{0{\cdot}0015d}{\sqrt{\lambda}}}.$$

Where the currents are in amperes and the lengths in kilometres, the two constants 4·25 and 0·0015 may depend on the conditions under which the experiments were made, and it will be of great interest if other wireless workers will check the formula against their results and see how closely it is applicable. It must not be expected that this formula will be closely confirmed by every observation. Mr. Austin's own observations show that this is not the case. In spite of the wide range of values he has dealt with, the observations do appear to group themselves round the smooth curves given by his formula.

The formula refers only to flat-topped aërials and to general day conditions. Mr. Austin remarks that the night signals are entirely irregular, being, in general, stronger than the day signals, and this he assumes is due to there being much less absorption at night, that is to say, the inverse distance law is then more nearly obeyed, even for very long distances.

It is perhaps of interest to compare Mr. Austin's formula with the measurements in the *Monarch* tests. Putting the data into Mr. Austin's formula, and taking the wave-length at 250 metres, which was approximately the case, the received current at a distance of 60 miles given by the formula is 590 microamperes, whereas it was actually only about 50 microamperes. It is evident, therefore, that the constant 4·25 is too large for this case. One reason for this may be the great difference in the type of aërial used, Mr. Austin's formula applying to a flat-topped aërial, whereas a straight aërial was used for the Holyhead-Howth experiments; another reason, the Howth aërial had a higher resistance.

The absorption coefficient, however, seems to fall in very well with the *Monarch* experiments, neglecting the short distances, which are irregular. Taking the slope of the curves for the *Monarch* crossing from Howth to Holyhead, the absorption is rather less than that given by Mr. Austin, but the slope of the curve for the *Monarch* returning from Holyhead to Howth indicates a slightly greater absorption.

A number of tables are given in the paper to facilitate the use of the formula in practice. These tables show how extremely important it is to use a long wave-length for long distances; for instance, for transmission over a distance of 2000 miles, with a wave-length of 1000 metres and two flat-topped aërials 450 feet high, 490 amperes is required in the transmitter, whereas at 6000 metres only 105 amperes is necessary. There are still, however, many obscure points in the long-distance transmission which Mr. Austin's formula does not account for; for instance, Mr. Marconi pointed out at the Royal Institution a short time back that there were two minima near sunset and sunrise in the curve representing the strength of the received signals across the Atlantic, and also two maxima. Can this be accounted for purely by variation in the absorption coefficient, and, if so, does the absorption coefficient during the minima bear the same relationship to the wave-length as that given in Mr. Austin's formula? Do the two maxima correspond to practically no absorption, or are they higher values than would be obtained if no absorption existed as if waves were concentrated, as Mr. Austin seems to consider possible?

Whether the formula turns out to be strictly right or not, it should form a good basis on which to compare different wireless systems, and it constitutes a real advance in the published knowledge of long-distance radio-telegraphy. W. DUDDELL.

EXPERIMENTS ON AËRIAL PROPELLERS.[1]

AN article in the April *Bulletin de la Société d'Encouragement* deals with some experiments on aërial propellers made by MM. Legrand and Gaudart, with the aid of a grant from the society. The greater part of the article is a discussion on the methods adopted by other experimenters for expressing their results. M. Legrand objects to the three coefficients usually adopted in expressing the results of propeller experiments, namely, "pitch," "fraction of pitch in each blade," and "percentage slip." He objects to the use of "constructional pitch" (which is usually taken as the pitch of the pressure face chords), as it is not constant for all parts of the blade in modern propellers. He also objects to the use of the pitch corresponding to no thrust, as this is not constant for all speeds; but in our opinion this latter is constant enough for all practical purposes.

M. Legrand's objection to the use of the coefficient "fraction of pitch in each blade" is that it is not definite for a given propeller; as, in modern propellers, it is not the same for all co-axial, cylindrical sections of the blades. This objection, however, is entirely overcome by using "disc area ratio," which is equivalent to "fraction of pitch," and is also absolutely definite for any given propeller. The objection advanced against the use of "percentage slip" is that the pitch not being definite, or the same for all parts of the blade, the slip is also indefinite.

Efficiency curves by Géber and Dorand are quoted, in which efficiencies at constant rotational speeds are plotted against translational speed. If, however, efficiencies at constant rotational speeds are plotted against percentage slip, and the pitch used in the reduction of the experimental results be stated—the percentage slip being equal to $100\left(\frac{\text{pitch}\times\text{revs.}-\text{translational speed}}{\text{pitch}\times\text{revs.}}\right)$—it is readily seen that the two sets of curves are equivalent and derivable from each other. Also, plotting against percentage slip has the advantage that it brings all the efficiency curves close together.

It is generally admitted that the indefiniteness of the pitch of a propeller is a disadvantage; but it seems, as yet, to be the best "coefficient" that can be used to give a general idea of the type of a given propeller. M. Legrand does not give any substitute for "pitch," and, in connection with his own experiments, differentiates between a propeller with a big pitch and one with a small pitch.

The experiments were carried out on full-size propellers, mounted on actual aëroplanes and driven by a 50 h.p. Gnome engine. The thrust was registered during the whole flight on an autographic diagram from a Richards dynamometer, working in conjunction with a flexible mounting for the propeller. An error is admitted of at least 2 per cent. of the maximum thrust in the calibration of the dynamometer. The rotational speed of the propeller was measured by means of a direct reading tachometer, and is probably correct to about 1 per cent. But the power absorbed was measured by assuming that the brake h.p. of the Gnome engine, at a given speed, did not vary during the course of a series of experiments. By this method of measuring, we should estimate the probable error on the measurement of power to be anything up to 10 per cent. The speed of translation of the machine was measured by means of an ordinary U tube, measuring the air pressure in a converging cone. This was calibrated by flying round a measured aërodrome, taking the speed with a watch. So that, taking into account the difficulty of flying exactly over the course and of reading a water-gauge on a vibrating aëroplane, the translational speed is probably not correct to closer than 3 per cent.

1 "Études expérimentales sur les hélices propulsives Aériennes." By M. Legrand (Bulletin de la Société d'Encouragement pour l'Industrie National, April).

The results given are very meagre, and are as follows:—The efficiencies varied between 53 per cent. and 69 per cent. The thrust fell off in flight about 33 per cent. from the value with the aëroplane anchored. The rotational speed of the engine increased in flight from 0 per.cent. to 15 per cent. above the speed with the aëroplane anchored, depending on the propeller. The experiments are to be continued with the aid of a further grant, and we may therefore expect more complete results of tests with the addition of more particulars of the propellers tested than are given in the present article.

It is to be hoped that the experimenters may improve the accuracy of their apparatus, so that their results may be of real scientific value, and not merely for the purpose of differentiating between a good propeller and a bad one.

FRANCIS H. BRAMWELL.

PHOTOGRAPHY IN SURVEYING.

FOR the last half a century continued efforts have been made to utilise photography in the preparation of accurate plans of country, and thereby economise some of the time expended in the detailed measurement of every feature and object. A photographic negative provides an accurate record of the area included in it, contains much detail which measurement alone cannot give, and is always available for future reference. On the other hand, the employment of photography requires certain technical knowledge, and a good judgment in the selection of stations and views; it is best suited to regions of considerable relief, but even then patches of ground are liable to be omitted altogether from the views, and such omissions are not recognised until the work is plotted; lastly, it necessitates considerable skill in the drawing office to get the best and most complete results from the field-work. Photogrammetry has, therefore, developed most rapidly in countries where mountainous districts offer favourable conditions for its employment, and where the season available for field-work is limited. France, Italy, Germany, Austria, Switzerland, and Canada have all made use of this method in topographical surveys, despite its drawbacks. Mr. A. O. Wheeler[1] describes in general terms the methods which are employed in Canada under the direction of Dr. Deville, the Surveyor-General of Dominion Lands, and employed by Mr. Wheeler on Dr. Longstaff's recent expedition in British Columbia. But the labour involved in utilising the information collected by the camera has always hindered its wider employment in surveying, so that we welcome a new method of automatically reproducing it on a plane surface, which is described by Prof. E. Brückner.[2]

Some years ago Dr. C. Pulfrich, of the firm of Carl Zeiss, of Jena, produced his stereomicrometer, by which the coordinates of points represented on a pair of stereographic plates were determined, and their positions defined, so that they could be plotted on a plan. In this instrument the plates are fixed, and the movements of the index pointers are measured. A further development was the stereocomparator, in which the plates are movable, and the points to be measured are brought under fixed marks, in this case the objectives of a stereoscope. By suitable mechanical arrangements the coordinates of any point on the picture and the stereoscopic parallax are readily determined, thus providing the necessary information for plotting the point measured. Lieut. von Orel, of the Military Geographical Institute in Vienna, conceived the idea of automatically recording the data thus measured, and the necessary modifications have been made to the stereocomparator so as to enable the data to be plotted mechanically on a sheet of paper. This instrument is called the stereoautograph, and in it the movements of the plates and the stereoscope of the stereocomparator are communicated to flat rulers resting on the drawing-board, and by their aid the positions of points are plotted on the plan. Not only is the horizontal projection of the detail effected in this way, but contour lines representing the relief can also be drawn.

Plans on a scale of 1 : 25,000 can be accurately produced in this way, and even one on the scale of 1 : 10,000 showed but slight differences from a precise measured survey of the same on this scale. The apparatus is said to be capable of producing a map sheet 35 cm. by 25 cm. of a mountainous region to the scale of 1 : 25,000 in about ten days' work, so that it promises to be of great value in reproducing the work of travellers and explorers who will take the necessary photographs. Photogrammetric methods do not apply where surveying is organised so as to utilise a *personnel* of moderate technical ability, where each individual carries out a single stage of the work only; but where skilled technical assistance is available, and each surveyor executes as complete a survey as possible of a given area, then stereophotogrammetry, simplified by Lieut. von Orel's instrument, seems to offer great possibilities, especially when conditions of work and of surface relief are also favourable.

Though primarily adapted to topographical representation, some have tried to adapt photography to large-scale (cadastral) work, and M. J. Gaultier has proposed methods for its employment. But the indoor work of the necessary precision is tedious and costly, so that in a recent paper[1] he proposes for such work an instrument which he names the "topometrographe." This is of the nature of a plane table for precise work, stoutly built and carefully levelled, on which a base-bar is clamped. This carries the pivots of two rulers set at a distance apart corresponding to the base line used. These rulers are set at any desired angle with the base-bar by means of divided circles, and their intersection locates the apex of the triangle. Very considerable accuracy is claimed for the method, which is to be based on a network of third- or fourth-order triangulation; but its effectiveness would appear to be restricted to special cases, where such elaboration in the field is compensated for by economy in the office.

BIRD-NOTES.

FROM the point of view of forest-conservation much interest attaches to Mr. F. E. L. Beal's report on the food of American woodpeckers, published as Bulletin No. 37 of the biological division of the U.S. Department of Agriculture. The report is based on the examination of the contents of a large number of stomachs of sixteen species of these birds; but since the number of specimens examined was much smaller in some cases than in others, it is quite probable that some modification of the order in which these species are tabulated according to the nature of their food may be necessary in the future. Another element of uncertainty in this respect is due to the rapidity with which the vegetable food of the cambium-eating species passes through the stomach.

As the forests of the United States, like those of other countries, have a host of insect enemies, among which wood-boring beetles are pre-eminent, any natural agency that will assist in keeping these pests in check is of the highest value. In the case of wood-boring beetles, woodpeckers occupy the first place as destroyers, and among these the two species of the three-toed genus Picoides are the most valuable. In the typical *P. americanus* no less than 94·06 per cent. of the food consists of animal matter; while as regards its insect-food, 71·05 per cent. consists of beetles and the remainder of ants. Most of these beetles are wood-borers, although a percentage consists of harmless species. Ants also are deleterious to trees, since they often take possession of the borings from which beetles have been extracted by woodpeckers, until they in turn are routed out by these birds. Woodpeckers are frequently charged with inflicting damage on sound trees; but the charge, except in the case of the American group of sapsuckers, is considered to be unfounded. As regards sapsuckers, which feed on cambium, these certainly do inflict damage, which in some cases may be serious although, on the other hand, they consume legions of ants.

The colouring of the Jack snipe forms, according to Mr. F. J. Stubbs in *The Zoologist* for July, an absolutely perfect protective adaptation. In some localities the only means by which the bird can be detected when squatting in its proper haunts is by looking for a couple of curved blades of faded grass of a brighter hue than any indi-

[1] *Geographical Journal*, June.
[2] *Mitt. d.k.k. geographischen Gesellschaft in Wien*, Bd. 54, No. 4.

[1] *Revue Scientifique*, May 6.

genous to the district. When detected, such supposed grass-blades are the yellow head-stripes of the snipe. If surprised on a patch of green turf or other inharmonious background, the bird will sometimes run and squat on the mud near a patch of herbage close at hand.

It is announced in the July number of *British Birds*, by Mr. A. H. Meiklejohn, that a breeding colony of fulmar petrels has established itself in Berriedale Head, Caithness, the only other nesting haunt on the mainland being Cape Wrath, Sutherland, which was first discovered to be the resort of these birds in 1901. The most southerly breeding-place in the British Isles is Barra.

Certain erratic lights observed at night on the hillsides at Villierstown ferry, Cappoquin, Ireland, during last winter, by Miss M. E. Dobbs and the local ferryman are tentatively attributed by the former, in an article published in *The Irish Naturalist* for July, to luminous owls, this opinion being based on the assertion of the aforesaid ferryman that the lights are due to birds. In a supplementary article published in the same issue, Mr. C. B. Moffat, after quoting additional testimony to the belief that birds are their source, suggests that these strange luminous emanations may be a form of *ignis fatuus*. It is true that the latter is generally a more flickering type of light, but one resembling Miss Dobbs's description is reported from the Donabate estuary, unless, indeed, the natives mistake a bird for a phantom. But Mr. Moffat goes even further than this, and suggests that the whole story of luminous owls, which, it will be remembered, was first reported by Sir Digby Pigott in a letter to *The Times* for December, 1907, may possibly turn out to be a myth. He notes, however, that an apparently similar luminosity has been attributed to bitterns and certain herons, especially an American species, but states that even this testimony is not definitely accepted by naturalists.

Among the contents of the July number of the Journal of the South African Ornithologists' Union is an article by Mr. C. F. M. Swynnerton on nests and eggs from Mount Chirinda, southern Rhodesia.

IONISATION AND CHARGED SMOKE PARTICLES.

IN the *Sitzungsberichte der k. Akad. der Wissenschaften* of Vienna, vol. 120, part i., Drs. V. F. Hess and G. v. Sensel discuss the results of a series of experiments on the ionisation of the atmosphere made by them during August and September, 1909, on an island separating the two branches of the Danube near Vienna. The observations were made from 9 a.m. to 9 p.m., and the curves for the diurnal variation show marked minima about 5 p.m., both for the positive and for the negative ions. The main object of the authors was to investigate the connection between the ionisation and the meteorological elements, but the period of observation was too short for the conclusions to be regarded as final. The principal results are briefly as follows. For low atmospheric pressure the excess of positive ionisation has double its value at ordinary or high pressures, and a similar difference exists between the values for falling and for rising barometer; the total number of ions, and the number of negative ions, decreases as the temperature increases—a result exactly opposite to that found by Simpson and Gockel: the number of ions is greater for clear than for cloudy sky, especially if the cloud is nimbus: the number of ions is less when the wind comes from the direction of the city; and it is independent of the relative humidity, a result also different from those of Simpson and Gockel, who found that the ionisation decreased as the humidity increased. The recent establishment of systematic observations of the ionisation at some of the principal observatories ought to permit of a fuller discussion of the questions treated in this paper, which will prove valuable in indicating the observations which are specially desirable.

The same number contains a discussion by Dr. K. Przibram of experiments on the charge carried by smoke particles, in the light of Cunningham's correction to Stokes' formula for the connection between the limiting velocity and the radius of the particle. Careful series of experiments on smoke of different substances indicated a definite tendency for the charge to depend on the radius of the particle, and led the author to conclude that the particles could carry charges less than the adopted value for the charge on the negative ion, or that certain factors entered into the motion of charged particles through a gas which had not yet been allowed for. In a note added after the paper had been printed, the author states that owing to a criticism by Regener, he repeated some of the experiments with the plates of his condenser closer together, when he found much less dispersion in the values for the charge. Consequently, the conclusions founded on the earlier experiments may be subject to modification.

HIGH-PRESSURE WATER-POWER WORKS.[1]

THE utilisation of high-pressure water-powers represents the latter portion of the wonderful and rapid development which has occurred in hydraulic works during the last twenty years. Such powers are necessarily situated in mountainous districts, and may be at some considerable distance from thickly populated centres where a demand for power exists. Comparatively low falls were more in use until the question of long-distance high-tension electrical transmission could be looked upon as a sound technical and commercial proposition, and this has only been satisfactorily solved within the last few years.

Hydro-electric stations do not lend themselves very readily to hard-and-fast rules. It by no means follows that what has shown itself to be satisfactory in one case will be equally satisfactory in another. Engineers of every branch are represented in work of this kind, besides surveyors, architects, miners, railroad men, and in some cases geologists and also meteorologists have to be consulted. High-pressure plants usually work out considerably cheaper than low-pressure plants for the same power, but a long transmission line may so increase the capital outlay on the former that a low-pressure station near the consumer is preferable. A very great advantage possessed by high-pressure plants over other types is the readiness with which the irregular flow of rivers may be regulated to supply a constant-power demand by means of storage reservoirs and weirs. The whole rainfall of a district may thus be utilised. Storage, however, increases the cost of a station very considerably. The greater the head of water, the more rational will a storage reservoir be, since the same quantity of accumulated water will represent a proportionately larger store of energy.

Too little attention is usually devoted to the pipe-lines and conduits carrying the water from the lake or river to the turbines. Not a few engineers consider that the pipe-line is a secondary part of a hydraulic power-plant. Pipe-lines are often built by engineers who are experts in the choice of material and in the manufacture of a pipe, but who do not understand the essentially important functions which a complete pipe-line, and especially a high-pressure pipe-line, has to fulfil. The general arrangement, the relative dimensions of different parts of the pipe-line, the methods of anchoring and placing of fixed points, are all such important factors that they can only be properly determined by the turbine builder.

The Necaxa power-station of the Mexican Light and Power Co. is supplied with water under a head of 1312 feet from a reservoir having a capacity of 1590 million cubic feet. The first part of the scheme, commenced in 1903, consisted of the construction of a large earth dam above the falls of the Necaxa River to form the storage reservoir which supplied the power-station with water for about 50,000 horse-power. The dam has a maximum height of 197 feet, length 1279 feet, and greatest breadth at the base 951 feet. An earth dam was selected as the type most suitable for a country periodically liable to earthquakes. Two feeder pipes 6 feet in diameter start from the intake tower in the lake and pass through a tunnel which emerges below the dam wall. These pipes are made of riveted plate, and pass to a receiver pipe which is under a pressure head of 177·8 feet. Six high-pressure pipes descend from the receiver to the power-house. Sluice valves are provided at the receiver to control each pipe, and air pipes are laid from behind the valves on each high-pressure pipe up the hill to a height

[1] Abstract of a paper read at the summer meeting at Zürich of the Institution of Mechanical Engineers by Mr. L. Zodel, of Zürich.

above that of the reservoir level. The six pressure lines are composed of welded pipes 30·7 inches external diameter, and have a thickness varying between 0·39 and 0·87 inch. The maximum static head is 1417 feet. The turbines are Escher, Wyss and Co.'s impulse wheels, each designed to generate 8200 horse-power at 300 revolutions per minute.

The company has greatly increased the water available by diverting the Texcapa, Tenango, Nexapa, and Xaltepuxtla Rivers into the Necaxa reservoir by means of an extensive system of tunnels through the dividing ridges. The catchment area has thus been raised to 154 square miles, and can shortly be further increased by another 77 square miles by bringing in the large Laxaxalpan stream. The present storage capacity of the entire system is about 4220 million cubic feet of water.

As a first step to enlarging the power-house, the capacity of each of the existing six turbines has been raised to 11,000 horse-power by fitting new runners and new nozzles. The velocity of the water in each of the six pipe-lines was thereby increased to the exceptionally high figure of 18 feet per second, a velocity which has not been found to be injurious in any way. Two new units of similar design and by the same makers have been installed; these are each of 16,000 horse-power, and are supplied with water through a new pipe-line system. The total capacity of the station is now 98,000 horse-power. The electrical energy is transmitted a distance of 93 miles to the city of Mexico and to other towns.

The power works of the Rio de Janeiro Tramway, Light and Power Co. are supplied from the largest artificial reservoir formed by a dam wall at present in existence. It has a total volume of 7840 million cubic feet. The length of the lake is 17 miles. The dam is of the arched concrete type. The gross maximum head at the power-house is 1015 feet. There are six impulse-wheel turbines, built by Escher, Wyss and Co., each generating 9000 horse-power at 300 revolutions per minute. The generators supply three-phase current at 6000 volts and 50 cycles, which is stepped up through transformers to a line voltage of 88,000 for transmission to Rio de Janeiro, the distance being 55 miles.

Some very difficult work had to be carried out on the pipe-line of the power-plant at Tyssedalen, near Odda in Norway. The Ringedals Lake provides an ideal natural storage reservoir at an elevation of 1426 feet above and 2·17 miles distant from the fjord at the edge of which the power-station is situated. A regulating tunnel from the Ringedals Lake discharges into the little Vetle Lake immediately below, which forms a second small regulating basin. A tunnel 11,200 feet in length passes through the mountain to the penstock chamber, from which the pipe-line leads down to the power-house. The tunnel is driven through granite for the whole of its length, and was completed in two years. The erection of the pipe-lines was work of a very difficult character. The total length is 2360 feet, and the pipes reach an angle to the horizontal of 55 degrees.

A typical high-pressure power-station in Switzerland is that of the Kraftwerk Brusio Company, which utilises the water of the Poschiavino River in the Canton Grisons on the south side of the Alpine chain. About 55,000 horse-power are developed, the greater part of which is transmitted to the industrial districts of northern Italy over a transmission line of 93 miles. The total head available is about 3280 feet, and is used in two stages. The upper lies between the Lago Bianco, on the Bernina Pass, and the Lago di Poschiavo, giving an effective head of 1970 feet for the Robbia station. The lower is between the Poschiavo Lake and the Italian frontier at Campo Cologno, where the head obtained is 1375 feet.

The River Siagne rises in the Alpes Maritimes province of south-eastern France to the north of Cannes. A power-station is situated near the village of St. Césaire, and utilises a fall of about 1142 feet of the Siagne; about 14,000 horse-power are available. The high-pressure pipe-lines of this plant have demonstrated in a most drastic manner what the consequences of incorrect design can be. The original pipe-line had to be abandoned after a few months' running on account of unsatisfactory working of the plant, and an entirely new pipe-line had to be built on totally different principles, in spite of the fact that the chief dimensions of the pipes were perfectly correct and amply sufficient for the conditions of head and discharge, and, moreover, were not altered in the second pipe-line. The principal faults were owing to the following:—(1) Too great a length of the upper portion, under low pressure, with pipes of small thickness, whereby a continual working or respirating phenomenon became apparent in this part of the pipe-line. (2) Insufficient fixing or anchoring of the pipes in the lower portion of the line, and a most curious position of the distributing pipe, in which very harmful vibration, combined with displacement of the pipes, could take place on sudden variations of water velocity or shocks in the pipe-line; this might easily lead to a burst, especially in the case of riveted pipes. (3) Unsuitable dimensions of the connecting pipes between the distributor and the turbines, with their length too great and their diameter too small, resulting in considerable accentuation of the pressure variations.

French engineers in general build pipe-lines without expansion joints; a large number of such high-pressure pipe-lines are now in continuous operation in France. This design must be characterised as irrational, especially in view of the demands made at the present day on the pipe-line of a central station with continually and rapidly changing water velocities.

THE SCIENTIFIC STUDY OF NAVAL ARCHITECTURE IN GERMANY.[1]

IT may sound strange if, in the land of ships—the land that has probably done most towards the practical and scientific development of the whole domain of shipbuilding—I take upon myself to describe the aims of scientific study in Germany and the methods which it is now adopting.

Apart from small unimportant beginnings, the real nursery for scientific study in the various domains of naval architecture in Germany has been the institution now known as the Königliche Technische Hochschule zu Berlin, in Charlottenburg. Since 1904 the Königliche Technische Hochschule in Danzig has likewise taken part in this work. The naval architectural departments of both these colleges have the same end in view, namely, the training of the young men who will later in life take a successful part in the building of the mercantile and naval fleets of Germany.

In accordance with the system adopted in all the technical colleges in Germany, it is a preliminary requirement for the admission of the students to the Charlottenburg technical college, that they should have passed the matriculation examination of a Gymnasium, Realgymnasium, or Oberrealschule. As these schools comprise nine forms, it follows that candidates for admission to technical colleges must be between eighteen and nineteen years of age. Since a further qualification is a practical training of one year at a shipyard of recognised standing, the age of the candidate is increased by six months—often by a whole year. To this must be added the period of military service, which is required of every physically and mentally sound German citizen, but which, in the case of an educated man who has obtained his volunteer certificate, is restricted to one year. For those who contemplate a career in the higher ranks of the Imperial naval construction department, the period of practical work and the year of service are spent in naval establishments, that is to say, in an Imperial dockyard and on board a naval training ship respectively, before the course of study at the technical college is entered upon. It may thus be said that the course of study begins when the student is twenty-one, and that it has been preceded by a certain period of preparation in the practical work of shipbuilding or marine-engine building.

The course of instruction is arranged in the following manner:—Within the department for naval architecture a distinction is made, in the first instance, between the professions of naval architect and marine engineer. The course of instruction itself in almost all the subjects comprises lectures and tutorials or "practices," the object here kept in view being that what is taught in the former is put into practical shape in the latter. It is a general principle

[1] From a paper read before the Institution of Naval Architects on July by Prof. O. Flamm.

in the German technical colleges, that so far as possible no lectures are to be delivered without the accompanying tutorials.

In all the departments devoted to different professional branches, the course is a four-year one. At the conclusion of the second year, the preliminary examination for the degree or diploma is held, the final examination being taken at the close of the fourth year. The first two years are principally devoted to the more general studies in mathematics and natural science subjects, although a beginning is made with the introductory lectures and tutorials in the main subjects at the outset of the first term. But whereas the general subjects at first take up much more of the student's time than the special subjects, this proportion gradually alters as the course proceeds till it finally becomes reversed.

Another feature of the arrangement of the studies is that the lectures are, so far as possible, delivered during the earlier terms, while the drawing-office work gradually assumes greater importance as the course proceeds. This is intended to give the student in his last year as broad a base as possible for designing and applying what he has learnt from the lectures.

The primary object of the course of instruction during the first two years is to give the student a general grounding on the broadest possible lines in mathematics and natural science subjects, and concurrently therewith to introduce him to the elements of his special subject, so that, after passing the preliminary examination, he may devote himself in a higher degree to the direct study of his profession during the last two years.

In the course of these two years, then, the tutorials gradually take the place of the lectures, and the professional study proper is gone into in detail. The student of naval architecture is engaged in designing and working out the plans of merchant and war vessels, and in studying the arrangement and working of shipyards, while the marine engineering student is at work on marine boilers, reciprocating, turbine, and internal-combustion engines. In addition, auxiliary engines and propellers are thoroughly gone into.

Students in each branch concern themselves with the other just so far that, in their respective parts of the work on one and the same vessel, they can completely understand one another, and give due consideration to each other's requirements.

The domain of airship construction and aërial navigation, which is closely related to naval architecture, has been included in the province of the latter, and it may be of interest to mention that quite a number of the first designers and engineers who have specialised in airship construction were formerly students in the department of naval architecture.

One of the important aims of science as applied to naval architecture is directed to the keeping of the rules of the classification societies in general accordance with the latest advances in knowledge. This refers chiefly to the arrangement, scantlings, and riveting together of the structural parts of the hulls of vessels, and to the application of the laws of mechanics, statics, and dynamics. A second aim is that the rules of these societies, which are gradually gaining in authority, shall be prevented from developing into crystallised and inelastic ordinances which interfere with the scientific development of ship design.

Both for instructional purposes and for scientific research work, suitable laboratories are nowadays of the very greatest value. In all branches of engineering, there are many questions the solution of which by pure analytical methods is impossible, and which therefore can only be dealt with by practical experiment. To what excellent use in this way have not the existing testing laboratories in almost all countries been put! At the Technical College in Charlottenburg the mechanical engineering section in particular has established numerous laboratories, and they have been of the utmost value both from the educational and from the industrial point of view.

The Technical College at Charlottenburg now possesses twenty laboratories, which serve the purposes of the research work of the professors as well as those of instruction. A short time ago a project for the installation of a second laboratory for the civil engineering section for the investigation of hydraulic questions was unfortunately rejected by the Prussian House of Representatives. It is a remarkable circumstance that in the entire establishment the section for shipbuilding and engineering should be the only one which has no laboratory! It must be admitted that this is very much to be deplored, and that the course of instruction as well as the solution of engineering problems is immensely impeded thereby. It may readily be understood, therefore, that the naval architectural section is doing its best towards the early attainment of an establishment of this kind so as to close up the gap in its structure.

My endeavours are directed to the establishment of a suitable naval architecture laboratory in which experiments may be made on the action of the screw propeller, and in which the gross and net amounts of work done by the latter, *i.e.* its efficiency, may at the same time be determined. Further experiments will then be made to determine the effect on each other of several screw propellers arranged abreast, or one behind the other, and also the effect exercised on them by the rudder. We shall then know whether it is possible to design high-speed propellers of high efficiency, and our knowledge over a wide range of under-water phenomena will be available for further advances in this branch of engineering. Students should take part in all inquiries of this kind, so that the results may benefit succeeding generations of engineers and enable them to play a leading part in the scientific progress of their time.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A REUTER message from Simla on August 3 states that Lord Crewe has accepted the scheme for a Mohammedan University at Aligarh, provided adequate financial support is forthcoming.

WE have received from the Department of Technology of the City and Guilds of London Institute the programme for the session 1911–12, containing regulations for the registration, conduct, and inspection of classes and examination of candidates in technological subjects, and for the award of teachers' certificates in manual training and domestic subjects. We notice that the names of the two examinations held at the end of the session have been changed from "ordinary grade" and "honours grade" to "grade I." and "final examination," corresponding, in a sense, to the two new examinations in science subjects instituted by the Board of Education under the names of "lower" and "higher"; but in certain subjects there are first- and second-grade examinations before the final examination can be taken. The list of subjects in which examinations are to be held in 1912 numbers seventy-nine, as compared with seventy-eight during the present year. The new subject is entitled "Heating and Lighting," and covers very fully the science and technology of these important processes. All inquiries for information in connection with the recognition of classes in technological subjects, examinations, and inspection should be addressed to the Superintendent, Department of Technology, City and Guilds of London Institute, Exhibition Road, London, S.W.

THE eighth annual report of the Education Committee of the City Council of Manchester for the year 1909–10 gives much interesting information as to the progress which is being made in the various grades of education administered by the committee. In the Municipal School of Technology the number of individual day and evening students enrolled for the session ending July 31, 1910, was 5018, as compared with 4988 for the same period in 1907–8, an increase of 30. The number of individual students enrolled in the day departments was 733, as compared with 780 for the session 1908–9. The class entries for the session were 11,071, against 10,500 for the session 1908–9. These figures do not include the class entries in respect of students in the day departments of the school. During the session, 200 students in the day departments of the school were enrolled as students of the Victoria University of Manchester in the faculty of technology, 97 with a

view to qualify either for the degrees of Master and Bachelor of Technical Science, and 103 for the certificate in technology. A large amount of original work was carried out by members of the staff and the more advanced students pursuing post-graduate courses in the various departments. Much of the work has been embodied in papers read before scientific societies, and published in the scientific and technical Press. The full record affords proof that the school compares favourably in the matter of research with other institutions of a similar character. Under the regulations adopted by the committee, a considerable number of tests and commercial investigations have been carried out during the year, chiefly in the departments of engineering and chemistry.

THE new handbooks containing the arrangements for the session 1911–12 at University College, London, in the faculty of engineering, the school of architecture, and the faculty of medical sciences have now been published. The college is a university centre for preliminary and intermediate medical studies. Its faculty of medical sciences comprises the departments of physics, chemistry, botany, and zoology (the preliminary medical sciences), also the departments of anatomy, physiology, and pharmacology (the intermediate medical sciences), and the departments of hygiene and public health and of pathological chemistry (post-graduate study). Each of the departments is also equipped for more advanced work, and provides facilities for research. The faculty of engineering, including the departments of mechanical heating and ventilation, electrical, civil and municipal engineering, is intended to provide for students wishing to devote themselves to engineering a systematic training in the application of scientific principles to industrial purposes. The courses are also suited to the requirements of students who intend to enter for appointments in the Indian Public Works Department, engineering department of the General Post Office, department of the director of engineering and architectural works in the Admiralty, Patent Office, and other similar services. The departments have been recognised by the Board of Trade as providing suitable technical training for marine engineers. Facilities are provided for post-graduate and research work in all the subjects. All communications should be addressed to the Provost, University College, London.

SOCIETIES AND ACADEMIES.

EDINBURGH.

Royal Society, June 19.—Prof. Bower, F.R.S., vice-president, in the chair.—M. Jules **Cardot**: Les Mousses de l'Expédition nationale antarctique écossaise. These were collected in various localities visited, and included a number of new species and genera.—Dr. J. **Aitken**, F.R.S.: Some nuclei of cloudy condensation. Some years previously the author, when enumerating the dust particles in the air at certain regions of the West Highlands remote from centres of population, had noticed from time to time a sudden, and at first inexplicable, increase in the number of dust particles. A recent study of the phenomenon had shown that the increase was due to the sunning of the material on the foreshore of neighbouring islands and coasts. The paper discussed the probable causes of this production of dust particles, and described a number of experiments on the direct effect of sunlight upon various substances.—Dr. A. A. **Lawson**: Nuclear osmosis as a factor in the mechanism of mitosis. A study of the spore mother-cells of Disporum, Gladiolus, Yucca and Hedera, and the vegetative cells in the root tip of Allium, has revealed a series of stages in the development of the mitolic spindle which has hitherto been overlooked. They are important and critical stages concerning the fate of the nuclear membrane, and are to be found in the early prophase, preceding the organisation of the equatorial plate. Contrary to the generally accepted view, it has been found that the nuclear membrane does not break down during spindle formation, but behaves as a permeable plasmatic membrane should behave under varying osmotic conditions. The interpretation of these stages throws an entirely new light on the problem of the "mechanism of mitosis," and necessitates a revision of the accepted views of nuclear phenomena. It goes to prove that osmotic conditions are active factors in the formation of the acromatic spindle.—Dr. A. G. **M'Kendrick** and Dr. Kesava **Pai**: The rate of multiplication of micro-organisms: a mathematical study. Assuming the law that the rate of increase of fast-growing organisms is proportional to the number of organisms present and to the concentration of the food-stuff, the authors express this in the mathematical form $dy/dt = by(a-y)$. At the beginning, y is small compared with a, so that the constant ab is equal to the rate of change of log y. From the graph which gives log y in terms of time, the value of ab may be readily obtained, and from the indications of the experiments the limit a towards which y tends may be inferred. The quantity also gives by a simple calculation the period of a generation. The numbers calculated from the integrated expression were found to be in good agreement with the numbers obtained by direct measurement.

July 3.—Dr. Horne, F.R.S., vice-president, in the chair.—Prof. A. H. **Gibson**: The resistance to flow of water through pipes or passages having divergent boundaries. The rate of loss of head in water flowing steadily along various types of expanding tubes was the object of the research—such types as circular pipes with uniformly diverging boundaries, rectangular pipes with two sides parallel and the other pair uniformly diverging, trumpet-shaped pipes with the curved boundary made so that the square of the speed fell off uniformly with distance, &c. In this last-named form there was a distinct reduction in the loss of head in a given length as compared with the loss in uniformly diverging tubes. The divergence which gave greatest efficiency was from 10° to 16° in the rectangular pipes, and from 7° to 10° in the circular pipes.—Dr. W. T. **Gordon**: The structure and affinities of *Metaclepsydropsis* (*Zygopteris*) *duplex* (Williamson). This Carboniferous fern was first recorded by Williamson in 1874, when he was investigating the structure of fossil plants from Pettycur, Fife, numerous petioles of the fern being discovered among his specimens. The same species had since been obtained near Régmy, in France; but in all these cases only fragments of petioles and pinnæ were discovered. Recently, however, stems and roots have been found at Pettycur. In a silicified mass of material several pieces of stems were obtained in close association with innumerable fragments of petioles and pinnæ. Certain emergences from the stem were noted, and an examination of the petioles soon established a series showing a continuous variation from the normal petiole trace to a trace which was identical with these emergences. In this way it was proved that the stems and petioles belonged to one and the same species. The stem stele is very simple in structure. The axis consists of a circular cylinder in which the outer zone is composed of long stout tracheides, while the inner zone is formed by a mixture of long narrow tracheides and conjunctive parenchyma. The stem emits petiole and root-traces at long intervals, and occasionally bifurcates dichotomously. In the theory of the medullation of the zygopterid stele, this stem is of some importance, since it exhibits a stage closely similar to that shown in the stem of *Ankyropteris corrugata* (Williamson). Like some other members of the Zygopterideæ, *A. corrugata* has a biseriate arrangement of the primary pinnæ, while in *M. duplex* and others a quadriseriate distribution of these appendages is shown. In both the quadriseriate and biseriate divisions it is now possible to arrange the stems in a series which demonstrates the gradual medullation of the stems, and is, at the same time, compatible with the geological age of the specimens:—

	Quadriseriate division	Biseriate division
Lower Carboniferous	(1) *Diplolabis römeri*	(1) No known stem
	(2) *Metaclepsydropsis duplex*	
Upper Carboniferous	(3) *Etapteris diupsilon* (*Lygopteris Grayi*)	(2) *Ankyropteris corrugata*
Permian		(3) *a. Ankyropteris scandens* *b. Ankyropteris Decaisnei* *c. Ankyropteris Brongniarti* } These three probably the same species

In each division the stems with the same number, (1), (2), (3), are at first sight practically indistinguishable, but it will be seen that the medullation in the biseriate division is geologically later than in the quadriseriate.—W. G. **Robson**: Laboratory note on a simple method of finding the radius of gyration of a body. When a body is suspended symmetrically by a bifilar suspension, its moment of inertia about the vertical axis through its centre of mass can be expressed very simply in terms of the period of oscillation about that axis and the period of oscillation as a pendulum in the plane perpendicular to the bifilar.

NEW SOUTH WALES.

Linnean Society, May 31.—Mr. W. W. Froggatt, president, in the chair.—Prof. T. D. A. **Cockerell**: The bees of the Solomon Islands. Only one species of bee (*Nomada psilocera*) had been recorded from the Solomon Islands up to the end of last year. Mr. Froggatt's collection, obtained in 1909, comprised representatives of fifteen undescribed species, referable to the genera Meroglossa, Halictus, Nomia, Crocisa, Anthophora, Cœlioxys, Megachile, and Trigona. The Solomon Islands evidently possess a strong Indo-Malayan element; but Mr. Froggatt's collection brings out the fact that there is also an Australian element, the striking representative of which is Meroglossa, now for the first time recorded from outside Australia.—H. J. **Carter**: Revision of Pterohelæus (continued) and of Saragus, with descriptions of new species of Australian Tenebrionidæ. The tabulation of the described species of Pterohelæus is continued, together with descriptions of five new species, bringing the total up to eighty-two. A tabulation of the species Saragus is also given, and descriptions of five new species, increasing the total to fifty-five. Sixteen new species of other groups of the Tenebrionidæ are described, including two for which new genera are proposed.—E. **Meyrick**: Revision of Australian Tortricina (concluded). The concluding portion of the revision deals with the two families Eucosmidæ (19 genera, 149 species) and Chlidanotidæ (2 genera, 3 species). The former is largely developed throughout the northern hemisphere, but is less conspicuous in Africa and South America, whilst in Australia and New Zealand it is inferior in numbers to the Tortricidæ. The real extent of its inferiority is, however, partially disguised by the number of species of Indo-Malayan type (especially in the genus Argyroploce) which have penetrated into Queensland. The family Chlidanotidæ is a curious one, comprising at present only a few small genera of Indo-Malayan origin.

June 28.—Mr. W. W. Froggatt, president, in the chair.—Dr. T. H. **Johnston** and L. **Harrison**: Notes on some mallophagan generic names.—T. **Steel**: The fertilisation of *Pittosporum undulatum*, Andr. The previously observed occurrence of two kinds of flowers borne on separate trees is confirmed, the one kind being male and the other female. The former are characterised by the conspicuous stamens, which are aborted and inconspicuous in the latter. Occasionally ripe seed-vessels containing fertile seeds have been noticed on staminiferous trees, and the flowers from which these were derived have been traced. These flowers were found to have shortened barren stamens, the anthers being shrivelled and non-dehiscent. In no case were staminiferous flowers found on female trees.—E. C. **Grey**: Contribution to a knowledge of the chemistry of blood. No. 1. Globin sulphate and globin from ox blood. (1) 100 c.c. of ox blood yields 16·79 grams of globin sulphate, which is equivalent to 15·43 grams of globin. (2) The globin from ox blood is more basic than that from the hæmoglobin of the horse. (3) The sulphate of globin precipitated from solutions containing varying concentrations of sulphuric acid is of constant composition, containing 8·08 per cent. sulphuric acid. (4) The percentage of nitrogen found in the globin sulphate is 14·9, from which the calculated percentage of nitrogen in the globin from the blood of the ox is 16·03 per cent. (5) The globin precipitated by trichloracetic acid was found to contain 0·45 per cent. sulphur.—Dr. R. **Broom**: The affinities of Cænolestes (Marsupialia). Thomas regarded this South American form as a diprotodont, not closely allied to any of the living forms, but more nearly related to the existing marsupials of Australia than to those of America. Miss Dederer, Gregory, and Sinclair, while agreeing that Cænolestes should not be placed in the Diprotodontia, prefer to relegate it to a distinct suborder, the Paucituberculata. After reviewing the evidence, the author concludes that as Cænolestes differs from the typical polyprotodonts only in tooth-specialisation, it should not be removed from the Polyprotodontia, but merely be made the type of a distinct family, or section at most.—P. **Cameron**: A collection of parasitic Hymenoptera (chiefly bred) made by Mr. W. W. Froggatt in New South Wales, with descriptions of new genera and species. Part i. Seventeen species, referable to the families Chalcididæ, Braconidæ, Evaniidæ, and Ceraphronidæ, are described as new.

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