THURSDAY, MAY 25, 1911.

MENDELISM AND BIOLOGY.

Mendel's Principles of Heredity. By W. Bateson, F.R.S. Pp. xiv+396. (Cambridge: University Press, 1909.) Price 12*s.* net.

THE time has come when a preliminary attempt may be made to forecast the position which Mendel's discovery will occupy in the history of biology, and when the widely divergent attitudes which have been taken up towards Mendelian principles may be profitably considered.

The reviewer is in the present case relieved of the duty, which usually falls to his lot, of indicating the nature, scope, and value of the contents of the book before him; for, whether we agree with Mr. Bateson or not, sceptics and adherents alike consider that his book is the fullest and most authoritative exposition of the results which have been achieved by those who have worked on the lines laid down by Mendel. These results may throw no light on the nature of heredity or on any problem which it has pleased the imagination of biologists to invent; but, be this as it may, the book before us is the source from which the fullest and most trustworthy information in regard to these results is to be sought, and no attention need be paid to the criticisms of those who are not intimate with its contents. Whatever the Mendelian doctrine is, here it is, for better or for worse.

To estimate the significance of this book we must, therefore, assign this doctrine to a place in the scheme of biology. The degree of success which will attend the efforts of any given person to perform this task will be inversely proportional to the faculty possessed by him of imagining that he may be mistaken. If he lacks this faculty altogether, complete success, so far as he is concerned, is assured, and the Mendelian hypotheses will either be set down as the correct picture, drawn now finally, once and for all, of the hereditary processes underlying the phenomena which they were invented to explain, or as the fantastic imaginings of unfortunate biologists who are unwilling or unable to take the whole of the available evidence into account. To us, who foster and preserve some of the attributes of childhood, these two extreme views appear no more than naïve and elementary, the utterances of men who, in the current phrase, "know their own minds." We cannot believe that in every department of the Mendelian hypothesis the explanation offered does more than approximate to that picture of the underlying processes which will ultimately be agreed upon as representing them as accurately as they ever can be represented. Still less can we believe that the Mendelian hypothesis is wide of the mark altogether, and bears no relation at all to the phenomena which it attempts to explain. How true a representation it is, can only be determined by subjecting its component hypotheses to rigorous experimental tests. Our own opinion, to which, however, we attach little weight, inasmuch as the experiments designed by us to effect this test are only, as yet, begun, is that the majority of the hypotheses will stand these tests well.

We may now pass from the question as to the truth of the Mendelian principles to that of the bearing of these principles on those products of the imagination which we agree to name "great biological problems," such, for instance, as the "nature of heredity" and the "origin of species." The former question must, we suppose, be regarded as a real one, but, of course, not one any answer to which will ever be regarded as the final one. But the latter involves so many notions, only remotely representing phenomena, and so many generalisations which are manifestly *interim* ones, that the discussion of its relation to Mendelian principles becomes a mere exercise in dialectic offering no prospect of ever so slight a progression in the direction of a clearer vision of actuality.

Let us deal first with heredity. The problems of heredity which are debated at the present day exist only for those who adopt that view of life which insists on the disparateness and circumscription of the units to the succession of which the continuation of the stream of life is due. To those, on the other hand, who think that the cutting up of this stream into individuals (which, so far as we can see at present, do certainly appear to be discreet) is an unwarrantable insistence on a secondary feature; and who think that the difference as regards the livingness of the objects of their several interests between a man who is not satisfied with observing less than, say, ten consecutive generations of a living thing and a man who dissects a rabbit, is as great as, and of the same nature as, the difference between a man who dissects a rabbit and a man who collects stamps—to these the favourite problems of heredity do not exist at all, though the material out of which these problems have been constructed is the chief object of their attention.

With regard to the light thrown by Mendelian results on the question of the origin of species. The idea that the process of specific differentiation is akin to that of Mendelian segregation will doubtless serve as a fertile incentive to investigation for years to come. But to suppose that evolution is due to causes which can be compared to the shuffling of marbles in bags seems to us to be an idea which throws no light on any problem, save on that of the value of the insight of those who are not ashamed to confess that they entertain it.

The strictly phenomenal or impressionist aspect of specific differentiation must be attacked by means of the instrument which Mendel has put into the hand of biologists—the analysis of the organism into its constituent characters by experimental breeding. But to suppose that the Mendelian method does any more than indicate the lines along which the attack on this particular problem is to be made betrays, in those who make this supposition, a high degree of that naïve sanguineness as to the powers of the human intelligence which constitutes, at the present day, the most formidable obstacle blocking our approach to a true vision of life and evolution.

BRITISH MARINE WORMS.

Ray Society: A Monograph of the British Annelids. By Prof. W. C. McIntosh, F.R.S. Vol. ii., part ii. Polychæta. Syllidæ to Ariciidæ. Pp. 233–524+23 plates. (London: Dulau and Co., Ltd., 1910.) Price 25*s.* net.

THIS volume constitutes a further instalment of Prof. McIntosh's large monograph of British Polychæts, and its publication raises the hope that the entire work will be completed in a few years. The families described are amongst the most interesting and the most familiar to naturalists, yet they have probably never received such detailed treatment as is here accorded, with the result that we now have such a survey as Huxley first planned when he undertook professional work. The variety and beauty of this section of the British fauna will be a surprise to most naturalists.

The most interesting points in the volume are the assumption of the "epitokous" stage among the Nereids, and the phenomenon known as "Palolo."

During their asexual or "atokous" stage, Nereids are provided with similar lobes and bristles on every segment, but when the breeding season ensues many species of this family undergo a metamorphosis. The head and eyes enlarge, the posterior two-thirds of the body grows out segmentally into new lamellar feet, and these in turn develop long swimming bristles. In this "hetero-nereis" or "epitokous" phase, the two sexes often differ in colour and in habits, and in at least one species there are again two castes of males. The behaviour no less than the appearance of these animals now finds a new expression. Up to this period, Nereis has lived a sluggish life in a burrow. Now as hetero-nereis, he or she strikes out for the open sea, swimming easily and gracefully by rhythmical contractions of the paddles, and discharging broadsides of ova or of milt into the water. This effort is probably the final act of a career, for, carried away by the act of discharge, these pelagic Nereids may rupture and die.

On this subject the veteran naturalist of St. Andrews has gathered together his own vast stores of information and also those of his fellow-workers. He traces the development of this metamorphosis in all available instances, and collates a great amount of information, not only as to British, but concerning all Polychæts that exhibit this phenomenon.

With regard to palolo, this Fijian word has reference to a peculiar swarming of Polychæts at the surface of the sea. At Amboina, round Japan, on the coast of Florida and Samoa, swarms of Eunicid worms suddenly appear at definite times and disappear as suddenly as they came. The interest of their advent is increased by its coincidence with a certain phase of the moon in two months of the year, October and November in some places, March and April in others. Several genera exhibit this habit of swarming on two or three definitely fixed nights if the weather be clear. By the following morning not a trace of them is to be seen.

Still more remarkable are the details of the process. During the preceding twelve months these Annelids have led a sedentary life, hiding as far as is known in crannies or burrows in rock and coral. No sooner, however, is the moon at full in March or in October, as the case may be, than these Eunicids turn round in their burrows, twist off their tails, and send them wriggling on to the surface, the head end meanwhile remaining in the burrow. The whole mature population simultaneously perform the act, with the result that the neighbouring water acquires an appearance not unlike that of vermicelli. These severed tail ends are provided with special ocelli, and swim away laden with ova or with milt, which they discharge with every contraction. In a few minutes disruption is complete, and hence by sunrise the act is over. Meanwhile the head-ends, ensconced in their burrows, are already making scar-tissue, and in time regenerate the missing portion.

Such in brief, though, of course, subject to local modifications, is the meaning of this expression, and we now ask is there a British palolo, or have we anything of this nature on our coasts? The monograph before us gives no certain answer. True, there is a British *Lysidice punctata* at Guernsey, closely allied to a species that acts palolo elsewhere, but at present such swarming, if it occurs, has escaped observation. As to this and many other features of habits, coloration, and development, there is still a wide field for research amongst Polychæts. We trust that the publication of this monograph will stimulate to fresh observations on this interesting group.

Rather unwillingly, a word of criticism must be added, and it is to repeat a request made in the review of the preceding section that appeared in this journal in 1908. It was there urged that the family name of each species should be placed as a headline to one of the two facing pages, preferably the left, and we would also ask for an outline classification in each part as issued. For working purposes the absence of these two simple devices creates an extraordinary amount of trouble, and the reviewer is, after careful search, still far from clear as to the classification of, for example, the Eunicidæ.

In conclusion, the magnificent plates of coloured figures reflect the greatest credit on everyone concerned in their production. Plate liii., for instance, representing *Nereis virens* in all its three feet of beauty is a wonderful picture. Prof. McIntosh is to be heartily congratulated on the completion of such a large section of this great work.

F. W. GAMBLE.

CHEMISTRY FOR MINERS.

Elementary Chemistry for Coal-mining Students. By Prof. L. T. O'Shea. Pp. ix+319. (London: Longmans, Green, and Co., 1911.) Price 6*s.* net.

THE object of this little book is to furnish coal-miners with a knowledge of as much of the science of chemistry and of its applications as they are likely to find useful in their everyday work. Its contents are thus naturally divisible into two sections, the first giving an outline of chemical principles, and the second a rather more detailed account of such portions of the subject of coal-mining as depend more especially upon the above principles.

Such a book undoubtedly raises the question whether it is advisable in the interests of the students to lay before them only fragments of a complete science, even though it be admitted that the particular fragments that are most likely to be useful to them in their after-career have been selected with care and discrimination. On one hand, it may be urged that it is better for the coal-miner to have a rudimentary knowledge of chemistry than to have none at all, and that unless the amount of science required of him is cut down to the lowest possible limits, he will have none of it, whilst on the other we have the obvious dangers that attend a limited knowledge of any subject, and in the present case more especially the risk that the man who has mastered such a book as Prof. O'Shea's will think that he has got a real grasp of the science of chemistry and will remain in ignorance of the vast field that this book does not profess even to touch upon. No chemist needs to be told that a book that treats only of the chemistry of certain of the metalloids must necessarily present only a very imperfect outline of the principles of modern chemical science, and there would probably be a pretty general consensus of opinion that, if possible, it would be far better for the mining student to learn the elements of chemistry as an abstract pure science from a book on chemistry, and, having mastered these, then to be taught what portions of that science he has to apply to the problem of his daily work.

Prof. O'Shea has evidently come to the conclusion that the latter method is the less practical, and no doubt there is very much to be said for his view; it must be admitted that the coal-miner who thoroughly masters his little book will benefit greatly thereby, and will certainly obtain a fairly clear understanding of many of the phenomena that he meets with in the pit. The first chapters give an outline of the leading principles of chemical combination, and of the physical and chemical properties of oxygen, nitrogen, air, hydrogen, water, sulphur, carbon, and the oxides of carbon, including a useful chapter on flame and the safety lamp; then follow a number of chapters on the application of the facts thus set forth, on coal, coking, and the recovery of by-products, on explosives, and on gas and dust explosions; the book concludes with some brief chapters on certain chemical and physical calculations, which will prove useful for the proper understanding of certain parts of the subject. Prof. O'Shea has done his work well, and has evidently selected his material with great care and judgment, and with a sound appreciation of the needs and limitations of the coal-miner. He has also taken care to express himself throughout in plain, simple language, and it may be suspected that it is to the desire for simplicity that a certain amount of slipshod writing in the book is due, as, for example, in such expressions as "one of the most improved forms," "a purely dust explosion," &c.; a somewhat flagrant case is the definition of the atomic weight of an element as "a number which represents how much heavier its atom is than the atom of hydrogen," where the author obviously means "how many times as heavy."

It is difficult to see why Prof. O'Shea should insist that nitro-glycerol is the more correct name for nitro-glycerine; the latter is a thoroughly well-known and generally accepted trivial name, and if he wants chemical exactitude, he should have used the strictly correct form, glyceryl tri-nitrate; it is now generally recognised that nitro-glycerine and gun-cotton are not, as Prof. O'Shea states, nitro-compounds, but nitrates. In the same way exception may well be taken to the statement that coal occurs in "veins." Such inaccuracies, though they are undoubtedly blemishes in an otherwise very well-written book, do not, of course, detract seriously from its value as a whole, and will presumably be corrected in a future edition. Prof. O'Shea may fairly be congratulated on having produced a little book that gives, within a convenient compass, a great deal of information that will prove extremely useful to all coal-miners, and be found to render very great assistance to the class for which it is more particularly intended. H. L.

ANOTHER BOOK ON EVOLUTION.

Phases of Evolution and Heredity. By Dr. David Berry Hart. Pp. xi+259. (London: Rebman, Ltd., 1910.) Price 5*s.* net.

THIS book is not written by a man red-handed fresh from an encounter with nature. If his hands needed washing before he wrote, it was to remove the dust of books. Would that the water could have removed the taint of much reading also. The notion that the truth must be sought in books is still widely prevalent, and the present dearth of illiterate men constitutes a serious menace to the advancement of knowledge.

The author of this book constitutes an exception to the law that the more certain a man is that he is right the more probable is it that he is wrong. Dr. Hart lays stress on the fallibility of the human intelligence. He realises that he may be mistaken. And he is. The title-page of his book bear these words:

"Every seeker after Truth is dependent on the knowledge of his Age. He must, therefore, shape his coat according to his cloth, and expect a misfit. The words of Cromwell to the General Assembly of the Scottish Church should ever ring in his ears: 'I beseech you, in the bowels of Christ, think it possible you may be mistaken.'"

The book deals with "Mendelism," "Biometry," "Mnemism," "Observation Bee-Hives," "Evolution in Religion," and "Men who have Revealed Themselves."

The obstacles which, according to Dr. Hart stand in the way of our acceptance of the Mendelian hypothesis seem to us wholly illusory. He does not see why segregation should not occur in F_1, and asks the following questions, which seem to us quite easy to answer. "1. Why, if this explanation be true, do we get all the plants of the F_1 tall-dwarf crossing, tall, and not talls and dwarfs in the 1:2:1 ratio?" [*Answer:* Because the only one kind of union between gametes can take place, namely tall×dwarf.] "2. The recessive quality reappears in F_2. Is it not, then, equal to the dominant?" [*Answer:* Yes, if you like.]

"Clearly it is only temporarily recessive." [Precisely.]

"3. How is the recessive element expressed in F_1? It has not disappeared, as it reappears in F_2 unaltered. It is not expressed in the 'soma' of the plant: Where is it?" [*Answer:* In its germ cells.]

Dr. Hart's amended Mendelian scheme on p. 43 may be all right, but we cannot understand it, and we know of no experimental evidence for the assertion that there are three kinds of zygotes in F_1, a tall-tall, $\left\{\begin{matrix}\text{tall}\\\text{dwarf}\end{matrix}\right\}$ tall, and a dwarf-tall. The reader must examine Dr. Hart's argument for himself.

The account of biometry is not very illuminating. "Galton," we are told, "formulated certain laws, which are important—that of filial regression, for instance; but the most widely known one, Galton's law, setting forth the supposed fractions making up the full heredity in the individual, is of great importance, and has been specially fought over since Mendelism began to exert its sway over Evolution. . . . We may therefore, using Mendel's term of unit-character, say that, according to Galton, offspring inherit one-half of their unit-characters from their parents, and the most of the other half from the grandparents and great-grandparents."

And, again:—

"The amount of hard work by biometricians in accumulating measurement-facts and noting minute variations is enormous. We get a good illustration of that in some of the late Francis Welldon's [*sic*] work. This eminent biologist was a most eminent follower [!] of biometric work, and . . . we see how Welldon spent himself, sometimes successfully and sometimes unfortunately, it must be said unsuccessfully, in arduous observations, unremunerative as yet in scientific deduction."

We cannot agree with this definition of biometry in the glossary at the end of the book, "Biometry is concerned with accurate measurements of 'organs,' their relations, and the laws governing their occurrence." It grieves us not to be inclined to praise this book, for the author is so manifestly earnest. But earnestness is not a sufficient qualification for authorship, and we cannot persuade ourselves that the book meets a long-felt want.

PHANTASMS OF THE LIVING.

Théorie Physico-chimique de la Vie et Générations Spontanées. By Prof. Stéphane Leduc. Pp. 202. (Paris: A. Poinat, 1910.) Price 5 francs.

PROF. LEDUC is not one of those who exaggerates the apartness of life. He thinks that the differences between an animate and an inanimate system are differences of degree, not of kind. It is in vain, he says, that one seeks for any exclusive characteristic of living things; it cannot be found in development, or nutrition, or irritability, or growth, or organisation, or reproduction. One discovers in living creatures only those physical forces which operate in the not-living world; biology, indeed, is part of the physico-chemistry of fluids. These conclusions are based partly on general reasoning, which appears to us fallacious, and partly on an interesting series of experiments, of which some illustrations may be given. A solution of 5 to 6 per cent. pure gelatine is spread on a slide; on this at regular intervals of 5 to 6 mm. one places by means of a pipette drops of ferrocyanide of potassium; these diffuse and meet and dry, giving a result like a tissue. The "artificial cells" pass through three stages of organisation, equilibration, and decline—ending, of course, in "death."

With a little ink and water one can conjure up all sorts of phantasms, some of them yielding very striking suggestions of karyokinesis. Periodic precipitations due to waves of diffusion may result in the artificial production of mother-of-pearl, which we can well believe, but we are not impressed by the "curious analogy" between some of the forms and "articulate animals." One of the figures is a little like a squashed scorpion, but is this sort of thing useful?

Prof. Leduc contributes an interesting short history of the biological study of osmotic phenomena, referring to Nollet, Rose, Traube, Harting, Quincke, and many others, and he gives a number of remarkable figures —the precise nature of which is in most cases left unstated—showing his own osmotic creations, produced by placing a fragment of calcium chloride in a saturated solution of carbonate of potash or tribasic phosphate of potash, or in similar ways. A fruitful solution to work with consists of 60 gr. of silicate of potash at 33°, 60 gr. of saturated solution of carbonate of soda, 30 gr. of saturated solution of di-basic phosphate of soda, and distilled water to make up a litre. Into this are placed fragments of chloride of calcium, and remarkable osmotic growths result. Some of the pictures of these and similar growths are mushroom-like, others worm-like, others coral-like, others shell-like, others mould-like, others leaf-like, and when a number are grouped together on a plate the effect is very quaint.

There can be little doubt that a study of these growths may in the course of time throw some light on the *rôle* of osmosis in organic growth. We think, however, that the author is going far beyond his results when he says that these osmotic growths exhibit "nutrition, assimilation, elimination, and irritability." The need of proof-reading is so conspicuous in this volume that we must direct attention to it. We read of Ernest Hœckel, Ulenhuth, Buttler Burke de Crambridge, Bütsehli, and so on; there are three or four errors in the title of a book by Rhumbler; and we see a German word with an accent. These are minute details, but they are congruent with the impetuous superficiality of the main thesis of the book.

IRRIGATION WORKS.

Notes on Irrigation Works. A Course of Lectures delivered at Oxford under the auspices of the Common University Fund. By N. F. Mackenzie. Pp. ix+111. (London: Constable and Co., Ltd., 1910.) Price 7*s.* 6*d.* net.

THESE lectures in book form have as their author an engineer whose competency to deal with his subject is sufficiently established by the fact that he was selected to be Under Secretary

for Irrigation to the Government of India. The duties of that office, coming after a career of practical work on irrigation schemes, would give that breadth of view with which a lecturer on so wide a subject as "Irrigation Works" should be endowed.

The irrigation works described in this book include more than the material works of irrigation, such as channels for irrigation and drainage and works of regulation. "Notes on Irrigation *Work*" would seem to be a more appropriate title. For, besides discussing weirs and irrigation channels—irrigation works properly so-called—the author describes what may be termed the embryonic growth of an irrigation project—that is, the preliminary surveys, studies, and calculations, which mark stages of development in the incomplete project. The final chapter, moreover, explains the revenue duties of the canal engineer of India. The canal engineer of Egypt is fortunate in escaping the harassing duties of revenue management, which in India are part of an irrigation officer's duties.

A separate chapter deals with the development of irrigation in Egypt since 1884 in a concise and comprehensive summary, and concludes with a short reference to possible future schemes. With this exception and a few references to works in Egypt under the head of weirs, the author has wisely drawn his illustrations from works in India with which he is personally acquainted, and treats his subject generally from the point of view of India. He thus avoids a fruitful source of error. The "eminent authority" whom he quotes as misconceiving the cause of the failure of Narora weir, leant too heavily on the broken reed of an official report, and fell into error for want of first-hand knowledge of the subject which he was using as an illustration. Mr. Mackenzie, with more caution, gives his opinion "with all reserve" as to the cause and manner of the accident. He may be right, but, as he points out, the local engineers decline to commit themselves to a positive opinion. There is, at least, one more theory of the cause of the accident, which has not yet appeared in print. Whatever the real cause may have been, the discussion, which has followed on the accident to the Narora weir and to which the author makes his contribution in his book, has been fruitful in establishing sounder principles upon which to base the design of weirs than had been recognised before.

A chapter on the design of irrigating channels is chiefly concerned with the important matter of silt deposit in the small distributing channels in the delivery zone of an irrigation system; but the method of water distribution on the rotation system is also described in general outline. An introductory chapter refers to the performance in the distant past and the promise in the near future of irrigation in Mesopotamia; also to the conditions which create a need of irrigation and drainage, and to the good effects of moderation and to the evil effects of excess in either.

The book is written in good, plain English, and is free from unnecessary technicalities, as lectures addressed to students should be, and as, indeed, all lectures might well be. The substance of the book is sound instruction, and irrigation engineers, as well as students, will find much useful knowledge in it, clearly expressed and convincingly demonstrated. A careful perusal of it would be a valuable preparation for a more detailed study of irrigation works and administration, either by books or by actual practice.

THE CRYSTALLINE SCHISTS.

Die Kristallinen Schiefer. Eine Darstellung der Erscheinungen der Gesteinsmetamorphose und ihrer Produkte. By Prof. U. Grubenmann. Zweite Auflage. Pp. xii+298+xii plates. (Berlin: Gebrüder Borntraeger, 1910.) Price 20 marks.

ORIGINATING in a course of lectures at Zürich, based largely on the author's own researches among the crystalline schists of the Alps, Prof. Grubenmann's book has already made for itself a place in petrographical literature. The two parts, general and special, issued separately in 1904 and 1906 respectively, are in the new edition included more conveniently in a single volume; but the general plan of the work remains unchanged, and the additions found here result merely from the growth of material during the last five years. Thus, in the first part, there is some revision of those sections which deal with the application of physico-chemical principles, and some interesting illustrations of original sedimentation, mixed injection, &c., are drawn from recent work in Finland and Scandinavia. The additions made to the second part of the book are perhaps more important, including a large number of chemical analyses, and some simplification of the classificatory scheme.

The general principles of Prof. Grubenmann's treatment are already known to petrologists. His classification is based primarily upon chemical composition. No distinction is made between metamorphosed sediments and metamorphosed igneous rocks, for it is urged that, even if their original characters are not wholly obliterated, metamorphism has set so marked a stamp upon them that the new characters supersede the old in significance. The author adopts Osann's chemical classification, originally devised for igneous rocks alone, and in this way arrives at twelve groups of crystalline schists. In each group there is made further a threefold division corresponding with different zones of depth, where the conditions as regards temperature and pressure are presumed to differ in an important degree. This division, an amplification of Van Hise's conception, is described as a "physical-geological" one; but, since the actual depths of the several zones are not the same in different groups of rocks, the geological significance is merely of a limited scope.

The distinction made between crystalline schists and "contact-rocks," which latter are excluded from consideration, seems to us an artificial one, and is difficult to defend in a scheme professedly based on the actual characters of the rocks. Barrow has shown that the great metamorphic aureoles of the Scottish Highlands can be divided into three zones, having sillimanite, cyanite, and staurolite as their

characteristic minerals. Here it is clear that the formation of one or other of these silicates depended solely on temperature, and in no wise on depth; but in the book before us sillimanite figures as a distinctive mineral of the deepest zone, and cyanite and staurolite of the middle zone. We are led to suspect that the author has overrated the influence of pressure as a factor in metamorphism. Such experimental data as we possess go to show that even very high pressures may not displace greatly the temperature-limits of stability of the rock-forming silicates.

Apart from such considerations, more or less theoretical, the work is a mine of valuable information. The classification at least serves its purpose as a standard of comparison, and the systematic treatment of the structures of crystalline schists will be especially useful. A. H.

PLANT LIFE OF MARYLAND.

Maryland Weather Service. By F. Shreve, M. A. Chrysler, F. H. Blodgett, and F. W. Besley. Vol. iii., The Plant Life of Maryland. Pp. 533. (Baltimore, U.S.A.: Johns Hopkins Press, 1910.)

THE weather service of the American State of Maryland, maintained by the Johns Hopkins University, Maryland Agricultural College, and the United States Weather Bureau, receives a broad interpretation. The first volume of the series dealt with the physiography and meteorology of the State, the second presented the results of many years' study of the climate and weather of Baltimore and vicinity, while the third is connected with the former in so far as vegetation is dependent upon physiography and climatic conditions. The main purpose of the present volume is to present an ecological description of the vegetation, which is demarcated into three zones. The coastal zone spreads inland as far as the "fall-line"; thence to a contour line of 1500 feet extends what is designated as the "midland" zone, and a mountain zone comprises land above that altitude. The term, "fall-line," it may be noted, is nowhere explained; reference to another source shows that at the junction of the Cretaceous or Cenozoic with older formations the rivers have falls or rapids.

The division into these three zones is suggested by the occurrence in the central counties of many species having a wide range, coupled with the appearance of a conspicuous southern floral element in the coastal zone, and an appreciable admixture of northern elements in the mountain zone; these facts throw some light upon the historical sequence of events. As for the details, these are well elaborated, and due consideration is given to the limits imposed by soil constitution, both physical and chemical, and by topography. Climatic conditions are extremely favourable to tree growth, so that forests are important in each of the zones. Originally extensive forests of white pine and pitch pine existed in the western part of the State, but now the white pine is limited to isolated specimens. The converse process is seen in southern Maryland, where scrub pine spreads over land cultivated before the Civil War; this is a first stage that is altered by the incursion of oak, and later by hickory. Apart from the forests, the various marsh regions in the coastal zone are interesting, also the serpentine barrens and Susquehanna gravels in the midland zone. To make the survey more complete, sections are devoted to agricultural and forestry matters, and an account of the floristic geography with a list of plants is supplied by Dr. F. Shreve. The text is illustrated by a considerable number of excellent photographs and by a few maps that would be more useful if the scale were larger. The volume is highly creditable to Dr. Shreve and his associates, and will take rank with the best local ecological studies.

OUR BOOK SHELF.

Salvarsan or 606 (Dioxy-Diamino-Arsenobenzol): its Chemistry, Pharmacy, and Therapeutics. By Dr. W. H. Martindale and W. W. Westcott. Pp. xv+77. (London: H. K. Lewis, 1911.) Price 5s. net.

IN this little book, the authors summarise all the essential information contained in the numerous publications that have appeared up to date on the Ehrlich-Hata remedy for syphilis. "Salvarsan" is the trade name given to the compound—which is chemically dioxy-diamino-arsenobenzol—synthesised by Ehrlich and his collaborators, and first introduced under the designation "606." Ehrlich has for some time past been studying the effects of various anilin dyes and organic compounds of arsenic on trypanosomes and other protozoan parasites. In quick succession he brought out more or less effective remedies, such as trypan red for bovine piroplasmosis (Texas fever), atoxyl and arsenophenylglycine for trypanosomiasis of man and animals, and, finally, "606" for spirilloses, diseases caused by spirillar micro-organisms, such as relapsing fever and syphilis.

S. Hata, of Tokio, conducted researches with "606" on the spirochætes of relapsing fever in rats and mice, and subsequently on the spirillosis of fowls. The drug was found to be extraordinarily efficacious, and it was an obvious further step to try it on syphilis, another spirochæte disease, with correspondingly successful results. Mercury has been used for centuries as a remedy, the one remedy, for syphilis, but a proper course of treatment with it extends over months, and it is impossible to make many patients realise the necessity for this, and hence the disease relapses, with, in many instances, dire results. With salvarsan, however, it is claimed that a single dose will in many instances effect a cure, an enormous advantage.

There can be little doubt that in salvarsan we have a most potent remedy for the cure of syphilis, though whether it will do all that has been claimed for it time alone can show. Unfortunately the drug is toxic, and requires to be administered in a special manner; it is not altogether free from danger in particular cases, and is contra-indicated in some of the worst forms of syphilis, *e.g.*, when the nervous system is involved. In the book under review, the authors give complete directions for the preparation and administration of the drug, and epitomise the precautions to be taken and the contra-indications for its use, and it should prove a very useful guide for the practitioner. Summaries of some of the principal contributions on the remedy are included, and a full bibliography is appended. R. T. H.

Outlines of Zoology. By Prof. J. Arthur Thomson. Fifth edition, revised. Pp. xxii+855. (Edinburgh, Glasgow, and London: H. Frowde and Hodder and Stoughton, 1910.) Price 12*s.* 6*d.* net.

In the case of a book written by such an experienced writer and teacher as Prof. Thomson, and especially at the appearance of a fifth edition, there is little room for critical comment. The qualities that have made this work such a successful handbook are well known to generations of Scotch students; the conciseness of its information, the caution of its statements, and the clearness of its comparisons. Even in its older form this text-book was notable for its close texture, for the compact nature of its information. Now that all the bearings of modern work upon its topics have been incorporated, it is a rendering not only of the outlines of zoology, but of much of the "corpus" of zoological knowledge, and he would indeed be a full man who could really possess the store of information, both old and new, that is contained in its pages.

Almost the only general criticism we have to make is the inadequacy of the treatment of the cœlom-theory. This important and difficult subject has recently been expounded so clearly in Prof. Sedgwick's text-book of zoology, and is of such fundamental importance that the fragmentary presentation in the book before us is a matter of regret, affecting, as it naturally does, nearly every division of the animal kingdom. The discussion on Echinoderm larvæ on p. 278 fails through such a want of what Moseley, we believe, described as "morphological grip." The "absence of the apical sense-organ" mentioned at the bottom of that page is surely an oversight. The apical plate is well developed in Echinid larvæ, and even bears eye-spots.

The text has been most carefully revised. Very few mistakes have been overlooked, but two call for mention. One of the most recently discovered insects —Acerentomon—is figured, a welcome sight, on p. 362, and is described there as being without antennæ, though antennæ are figured and described in the legend. The other occurs on p. 235, where, in the second paragraph, the word "sexes" is written "series." Such minute defects are, however, of little account. A notable feature of this edition is the large number of new figures.

Étude sur l'Assurance complémentaire de l'Assurance sur la vie. Avec de nombreux développements sur les Assurances contre la Maladie et l'Invalidité. By P. J. Richard. Pp. iv+118. (Paris: A. Hermann et Fils, 1911.) Price 3.50 francs.

There has lately been a movement among insurance companies in various parts of the world to combine with ordinary life insurance benefits dependent upon sickness, so that in the event of incapacity no premiums are payable, and sometimes an annuity is received. This movement has led to the mathematical investigation of the underlying principles, and the subject has proved attractive to one or two writers, owing, perhaps, to its complexity, for it is necessary to deal with the probabilities of death, sickness (permanent and temporary), and recovery, all of which vary with the age and occupation of the life assured, as well as with the time that has elapsed since the person was medically examined for insurance. M. Richard, in his recent publication, evolves the formulæ that might be used, and gives specimen tables to enable us to form an idea of how the premiums might be calculated, although, as he points out, we have not sufficient statistical data to enable us to use his formulæ satisfactorily.

The best solution of the problem is probably the statistical one which sets out on one hand the payments made to the offices, and on the other the various benefits allowed to the insured. The subject is, however, at present too new on its practical side to enable us to use this solution, and until experience provides us with data, M. Richard's neatly-printed little book will prove interesting to those who are concerned with actuarial problems in theory and practice, and have perhaps already been attracted to the subject on which he writes by the earlier work of Schaertlin and a few other writers.

Recueil d'Œuvres de Léo Errera. Physiologie générale. Philosophie. Pp. xiv+400. (Brussels: H. Lamertin; London: Williams and Norgate, 1910.)

The late Prof. Errera was possessed of an inherent faculty for analysing subtle problems by a process of concise, logical argument, and this faculty is particularly apparent in his treatment of certain of the general physiological subjects discussed in this fourth volume of collected papers. One of the best instances is supplied by the notes arranged for a course of lectures debating the existence of a vital force in plants. Two lectures on sleep were delivered before an audience composed largely of doctors. The view put forward by the author that sleep is induced by the formation of toxic bodies was opposed by several doctors present, but was not refuted.

Three papers only can be classed as direct contributions to botany, although arguments are deduced from the plant world in all of them. One of these discusses the question whether acquired characters can be inherited, and answers it in the affirmative on the strength of cultural experiments with *Aspergillus niger*, carried out by Dr. Hunger in the Botanical Institute at Brussels. Another paper dealing with the struggle for pre-eminence as exemplified by the growth of lateral branches of a conifer when the main stem is destroyed, was read before the British Association at the Cambridge meeting in 1904. Two essays on the individual and the assertion of life are published for the first time. The papers generally manifest a copious knowledge and ready application of the latest scientific facts, and botanists in particular will appreciate the arguments and views expressed with regard to spontaneous generation and the existence of a soul in plants.

Wild Flowers as They Grow. Photographed in Colour direct from Nature. By H. Essenhigh Corke, with descriptive text by G. Clarke Nuttall. Pp. vii+197. (London: Cassell and Co., Ltd., 1911.) Price 5*s.* net.

The first point of interest in this volume is supplied by the coloured illustrations, which are the outcome of photographs taken from nature direct by the Lumière process, and reproduced by a four-colour printing operation. Most of the colour tones are well rendered, notably the yellow and green of the primrose, the blues of the harebell flower, and the blended colours of the bee orchis; only the yellow colours of the dandelion and toadflax are distinctly incorrect. From a combined natural and artistic point of view the wild strawberry is excellent, as are several others, especially when it is considered that an exposure of minutes is required for taking the photographs. In the accompanying letterpress Mr. Nuttall presents a clear and precise description, adapted for general readers, of the chief features of biological interest observable in the twenty-five plants selected, and comments on the popular names, superstitions, and other such details. The text and illustrations together form an attractive volume, and the cost is moderate.

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.]*

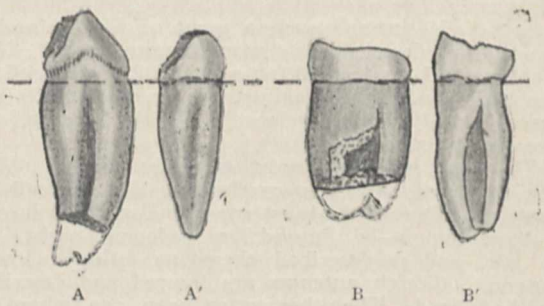
Discovery of the Teeth of Palæolithic Man in Jersey.

AT the close of last year Messrs. E. T. Nicolle and J. Sinel reported (*Man*, December, 1910, p. 185) some of the results of an exploration of a Palæolithic cave-dwelling situated in the cliffs of St. Brelade's Bay, on the south coast of Jersey. Amongst the mammalian bones found on the floor of the cave, Dr. A. Smith Woodward and Dr. C. Andrews recognised remains of the woolly rhinoceros, the reindeer, and two varieties of horse. Abundant evidence of former hearths and numerous flint implements were found with the bones. Nine human teeth were also found, and it is to the nature of these I wish now to direct attention. The exploration of the cave was continued by Mr. R. R. Marett, reader in social anthropology, Oxford University, who is now preparing for publication a full account of the various "finds" made in the Jersey caves. By his courtesy I was given an opportunity of examining the human teeth, which are to be fully described by Mr. Francis H. J. Knowles. Three of the teeth, all of which are fossilised, but in an excellent state of preservation, belong to the upper jaw—a second left premolar, a first right and a second left molar; the six teeth from the lower jaw are a canine, first and second premolar and second molar of the left side, a second incisor and second molar of the right side. It is thus possible to reconstruct the dentition of this individual—for clearly all are from the same set—with a fair degree of accuracy. The recognition of each member of the series was made easy by their close resemblance to the teeth of the Heidelberg mandible, usually regarded as the oldest example of Pleistocene man yet discovered in Europe. The teeth of the Gibraltar cranium, which is probably a very primitive and early example of the Neanderthal type, were also of assistance. In many features the teeth of the Krapina men are recalled. There can be no doubt that the St. Brelade individual to whom these teeth belonged must be ranked as one of the most, if not the most, primitive of the examples of the Neanderthal type yet discovered.

When the Heidelberg mandible was found in 1907 embedded in the Mauer sand beds, at a depth of nearly 90 feet, anthropologists were surprised by the fact that while the crowns of the teeth did not greatly exceed modern dimensions, the mandible itself was so massive as to recall the form found in the orang and gorilla. The important fact brought home to us by the Heidelberg discovery was that the outstanding feature of the teeth of Pleistocene man, as compared with those of modern man, are the size and character of the roots of the teeth, not the size or character of their crowns. The stout roots and massive mandible indicated the roughness and toughness of the food, and the huge muscular strength exerted in mastication. Now, as regards the characters of the roots, these now found in the cave of St. Brelade exceed all human teeth previously discovered. Although the crowns of the teeth are smaller than those of the Heidelberg mandible, the roots are in most cases absolutely, and in other cases relatively, greater in their diameters, and indicating a smaller but still more powerful mandible in the St. Brelade individual.

The characters of the roots of the St. Brelade teeth may be seen from the adjoining figure. Two of the teeth are represented, A, the left lower canine from its proximal or mesial aspect, and B, the second lower molar, also from the same point of view. Typical specimens of the same teeth in a modern European are shown in A′ and B′. The difference in thickness is striking; the length of the roots is nearly the same. So specialised are the tooth roots in Neanderthal man that Klaatsch and Adloff exclude this race from the ancestry of modern man. In the specimens figured of the second lower molars, both St. Brelade and modern, the two roots are fused, but the process of fusion is absolutely different in the two. In the Brelade specimen the roots have become so hypertrophied and strengthened that they have come together as a result of overgrowth; in the modern molar the roots have dwindled and atrophied and become approximated by a process of retrogression. In the anthropoids, as in well-developed molars of modern man, the roots are well developed, separate, and spread. The roots of the first molars of modern man thus resemble those of the anthropoid, whereas the typical molars of the Neanderthal race appear to differ absolutely from the anthropoid type. At first sight it appears as if Klaatsch and Adloff must be right in tracing the root-forms in the molar teeth of modern man to a primate ancestor, and in excluding the highly specialised roots of Neanderthal man from the ancestry of the molars of modern man. In this I think they are wrong, for were retrogression to overtake the masticatory development of the Neanderthal type of man, then the apparent fusion of the roots would vanish, and they would again appear as separate structures as in the well-developed molars of modern man. This stage of retrogression can be seen in the teeth of the men of Spy. When we speak of the Neanderthal race we must remember that it probably endured throughout the Pleistocene period, one covering several hundred thousand years, and that we must expect to find many forms. The Spy men appear to belong to the latter part of the period; the Heidelberg and Brelade men to the earlier.

The teeth of Pleistocene man are highly specialised as regards their roots, a character in which they altogether depart from the anthropoid form. The change in root form



is best explained by the supposition that the human method of mastication had been evolved from the anthropoid long before the end of the Pliocene period. The peculiarity of the human method of mastication is the side to side or grinding movement of the lower jaw; in the anthropoid the movement is a crushing or cutting movement. The great canine teeth are implanted as maxillary guides to prevent any side to side action and ensure that the mandible will not slip or "skid" when the powerful muscles of mastication are at work. The human method of mastication was only possible when the canine teeth began to sink, as in the female chimpanzee, almost to the level of the other teeth. That the human canines were once anthropoid in form there can be no doubt; their embryological history leaves room for no other opinion on this point. When, however, the side to side movement in mastication was evolved, the implantation of the teeth had to be strengthened to meet the side to side strain. It is that stage which is preserved for us in Pleistocene man. It is very remarkable that in modern times the side to side movement has disappeared in highly civilised races, and the former cutting bite, ensured by the lower incisors passing up behind the upper, has appeared. With the improvement in food in more modern times, the usual primate form of tooth roots reappeared. In the St. Brelade dentition the first lower premolar is highly specialised, as is the case in the anthropoid; its specialisation originally depended on the fact that it had to serve as the opponent of the massive upper canine. The discovery, made under the auspices of the Société Jerviaise, thus not only serves to show the extension of the Neanderthal type to the Channel Islands, but supplies most important facts bearing on the evolution of man.

A. KEITH.

Botanical Research at Peradeniya.

IN *The Times of Ceylon*, April 12, is published a communication, dated June 20, 1910, from the Governor of Ceylon to the Secretary of State for the Colonies on the question of a Department of Agriculture for that colony. With the proposals put forward in that memorandum we are not concerned, but there is one feature in connection with it against which we cannot but strongly protest. Appended to the memorandum are certain notes by Mr. Dunstan, of the Imperial Institute, of which one runs as follows:—

"Owing to the agricultural duties which are now performed by the botanical officers at Peradeniya, and for which they are not specially qualified, no botanical research is being carried on, and the scientific reputation of the establishment, which was at a high level in the days of Thwaites and Trimen, is suffering."

We are confident that this statement cannot be justified. A reference to the Annals of the Royal Botanic Gardens, Peradeniya, founded by Dr. Willis in 1901, gives evidence of the amount of valuable work that has been carried out in recent years. We may mention, without attempting to be exhaustive, the researches of Messrs. Green, Holtermann, Keeble, Lang, Lock, Parkin, Pearson, Petch, Smith, Svedelius, Willis and Wright, which have all been carried out at Peradeniya during Dr. Willis's directorship. At the present time Dr. Willis and Dr. Lock, and Messrs. Petch and Green, are actively engaged in research.

In our opinion there would be a general agreement among biologists that the high reputation of the Royal Botanic Gardens has been fully maintained—to say the least of it—under the direction of Dr. Willis. To the sympathy of the staff with scientific progress, and to their ability in smoothing the way for those who visit the gardens for purposes of research, two of us, who lately stayed there for scientific work, can personally testify.

We are relieved to read that the Secretary of State, in his answer to the memorandum, has not associated himself with the paragraph above quoted. But we feel bound to make some protest against what seems to us to give an entirely misleading impression of the high position, as a centre of research, which Peradeniya has attained under Dr. Willis's initiative and guidance.

R. H. BIFFEN, Professor of Agricultural Botany.
F. F. BLACKMAN, Reader in Botany.
FRANCIS DARWIN.
J. STANLEY GARDINER, Professor of Zoology.
R. C. PUNNETT, Professor of Biology.
A. C. SEWARD, Professor of Botany.
A. E. SHIPLEY, Master of Christ's College and Reader in Zoology.
T. B. WOOD, Drapers Professor of Agriculture.
Cambridge University, May.

The Heraldic Yale.

SUPPOSING a traveller on his return from Africa were to tell a friend in the Heralds' Office that he had seen a beast, in general appearance like an antelope, with divided hoofs and a long tail bunched out at the end like an elephant's: having horns, roughly corrugated and protuberant on his forehead like a ram's, though he could not be quite sure as to their form, because he saw him only in profile, and they seemed movable, one sometimes pointing forward and the other backward: further, that he had two enormous tusks and a lower jaw like a goat's, that is, with a long beard.

His friend might take out his pencil and embody what he was told in a rough sketch something like this, Fig. 1, saying, "That's very interesting, for your description of the beast combines all the characters of the heraldic Yale, which some say had an African origin."

Supposing the traveller then strolled round to the British Museum and reproduced, as well as he could, the sketch drawn by his heraldic friend, but, on being cross-examined, was forced to admit that what appeared to him to be tusks might have been the tips of the beast's curved horns, which from another point of view did seem to point different ways; that the upper part of his tail was not covered with short hair only, as in the elephant, but was more bunchy below, and from the animal's manner of whisking it about the bunchiness was exaggerated. Supposing, also, that he was not clear as to the points or protuberances on the top of the animal's head—whether they

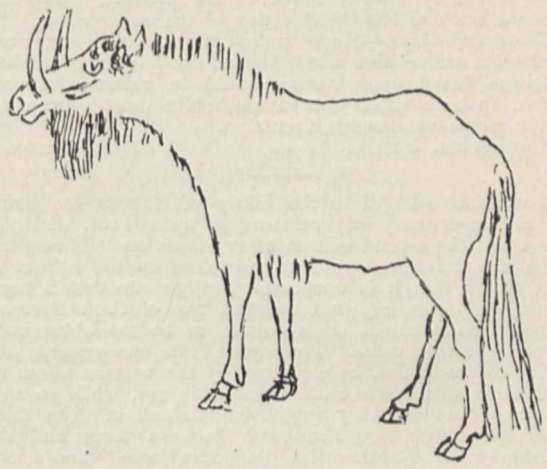


FIG. 1.

were the tips of his ears or bases of horns, or both—and that he was led to modify his picture, as in Fig. 2.

His British Museum friend also might say, "That's very interesting, for it is not unlike an African beast known as the gnu, from its native name nju."

Talking the matter over afterwards with a third friend, who was learned in folk-lore, he was told that it was

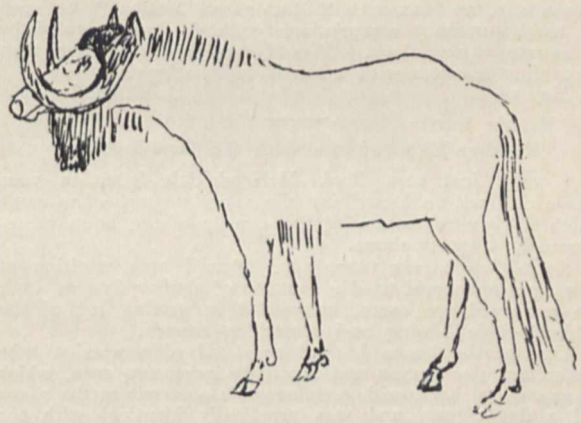


FIG. 2.

very interesting as an example of how heralds and artists had modified in time the strange form of the gnu into accord with the characters of the only animal of the kind which they did know, namely, the antelope.

T. MCKENNY HUGHES.

Dynamical Enunciations.

UPON Newton's classic definitions and laws of motion various criticisms have been passed by A. E. H. Love, E. Mach, K. Pearson, H. Poincaré, and others.

Some writers emphasise one aspect of the subject, some another, and most are destructive rather than constructive. But, if the full value of this critical work is to reach the ordinary student, it seems desirable that teachers should have at hand some brief statements embodying those central positions on which there is fair agreement in modern thought.

As an attempt in this direction, the following enunciations are, with great diffidence, submitted:—

Law of Motion.—Accelerations occur only in opposite pairs, the ratios of which are constant for given particles.

Definition of Mass.—The masses of particles are positive constants, inversely as their mutual accelerations.

Definition of Force.—Force is the product, mass into acceleration, and has the direction of the acceleration.

Choice of Axes.—Since motion is relative, force and mechanics are relative also. Hence, the foregoing and any problems based upon them should be referred to axes which, in each case, yield a mechanics most appropriate to the phenomena under discussion.

Nottingham, May 12. E. H. BARTON.

I AM much obliged to the Editor of NATURE for giving me an opportunity of commenting upon Prof. Barton's letter. In the second edition of my book on "Theoretical Mechanics" I have expressed my ideas on the subject at such length that it is unnecessary to go into details here. It may suffice to say that the first two of Prof. Barton's proposed enunciations seem to me to be too abbreviated to be of much value. To anyone who understands the theory of mechanics, as explained by the writers whom he cites, such statements could be of little use, while to anyone who does not they might be misleading. The third enunciation does not distinguish between force and the quantity which Routh called "effective force" and I call "kinetic reaction." The distinction appears to me to be important. The fourth enunciation would seem to permit an undesirable degree of freedom in respect to the choice of a reference system. I do not wish to suggest that Prof. Barton means by his brief enunciations something different from what I mean in my book, but rather to point out that such brevity as he aims at may be inconsistent with clearness in the statement of principles. One way of bringing the results of modern critical discussions concerning the laws of motion within the reach of the "ordinary student" would be to publish a short tract, on the same scale, say, as Maxwell's "Matter and Motion." In such a tract summary enunciations could be accompanied by adequate explanations. Would not this be better than providing teachers with a set of enunciations?

May 18. A. E. H. LOVE.

Further Experiments with the Gramophone.

I HAVE just seen Prof. McKendrick's letter in your issue of April 20, describing the experiments he has made with a view to improving the quality of the notes reproduced by a gramophone.

Some five or six years ago, when I was working at the auxetophone, I tried a number of similar devices, and, to a very large extent, succeeded in getting rid of the objectionable hissing and scratching sounds.

One of the horns I tried consisted of a wooden tube of rectangular section and gradually increasing area, which was doubled backwards and forwards on itself in the shape of a flat zigzag, and was practically identical with the metal horn illustrated in your paper.

In the end I found it was best to use a coiled metal trumpet of large size and gradually increasing area and about 48 feet long, in which I introduced several right-angled and "U" shaped bends; further, I fitted a "T" shaped tube close to the reproducer, which made a considerable improvement in the quality of the tone. The longer sound waves passed through this "T" shaped bend with little loss, but the very short waves, which caused most of the scratching, were absorbed at the bend, especially if the blank end of the "T" was filled with cotton wool or some other similar substance, or if an inner sliding tube, with the end closed, was introduced into the blank end of the "T," and pushed in, so as to throttle the sounds at the bend.

I also fitted a flexible joint between the needle and the actual reproducer, which further eliminated these high-period vibrations. This flexibility was obtained by giving the joint very large clearance, and filling the space in between with a highly viscous substance.

I found considerable improvement, as well, in the tone when a paper diaphragm, or when moderate quantities of paper, linen, &c., were put in the trumpet.

In conclusion, I might say that my own experiments quite bear our Prof. McKendrick's opinion on the importance of using suitably shaped trumpets in order to obtain pleasant natural reproductions of musical tones and of the human voice. CHARLES A. PARSONS.

Heaton Works, Newcastle-on-Tyne, May 17.

German East African Dinosaurs.

WITH reference to your note on the German East African Dinosaurs (NATURE, May 18, p. 390), *Die Woche* of May 6 reproduces an interesting series of photographs of the remains, taken on the site of the excavations.

Matlock, May 20. F. GILLMAN.

BREATH FIGURES.

THE manner in which aqueous vapour condenses upon ordinarily clean surfaces of glass or metal is familiar to all. Examination with a magnifier shows that the condensed water is in the form of small lenses, often in pretty close juxtaposition. The number and thickness of these lenses depends upon the cleanness of the glass and the amount of water deposited. In the days of wet collodion every photographer judged of the success of the cleaning process by the uniformity of the dew deposited from the breath.

Information as to the character of the deposit is obtained by looking through it at a candle or small gas flame. The diameter of the halo measures the angle at which the drops meet the glass, an angle which diminishes as the dew evaporates. That the flame is seen at all in good definition is a proof that some of the glass is uncovered. Even when both sides of a plate are dewed the flame is still seen distinctly though with much diminished intensity.

The process of formation may be followed to some extent under the microscope, the breath being led through a tube. The first deposit occurs very suddenly. As the condensation progresses, the drops grow, and many of the smaller ones coalesce. During evaporation there are two sorts of behaviour. Sometimes the boundaries of the drops contract, leaving the glass bare. In other cases the boundary of a drop remains fixed, while the thickness of the lens diminishes until all that remains is a thin lamina. Several successive formations of dew will often take place in what seems to be precisely the same pattern, showing that the local conditions which determine the situation of the drops have a certain degree of permanence.

An interesting and easy experiment has been described by Aitken (Proc. Ed. Soc., p. 94, 1893). Clean a glass plate in the usual way until the breath deposits equally.

"If we now pass over this clean surface the point of a blow-pipe flame, using a very small jet, and passing it over the glass with sufficient quickness to prevent the sudden heating breaking it; and if we now breathe on the glass after it is cold, we shall find the track of the flame clearly marked. While most of the surface looks white by the light reflected from the deposited moisture, the track of the flame is quite black; not a ray of light is scattered by it. It looks as if there were no moisture condensed on that part of the plate, as it seems unchanged; but if it be closely examined by a lens, it will be seen to be quite wet. But the water is so evenly distributed, that it forms a thin film, in which, with proper lighting and the aid of a lens, a display of interference colours may be seen as the film dries and thins away."

"Another way of studying the change produced on the surface of the glass by the action of the flame is to take the [plate], as above described, after a line has been drawn over it with the blow-pipe jet, and when cold let a drop

of water fall on any part of it where it showed white when breathed on. Now tilt the plate to make the drop flow, and note the resistance to its flow, and how it draws itself up in the rear, leaving the plate dry. When, however, the moving drop comes to the part acted on by the flame, all resistance to flow ceases, and the drop rapidly spreads itself over the whole track, and shows a decided disinclination to leave it."

The impression thus produced lasts for some days or weeks, with diminishing distinctness. A permanent record may be obtained by the deposit of a very thin coat of silver by the usual chemical method. The silver attaches itself by preference to the track of the flame, and especially to the *edges* of the track, where presumably the combustion is most intense. It may be protected with celluloid, or other, varnish.

The view, expressed by Mr. Aitken, which would attribute the effect to very fine dust deposited on the glass from the flame, does not commend itself to me. And yet mere heat is not very effective. I was unable to obtain a good result by strongly heating the *back* of a thin glass in a Bunsen flame. For this purpose a long flame on Ramsay's plan is suitable, especially if it be long enough to include the entire width of the plate.

It seems to me that we must appeal to varying degrees of cleanliness for the explanation, cleanliness meaning mainly freedom from grease. And one of the first things is to disabuse our minds of the idea that anything wiped with an ordinary cloth can possibly be clean. This subject was ably treated many years ago by Quincke (Wied. Ann. II., p. 145, 1877), who, however, seems to have remained in doubt whether a film of air might not give rise to the same effects as a film of grease. Quincke investigated the maximum edge-angle possible when a drop of liquid stands upon the surface of a solid. In general, the cleaner the surface, the smaller the maximum edge-angle. With alcohol and petroleum there was no difficulty in reducing the maximum angle to zero. With water on glass the angle could be made small, but increased as time elapsed after cleaning.

As a detergent Quincke employed hot sulphuric acid. A few drops may be poured upon a thin glass plate, which is then strongly heated over a Bunsen burner. When somewhat cooled, the plate may be washed under the tap, rinsed with distilled water, and dried over the Bunsen without any kind of wiping. The parts wetted by the acid then behave much as the track of the blow-pipe flame in Aitken's experiment.

An even better treatment is with hydrofluoric acid, which actually renews the surface of the glass. A few drops of the commercial acid, diluted, say, ten times, may be employed, much as the sulphuric acid, only without heat. The parts so treated condense the breath in large laminæ, contrasting strongly with the ordinary deposit.

It must be admitted that some difficulties remain in attributing the behaviour of an ordinary plate to a superficial film of grease. One of these is the comparative permanence of breath figures, which often survive wiping with a cloth. The thought has sometimes occurred to me that the film of grease is not entirely superficial, but penetrates in some degree into the substance of the glass. In that case its removal and renewal would not be so easy. We know but little of the properties of matter in thin films, which may differ entirely from those of the same substance in mass. It may be recalled that a film of oil, one or two millionths of a millimetre thick, suffices to stop the movements of camphor on the surface of water, and that much smaller quantities may be rendered evident by optical and other methods. RAYLEIGH.

NORTH SEA FISHERY INVESTIGATIONS.[1]

THE third Report on the Fishery and Hydrographic Investigations conducted by the Marine Biological Association under the international organisation is the most interesting yet published. It contains statistical papers dealing with the abundance and migrations of edible fishes in the North Sea; the age and growth-rate of plaice from the same region; and the fishing action of trawl nets with respect to the size of mesh. There are also accounts of the distribution of fish-eggs in the North Sea during the summer, and of the physical conditions of the water of the English Channel, and its contained plankton throughout the year 1906.

The first, and most lengthy, paper in the Report is one of unusual interest and value. In it Miss R. M. Lee has summarised and discussed a series of records kept by the masters of nine Grimsby steam trawling vessels, which fish over the whole of the central part of the North Sea. These records cover the period 1904–8, and represent the results of 14,543 hauls of the otter trawl net, which means about 53,995 hours' fishing. The statistics have been treated most clearly and concisely, and show for each of twenty-three areas into which the whole North Sea has been divided, the monthly average quantities of each of the more important species of marketable fishes caught by the vessels per ten hours' trawling. In order to render these results comparable with those obtained by other statistical workers (Fulton, D'Arcy Thompson, Redeke), the author has calculated factors which enable one fishing unit to be converted into any of the others used.

From these data (which are based on the practical knowledge acquired by a number of very experienced fishermen) Miss Lee has deduced the general distribution of each of the species of fish considered over the whole area of North Sea represented, the migrations from one subarea to others, the spawning movements of the fishes, the variations in density from month to month, and the general change in the productivity of the fishing grounds from year to year. Her paper, and a former one which dealt in a similar way with records kept by a number of Lowestoft sailing-trawler skippers, form a picture of the present condition of the North Sea fishing area which must prove to be of inestimable value for the fishery administrators of the future. If, in the early 'seventies, before steam trawling had become the predominant method of fishing, such a summary by a trained statistician had been made, how much controversy and trouble might have been avoided! Even as it is, a comparison of Miss Lee's results with those imperfect records which we possess of fishery operations in the North Sea in the 'seventies and 'eighties shows most strikingly the change which has taken place, and enables us to realise, to a degree hitherto unattainable, how very great must have been the diminution of the stock of fish inhabiting the North Sea. It is not a question of the decadence of a fishing ground, but rather the fishing-out of an accumulated stock, and the establishment of a new equilibrium, on a lower level, between the natural powers of recuperation of a fish population and the catching power of the British and Continental fishing fleets. And there can be little doubt that, in the absence of concerted measures for cultivation, this equilibrium must settle down to still lower levels. It is sincerely to be hoped that this work may be continued by Miss Lee.

Dr. Wallace has continued his former work on the natural history of the plaice and subjects to detailed analysis, a mass of data representing individual deter-

[1] Third Report (Southern Area) on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters, 1906–8. [Cd. 5546]. 1911.

minations of length, sex, age, and weight of over 20,000 plaice from various North Sea fishing grounds. The results show clearly that the conditions with regard to nutrition vary from ground to ground, and they suggest that a knowledge of these conditions may, in time, enable fishery authorities to increase the productivity of the North Sea by the "transplantation" of fish from grounds on which the growth is slow to other grounds on which the conditions of life are more favourable. Dr. Wallace's paper supplements that of Miss Lee in that it gives us data which cannot be obtained by ordinary methods of commercial statistics, and which are quite essential for the proper understanding of the latter.

Mr. Todd's experiments on "covered nets" are designed to elucidate the fishing action of the trawl net in respect of the numbers and sizes of fish which escape capture by the mesh employed. The outside parts of the trawl nets used have been covered by other loose nets of narrower mesh, and the fish which have escaped capture by the inner wide-meshed net are intercepted by the outer narrow-meshed net. Mr. Todd tabulates and discusses the results of a number of such experiments.

Mr. Wollaston gives an account of the first cruise made by an English vessel expressly for the purpose of determining, by means of specially constructed nets, the distribution of fish-eggs in the open sea. The cruise was made in June, 1909, in the North Sea, by the vessel *Huxley*, and tables are given which show in detail the results of the experiments made at each observation station, while synoptic charts represent the numbers and distribution of the eggs of certain species of summer-spawning fish present per square metre of sea surface in the neighbourhood of the stations. By far the most interesting part of Mr. Wollaston's paper is that devoted to a description of the methods employed. The net was specially constructed, and its "constants" were calculated so that it was possible to estimate approximately the average volume of water which was filtered through its meshes. Welcome improvements in the methods of preservation of the fish-eggs caught, so as to avoid distortion, and obscuration of finer details of structure have been developed. The author then proceeds to apply the methods of modern biometricians to the analysis of his data. It has hitherto been impossible, in work of this kind, to avoid the confusion of eggs belonging to closely allied species, since in some cases a fish-egg can only be identified by measuring its diameter, and that of the contained oil globule. In some pairs of species these pairs of characters overlap, and it was an error of this nature that vitiated (to some degree) the results of Hensen's famous North Sea cruise of 1895. Mr. Wollaston, however, elaborates a mathematical method whereby the eggs belonging to two such overlapping species can be separated. If in a number of examples of the eggs of one species two measurable variable characters, such as the diameters of the egg and oil globule, be determined, then the frequencies of these two variables can be represented by an equation, which is that of an elliptic "correlation surface." But a group of eggs may include two species allied together in that the diameters of the eggs and those of the oil globules do not differ greatly; nevertheless it is only by these characters that the eggs may be recognised. In such a case the correlation surfaces overlap. Mr. Wollaston then shows that it is always possible, by means of relatively simple mathematical methods, to decompose the compound correlation surface so obtained; and to estimate with a very fair degree of probability the actual numbers of each species of egg in the group. We believe that this method is quite a novel one.

The plankton and hydrographic investigations relate to the year 1906. Mr. Bygrave has given the usual tables recording the distribution and relative density of the planktonic organisms present in the Channel in that year. He shows that the density of oceanic plankton may be correlated with the salinity of the water. The seasonal changes taking place in the abundance of the plankton are also discussed, and the author adopts Brandt's hypothesis, according to which the spring maximum of density of Diatom and Peridinian plankton is the result of the accumulation of food-stuffs in the water during the preceding winter months, while the summer minimum is due to the activity of denitrifying bacteria, which decompose nitrogen compounds, so that the latter cannot be used up by the diatoms.

The hydrography of the English Channel is discussed by Mr. Matthews in a short paper of great general interest. An account, illustrated by charts, of the salinity and temperature variations during the year 1906 is given, and the author then discusses the results of calculations of the mean salinities during the years 1903–9. He shows that in addition to the annual salinity variation, there is a two-yearly periodic change, of such nature that the "even" years are characterised by a high range of salinity variation, while in the "odd" years the range of variation is low. The annual and biennial periods are superposed on a longer one, probably twelve-yearly. These discussions anticipate a further paper, which promises to be one of very great interest. J. JOHNSTONE.

A ONE-VOLUME NATURAL HISTORY.[1]

TO compress even a sketchy account of the leading types of existing animals into a small octavo volume of just over 560 pages, and that illustrated by a number of relatively large figures, is a task of stupendous difficulty. In the present instance the author has increased the difficulty by introducing—

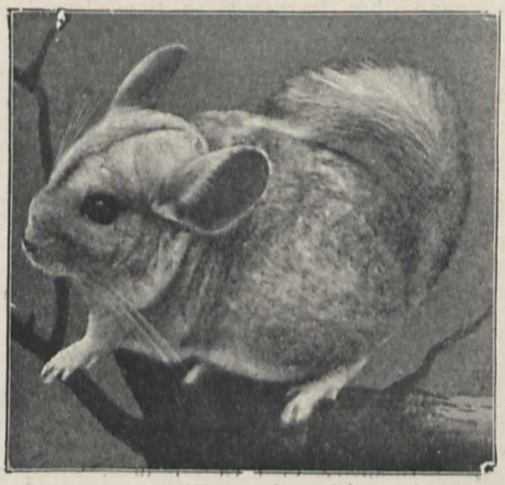


FIG. 1.—A Chinchilla. From the "New Illustrated Natural History."

probably in accordance with what I believe to be a mistaken notion on the part of publishers—a number of anecdotes, which merely waste space. This may perhaps account for the very imperfect diagnoses of most of the groups and species, which appear in many cases insufficient for their identification by those who

[1] "New Illustrated Natural History of the World." By E. Protheroe. Pp. xx+564. (London: G. Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., n.d.) Price 7*s.* 6*d.* net.

are not naturalists, and for whom alone the volume is intended. As is usual in works of this nature, vertebrates claim the lion's share of the volume, the lower groups being accorded only sixty-eight pages, which is, of course, an altogether inadequate proportion of space.

Nevertheless, Mr. Protheroe has succeeded in producing a readable, and certainly a remarkably well illustrated volume, which is calculated to attract a large circle of readers. With the exception of the twenty-four coloured plates, the illustrations are from photographs, some of which are naturally better than others. In some instances the photographs, like the one of a tur (p. 169), are taken from immature specimens, which convey no idea of the adult animal. In other cases, as in the so-called Canadian skunk

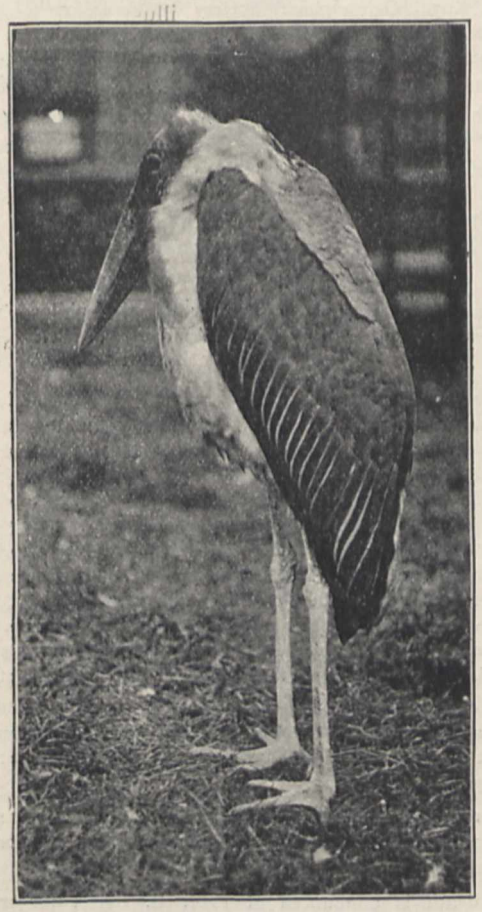


FIG. 2.—A Marabou Stork. From the "New Illustrated Natural History."

(p. 95) and dwarf buffalo (p. 162), animals are wrongly identified; while in the figure of a wild ass (p. 155) the reader is left to discover for himself whether it is intended for an Asiatic or an African species, and there is no reference in the text to the figure of an "Australian Rail" on p. 366. As regards the coloured plates, it will perhaps suffice to say that while some are excellent, the others are probably the best that could be produced for the money; but in the figure supposed to represent the black rhinoceros it seems as if the artist had made a "composite" portrait of the African and the great Indian species. Two photographs are reproduced as samples.

As regards the text, this, in addition to much more or less irrelevant matter, is marred by a large number of omissions and errors, of which only a few, and these in the sections on mammals and reptiles, can be mentioned here. In the Insectivora, for instance, no mention is made of Chrysochloridæ, Gymnurinæ, Solenodontidæ, or Potamogalidæ, while the Centetidæ are intercalated between Tupaiidæ and Macroscelididæ, and the reader is left to find out for himself the genus name of the typical representatives of the latter. Space for these omissions might have been found by cutting down the account of monkeys. Among the rodents, Pedetes is still classed with the jerboas (p. 126), and is said to be "a very similar species," while American porcupines are not separated as a family from their Old-World relatives.

Passing to ungulates, it may be noted that Grévy's zebra (p. 156) is stated to range "the Victoria Nyanza regions," whereas its habitat is east and north of that lake; and that not a word is said with regard to the range of the white rhinoceros (p. 152). On p. 169 we are informed that the Alpine ibex is "the most probable forbear of the common goat," and on p. 171 that the takin "is a native of the highest and least-known regions of Tibet." Perhaps, however, the worst misstatement in the book occurs on p. 241, where it is asserted that the opossum family is "remarkable among the marsupiated animals, because it is the only one that is not Australian." Has the author never heard of Cænolestes?

Among the reptiles it must suffice to state that there is no mention of Schlegel's gharial, that the reader is left to find out for himself what part of the globe is the home of the Chelydridæ (p. 404), and that it is scarcely true to say that the tuatera has teeth on the palate (p. 428).

Although the book has merits, I am driven to conclude from the foregoing and other instances either that the author is terribly careless, or that he is not up to his work. R. L.

PROF. JOHANNES BOSSCHA.

THE career of this eminent physicist has not only been of importance for the advancement of physics, but also of the greatest benefit to the development of exact science in Holland. Born on November 18, 1831, at Breda, Bosscha was initiated in physics by van der Willigen, and entered the University of Leiden in 1850. His eminence as a student in different respects foreshadowed the leading position he occupied in later life. In Bosscha's later observational work the influence of the great astronomer Kaiser is evident. In March, 1852, he took his degree with a dissertation on the differential galvanometer, worked out in the Physical Laboratory at Leiden, then under the direction of Rijke. After a short stay at Berlin, he returned to this laboratory as assistant. Attention was soon directed to him by the vigorous part he took in the great scientific movement in connection with the law of conservation of energy. The most important problem dealt with in his well-known papers on the mechanical theory of electrolysis is the test of Kelvin's calculation of the electromotive force of a galvanic cell from the heat developed by the chemical processes which accompany the current. By determining in absolute measure the electromotive force of the Daniell cell, he contributed to the work which ultimately led to the adoption of the C.G.S. system of electrical units. He gave a solution of multiplex telegraphy, and several rules

and methods introduced by him have passed through the text-books into the electrotechnic practice.

In the time that separates this period of experimental activity from its resumption in 1873 fall ten years devoted to the organisation of secondary education and the reorganisation of the higher technical instruction in Holland, which have proved a great boon to the country. The secondary schools have spread enlightenment everywhere, and, providing everywhere the preparatory instruction necessary for attending the polytechnicum, they laid the foundation for the development which technics have taken in Holland. Equipped as they were by Bosscha's influence with physical and chemical laboratories, they have since attracted to science the greater number of the men of the present generation that have devoted their life to it. Though absorbed in this very successful organising work, Bosscha found time for his discussion of Regnault's measurements, which added much to the value of these classical researches.

Professor since 1873, and director of the Polytechnicum at Delft since 1878, Bosscha found the opportunity to continue his efforts for the reorganisation and development of this institution. He was foremost among those who raised its status to that of a technical university, what it afterwards became officially. Bosscha's clear and fascinating lectures live in the grateful memory of broad circles of his pupils. He was the acknowledged master in criticism of experimental methods. To have felt the influence of his insight, inspiration, and high aims was to be full of admiration and gratitude for one's life. The main scientific work undertaken by Bosscha in this period was in relation with the new Dutch standard metres; an investigation of Fizeau's focussing method was the starting point for a study which led him to the development of a complete theory of centred optical systems. The series of Bosscha's metrological researches will always be regarded as a masterpiece of scientific work of precision.

To uphold Holland's honour in the domain of science was Bosscha's constant aim all his life. Having accepted in 1885 the secretaryship of the Dutch Society of Sciences at Haarlem, he became the soul of this institution. His manifold occupations—it will suffice to mention the reorganisation of the Dutch Meteorological Service—were all directed to the promotion of science, the extension of its influence, and the increase of sympathy for Dutch science abroad. Working to the end of his life with unimpaired power of thought, vivacity of appreciation, and glowing love for what was right, serving science with his enthusiasm and eloquence, he was always honoured by the Dutch physicists as their leader. The last years of his life were devoted to the edition of Huygens's correspondence and works. To his literary talents and his passionate love for historical justice we owe many vivid pictures of past scientific life. As to Huygens, it may be said that he was resuscitated by Bosscha, and no less talents than his were needed to get all from Huygens's hand presented to the scientific world in a form corresponding to Huygens's greatness.

Bosscha's increasing veneration for Huygens was well in harmony with his own searching love for truth, his aristocratic turn of mind, and his profound sense of beauty. He combined great courage and force of mind with an almost childlike simplicity and trustfulness and an infectious optimism. We lose in him a noble, frank character, and a friend to whom one never went without being warmed by his kind affection and stimulated by his faith that the future belongs to the great ideas.

H. KAMERLINGH ONNES.

NOTES.

DR. FREDERIC A. LUCAS has been appointed to succeed Dr. H. C. Bumpus as director of the American Museum of Natural History, New York, and will take office on June 15. The new director, who is now in his sixtieth year, has been chief curator of the Brooklyn Institute of Arts and Sciences since 1904. He had previously served for twenty-two years in various posts in the U.S. National Museum at Washington. As an author he is best known for his books and papers on palæontology and comparative anatomy, as well as on museum methods.

PROF. UGO MONDELLO, director of the geophysical observatory at Leghorn, has accepted the post of director of the Observatorio Regional do Rio Grande do Sul, Brazil.

LORD CURZON OF KEDLESTON has been elected president of the Royal Geographical Society in succession to Major Leonard Darwin. Captain H. G. Lyons, F.R.S., has been appointed one of the honorary secretaries, and Sir G. D. Taubman Goldie, F.R.S., the foreign secretary, of the society.

THE Hanbury medal of the Pharmaceutical Society for 1911 has been awarded to M. Jean Eugène Léger, of Paris. The new medallist is chief pharmacist to the Hôpital St. Louis at Paris, and a member of the committee of revision of the French pharmacopœia.

DR. J. G. FRAZER (author of "The Golden Bough," &c.) has been elected a member of the philosophical-historical section of the Royal Academy of Sciences of Berlin.

WE regret to have to record that at the Paris-Madrid aëroplane race at Issy-les-Moulineaux on Sunday last a deplorable accident occurred, causing the death of M. Berteaux, the French Minister of War, and severe injuries to M. Monis, the French Prime Minister. It appears that one of the competitors in the race, M. Train, finding that neither the engine nor rudder of his machine was working satisfactorily, decided to descend, and in endeavouring to avoid coming into contact with a detachment of cuirassiers and the spectators, dashed into the group of Ministers and their party, who only came into the aviator's view as the cuirassiers rode clear of the group, with the lamentable result given above.

WE announce with deep regret the death, on Saturday last, at the age of eighty-seven years, of Dr. N. Story-Maskelyne, F.R.S.

WE regret to notice the death, which took place on Monday last, of Mrs. W. P. Fleming, the curator of astronomical photographs at Harvard.

THE death is announced of Prof. B. Peter, for many years the first assistant at the Leipzig Observatory. Prof. Peter was born at Weida, in Saxe Weimar, in 1853, and studied medicine at the University of Jena, but his liking for mathematics and natural science led him to accept a position, under Prof. Karl Bruns, at the Leipzig Observatory in 1876. Six years later he was advanced to the position of first observer, and in 1899 was named professor of practical astronomy, holding both posts until his death.

MR. ROBERT SERVICE, who has just died at Dumfries, was one of the best naturalists in Scotland. His profession of nurseryman and seedsman prevented his attending a university, and also involved close attention to business for every working day. Nevertheless, he knew intimately the haunts of every bird in the south of Scotland. Not only so, but he thoroughly understood

mammals, fishes, Amphibia, and reptiles. He was an excellent entomologist, and took an especial interest in bees and the larger Diptera. Most unfortunately, his published papers represent but a very small part of this wide acquaintance with birds and beasts of all kinds. He was never able to afford the heavy cost of publication which must, for some inscrutable reason, always be incurred in Great Britain if a book is of a scientific nature. Much of his work is included in the recent "Birds of Dumfriesshire," by Mr. H. S. Gladstone, but by far the greater part of it is lost. It is by no means unusual for working men to be real naturalists, at least in Scotland; but Robert Service was far more scientific, and had a far wider knowledge than even Edwards and Dick, whose names are known to the general public. He managed somehow to keep abreast of modern authorities, in spite of the difficulties involved by residence in a small country town. His death is a serious loss to the natural sciences in the south of Scotland, and under present conditions it is a loss that cannot possibly be repaired.

The Times announces that enough money having been raised by subscription for the erection of a statue to Captain Cook, permission has been given for the statue to be placed on the Mall side of the Admiralty arch, at the end of the Processional road, on the right hand going towards Charing Cross, and the execution of the statue has been entrusted to Sir Thomas Brock, K.C.B., R.A.

ACCORDING to *The Pharmaceutical Journal*, a statue to the memory of Priestley is to be erected in the market-place of Birstall, the town of his birth.

THE committee of the Robert Koch memorial endowment for the encouragement of research in the subject of tuberculosis has decided to give grants to Prof. Schieck and Dr. Krusius for investigations on tuberculosis of the eyes, to Dr. Weinberg for statistical inquiries relative to tuberculosis, and to Prof. Gaffky for the continuation of his researches. Since the year 1908 the sum of 3600*l.* has been expended by the committee in scientific work.

THE new Research Institute of the Cancer Hospital was opened on Tuesday by the Duke of Connaught, who said he hoped that the institute might be the forerunner of wonderful discoveries in combating the disease of cancer, and that success would be the result of the labours of those who should engage in research.

THE conversazione of the Royal Society of Arts will be held on Tuesday next—May 30—in the galleries of the British Museum (Natural History), from 9 p.m. to 12.

ON Tuesday next Prof. W. W. Watts will deliver the first of two lectures at the Royal Institution on "Charnwood Forest: its Ancient Volcano and its Fossil Landscape"; on Thursday, June 1, Mr. T. Thorne Baker begins a course of two lectures on (1) "Changes Effected by Light," (2) "Practical Progress in Wireless Telegraphy"; and on Saturday, June 3, Dr. W. L. Courtney begins a course of two lectures on "Types of Greek Women." The Friday evening discourse on June 2 will be delivered by Commendatore G. Marconi on "Radio-telegraphy," and that on June 9 by Prof. Svante Arrhenius on "Applications of Physical Chemistry to the Doctrine of Immunity."

THE fifty-fourth general meeting of the Institution of Mining Engineers will take place on Thursday, June 1, in the rooms of the Geological Society. The following papers are announced for delivery:—A flame test for the estimation of oxygen and black-damp in naked-light mines, by Dr. J. S. Haldane, F.R.S.; An experiment on the effect of reversing the main air-current, by Mr. J. Bain and Dr. J. S. Haldane, F.R.S.; Notes on contrivances designed to prevent over-winding, with some instances of their failure, by Messrs. W. H. Pickering and G. Poole; The Otto-Hilgenstock direct-recovery process and its application, by Mr. E. Bury. The following papers, which have already appeared in the Transactions, will be open for discussion:—The mining school at Bochum, Westphalia, by Prof. H. Louis; Progress in the use of exhaust steam-power, by Mr. J. Burns; The Elliott-Jones vertical coke-oven, by Mr. T. C. Futers.

AN International Rubber and Allied Trades Exhibition will be held in the Royal Agricultural Hall from June 24 to July 14, and on July 3 there will be a rubber conference at which the many problems in connection with the industry will be discussed.

THE eighth International Congress of Applied Chemistry is announced to be opened, at Washington, by the President of the United States on September 4, 1912; the further meetings of the congress will be held in New York from September 6 to 13. The congress will be divided into twenty-three sections and subsections, and papers intended for presentation or publication should reach the American committee not later than July 1, 1912.

THE preparations of the German Antarctic Expedition were completed at the beginning of May, and on May 7 the *Deutschland* sailed from Bremen. Lieut. Filchner will join the ship in Buenos Ayres in four months' time, whither additional stores and equipment are also being sent. The general plan is to enter the Weddell Sea to the south of South America, and endeavour to establish the relation of the masses of land lying east and west of the South Pole. Great importance is attached to the installation of a land station and its maintenance for so long a period as possible. From this point geographical, geological, astronomical, magnetic, meteorological, and biological work will be carried on by the staff of eleven members of the expedition, who will be here quartered. Four of them will make a dash for the South Pole with Nansen sledges. The ship, the *Deutschland*, is a converted whaler with auxiliary steam of about 300 horse-power, and has been especially fitted with a view to the comfort of the explorers. She is equipped with a wireless telegraph installation, and is taking out three motor vehicles and one motor boat, since motor transport is to be largely employed, though both dogs and Manchurian ponies are also to be utilised.

SPEAKING in the House of Commons on Wednesday of last week on the Budget proposals, Mr. Balfour asked the Chancellor of the Exchequer to exercise caution in carrying out his scheme for the expenditure of large sums of money on building consumption sanatoria. In the public mind, he said, there had perhaps been an exaggerated enthusiasm for this method of dealing with tuberculosis. There was an idea that this open-air treatment had produced such marvellous results that through it alone tuberculosis could be, if not exterminated, at all events diminished to such an extent that it might be reduced to one of the rare zymotic diseases. He was not sure that the most recent investigations bore out that view. There were very able investigators who took the view, after examining the actual results in this country and in Germany, that so many complete cures must not be expected as was at one time hoped for. He took a sanguine view as to the treatment of tuberculosis, for he believed that science had made great strides and was still destined to make great strides, but

when they came to such large sums as those mentioned by the Chancellor of the Exchequer, it was possible to waste money on permanent buildings which might be better devoted to scientific investigation into the cause of the disease. They must not assume that all that they had to do was to spend money on these sanatoria in order to effect a cure. What was important was that medical science had made great progress, and we required further investigation and perpetual study as to how these people were to be treated when in the sanatoria. One of the greatest benefits, perhaps, of establishing these sanatoria would be in giving expert medical authorities the opportunity of carrying on investigations which would enable them in the future to deal with this disease in a way they were not able to do at present. In reply, Mr. Lloyd George said he agreed that the important thing was to encourage scientific investigation, so as to arrive at the best methods of cure. That was provided for in his Bill. There would be set aside a special fund for the purposes of scientific research. The Government would make use of and assist existing sanatoria, those which had been maintained by voluntary contributions, and even those which were built by private enterprise.

AT a meeting of pathologists interested in medical museum work, recently held at the Royal College of Surgeons of England, for the purpose of receiving information upon the International Association of Medical Museums, and with a view to extend the membership and general usefulness of that body in Great Britain, the following resolutions were passed:—(1) That after the arrangements for the meeting of the International Congress of Medicine at London in 1913 are completed, steps shall be taken to arrange for a meeting of the International Association of Medical Museums in conjunction with this congress. (2) That the three great English medical societies, namely, the Pathological Society of Great Britain and Ireland, the Anatomical Society, and the Royal Society of Medicine, be made cognisant of the action of the International Association of Medical Museums, and that co-operation with these societies be attempted with special reference to the publication in their journals of the Department of Exchanges, as well as announcements and short reports of meetings. (3) That one or more correspondents in London be appointed to act as local secretaries.

THE Entomological Society of London held a Conversazione on Wednesday, May 17, in the rooms of the Linnean Society, which had been kindly lent for the purpose. The exhibits were very varied, and there was much to interest the non-entomological as well as the scientific portion of the assembly. The "livestock," including Observation Nests of ants with various myrmecophilous insects, shown by Messrs. Donisthorpe and Crawley, larvæ and pupæ of British Lepidoptera by Mr. Newman, fleas with ova, larvæ, and cocoons by Mr. Bacot, and "stick insects" in every stage of development by Mr. Baldock, were a constant source of attraction. Many fellows exhibited interesting and attractive insects of various orders, including eight drawers of mimetic Lepidoptera brought by Prof. Poulton, the three newest European butterflies (*Callophrys avis*, *Pieris manni*, and *Erebia palarica*) by Dr. Chapman, the pick of the results of thirteen years' breeding of *Angerona prunaria* by Mr. Pickett, and a wonderful drawer of gynandromorphs from the Tring Museum. There were several microscopic and photographic exhibits, Mr. Main's stereoscopic photos and Mr. Enock's Mymaridæ deserving special mention, while further variety was secured by Mr. Eltringham's and Mr. Wheeler's water-colour drawings of butterflies, Mr. Prideaux's method of scale-transference, Prof. Image's interesting books, including Stainton's annotated copy of Wood's "Index Entomologicus," the Obligation Book of the Society with its many interesting autographs, and the various relics of Linnæus exhibited by the Linnean Society. During the evening lectures were given, with lantern illustrations, by Prof. Poulton on "Recent Discoveries in Insect Mimicry," and by Mr. Enock on the Tiger Beetle (*Cicindela campestris*).

A COMMUNICATION has been received from the Decimal Association directing attention to a recent report of the council of the British Medical Association with reference to the adoption of the metric system of weights and measures by medical practitioners. This report recommends that both the theoretical and the practical instruction of medical students in pharmacology and materia medica should henceforth be according to the metric system. As regards practitioners who have been trained in the imperial system of weights and measures, the suggestion is put forward that a transitional procedure should be adopted which, while immediately introducing some of the advantages of the metric system, would also facilitate the change from the old system to the new at a later date. Cooperation with pharmacists will be necessary in order to deal with cases where prescriptions are given to be made up by any chemist the patient may choose. It is recommended that the local divisional bodies should, after ascertaining that medical opinion in their district is ripe for the step, arrange a conference with the local pharmaceutical association in order to arrive at a mutual understanding in the matter.

MR. P. W. STUART MENTEATH continues in *Biarritz-Association* his somewhat controversial papers on "Les Gisements metallifères des Pyrénées Occidentales." Despite the title adopted, the work is mainly directed against the too hasty adoption of the theory of recumbent overfolds as an explanation of the facts of mountain-structure. Numerous sections illustrating the author's observations are given in the third part (March, 1910). The fifth part (March, 1911) criticises the views of Pyrenean structure held by M. Dalloni; but the arguments are marred by a certain obsession in regard to "Darwinisme," the evolutionary theory being held responsible for most of the errors of geologists. Perhaps the same obsession explains a mysterious allusion, at the conclusion of part iv., to the reduction of our "facultés légitimes à celles des singes et des perroquets." Where the author emphasises the effects of ramifying igneous injections, associated with mineral veins, in inducing metamorphism, he seems to be on more serious and surer ground.

THE *Geologische Rundschau* continues to provide admirable essays on current work and problems in geology, in addition to original papers. The "Besprechungen" themselves are original, in that they consist of critical reviews by specialists. H. Potonié brings together his own results under the head of "Kaustobiolithe" in part vi. of the first volume, p. 327 (December, 1910). In the following part (March, 1911), R. Lepsius urges that the high watershed in Scandinavia lay to the east of the present one in glacial times, and thus allowed of the recognised movements of the ice. He does not approve of the theory of the ice-dome, and prefers to rely on considerable warping and faulting of the country to account for its present general contour and the basins of many of its lakes. Critics may point out the evidence that exists in Jämtland and

elsewhere of the movement of ice over obstacles rising 1000 metres or more above the glaciated valley-floors. W. von Seidlitz describes in the same number the adventurous excursion organised by Axel Hamberg for five members of the International Geological Congress of 1910. The six geologists, in visiting the Sarek Mountains in Lapland, required a train of six Lapps and twenty-four reindeer. The masses of crystalline rocks overthrust on Silurian strata proved of special interest. In volume ii., part ii. (May, 1911), O. A. Welter notices seventy-three recent papers on nephrite.

THE fourth annual meeting of the American Peat Society was held in Ottawa in 1910, and the proceedings are recorded in full in the journal of the society issued for January, 1911, and published at Toledo, Ohio. The members look to the future rather than to the present; but the rapid consumption of coal-supplies gives a patriotic importance to those who try to develop the use of peat. Of course, the manufacture of ammonium sulphate also comes under consideration. The Canadian Department of Mines has issued a second edition, with maps and engineering drawings, of Bulletin No. 4, on the "Investigation of the Peat Bogs and Peat Industry of Canada during the season 1909–10." The author is Mr. A. Anrep, jun., peat expert, and valuable papers are translated from foreign sources. That on the Ekelund process for drying powdered peat at a high temperature is likely to attract the most attention.

MR. C. D. WALCOTT has carried the history of the indubitable Merostomata back into Middle Cambrian times (Smithsonian Miscellaneous Collections, vol. lvii., No. 2, April 8). Two new genera, Sidneyia and Amiella, are described by him from the Rocky Mountains near Field, on the Canadian Pacific Railway, and are the result of a laborious and systematic examination of the strata. Both genera fall into a new sub-order of the Eurypterida, the Limulava, with four pairs of cephalo-thoracic appendages and simple antennæ, in this resembling the trilobites. Beltina, the fragmental pre-Cambrian form regarded as a Merostome, receives further discussion and illustration, but Redlichia, of the Lower Cambrian of Indo-China, is styled "the oldest Merostome now known."

MUSEUMS in America are in the fortunate and enviable position of being able to draw, in addition to their regular State grants, large pecuniary contributions from private benefactors. In the report for 1910, the American Museum of Natural History acknowledges its indebtedness to this source of revenue, the president remarking that while the "income from endowment has not materially increased, the total gifts towards exploration and exhibition exceed those of any previous year in the museum's history." Even so, the financial resources appear unequal to the demands upon them, for it is further stated that "the addition of three new departments since 1907, namely, of Living Fishes and Reptiles, of Woods and Forestry, and of Public Health, has made serious demands upon our income. . . . Thus the increased endowment afforded by Mr. Jesup's bequest, which cannot by its terms be used for any item of maintenance, is offset by these increases." Among the additions to the exhibited collection, mention may be made of a group of Pribilow sea-bears, of which a photograph is given in the report. A special feature of the year was the unusual number of collecting expeditions, of which there were ten to various parts of the United States and fourteen to other territories.

IN *The Field* of May 13 Sir Ray Lankester gives, under the title of "The Earliest Picture in the World," an illustrated description of a cylinder of stag's antler found in 1875 in the cavern of Lorthet, near Lourdes, Haute Pyrénées, on which are incised figures of three red deer and several salmon-like fish. The specimen belongs to the Elaphotarandian epoch, when the Arctic fauna was being replaced by the animals characteristic of modern Europe. The author gives a flat picture printed off from the cylinder, and adds two restorations of the missing portions of the figures of the deer. In his opinion, the prehistoric engraver worked from a similar flat picture, and it is further suggested that incised cylinders of this type were used by their makers as "blocks" from which to print impressions on birch-bark and other suitable materials.

TO *The Times* of May 15 Dr. Shipley communicates a letter on the so-called "eale" or "yale," in which it is pointed out that the original account was given by Pliny, from whom Topsell seems to have derived the materials for a fuller notice in 1607. These accounts present the animal in a somewhat different guise from those previously quoted. It is described as of the size of a hippopotamus, with an elephant's tail, a black or tanny colour, the jaws of a boar, and two horns, which could be moved independently of each other, of more than a cubit in length. Topsell adds that it was fond of water. Its home was Ethiopia. If the statement as to its size be trustworthy, the only animal that would accord with the description would be an African rhinoceros; and we believe there are legends as to the mobility of the horns of the latter. On the other hand, rhinoceroses were known to the ancients. Whatever be the truth on this matter, it seems impossible to identify the antelope-like or goat-like animals in the arms of Christ's College with Pliny's eale.

ACCORDING to the report for 1910, the Natural History and Polytechnic Society of Bootham School, York, continues to attract a satisfactory number of working members, the natural history section including sixty-five scholars. Meetings and excursions were held from time to time, and the admirable practice of inducing the members to keep diaries, based on actual observations, has been continued.

THE hon. secretary of the Selborne Society informs us that the nesting boxes made from natural logs which the society introduced at the beginning of the year have been very successful. In some cases correspondents (who number well over seven hundred) have had all the boxes which they have put up tenanted, and a special experiment made in the Brent Valley Bird Sanctuary has resulted in possession being taken of all but one of the boxes concerned. The committee of the society has arranged an exhibition of the boxes in the science section of the Coronation Exhibition, and photographs of the boxes, showing the nests within and the birds sitting, will be published in "The Country Home" for June.

THE report of the advisory committee for the Tropical Diseases Research Fund for the year 1910 (Cd. 5514, 128 pp.) shows that the campaign against these diseases is being prosecuted vigorously from the several aspects of prophylaxis, treatment and research into the structure, life-history, and modes of transmission of the causal organisms. Prof. Ross and Dr. Thomson have shown that, by the use of improved methods, malarial parasites can be found in the blood in the apyrexial periods, occurring in numbers so small as 20 per cubic mm. Relapses are thus explicable as the result of the usual mode of increase in the number of such parasites; the presence of crescents reproducing parthenogenetically is not essential for the production of a relapse. Dr. Wenyon has given

an account of his investigations, carried out at Bagdad during the summer of the past year, on Oriental sore; his experiments indicate that Stegomyia is under suspicion as the transmitter of this disease. Numerous other important researches, completed or in progress, are reported upon, *e.g.* by Prof. Minchin on trypanosomes and fleas, Dr. Woodcock on Halteridium, Dr. Castellani on a type of bronchitis common in Ceylon, and due apparently to the attack of a new species of the fungus Oidium, Drs. Fraser and Highet and others on beri-beri in the Malay States and Siam.

To the Bulletin of the Johns Hopkins Hospital for May (vol. xxii., No. 242) Dr. Pearce Bailey contributes an article entitled "A Florentine Anatomist." This is no other than that versatile genius Leonardo da Vinci, who planned to write a treatise on anatomy in one hundred and twenty volumes, and left note-books rich in drawings with marginal explanations, and he was the first to acquire an accurate knowledge of descriptive anatomy. A short biographical sketch of Sir Richard Owen is also contributed by Dr. Rohrer, with four characteristic portraits and an illustration of Sheen Lodge, where his last days were passed.

THE catalogue of additions to the library and the list of new garden plants of the year 1910 have been issued as Appendix II. and Appendix III. to the current volume of *The Kew Bulletin*. In the former the printing is confined to one side of the page, so that the titles may be cut out and used as index slips; the latter provides an authentic list of correct names. As in recent years, an outstanding feature of the new garden plants is the predominance of Chinese novelties, although, except for eight species of Rubus, the additions are scattered through numerous genera; the introductions traceable to Mr. E. H. Wilson's last journey are beginning to arrive through the Arnold Arboretum and other sources. Several fine orchids have, as usual, been introduced by Sir Trevor Lawrence; among those which gained botanical certificates were *Megaclinium fuscum* and *Polystachya paniculata* from Africa, and *Dendrobium karpense* and *Bulbophyllum polyblepharon* from New Guinea.

A NUMBER of new records of flowering plants and ferns for the National Park, Wilson's Promontory, Victoria, are noted by Mr. J. W. Audas in *The Victorian Naturalist* (vol. xxvii., No. 11), which raise the total to 600 species. Amongst them are species of Pterostylis, Xanthosia, and Hydrocotyle, an uncommon creeper, *Myriophyllum amphibium* and *Selaginella Preissiana*. The list includes some apparent aliens, such as *Fumaria officinalis*, *Nasturtium officinale*, and *Spergularia rubra*. Several plants were noted as rapid colonisers on burnt ground, of which *Burchardia umbellata* was the most conspicuous. A succulent form of *Stackhousia umbellata* was found on the beach where the crimson and occasionally white-flowered *Kennedya prostrata*, the "running postman," attracted attention; on the sand dunes, the grasses *Spinifex hirsutus* and *Festuca littoralis* proved their value as efficient sand binders.

AN interesting report on the progress of agriculture in India is issued from Pusa. The improvements in cotton-growing are now making themselves felt in many thousand acres of the great cotton areas in the presidencies of Bombay and Madras and in the Central Provinces, while the plant-breeding work of the United Provinces seems likely materially to improve the crop there. Special mention is made of the wheat-breeding experiments, which have now reached considerable dimensions, and have resulted in the production of varieties better in quality than anything yet grown in India. Progress is also recorded in the reclamation of the salt lands of Sind, and in the rigorous campaign against the palm disease in the Godavery delta, which has resulted in the saving of lakhs of rupees every year. Progress in agricultural education has, however, been slower than in investigation, but the cause is not far to seek—colleges have had to be built and staffs collected before much could be done. But the beginning is made, and good work may be looked for here also.

WE have received copies of the South African National Union Journal, the organ of a society having for its object the encouragement of South African industries. A number of articles are published showing the products that South Africa can supply for which there is a good market, and we note that stress is laid on the importance of keeping up the supplies of maize and of bacon. Mr. Burtt Davy writes on the value of peanuts for human food, and argues that, for the strict fruitarian, peanuts are not only the cheapest, but also the best source of energy.

THE opening up of British West Africa is dealt with at some length in No. 4 of *Tropical Life*. The five colonies S. Nigeria, N. Nigeria, the Gold Coast, Lagos, and Sierra Leone can, it is claimed, produce nearly every important tropical product except perhaps tea and sugar. Much, however, is needed in the way of organisation; trade routes are needed, land laws require amending, and labour supplies have to be arranged. An association has recently been formed with the object of accomplishing some of these objects.

WITH characteristic thoroughness, the Americans are introducing agricultural education into the Philippines. It is less than two years ago that the first agricultural college was started at Los Baños with twelve students, the classes being held in tents, with no appliances, not even blackboards, at first, and with so few seats that the students had to carry their stools about with them. Now it has a hundred students, laboratories, and class-rooms, and by next year will have accommodation for five hundred students. We have received the first two numbers of its journal, *The Philippine Agriculturalist and Forester*, published by the "student body" of the college, and containing interesting accounts of agriculture as it now is, and of possible improvements on present methods.

IN the year 1907 the Jamaica Weather Service, which had been dormant for some years, was resuscitated and associated with the United States Weather Bureau, which placed at its service an electrical recording anemometer by Friez, designated a "triple register." The Kingston Observatory has now published the results of wind direction and velocity between August, 1908, and July, 1909, for each hour and month. The tables show in all months a gradual increase in velocity from midnight to 1h. or 2h. p.m., followed by a decrease. Another prominent feature of the diurnal range is the sudden decrease for a little time just after sunrise, owing probably to the gradual disappearance of the land breeze. By extracting the number of miles from each direction, it is shown that 51·2 per cent. of wind comes from the S.E., and 23·9 per cent. from the north (land wind). The average hourly velocity of the former is 11·2 miles, of the latter only 4·0 miles. The annual resultant derived from the hourly components is E.S.E. ¼ E. 2·5 miles per hour. During the period under review the greatest hourly velocity was 30 miles (factor 3).

AN average rainfall map with isohyets of Victoria compiled from yearly records available for a period of 15 years

and upwards has been received from the Central Weather Bureau at Melbourne. It has been drawn to the same scale as that of New South Wales (published last year), the two forming a comprehensive and valuable rain-chart of the south-eastern portion of Australia. The average rainfall of Victoria is 27·19 in., ranging from 10·80 in. in the Mallee district (north-west) to 68·75 in. in Cape Otway Forest district (south). The map shows an approximate distribution as follows:—40–> 60 in. over an area of 12 thousand square miles; 20–40 in. over 43⅛ thousand, and < 15–20 in. over 32½ thousand square miles. The great influence of proximity to the mountains and seashore is plainly shown; the abundant rains on the Australian Alps, Cape Otway, and Gippsland ranges being particularly conspicuous.

In a paper read before the Royal Photographic Society, Mr. Chapman Jones dealt with the relationship between the size of the particle and the colour of the image in the case of lantern-slides developed to show a coloured deposit. The author referred to Zsigmondy's statement that the colour of colloidal solutions has no direct dependence upon the size of the particle, and his suggestion that the cause of the colour is not to be sought for in the sizes of the particles, but rather in the distances between them. Mr. Chapman Jones has investigated the matter, not by the usual ultramicroscopical method, but by enlarging the particles by mercurial intensification. Mercury is added in definite proportions by treating the film containing the particles first with mercuric chloride and then with a ferrous oxalate developer, each treatment adding one atom of mercury to each atom of silver, or of silver and of mercury that is present, the linear enlargement for eight enlargements, the maximum employed, being 7·134. The enlarged particles were then measured by means of a microscope and eye-piece micrometer, the accuracy of measurement being about 5 per cent. The results obtained showed that films that gave the same colour contained particles of approximately the same diameters, particles below 0·10 micron giving no visible colour; particles from 0·10 to 0·13, yellow; from 0·14 to 0·17, orange; from 0·17 to 0·19, pink, brown, or purple; and particles above this size, grey. No connection between the distance apart of the particles and the colour was found, but a measurement of the refractive index of gelatin and calculation of the half wave-length of light in gelatin, showed that the size of the particle giving a definite colour could be taken to correspond approximately with the half wave-length of light the absorption of which would give that colour, the particles being rather smaller than the calculated half wave-lengths. The authors conclusions are that the size of the particle is the determining factor in selective scattering, and that light is scattered by particles that approximate in diameter to half a wave-length of the scattered light.

Himmel und Erde for April 29 contains an article by Prof. B. Donath, of Berlin, on the gyrostat and its technical future. After explaining the precessional motion of a gyrostat by means of the ordinary toy, Prof. Donath gives an account of Schlick's application of the gyrostat to the diminution of the rolling motion of ships, and hints that a similar device may in the future form part of the equipment of the aëroplane. The greater part of the article is devoted to the applications of the gyrostat to mono-rail transport by Brennan and by Scherl, and to the gyrostatic compass by the brothers Anschütz. In the case of the compass, the theory is clearly explained, and views of the various parts of the instrument are given. The author is naturally optimistic as to the future of the compass, but expresses himself more guardedly as to that of the mono-rail.

The opportunity for the dissemination of nature knowledge offered by the boy scout organisation should not be lost sight of by those who desire to see the study of natural phenomena become more popular in the future than it has been—unfortunately for us and for our boys and girls—in the past. A lecture recently delivered in Leeds by Mr. Elgie was, according to *The Leeds Mercury*, attended by some 400 of the scouts, who paid enthusiastic attention to the lecturer's instruction as to the apparent movements of the stars, their grouping in constellations, and the simpler methods by which geographical direction may be ascertained from observation of the heavens. These same subjects are, we understand, also dealt with by Sir Norman Lockyer, in an additional chapter, in the new edition of his "Primer of Astronomy"; in this chapter the author shows the disposition of the most easily recognised asterisms throughout the year, so that the scout may, on recognising any group of stars, determine at once the cardinal points, and so find his direction. Workers in other fields of science, *e.g.* geology, botany, &c., might usefully give a little time to the simple instruction of the young people already so admirably organised by the general movement.

The Cairo Scientific Journal for April contains a paper on work under compressed air at the Boulac Bridge, read by Mr. Arthur J. Knowles before the Cairo Scientific Society on March 2. The Nile at Boulac is very deep; in places there are more than 66 feet of water at low Nile. The number of men who actually worked in compressed air during the sinking of the piers and abutments of the bridge was 493. One hundred and fifteen cases of illness were dealt with by the doctor, one man being attacked three times, thirteen men twice (one fatally), and eighty-six men were attacked once (three fatally). One case resulted in total deafness, four were fatal, and the remaining cases completely recovered. Two of the fatal cases were due to the heart and circulatory system, one to the lungs, and one to hæmorrhage of the spinal marrow. The majority of the cases were of pains, cramp, slight palsy, and temporary paralysis of limbs and joints. The labourers were all natives of Egypt, supervised by Europeans, but the latter were not in the compressed air for such long periods as the labourers. The author regrets the non-provision by the contractors of a medical air-lock, into which men suffering from the effects of too rapid decompression can be put and recompressed. This remedy is almost universal in English and American practice, and has been attended with great success.

The Cambridge University Press announces for early publication in the series of "Cambridge Manuals of Science and Literature" "Aërial Locomotion," by Messrs. E. H. Harper and A. Ferguson, and "Electricity in Locomotion," by Mr. A. G. Whyte. The first-named work will contain an introduction by Prof. G. H. Bryan, F.R.S., and chapters on general principles, propellers and motors, stability and control of aëroplanes, model aëroplanes and gliders, aëroplanes, dirigibles, &c., and Mr. Whyte in his volume will give an account of the application of electricity to locomotion and show the present condition of affairs and the developments which may be looked for in the near future. There are to be chapters on the mechanism of the overhead and of the "stud" systems, on electric railways and on electric traction on main line railways. There will also be a discussion of petrol-engine electric power.

The age of Sir Nathan Bodington, given in NATURE of last week as eighty-two, was sixty-two years.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR JUNE:—

June 1. 5h. 0m. Mercury at greatest elongation W. of the Sun (24° 30′ W.).
6. 15h. 0m. Mars at greatest heliocentric latitude S.
7. 17h. 6m. Jupiter in conjunction with the Moon. (Jupiter 1° 0′ N.).
14. 14h. 16m. Uranus in conjunction with the Moon. (Uranus 4° 35′ N.).
20. 12h. 44m. Mars in conjunction with the Moon. (Mars 0° 12′ N.).
22. 1h. 35m. Sun enters Sign of Cancer. Solstice.
22. 22h. 38m. Saturn in conjunction with the Moon. (Saturn 3° 3′ S.).
25. 9h. 14m. Mercury in conjunction with the Moon. (Mercury 3° 32′ S.).
27. 2h. 38m. Neptune in conjunction with the Moon. (Neptune 5° 28′ S.).
29. 5h. 8m. Venus in conjunction with the Moon. (Venus 3° 40′ S.).
29. 13h. 0m. Mercury in perihelion.

THE TAIL OF HALLEY'S COMET ON MAY 20, 1910.—No. 4496 of the *Astronomische Nachrichten* contains further notes on the question of the direction of the tail of Halley's comet on the evening of May 20, 1910. Prof. Eginitis returns to the discussion, with M. Antoniadi, concerning the appearance of a tail directed *towards* the sun, and suggests that the latter has failed to recognise the exceptional position of the tail, with regard to the earth and sun, at the time, and also its curvature; such conditions would account for the phenomena observed at Athens about which Prof. Eginitis has no doubt and M. Antoniadi contends were impossible.

THE SPECTRUM OF THE RING NEBULA IN LYRA.—Some interesting spectra of the Ring Nebula are published by Mr. Keivin Burns in No. 193 of the Lick Observatory Bulletins. The photographs were taken with a slitless spectroscope attached to the Crossley reflector, in order to determine the spectral type of the central star. Stained and unstained plates were employed, and, in passing, it is interesting to note that a "Cramer Crown" plate stained twenty-one days previously was 50 per cent. faster in the red than a newly stained plate from the same box. The length of the spectrum is only 3·3 mm. between λλ 6560 and 3730, and the width of the image of the Ring is 1·6 mm. in declination.

A comparison of adjacent stellar spectra with the spectrum of the central star showed that while between λλ 6600 and 5800, the latter was only as bright as a 14·2 mag. star of type A or F; at λ 3300 it was as bright as an F-type star of magnitude 12·4. In fact, the spectrum of the central star is relatively stronger in the ultra-violet than that of the bluest of the many Orion-type stars which have been photographed with the same instrument; yet there is not the great difference between the visual and photographic magnitudes of this star that there is generally thought to be. Mr. Burns states that, if isolated, both the central star and the other star within the Ring would be easy objects for moderately large telescopes; he finds their visual magnitudes, by photographic methods, to be 14·1 and 14·7, while their photographic magnitudes are 13·2 and 14·5 respectively. The similarity of the spectrum of the central star to the spectra of central stars, or condensations, in other nebulæ removes any doubt as to its connection with the nebula.

The following radiations were found in the spectrum of the nebula itself:—λλ 3450, 3730, 3870, 3970 (Hε), 4100 (Hδ), 4340 (Hγ), 4690, 4860 (Hβ), 4960–5010 (chief nebula line), 5880 (D_3), and 6560 (Hα). Of these, the radiation at λ 3730 is by far the strongest, on the ordinary plate, and is followed by the chief nebula line; the hydrogen lines are relatively faint. The sizes of the rings due to λ 3730 and the hydrogen lines appear to be the same, while those due to the nebula lines λλ 3870 and 500 appear to be smaller. The monochromatic images of the ring show far more detail than a composite image, a fact which suggests that they differ in detail.

PROPER MOTIONS OF STARS BETWEEN +75° AND +80° DECLINATION.—By the comparison of the positions determined at the Kasan Observatory with those given in twenty-two earlier catalogues, Prof. Dubiago has determined the proper motions of some 730 stars, and publishes them in No. 4496 of the *Astronomische Nachrichten*. All these stars occur in the Kasan A.G. zone between declinations +75° and +80°, and the complete results are to appear in No. xv. of the Publications of the Kasan Observatory.

THE GYRO-COMPASS.—A brief description of the gyro-compass, which was exhibited at a recent meeting of the Royal Astronomical Society, appears in the May number of *The Observatory* (No. 435, p. 190). This compass is quite independent of the earth's magnetism, and may therefore be employed in many positions where an ordinary magnetic compass would be useless. It was, in fact, primarily designed for use in polar research, but now proves to be quite unsuitable; it is, however, trustworthy between latitudes 70° N. and S., and is being adopted by several Governments for use in their navies.

The rotating disc is floated on mercury, so that it is free to move in two directions, and the rotation of the earth causes the axis to set itself due north and south. The axis is geared up to an indicator, so that the needle always points N. and S. when the gyro is running. The rotation of the disc is produced by an ingenious electric motor of which the disc forms part, and the inherent tendency to prolonged oscillation is overcome by a most ingenious system of damping by currents of air, the application of the blasts depending upon the amplitude of the oscillation at the moment.

A fuller description of the instrument is given by Mr. G. K. B. Elphinstone in a book, "The Anschütz Gyro-Compass," published by Hugh Rees, Ltd.

ANCIENT OBSERVATORIES IN INDIA.—An illustrated description of the five astronomical observatories erected at the beginning of the eighteenth century by Saway Jay Singh, the Maharaja of Ambhery in Rajputana, is one of the interesting papers in the May number of *L'Astronomie*. M. Ducret, who describes the equipments, states that the observatories were situated at Benares, Muttra, Delhi, Ujjain, and Jaipur, but with the exception of the last named they are in a sad state of ruin. A photograph of the Jaipur Observatory shows huge masonry erections by which the altitudes and azimuths of the celestial bodies could be determined. The installation shows that in 1718–34, when the observatory was erected, the study of astronomy of position was well advanced in India.

THE BRITISH SOLAR ECLIPSE EXPEDITION.

March 30, 1911.

AT the moment of writing we are fifty-five days out from home, and are steaming along steadily in H.M.S. *Encounter* towards the island of Vavau, which we hope to reach on Sunday evening next (April 2). Since leaving Sydney, on March 25, we have experienced a N.E. or head wind all the time, which has somewhat reduced our speed. To-day we are in lat. 25° 20·5′ and long. 174° E., *i.e.* we are well to the north-east of Norfolk Island and to the south of Hunter or Fearn Island.

When boarding the ss. *Otway* at Tilbury on February 3, I was the sole representative of the Solar Physics Observatory's expedition on board, for Father Cortie and Brother McKeon, who joined the ship at the same time, represent the party sent out by the Joint Eclipse Committee. It was not long before I discovered that many cases containing self-recording instruments, books, photographic materials, lantern-slides, &c., for use on the voyage, were not placed in my cabin, and it was only at Port Said that I finally heard by cable that they were all neatly stowed away in No. 2 hatch with hundreds of tons of cargo above them, and therefore inaccessible until Sydney was reached. Fortunately, I had my 5×4 Kodak with me, and supplies of films were easily obtained at Marseilles, Naples and Colombo *en route*.

On the whole, the weather was cold for the time of year on the way out to Australia, and it was only in the doldrums that a high temperature and moisture-laden

atmosphere were felt. I had intended to keep running three self-recording instruments, lent me by Dr. W. N. Shaw, to record pressure, temperature, and the hydrometric state of the atmosphere on the way out and home; but, alas! these were in No. 2 hatch.

We reached Marseilles on February 9, and Mr. F. K. McClean, a volunteer for my party, joined the ship, having travelled overland from London. Unfortunately, we passed Messina at 3 a.m. in the morning, so that the scene of the great earthquake could not be distinguished.

Solar halos were visible daily, and these corroborated the low temperatures we were experiencing. On February 15 Port Said was sighted; it was a beautiful morning, but the air distinctly chilly. The same evening we entered the canal, and took only sixteen hours to get through. In the Gulf of Suez, even with a following wind, it was not hot; in fact, low temperatures were the chief features of the voyage. At Aden my notes state:—"It has been exceptionally cool the whole journey, and especially through the Red Sea."

In the Indian Ocean the temperature began to rise, and the thermometer in my deck cabin, with an electric fan running, registered usually 78°–82° F. at about 11.30 p.m. Colombo was reached on February 25, and although it was somewhat warm on shore, it was nothing to what it was in December, 1897, when I was there on the way out to India for the eclipse of 1898. On the evening of February 26 we had a fine display of lightning. The colour of the flashes was a distinct violet, and each flash, or rather the great majority of them, appeared to quiver, *i.e.* did not seem to be instantaneous, and gave the impression that several flashes passed down the same path in the air. The flashes were, however, too distant to photograph; otherwise I would have recorded their multiple nature by photographing them with a moving camera. The phosphorescence on the water was brilliant that evening (and my cabin temperature 83° F.). I have never been farther south than Colombo before, and so I had been looking forward with considerable interest to reaching the doldrums. I wished to observe and photograph the beautiful cloudscapes which are special to that region.

FIG. 1.—SS. *Otway* leaving Sydney Harbour for Brisbane. H.M.S. *Encounter* in Harbour (three funnels).

Monday, February 27, I labelled my cloud day. There were small but superb cumuli sailing over the sky slowly all day. Each cumulus was practically a nimbus, and rain was falling in dense sheets from most of them. The under surface of each cumulus was very flat, and their bottoms seemed to be about 4000–5000 feet high. As we were roughly in latitude 7°, the sun at midday was very high—nearly overhead. Thus the lower portions of the clouds were in deep shadow, and, looking towards the horizon, tier upon tier of their lower portions, due to perspective, made an impressive sight. This day ended with one of the most majestic sunsets I have ever seen. The sun, sinking behind these distant cumuli, rendered them of varied colours. Some were picked out in inky-black with golden edges, while others were tinged with a ruddy hue, with purple for their main mass. Just above the sun, but tremendously high up in the upper reaches of our atmosphere, was a beautiful delicate mass of cirro-cumulus in the form of waves. These exhibited all the colours of the rainbow, and were brilliant in the extreme. A powerful pair of binoculars showed both their structure and colour. Beautiful golden rays also shot up from the sun, making the scene one of perfect beauty. The sight of these rays at sunset are alluded to by sailors as "the sun setting his back stays." After the sun had set, all the clouds became an inky-violet colour, and took all shapes, from French poodles to whales or 4·7 guns. This wonderful sunset was followed next day by an even more perfect sunrise. The sea exhibited that oily look so well depicted by Somerscales—and long rollers were sluggishly passing by making the *Otway* pitch a little. Even the bow way of the *Otway* refused in this oily sea to break, but sped silently away from the ship's side. The horizon at the east, with the distant yet unilluminated cumuli, brought to one's mind spectroheliograph photographs of the sun's limb with the prominences around it, the cloud-forms representing the latter. Gradually the most beautiful dawn began to appear, and the sequence of events during the sunrise seemed to be exactly the reverse of the sunset the night before. In this case the "front stays of the sun" formed a conspicuous feature.

The evenings now were very warm and humid, and my cabin temperatures, at about 11.30 p.m., varied from 82° to 85° F., even with the electric fan running.

The approach to Australia is not very inspiring, for the coast at Fremantle is very low-lying, both to the north and south. It was here that I first experienced the great kindness of Mr. H. A. Hunt, the Commonwealth meteorologist, during my brief visit to Australia. Knowing that the ship would put in at Fremantle, he arranged for the meteorologist of the Perth district, Mr. Kerr Lewis, to meet me and show me round Perth. But I left the ship to catch the steamer for Perth instead of the train, so we missed each other, and I did not see him until I returned to the *Otway* again in the afternoon. Mr. McClean and I and a Mr. E. C. Anderson, whom I have commandeered as a volunteer observer for our expedition to Vavau, went off and visited the Perth Observatory. It was there we learnt that Mr. Cooke, the director, was away in Melbourne on the Boundary Commission, and we gathered some information about the Australian eclipse party to Vavau also. Mr. Kerr Lewis, the chief assistant at the observatory, very kindly showed us over the observatory, which is in a fine position overlooking the

surrounding country. In recent years the growth of houses in the neighbourhood has been so rapid that its position will soon be spoilt, if it is not already.

The journey from Fremantle to Adelaide was livened by a lecture by Father Cortie on "Comets," and by Mr. McClean on "Flying." To give an idea of the low temperature conditions during this portion of the journey, furs and overcoats were generally worn, and my cabin temperature was about 65° F. When at the Perth Observatory I was informed that the past season in Australia had been phenomenal, the summer having been cold and very wet. This I afterwards found was the case generally for the whole of the southern portion of the continent.

SECOND LETTER.

April 1.

On the morning of March 11 we arrived at Adelaide, and moored alongside the quay. Father Cortie there received a letter from Captain Colomb, the captain of H.M.S. *Encounter*, the ship which had been put on special service to assist both Father Cortie and my party at the eclipse. Captain Colomb informed us that his ship was at present in dry dock at Coccatoo Island at Sydney, and that he would be ready to sail with our party from Sydney on March 25 if that date was convenient. We informed him that this arrangement suited our plans admirably, and at his request we notified him of the amount of our luggage. At Adelaide Mr. Cooke, the Government astronomer of W. Australia, and Mr. Dodwell, the Government astronomer of S. Australia, met us. The Commonwealth Government placed a motor-car at our disposal, but unfortunately our time was so limited that we were unable to make much use of it.

FIG. 2.—Rain Squalls on the Equator.

The journey to Sydney proved most instructive. The region round Ballarat, where we visited my brother, is studded with past and present gold mines. There we were shown over the most up-to-date assaying plant, owned by Mr. Edwards. The following morning a motor run of 100 miles brought us to Bendigo, and we had experience of Australian cross-country roads; in many cases it was a mere track, with no metal at all on it. I was told that I was seeing Australia under very abnormal conditions for that time of year, for instead of scenery of predominating *brown* tints, I was passing through a country as green as any scenery in England. This was due to the exceptional rainfall. At Bendigo we were shown over a battery of 110 stamps. The same evening we left for Melbourne, and the next morning Mr. Hunt, the Commonwealth meteorologist, took us to call on the Hon. King O'Malley, the Minister for Home Affairs. He very kindly welcomed us to Australia, and explained to us the working of his department. Mr. Hunt also showed us over the Meteorological Office of which he is chief. I was in time to see the very efficient system which he has adopted in making his daily forecasts for the whole of Australia. I made the acquaintance of Mr. G. H. Knibbs, the Commonwealth statistician. Next morning (March 15) I visited the Melbourne Observatory. Mr. Baracchi was there full of the question of the Boundary Commission and the coming eclipse, of which he is chief. I renewed my acquaintance with Mr. Baldwin, who some years ago visited the Solar Physics Observatory at South Kensington, and also met Mr. Short, another assistant. I viewed with great interest the great Melbourne reflector, with which I was so familiar from book illustrations. My old friend Dr. Skeats, of the Royal College of Science, but now professor of geology at the Melbourne University, took me off to lunch to meet many of his *confrères*, and then we made a quick tour of the University. This University is growing very rapidly, and arrangements are already in preparation for a considerable increase of the various departments. I had the great pleasure of meeting Mr. Grayson there, who has so successfully achieved the art of ruling very thin lines on glass exceedingly close together—nearer together than those on any gratings yet ruled. He showed me the extremely ingenious methods he was adopting to produce the portions of the mechanism for ruling gratings. The work was of the very highest order, and he accomplishes every portion of it himself. It will be a grand day when we can order large-size ruled gratings from Australia.

On the morning of March 16 Mr. J. Brooks, retired Trigonometrical Survey of New South Wales, and Mr. W. E. Raymond, first assistant, Sydney Observatory, met us at the railway station. Both Mr. Brooks and Mr. Raymond form part of my eclipse party, and both are familiar with eclipse work, as they were with Mr. McClean on his eclipse expeditions to Flint Island and Tasmania. Further, both Mr. McClean and I had been in correspondence with them from England, asking them to make many preparations locally, which they had most satisfactorily carried out. Our total instrumental and camp equipment was increased from 4½ tons to about 6 tons. I had intended to call on Vice-Admiral King Hall and Captain Colomb, of H.M.S. *Encounter*, as soon as possible, but found on my arrival that the former was away in Tasmania and the latter with his ship in dry dock. March 17 was a very busy day. First it was necessary to be down at the wharf to tally off all the eclipse cases as they came out of the *Otway*, though the majority were not going to be moved until late that evening. Then the Lord Mayor of Sydney was going to give us a civic welcome, which was to take place at noon that day. We all assembled at the Mansion House at the time appointed, and were met by Profs. Moors and Pollock, of Sydney University, the Rev. Father Pigot (representing the Eclipse Committee of the Australasian Society for the Advancement of Science), Mr. J. Mangle, the Rev. Dr

Roseby, Dr. Quaife, Mr. Guthrie, Mr. W. E. Raymond, and Mr. Hamlet (representing the British Astronomical Association and the Royal Society).

Prof. Moors, introducing our two parties, remarked that the Australian expedition, which was going to Vavau to observe the eclipse, expected to learn a great deal from us. After Mr. Hamlet's reference to the voyage of Captain Cook in 1770, when he sailed to the South Seas to observe the transit of Venus, and also to the British and Commonwealth expeditions on the present occasion, the Lord Mayor heartily wished all the expeditions success, and instanced the voyages of Sir Ernest Shackleton and Captain Percy Scott as showing what could be gained to science by close study under arduous conditions.

Prof. Pollock expressed the hope that the advent of the present British parties would benefit the scientific workers in Australia and raise and sustain that enthusiasm without which no good work was ever accomplished. Father Cortie replied in an appropriate manner, pointing out that Britishers felt quite at home in Australia, and that such expeditions helped to cement further, if necessary, the friendship between Australia and the Mother Country.

In my reply I laid particular stress on the importance of the occasion for furthering the proposal for a Solar Physics Observatory for Australia. I pointed out the importance of filling up the gap of longitude between Kodaikánal (India) and Mount Wilson Observatory (U.S.A.), and that in Australia the weather conditions were ideal for a large observatory of this kind. I also indicated the important part played by the sun in controlling our terrestrial atmospheric movements, and that a close study of the sun was of first importance to Australians, whose population was so largely composed of those who reaped benefit from the soil. After this pleasing ceremony was over we adjourned to another room to drink the health of the King.

In the afternoon we all went to Coccatoo Island to call on Captain Colomb, the ship being still in dry dock. He greeted us very heartily, and at his request we gave him an account of our programme and requirements.

In the evening we all attended a meeting of the British Astronomical Association, and at its conclusion Mr. McClean, Mr. Anderson, and I went with Mr. Raymond to the observatory to see the show clusters, nebulæ, and double stars of the southern hemisphere.

The following morning was occupied in tallying all the eclipse cases from the *Otway*. These were to be transferred to H.M.S. *Encounter* by steam lighter on Monday, March 20. During the afternoon I boarded the *Encounter* to give Captain Colomb detailed information about the assistance required. I suggested to him the importance of communicating with England as soon as possible after the eclipse in order to inform the home authorities of our results. This he took in hand, and it was arranged that H.M.S. *Encounter* should send a wireless message to H.M.S. *Pioneer* at Auckland, which would be transmitted through to England by cable.

The next day (Sunday, March 19) we all went out by steamer to the beautiful River View Jesuit College, where Father Cortie and Brother McKeon were staying. The rector and the fathers received us in a most hospitable manner. The college is situated away up towards the beautiful harbour of Port Jackson, and is an imposing structure amongst lovely scenery. Since our arrival in Sydney it had been very hot, and the damp atmosphere had made our various duties rather laborious; even the Australians considered it so. The steam to River View was delightful in the extreme, and we were able to gain some idea of the great future such an important port must have. There is very deep water everywhere, and the largest ships can lie alongside any of the innumerable harbours. At River View the very beautiful seismographs, which are in the charge of the distinguished worker Father Pigot, were shown to us. Every detail of these instruments and their functions were carefully pointed out.

The next day (March 20), at an early hour, the steam lighter was alongside the wharf, and Mr. McClean and I went and superintended the placing of the cases in the lighter. Then we steamed away, and with the help of the *Encounter's* crew got all the cases safely stowed away in torpedo flats and other available spots.

This morning I had expected Mr. Hunt to arrive from Melbourne, as I had been requested by the Hon. King O'Malley, the Minister for Home Affairs, through Mr. Hunt, to visit and report on the proposed site for the Solar Physics Observatory near the new Federal Capital site, and Mr. Hunt was to escort me there and back. Mr. Baracci had arranged to proceed to the site from Melbourne, and we were all to meet there. At midday I met Mr. Hunt, and he proposed that we should start the same evening, to which I consented. In the meantime, Mr. Hunt took me to call on Mr. Stephen Mills, the Collector of Customs, who is the successor to Colonel Lockyer (now retired); the latter I met in Melbourne a few days ago. Colonel Lockyer had very kindly given me two letters, one for Father Cortie, which would clear us of any difficulty that might arise in relation to custom duties. These proved very useful, and saved us much anxiety.

W. J. S. LOCKYER.

(To be continued.)

THE WORK OF THE ROYAL GEOGRAPHICAL SOCIETY.[1]

IN looking to the future, it is important to inquire how the society will be able to maintain its reputation and its usefulness in the new conditions of geographical knowledge. It is true that the South Pole is as yet uncaptured, that the map of Arabia is still largely composed of great blank spaces, and that the bend of the Brahmaputra is drawn by guesswork in our atlases. But all these problems will, it is probable, be solved before long, and where then will be the field in which the explorer may hope to win renown by robbing the unknown of its romance? We must sooner or later face the fact that the work by which this society has become best known in the past represents an almost finished chapter in geographical history, and we should sometimes, in preparation for the future, ask ourselves what ought to be our *rôle* when the last leaf in that chapter has actually been turned.

When endeavouring thus to take time by the forelock, we should perhaps in the first place inquire more precisely as to the nature of the change which is now taking place, and as to how soon it is likely to be accomplished. Systematic surveys are, we know, being pressed forward in many parts of the world, of which until recently the maps were produced mainly by the efforts of enthusiastic amateurs, whilst now they are turned out with almost machine-like regularity and precision by Government officials. As to the British Empire, the annual reports of the Colonial Survey Committee show how rapid has been the advance in this direction, and what satisfactory progress has been made, though in certain localities the authorities, in spite of past experience, seem disposed to linger on in a state of comparative topographical ignorance. Outside the British Empire similar changes are taking place, though less rapidly, with the result that when the international map of the world on the scale of 1 : 1,000,000 is completed, as it will be before many years have passed, a large proportion of it will be based on surveys sufficiently accurate to ensure the work holding good for many a century to come, except for the rise of new towns and the alteration in political boundaries. But in spite of all this progress there are likely to remain vast tracts of land, mapped in a fashion, no doubt, but with the details inaccurate and incomplete, where for at least half a century or more from this date the independent traveller will find ample opportunities of adding to the knowledge of the earth we live in. Indeed, for some years to come large areas are likely to exist our knowledge of which can only be increased at the risk of the traveller's life. But although the available topographical information concerning many regions will for long remain very imperfect, yet it is inevitable that the day will come when the whole world will be mapped with fair accuracy, and to that condition of things this society will have to adapt itself.

Nearly all great changes, however, take place gradually, the process of evolution being, as a rule, an advance

[1] Extracts from the address of the president, Major Leonard Darwin, at the anniversary meeting of the Royal Geographical Society, May 22.

made by a great number of small steps; and no sudden geographical revolution need be feared. To move with the times ought not to be very difficult, therefore, and to do so it is mainly necessary to look to the immediate future, or to take "short views of things," to use the words of that wise man Sydney Smith. If this policy be steadily pursued, there need be no cause for alarm for many years to come, at all events; for, as already suggested, plenty of geographical work yet remains to be done. We ought no doubt, in view of the changing conditions, to direct our efforts with more persistence than heretofore in the direction of encouraging travellers to make systematic and detailed examinations of comparatively small areas, and not merely to cover long distances with the result of doing little more than confirm the impressions of previous explorers. Their surveys should be as good as is possible in the circumstances, and the information they collect should be extensive, varied, systematic, and recorded with reference to the needs of the students of science and history, as well as of the man of commerce. In short, the traveller of the future ought to be a trained topographer, or to have thoroughly prepared himself in advance for some definite class of investigation.

As regards internal administration, the aim must be to make the society's house a place where accurate information can readily be obtained concerning all countries, including our own, the information thus supplied being all that could be described as geographical within the most elastic meaning of the word. The acquisition of suitable maps and books should, indeed, in future only be limited by financial necessity, whilst the collection of geographical photographs should be well maintained. No pains should be spared to make our systems of indexes as perfect as possible, a subject to which, as a fact, considerable attention has recently been paid; and with such aids the staff should be in a position to give every assistance to all students wishing to utilise the vast stores of information which the premises should contain. In short, we shall want more maps, more books, more photographs, and a more convenient house to hold both them and the steadily accumulating objects of interest which we own; and if the society continues to grow in usefulness on the lines suggested, we must look forward to the possibility of a material increase being needed in the number of the staff. Moreover, our means of keeping touch with foreign countries should be considered from time to time, to see if they are not capable of improvement. For example, as a single possible suggestion, might it not be worth considering whether British consuls, whilst actually serving abroad, should not be allowed to join our ranks with some special advantages as regards fees? Then, again, partly with the same object of facilitating the supply of information to our fellows, partly with the view of making our collections more generally useful, and partly in order to disarm the criticism made against us of wishing to poach on the preserves of other sciences, it might perhaps be well to allow the fellows of certain other learned societies to use our libraries with the same freedom with which they can now consult the maps in our map room.

As to the work of exploration and investigation for which we are not directly responsible, this should, as heretofore, continue to receive our warmest encouragement and our help when possible.

One other function which this society may always usefully perform, and one which has thus far been too much neglected. Science is cosmopolitan, and certainly the records of this society's proceedings during recent years, where the names of Sven Hedin, Peary, Charcôt, and many other distinguished foreign explorers so prominently appear, prove that this aspect of our duties is not now being overlooked. It is not, however, as it seems to me, in the least inconsistent with a belief in our world-wide obligations to hold that the work done by our fellow-countrymen has an especial claim on our attention, and that one of the aims of a national geographical society should be to keep alive the knowledge of the great deeds of British explorers in the past. Is it not probable that the history of Australia and New Zealand would have taken a very different turn if the work actually done by Captain Cook had been forestalled by some explorer owing nothing to these isles? And yet to that great man no fitting monument has yet been erected. As to Africa, its map should have the names of our fellow-countrymen written all over it if intended to indicate the historical development of that continent—a development due in large measure to British exploration, the history of which we should never allow to die. In the case of thousands of adventurers who set forth to America and elsewhere from these islands in times gone by, and to whose exertions is largely due the fact that English is now the most widely known language on the face of the earth, and that these islands hold in relation to their size an absolutely unique place in the history of the world, it is true that of these men we do not even know their names, though the effect of their exertions yet surrounds us on every side. It is to be hoped, therefore, that there will always exist in this land a body of men banded together with the object, amongst others, of making more widely known what was done by British explorers in the past, and of honouring the heroic spirit of these unnamed thousands which drove them forth to face untold dangers, and thus to help to build that Empire of which we are so proud.

ORGANISATION AND PROGRESS IN ECONOMIC BIOLOGY.

DURING the past decade economic biology has slowly but surely taken a definite place in our system of sciences in this country, and although at present but a sturdy infant, it would seem that it is destined to play no mean part in stimulating research and experimentation in the near future.

We have, fortunately, outgrown the prejudice that has for many years clung to practical science, and on all sides we can see investigations taking place of deep and far-reaching scientific interest, but at the same time fraught with great import to man and his multifarious activities.

Once men begin to think and work along certain definite lines, it is not unnatural that they should seek to associate together, in order to discuss their methods of work, and the latest results obtained by their investigations. Without such association much unnecessary duplication of work occurs, and the lack of organisation retards otherwise legitimate progress.

The foundation of the Association of Economic Biologists in November, 1904, was the outward expression of a feeling such as this that had long been simmering in the minds of economic biologists in the British Isles, and on the occasion of the tenth general meeting, which has recently been held at the University of Birmingham, where the first meeting took place, it seems not unnatural that we should pause and reflect upon the organisation and progress of this special branch of biological science.

During the life of the above association, meetings have been held at the universities of Birmingham, Liverpool, Cambridge, Edinburgh, Oxford, and Manchester, and one each at the Imperial Institute and University College, London. In looking at the list of papers read at these meetings, one cannot fail to be struck at the large amount of original work that has been carried out by the members, much of which has been published and adequately illustrated. The problems discussed relate to almost every subject wherein the economic biologist can aid or assist the physician, veterinarian, agriculturist, horticulturist, stock breeder, fruit grower, forester, fisherman, manufacturer, &c. Since 1904 the members of this association have contributed in no small degree to the general advance that has been made in this particular science.

With progress and increased interest the workers also increase, and it is significant that at the last two meetings questions relating to organisation have figured prominently in the programmes. Few will forget Prof. Hickson's admirable address delivered last year at Manchester, on the place of economic zoology in a modern university, or the discussion that followed, both clearly indicating how fully it was realised that a sound scientific training was the best preparation for future specialisation.

In a more restricted sense, Mr. H. Maxwell Lefroy dealt with the training of economic entomologists at the last meeting. Mr. Lefroy has had a long and unique experience of the kind of men that are required in our colonies, but so far he has failed in his efforts to obtain such from

this country. From his address we gather that he would dissociate entirely the training in entomology from the general zoological training, doing it as a post-graduate course. The trend of the course, he pointed out, must not be that of the comparative anatomist, the evolutionist, the systematist, or the histologist. The difficulty in making economic zoologists in England, he thought, would be the preponderance of the academic view and the total absence of the economic view based on experience. English universities have a very long way to go before they can turn out entomologists of the practical stamp that America does.

Referring to the lack of knowledge of entomology of the medical men who apply themselves to entomological problems, he described it as very painful, but in England there are so few places where medical men can obtain their training, and even then it seems to lack much. The kind of training in our universities is too academic for men who are required to solve problems requiring practical solutions.

We are on the threshold of greater things, and whatever problem comes one must put one's hand on. Only so is the practical entomologist going to convince an unlearned public and sceptical governments that there is anything at all in it, and we are, in England certainly, beginners who must look to the future. England should be the source at least of the entomologists of her Empire, but she is not, and unless radical changes take place in the atmosphere of her teachers, she will not be. The training will have to be that of practical field entomologists if the demand has to be met from England, and the last thing it wants is the academic zoological training of the average English university.

A perhaps more important subject to economic biologists generally was Mr. H. Maxwell Lefroy's address on the standardisation of economic nomenclature. The almost hopeless muddle that at present reigns in the nomenclature in the literature bearing on economic biology is little short of appalling.

Mr. Lefroy proposes to meet this difficulty by having a standard catalogue of the important species with the name most in use in biological literature definitely decided on, so that the further changes in nomenclature need not affect the economic biologist. The guiding principles would be that it should be independent or unaffected by the rules of priority. It should be based on the name used in important biological literature. Genera in which there is a close uniformity of habit and life-history, or which form a distinct class of pest, shall, for this purpose, be retained whole and not subdivided, *e.g.* Lecanium, Dactylopius, Agrotis, Gryllotalpa. To make existing and future biological literature accessible by adopting and making permanent the name under which it was written, and not to perpetuate inviolate the author of a name or description in the systematic literature. Writing recently on this subject, Mr. Lefroy stated, "In this matter, teachers and practical entomologists alone are concerned; to the systematic entomologist, the mazes of synonym and priority are (apparently) the breath of life, and the pastime might be a quite harmless one; . . . but to practical men who wish to check the growing spread of insects from country to country, who wish to cooperate to deal with big problems, who see in agricultural education the chief solution of these big problems, the question is one of vital importance. I think all economic entomologists will agree that we are immensely adding to the difficulties of our work, if it is to be anything more than parochial, either by modifying our nomenclature in accordance with the priority discoveries of systematists or by arbitrarily using the nomenclature we think most suitable. It is impossible for an isolated worker in a far country to do more than offer suggestions; I feel assured it will be for the permanent ultimate good of our science if we can overcome this growing monster, and I think the Association of Economic Biologists might fitly take up the subject."

As the outcome of Mr. Lefroy's suggestion it was decided to form a committee to consider and report upon the matter. The committee appointed were Richard S. Bagnall, Prof. Geo. H. Carpenter, H. Maxwell Lefroy, Dr. R. Stewart MacDougall, Robert Newstead, and Walter E. Collinge (hon. sec.).

Such a scheme will greatly facilitate investigation and the reference to work done, and this desire to place matters upon a sound basis is perhaps one of the best auguries for the future prosperity of the association.

A further very interesting discussion was initiated by Dr. J. H. Priestley on the systematic recording of diseases of economic plants. The Biological Committee of the Agricultural Education Association have for some time past given consideration to the question of establishing at a convenient centre a record, as complete as possible, of the various fungus, insect, and other diseases of economic importance, reported in the British Isles from time to time. The main object of such a record would be to aid the scientific investigator who wished to get into touch as quickly as possible with the scattered literature and notes dealing with the distribution of, and other questions relating to, some disease or pest of which he was making a particular study. It had been decided to approach other bodies likely to be interested with a view to cooperation. It was decided to give the scheme approval and support.

All these activities indicate the growing importance of the subject, the possibilities of which we have yet but dimly realised; the multifarious lines of research are vast and the field is an ever widening one, and the need for work and workers pressing. That the workers of this country will bear their share in elucidating some of the hidden mysteries, and directing their application on the problems of our everyday life, is greatly to be hoped.

W. E. C.

ECOLOGICAL STUDIES.

A NOTE by Dr. C. C. Hosseus on the flora of Wang Djao, a station on the Meping River in middle Siam, appears in Engler's *Botanische Jahrbücher* (vol. xlv., part iii.). Trees of *Dipterocarpus laevis* and other species clothed with epiphytes, especially orchids, are prominent along the river banks. On the savannah lands in the vicinity *Cassia siamea* is the dominant tree, while *Andropogon brevifolius*, species of Scitamineæ, and *Hibiscus Abelmoschus* are conspicuous amongst the ground vegetation.

In the Bulletin of the Illinois State Laboratory of Natural History (vol. ix., art. 3), Dr. H. A. Gleason presents an instructive ecological study of the vegetation of the inland sand deposits of Illinois. He distinguishes prairie, blowout, swamp, and forest formations. The prairie formation consists largely of bunch grass associations, in which *Koeleria argentea*, *Leptoloma cognatum*, *Panicum pseudopubescens*, and *Andropogon scoparius* are dominant species, either alone or in combination. On the patches between the grass clumps there grow various perennials of the type of *Aster linariifolius*, or *Callirhoe triangulata*, some annuals, and *Selaginella rupestris*, which spreads in circular rings. The formation and different aspects of the sand dune are described. The most efficient dune-formers are *Panicum virgatum*, which possesses long tough roots and tufted stems densely covered with persistent leaves, and a local variety of *Rhus canadensis*, which continually grows above the sand that collects around its dense tangle of stems.

A phytogeographical sketch of the Andes in the south-east of Bolivia, communicated by Mr. K. Fiebrig to Engler's *Botanische Jahrbücher* (vol. xlv., part i.), provides a good biological account of the remarkable modifications developed on the wind-swept high plateaux, the Punas, at an altitude of 12,000 feet. Cushion plants of a much branched, closely compacted character are displayed by *Azorella madreporica* and *Pycnophyllum Pilgerianum*, while a less extreme type is developed by many of the Compositæ, an Ephedra, and the globular cacti. Acaulescent long-rooted plants are exemplified by species of Astragalus, a new species of Alyssum, and *Dalea callianthes*. The numerous dwarf shrubs include many species of Compositæ, a Fabiana (Solanaceæ), and the thorny rosaceous plant, *Tetraglochin strictum*. Several bulbous plants occur, notably an Alstrœmeria and a grass-like Sisyrinchium, and an evil grass, *Festuca orthophylla*, covers extensive patches with porcupine-like leaves. Other formations described are the Alpine, the valleys, and the lowland forests.

SOME RECENT WORKS ON AQUATIC ANIMALS.[1]

(1) DR. PASCHER'S monograph contains the first instalment of observations in progress on the biology of this "Grossteich"—a lake situated about 100 km. north of Prague. The present memoir, on the Chrysomonads (except the purely planktonic forms), deals with their classification (two new genera and eight new species being described), structure, motion, division, and encystment. The occurrence of contractile vacuoles in Microglena and of siliceous needles, as long as the cell, projecting from the surface of Mallomonas, are among the more noteworthy features referred to.

(2) The genus Ceratium is so common a constituent of the fauna of many lakes and seas that an account of its species, and the help offered in their more accurate identification, will be welcome to workers on plankton. A short account is given of the morphology and fission of *C. tripos*. The genus is divided into four sub-genera, the armature and relationships of which are examined. It is concluded that the genus probably arose in temperate waters, and spread thence into warmer and colder regions. There are no known "bipolar" species. *C. cornutum*, one of the three widely distributed fresh-water species, seems to be the oldest living species and to stand nearest to the hypothetical ancestor of the genus. The structural plan of the fresh-water species suggests that they are primitive, and that by migrations into the sea the marine forms have arisen, and subsequently attained their great differentiation. The author regards the heteromorphic chains discovered by Lohmann, in which the individuals at the two

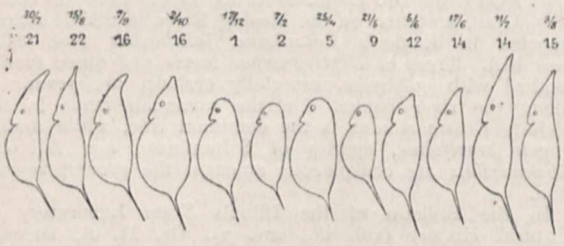


FIG. 1.—*Hyalodaphnia cucullata*, from Fursee, Denmark. Note the elongation of the cephalic shield in the individuals taken in the summer. The upper row of figures indicates the day and the month of capture of specimens, the lower row the temperature of the water (in degrees centigrade).

ends of the chain present more or less the characters of two distinct species, not as normal, but as due to retrogressive phenomena; possibly the reduced salinity of the Baltic, in which they were observed, is responsible for their formation.

(3) Dr. Wesenberg-Lund gives an account of some of the more recent work on fresh-water organisms, especially of his own observations on the planktonic fauna of the Danish lakes. He directs special attention to the variations in temperature, specific gravity, and viscosity of the waters of lakes at different periods of the year, and points out that, while the change in the specific gravity due to temperature variation is insignificant, the viscosity alters very considerably, being, in fact, only half as much at 25° C. as at 0° C. He concludes that, correlated with this latter factor, are certain morphological changes. For instance, examples of the Daphnid Hyalodaphnia, taken in summer, exhibit great elongation of the cephalic shield, which has the effect of so shifting the centre of gravity that, while the animal previously swam almost perpendicularly, it now moves almost horizontally, and its resistance to falling is thus very considerably increased. In the nearly related Bosmina the body is, in summer, higher than long, but in winter longer than high; the antennæ are twice as long in summer as in winter. It is pointed out that when the extent of these "temporal" variations is fully realised there will, no doubt, be a great reduction in the number of recognised species. A further example of modification is given—the rotifer *Asplanchna priodonta*, the body of which is in winter subspherical, but in summer is about five times as long as broad, and approximately cylindrical, so that if the horizontal position be assumed in swimming, the animal presents a greater resistance to sinking. Increase in the length and number of processes (*e.g.* Ceratium) or an increase in the surface of organisms is noticeable in summer, correlated with the increased flotation required.

(4) Dr. Weigold's account of the Lyncodaphnids and Chydorids of Saxony contains much information regarding the specific characters and biology of these Crustacea, details being given of the number of moults, the length of life observed, locomotion, relations of the sexes, variation

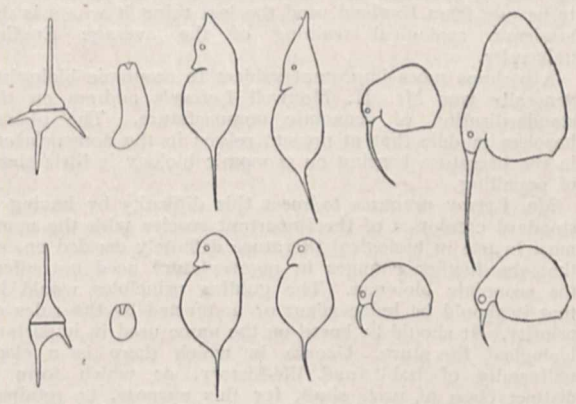


FIG. 2.—*Ceratium hirundinella*, *Asplanchna priodonta*, *Daphnia hyalina*, *Hyalodaphnia cucullata* and *Bosmina coregoni* (two races). Upper row; summer forms with increased power of floating; lower row; winter forms.

in form and numbers. The introduction of Chydorids to isolated waters is brought about almost exclusively by birds. The author has carefully worked out the breeding seasons, and shows that, in the plains of central Europe, the Chydorids have two sexual periods, sometimes almost confluent, but exhibiting maxima in July and October; in more northerly regions and in mountain waters the maxima approach one another, and finally blend into a single breeding period in August-September.

(5) The work described in the fifth memoir was undertaken in order to decide, by renewed observations and experiments, whether the conclusions reached by Weismann or those of some of his critics are to be accepted. The main results go to show that *Daphnia magna* passes, during the course of a year, through several phases, but the various generations and broods are not so sharply circumscribed, in regard to the mode of their egg-formation, as Weismann believed. The author states his views of the sequence of phases thus:—resting egg—strong tendency to parthenogenesis—waning of parthenogenesis and increased tendency to sexual reproduction—strong tendency to sexual reproduction—resting egg. The parthenogenetic and resting eggs, the genesis of which is traced, differ from one another, not only in number and in nature of yolk and shell, but also in mode of formation; each of the former arises from a group of four cells, one of which becomes the egg, while the other three are

[1] (1) Monographien und Abhandlungen zur Internationalen Revue de gesamten Hydrobiologie und Hydrographie. Band 1, Heft 1.—"Der Grossteich bei Hirschberg in Nord-Böhmen. I. Chrysomonaden aus dem Hirschberger Grossteiche. Untersuchungen über die Flora des Hirschberger Grossteiches. 1. Teil, von Dr. A. Pascher. Pp. 66+Taf. iii. (Leipzig: Verlag von Dr. Werner Klinkhardt, 1910). Price 10 marks.

(2) Die Ceratien. Eine kurze Monographie der Gattung Ceratium Schrank, von E. Jörgensen. Pp. iv+124+Ta. x. (Leipzig: Verlag von Dr. Werner Klinkhardt, 1911.) Price 11 marks.

(3) Grundzüge der Biologie und Geographie des Süsswasserplanktons nebst Bemerkungen über Hauptprobleme zukünftiger limnologischer Forschungen, von Dr. Wesenberg-Lund. Pp. 44. (Leipzig: Verlag von Dr. Werner Klinkhardt, 1911.) Price 1.50 marks.

(4) Biologische Studien an Lyncodaphniden und Chydoriden, von Dr. H. Weigold. Pp. 118+Taf. x-xii. (Leipzig: Verlag von Dr. Werner Klinkhardt, 1911.) Price 5 marks.

(5) Studien und Experimente über die Eibildung und den Generationzyklus von Daphnia magna, von U. v. Scharfenberg. Pp. 42+Taf. viii+ix (Leipzig: Verlag von Dr. Werner Klinkhardt, 1911.) Price 2 marks.

(6) Natural History of the Larvæ of Donaciæ. By Dr A. G Böving. Pp. 108+plates viii. (Leipzig: Verlag von Dr. Werner Klinkhardt, 1911. Price 5 marks.

nurse-cells; the resting egg arises from a modified group of four cells, which absorbs numerous other four-celled groups. The author confirms Weismann's statements that the origin of resting eggs is not connected with any influence of the male, that these eggs do not enter the brood pouch, but if not fertilised degenerate in the ovary, that the carapace of Daphnia changes into an ephippium only if the ovary is forming resting eggs, and that these eggs invariably give rise to females.

(6) The Donaciinæ, a sub-family of the Chrysomelidæ (leaf-beetles), are of special interest on account of certain peculiar features in the habitat and mode of life of the larvæ, which are fully described and illustrated in Dr. Böving's memoir, which also contains an exhaustive account of the larval anatomy. The author concludes that the features hitherto utilised to differentiate the larvæ of Hæmonia and Donacia are unserviceable; it has, in fact, not been possible to find real generic distinctions between the larvæ, although the adults present well-marked differences. Conversely, though the adults of Donacia and Plateumaris have been found to exhibit only small differences, from which it might have been expected that the larvæ would be difficult to distinguish, it is shown that the larvæ of Plateumaris, here described for the first time, are dissimilar from those of all other Donaciinæ. The larvæ gnaw the roots of certain aquatic plants (Potamogeton, Sparganum, Carex, &c.), and while doing so arrange the head and prothorax so that the latter forms with the plant a water-tight compartment in which the head can work undisturbed by, and the food be kept from admixture with, water and dirt. The mandibles of the larva have a cutting, and not a crushing, edge; they cannot be used for grinding, and, in fact, serve only to make an entry into the plant tissue, the sap of which then exudes and is received by the laciniæ of the maxillæ and passed backwards into the gut. The larvæ seem to feed exclusively on the sap; an examination of the gut contents, which consist of a homogeneous yellow fluid, shows that cell-fragments are not present. The external features of the head, the mouth parts, the muscles, and the mechanism of feeding are considered in great detail.

Aquatic insects have adopted various devices for obtaining a sufficient supply of air; the larvæ of the Donaciinæ have chosen a very remarkable one, namely, to tap the reservoirs of air in the intercellular spaces of the submerged parts of plants. At the posterior end of the abdomen is the "abdominal organ," which the author shows to be a bifore spiracle. The terminal hook of this organ is plunged into the vegetable tissue, air passes from the latter into the organ, and apparently through thin membranes into an atrium, which leads into the main trachea. The spiracular slit in the abdominal organ serves for expiration.

The making of the cocoon is described at length. The outer envelope is formed by a secretion of the whole body, and is lined with a substance produced in four large œsophageal glands; the larva gnaws one or two holes through the bottom of the finished cocoon so as to make connection with the air spaces of the root to which it is attached; air is thus secured for the pupal stage. The author gives a list of the food plants of the different species of larvæ of this family found in Denmark, and accounts of the gnawings, the sizes of the larvæ at different periods, the length of larval life, hibernation, the flying period of the adults, the eggs, and the post-embryonic development. The memoir forms a substantial addition to our knowledge of the anatomy, biology, and development of these interesting larvæ.

J. H. A.

PHYSICAL ANTHROPOLOGY OF AUSTRALASIAN RACES.

IN the Proceedings of the Royal Society of Edinburgh for the present session (1910–11) appears a series of four papers devoted to the physical anthropology of the races of Australasia. The papers are by three authors, two of them human anatomists, Prof. R. J. Berry and Dr. A. W. W. Robertson, the third a mathematician, Mr. K. Stuart Cross. The authors seek to fix the position of the Tasmanian and Australian natives amongst present and past races of mankind by applying biometrical methods to certain measurements of the skull.

The most valuable paper of the series is that by Dr. Robertson, where he gives the data obtained from measurements of 100 Australian crania. By applying Prof. Karl Pearson's test for purity of race, Dr. Robertson finds the native Australians are "pure" when the measurements of the width of the cranium is considered, but "impure" when the lengths are investigated. It will be seen that Dr. Robertson's results are somewhat equivocal, and may be quoted in support of either the unity or duality of the Australian race. Similar methods applied to the Tasmanian race show a much higher degree of homogeneity or purity. The difference in purity between the Australian and Tasmanian races may be explained by the fact that one is spread over a large continent, while the other is confined to a small island.

An attempt is also made by the authors to fix the position of the much-discussed Tasmanian race in the scale of human evolution. The result will somewhat surprise those who have sought to establish racial relationships on an analysis and comparison of mere anatomical characters, for by the methods here employed the Dschagga negro comes out as the advance guard of the human race, well in front of the European, while the native Tasmanian gains a good place, being sandwiched between two ancient Europeans—the man of Brünn and the Cro-magnon race.

From an anatomical point of view the results are surprising, for it would be hard to find greater cranial contrasts than those between the Tasmanian and Cro-magnon on one hand, and the Tasmanian and Brünn on the other. There can be no doubt, however, as to the high value of the new data with which these papers supply anthropologists.

THE PRODUCTION AND IDENTIFICATION OF ARTIFICIAL GEMS.[1]

I PROPOSE to limit the term "artificial" to such productions as possess the same chemical composition and physical constants as the natural stones, differing from them only in minute details consequent upon their being produced in the laboratory instead of being dug out of the earth, all other makeshifts being properly described as "imitations."

The scientific examination and identification of gems is a matter of the greatest interest, but it would take far too much time to discuss it in detail; and it is quite unnecessary to do so, because it has already been brought before the society most exhaustively by our chairman, Dr. Miers.[2] I propose, therefore, merely to remind you of the main points.

In order to bring this matter up to date, however, I must refer briefly to one or two particulars in which advance has been made since the time of these lectures.

The most important properties of a precious stone are those depending upon its refractive powers. Until recently, the accurate determination of the refractive index of a stone was a matter involving the use of complicated and expensive instruments, and a matter for the skilled mineralogist rather than the practical jeweller. It is true that at the time Dr. Miers published his lectures there existed an instrument known as the reflectometer, but the determination of the refractive index with this was a matter of some difficulty even in skilled hands, and its value for commercial purposes was very small. Since that time, however, thanks to the ingenuity of Dr. Herbert Smith, this instrument has been improved out of all recognition, and in its place we have the Herbert-Smith refractometer (Fig. 1), by means of which anyone of normal common sense can determine the refractive index of a stone in a few seconds without even removing it from its setting, and which, with a little practice, will also enable one to determine with similar ease the amount and kind of double refraction and the degree of dispersion.

Taking the properties of precious stones as a whole, the great point about them is the remarkable combination of qualities; it is not so much that they have optical

[1] Abstract of a paper read before the Royal Society of Arts on April 26, 1911, by Noel Heaton.

[2] Cantor Lectures on Precious Stones, April, 1896.

properties which make them extraordinarily beautiful, or that they have remarkable hardness and durability, but they have *both*, and it is the impossibility of reproducing this combination in any other material that renders the detection of imitations a matter of ease in the hands of anyone familiar with the facts.

The most important point to remember about paste is its lack of durability; it is not only too soft to stand much wear, but its composition is so unstable that it rapidly deteriorates and loses its brilliancy on exposure. You will see, therefore, that although there is a certain legitimate scope for such paste imitations, they are very unsatisfactory substitutes for the genuine article. This being the case, as scientific knowledge has advanced, attention has been more and more concentrated on the problem of producing by artificial means the actual minerals found in nature, and thus obtaining what I have defined as artificial in contradistinction to imitation jewels, having both the beauty and durability of the natural article without the objectional concomitant of enormous cost.

The first point to be considered in attacking this problem is the composition of the stone, as it is obvious that, other things being equal, the possibilities of success are greater with a stone of simple than one of comparatively complicated composition. The economic aspect has also to be considered—it is not much use devoting time and ingenuity to the production of an artificial stone when the natural one is so common that the cost of the two would be practically identical.

Commercially, we are as far from being able to produce artificial diamonds as in the days of the alchemists. It is,

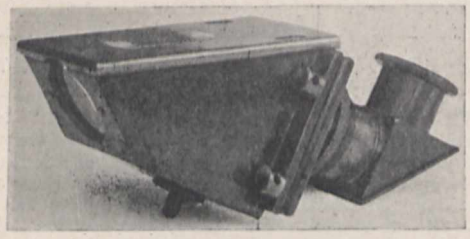


FIG. 1.—The Herbert Smith Refractometer.

perhaps, a bold thing to say that no such thing as an artificial diamond will ever be placed on the market, but one can safely assert that, so far as our knowledge stands at present, it is impracticable. In saying this, I am quite aware that statements as to the commercial production of synthetic diamonds being an accomplished fact have quite recently appeared broadcast in the public Press, but those who are responsible for such statements are (shall we say?) under a misapprehension as to the meaning generally conveyed by the term "synthetic," and are unable to follow the distinction I have drawn between an artificial gem and an imitation.

The chief problem to be faced is that of attaining the necessary temperature, and it is not surprising that crystalline alumina was produced as a scientific curiosity so far back as the commencement of the nineteenth century. It is at this time that we first begin to hear of the oxy-hydrogen blow-pipe (or the gas blow-pipe, as it was then called). The process of producing reconstructed rubies by means of the oxy-hydrogen blow-pipe is, roughly, as follows:—The residue from cutting rubies and small worthless stones is broken into coarse sand, a small quantity of which is placed on the centre of a disc of platinum; this is then carefully brought to the fusion point, care being taken at this stage not to raise the temperature to such an extent as to melt the platinum support. So soon as this mass is fused it serves to protect the platinum, and the reconstructed ruby can be built up on it by adding the fragments of ruby one at a time by means of small platinum forceps. These pieces have to be dropped on with great care in order to secure incorporation with the mass and prevent, so far as possible, the formation of air bubbles. It will be readily understood that this process is a tedious and laborious one, and, in fact, the formation of masses of sufficient size to yield large stones on cutting is a matter of such difficulty that the cost of production is very high.

Just about seven years ago, however, Verneuil[1] overcame this restriction when he hit on the extremely ingenious idea of introducing the raw material through the blow-pipe, and thus placing it on the support automatically. The blow-pipe is arranged vertically over a small insulated chamber containing the support on which the mass is to be built up. The oxygen tube communicates at its upper extremity with a funnel-shaped hopper, in which is suspended a small sieve filled with the raw material, which is rhythmically shaken by means of a small hammer actuated by an electromagnet or cam. Each time the hammer taps the support of the sieve, causing it to vibrate, a small quantity of the powder falls through into the tube below, and, carried along by the gas, passes out at its lower extremity into the zone of flame, where it is immediately raised to the fusion point, and falls as a melted globule on to the support below.

This support is arranged with a screw adjustment, so that as the mass of corundum is gradually built up by the constant addition of fresh globules the surface can be kept at a constant level, and the portion already formed removed from the zone of heating so as to allow it to stiffen. When the apparatus is first started the blow-

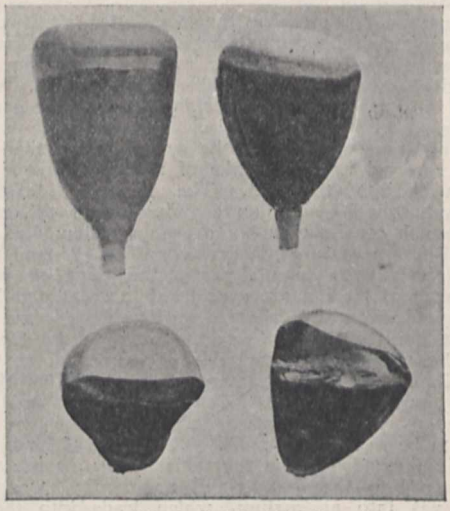


FIG. 2.—"Boules" of Artificial Corundum.

pipe is adjusted so as to give a comparatively cool flame, and the powder is admitted slowly. By this means a small "stalk" is formed, which insulates the mass from the support and prevents the fusion of the latter. When this has been formed, the full pressure of the blow-pipe is put on, and the rate of admission increased, with the consequent formation of a "boule," as it is termed, having the shape of a pear, as illustrated in Fig. 2.

With this apparatus a boule weighing some twenty to thirty carats, and capable of yielding two cut stones of about six carats each, can be prepared in about half an hour almost automatically, a single operator being able to control several machines.

The "synthetic" corundum produced in this way, if pure ammonium alum is used, is, of course, colourless, and can be used as artificial white sapphire. If a small proportion of chrome alum is added, the resulting stones are rubies, and other colours may be produced in the same way. For a long time all attempts to reproduce the fine blue of the sapphire failed. A year or so ago, however, the problem of producing synthetic sapphire was finally solved by the use of titanium oxide, a very unexpected result considering the chemical position of this element. The artificial production of the corundum gem-stone may be considered to be completely solved, and cut stones can now be obtained in every variety of colour, from pure

1 "Mémoire sur la reproduction artificielle du rubis par fusion," M. A Verneuil, *Annales de Chimie et de Physique*, September, 1904.

white to ruby and sapphire, at prices ranging from four to ten shillings a carat, according to colour, quality, and size.

Whatever may be their economic importance, a very much debated question, there can be no doubt as to the scientific interest of this group of artificial gems. In the first place, it is a matter of some interest that a mass of fused material formed in this way should not only be crystalline, but possess all the characteristics of a single crystal. Crystallographers are agreed that each boule is a single crystalline individual, with the axis roughly perpendicular to the plane of formation—that is to say, running from the point of attachment of the pedestal to the top of the mass.

Then there is the matter of coloration. One would like very much to know what is the state of combination of the chromium in a ruby, and whether the colour is produced by chromium aluminate in solution or metallic chromium in molecular suspension.

A point of more practical interest is the fact that although the artificial corundum is a true crystal, it possesses the shape and formation of a congealed liquid or glass. The practical interest of this lies in the fact that it affords the only means of distinction between this artificial corundum and the naturally formed gem-stone. Being of exactly the same composition and crystalline structure as the natural mineral, it cannot be identified by any of the physical tests I briefly referred to above. For all practical purposes, the artificial ruby *is a ruby*, and one can only deny that it is a "genuine ruby" if this

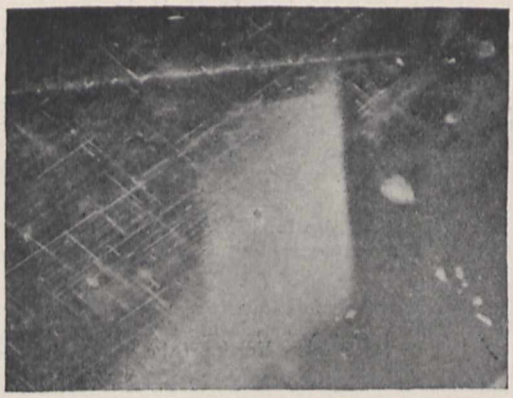


FIG. 3.—Section of Natural Ruby, ×100.

word is held to connote essentially a product found in the earth and not made by man.

And yet, owing to the curious anomaly of its structure, the artificial product can almost invariably be distinguished from the natural with the greatest ease. In the naturally formed stone any foreign matter which may be present is coerced into following the lines of growth of the crystal, and more particularly bubbles of gas which may be present in the liquid are distorted from their natural shape so as to accord with this symmetrical growth. It is the great exception to find a natural ruby entirely free from such inclusions, which generally form irregular cavities with a decided tendency to geometrical shape.

In the great majority of cases examination of the cut stone with a lens is sufficient to decide the artificial process of formation, but in doubtful cases a more minute examination may be made by placing the stone in a little cell filled with highly refracting liquid, in order to secure regular illumination, and examining it under the microscope by transmitted light, when the minutest trace of structure can be detected. In the case of an absolutely flawless stone it would be impossible to decide whether it were natural or artificial, but such stones are so rare that this case is almost theoretical.

Reconstructed emeralds have been made by the Verneuil process, but these are, of course, amorphous, and do not possess the double refraction and other properties consequent upon the crystalline structure of the natural stone. The problem of producing this stone artificially has not as yet been solved.

The opal ranks with the diamond in resisting attempts at artificial production, and is even superior to it in that it cannot be really successfully imitated.

The peculiar lustre of the pearl, like the colour of the opal, is due rather to its structure than its composition. It is formed in the oyster by the deposition of successive layers of calcium carbonate round some central object, and consists of an innumerable number of thin overlapping laminæ of the crystalline variety of this substance known as aragonite. These layers being semi-transparent, the light falling on the surface is partially reflected from the surface and partially transmitted into the stone, where it suffers reflection from the surface of lower layers.

Perhaps the well-known Japanese pearl may be correctly described as artificial pearl, although the oyster has a great deal to do with it.

Such pearls are formed by introducing a mother-of-pearl shape between the shell and mantle of the oyster, and then leaving the oyster alone for a time to allow it to convert this into a pearl by the deposition of several layers of nacre. The mass is then removed from the shell and converted into the semblance of a true pearl by supplying a back of mother-of-pearl. Such pearls, however, never have the fine orient of those produced under normal conditions, and they can readily be detected by examining the back, when the lustreless mother-of-pearl and the line of junction can be detected.

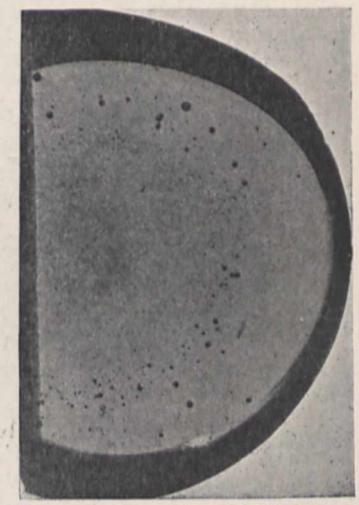


FIG. 4.—Section of Artificial Ruby, ×10.

Nobody has any right to supply anyone with paste under the name of artificial (or synthetic, or scientific, if these names are preferred) gem. I think that the distinction between the two should be clearly recognised, and that it should not be permitted to use the term artificial indiscriminately. At present this is being widely practised; every day one sees offered for sale "rubies, emeralds, sapphires, and pearls artificially produced, and having all the properties of the natural stone." Now, as I have indicated, such a thing as an artificial emerald answering this description is unknown, and, as a matter of fact, the stones supplied under this title are, as a rule, nothing more or less than paste imitations, the public being deliberately led to believe otherwise. There is in this case, as I have indicated, a real practical difference between the two articles, not merely a question of opinion.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—In the faculty of medicine an important change in the organisation of clinical teaching is being made. Hitherto this branch of teaching has been quite outside the control of the University. A clinical board appointed by the staffs of the Queen's and General Hospitals has directed the teaching and collected and administered the fees of students. In future the clinical board is to consist of nine members, of whom five will be appointed by the University and four by the two hospitals. The board will arrange all details of clinical teaching, and will nominate to the council of the University persons in the hospitals to act as clinical teachers, who will become members of the University staff. The fees for this teaching will be paid to and administered by the University. In consequence of the new arrangement, medical studies will be recognised by the Board of Education as a "technical" subject, in

aid of which a grant of money may be made—a privilege which could not be allowed so long as a part of the medical curriculum lay outside the control of the University.

CAMBRIDGE.—Mr. A. E. Shipley, F.R.S., Master of Christ's College, and Mr. P. V. Bevan, of Trinity College, have been approved by the general board of studies for the degree of Doctor in Science.

The Rede lecture will be delivered on Thursday, June 8, at 10.30 a.m., in the lecture room of the Botany School by the Hon. C. A. Parsons, C.B., F.R.S.

It is proposed that Dr. Haddon, F.R.S., and Dr. W. H. R. Rivers be appointed to represent the University at the Universal Races Congress to be held in London in July.

LONDON.—Mr. Andrew Carnegie has given a donation of 5,000*l.* towards the building and equipment of the Institute of Medical Sciences of University College.

Sir Felix Semon has offered to the University for the foundation of a lectureship in laryngology the sum of 1,040*l.*, being the amount presented to him by British laryngologists on his retirement from practice. The benefaction has been accepted by the Senate.

The degree of D.Sc. (engineering) has been conferred upon Mr. F. C. Lea, an external student, for a thesis on "Influence Diagrams as concerned with Stresses in Structures" and other papers, and the degree of D.Sc. in geology has been conferred on Mr. R. L. Sherlock, an external student, for a thesis entitled "Relationship of the Permian to the Trias in Nottinghamshire" and other papers.

It has been decided to invite the committee of the fifth International Philosophical Congress to hold the meetings of the congress in the University buildings in the spring of 1915. The following appointments have been made:—The principal (Dr. H. A. Miers, F.R.S.), representative of the University at the celebration of the centenary of the Royal Frederick University of Christiania in September, 1911; Prof. J. D. Cormack, governor of the Imperial College of Science and Technology (in place of Sir Arthur Rücker, F.R.S., resigned); Dr. Thomas Buzzard, governor of Westminster Hospital Medical School.

MANCHESTER.—To enable those taking up farming, estate management, or the teaching of agriculture to obtain a thorough scientific and practical training in agriculture, an arrangement has been made between the University of Manchester and the College of Agriculture and Horticulture, carried on by the Cheshire County Council at Holmes Chapel, by which a scheme for complete courses of instruction in agriculture has been established. A course of study leading to the degree of B.Sc. in agriculture or to the diploma of the Agricultural College may be pursued. The students take lectures and laboratory work in chemistry, physics, and biology, as well as special courses in agriculture, estate management, agricultural chemistry, agricultural botany, agricultural zoology (including entomology). The courses in agriculture and estate management and part of the course in agricultural chemistry and in botany are taken at the Agricultural College. A special prospectus has been prepared giving full particulars of the courses.

Prof. T. W. Richards, of Harvard University, who is to deliver the Faraday Lecture of the Chemical Society, is to receive the honorary degree of D.Sc. on July 8.

OXFORD.—Dr. H. L. Bowman, Waynflete professor of mineralogy, has been appointed secretary to the delegates of the University Museum, in place of Mr. H. Balfour, curator of the Pitt-Rivers Museum, who resigns the office next month.

Dr. W. T. Brooks, Christ Church, has been appointed Litchfield lecturer in medicine as from October next.

Mr. William Bateson, F.R.S., has been appointed Herbert Spencer lecturer for 1911.

THE Edward Kempton Adams research fellowship has been awarded by Columbia University to Prof. R. W. Wood, of Johns Hopkins University.

PROF. R. PATRICK WRIGHT, principal of the West of Scotland Agricultural College, has been appointed agricultural adviser to the Scotch Education Department.

WE learn from *Science* that Dr. E. B. Wilson has been designated Da Costa professor of zoology in Columbia University in succession to Prof. H. F. Osborn, who becomes research professor of zoology.

DR. H. WENHAM, of the Union Medical College, Peking, announces that for the first time in history the Chinese Government has granted a medical degree. Sixteen out of twenty-one candidates have passed the required examinations.

THE University Society of Nottingham and the East Midlands was formed on Saturday last at a meeting held at the Nottingham University College, the object of which is the furtherance of university education in the East Midland counties.

THE West Riding Education Committee has appointed Miss Helen M. Wodehouse to the principalship of the Bingley Training College, which is to be opened in September next. Miss Wodehouse is at present lecturer on philosophy in the University of Birmingham.

IT has been decided that Dr. Roberts, the secretary of the forthcoming Congress of the Universities of the Empire, shall visit Montreal in order to be present at the preliminary Conference of Canadian Universities, which is to be held in the first week of June, to ascertain the views of the Canadian universities as to the most suitable questions for discussion at the congress and to give any information respecting the steps that are being taken in the United Kingdom.

IN the April issue of *The Technical Journal*, which has now been received, a new series of articles on "Famous Technical Schools" is initiated with an illustrated description of the Glasgow and West of Scotland Technical College, by Drs. G. S. Cruikshanks and F. J. Wilson. It is proposed that the series shall not be confined to schools in the United Kingdom, but shall deal, so far as possible, also with the leading Continental and American schools.

THE fifth annual conference of the Association of Teachers in Technical Institutions will be held at Southport on June 5 and 6. Mr. Barker North, of the Bradford Technical College, will deliver the presidential address, and among the questions arranged for discussion are "The Organisation of Higher Technical Instruction," "The Representation of Teachers on Educational Bodies," "The National Organisation of Technical Education," and "The Salaries and Pensions of Technical Teachers." Further particulars of the conference may be obtained from the hon. secretary of the association, Mr. P. Abbott, The Polytechnic, Regent Street, W.

THE record of a notable achievement was contained in the final report of the building committee of the Glasgow and West of Scotland Technical College presented to a recent meeting of the governors. The committee reported the completion of the buildings, the foundation stone of which was laid in May, 1903. The buildings contain about seven acres of floor space, and the cubic contents amount to 7,292,382 cubic feet. Their cost, including professional fees and electric lighting and ventilating installations, was 272,320*l.*, or less than 9*d.* per cubic foot, although they are of the most substantial fireproof construction. The portions of the site not previously in the possession of the college were purchased for the sum of 46,153*l.*, and the equipment of the laboratories cost 34,746*l.*, making a total expenditure of 353,228*l.* The whole expenditure involved in this large undertaking has been met without the incurrence of any debt. The college received grants from the Scotch Education Department of 88,660*l.*, and voluntary subscriptions and donations amounting to 278,603*l.*; a balance of 14,000*l.* is therefore available to meet additions to the laboratory equipment now in course of construction or about to be ordered. These additions include an experimental steam turbine of the multi-stage impulse type and

of 200–250 horse-power; also a larger turbine of the reaction type. A high-speed paraffin engine of 40 horse-power and a four-cylinder petrol motor have been presented recently to the laboratory. The development of the college has kept pace with the increased accommodation. Last year a school of navigation was established, and its success has justified the governors in contemplating the purchase of a sea-going training vessel. A lectureship in sugar manufacture has also been instituted. Mr. Alfred Campion, who was appointed lecturer in metallurgy two years ago, has been raised to the rank of professor.

A MEETING of the Association of Teachers in Technical Institutions was held on May 20 at the Cardiff Technical School to consider the formation of a South Wales branch of the association. There was a representative attendance of technical teachers from Cardiff, Swansea, Newport, and the county of Glamorgan. An address was delivered by Mr. P. Abbott, the honorary secretary of the association, on "The Aims and Work of the Association." Mr. Abbott said technical education was the last branch of education to be organised, and consequently technical teachers were the last to band themselves together for the purposes of joint action. The organisation of technical education has not yet gone far, and it is probably safe to say that in this respect we are ten years behind Scotland and twenty years behind Germany. It must be recognised that conditions are changing, and that the extent of the prosperity of a country in the future will be determined more and more by the number of skilled and highly trained industrial experts that it possesses. If this work of organising technical education is to be efficient there must be cooperation. On one hand are those whose business it is to organise, administer, and finance technical education; on the other there are the teachers with an acquaintance with the calibre and the economic conditions of the students. The two classes are complementary, and for true progress the teachers must make their contributions to the solution of the problems involved. Facilities must be provided for the interchange of views and the formulation of opinions. Hence the association has the highest of all claims for the support of technical teachers. Mr. Abbott dealt at some length with the work done by the association, and especially in connection with examinations and curricula. In many respects, he said, the technical teacher is to-day in a relatively worse position than any other section of the teaching profession. Returns showed that the full-time technical teacher is usually paid worse than the secondary-school teacher. In conclusion, Mr. Abbott emphasised the national character of the association. A resolution was passed unanimously in favour of the formation of a South Wales branch.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society May 18.—Sir Archibald Geikie, K.C.B., president, in the chair.—Prof. W. M. **Bayliss**: The properties of colloidal systems. II.—On adsorption as preliminary to chemical reaction. The existence of an "adsorption compound" containing acid and base uncombined chemically, and which can be isolated, is described, together with the manner of its conversion into the true chemical compound or salt. It is shown that a similar kind of compound is formed between an enzyme and its substrate, preliminary to the particular chemical change brought about by the enzyme in question. Adsorption between enzyme and substrate as affected by the presence of neutral salts is investigated, and found to follow the laws of "electrical" adsorption. The relation between the concentration of an enzyme and its activity is shown to be expressed by an exponential formula, the value of the exponent varying considerably according to circumstances. In certain conditions it may be unity, and in others the square root, but is usually between the two. Accordingly, the view that the rate of an enzyme action at any given moment is a function of the amount of the adsorption compound of enzyme and substrate in existence at that time is to be regarded as fairly well established.—S. M. **Jacob**: Inbreeding in a stable simple Mendelian population, with special reference to cousin marriage. The paper investigates, on the basis of Mendel's conception of the segregation of unit-characters, the proportions of different types among the offspring resulting from alliances of various degrees of inbreeding. A detailed examination is made of the consequences of first-cousin marriages, the form of inbreeding most frequently met with in actual human populations, while unions of other degrees of affinity, both those closer and those more remote, are also considered. The important point is brought out that for an evil which is a Mendelian recessive and is of common occurrence, a first-cousin marriage will not be much more likely to produce defective offspring than any other kind of marriage, but that a very rare recessive evil is relatively far more readily developed by such a consanguineous marriage. Now it is probable that there are very many of these rare defects latent in man. As the chance of a *particular* one of these appearing is increased by cousin marriage, the appearance of any random one of the large number is rendered much more probable by such a union. The same is true, on the Mendelian hypothesis, for any desirable qualities when such can be shown to be recessive. It is also established that the relative frequency of the appearance of the allogenic constituent in the offspring of related pairs diminishes by about one half for each grade of cousinship, so that the efficacy of cousin marriages in developing the recessive character diminishes with the grade of the marriage. In general, inbreeding accentuates both the pure dominant and the pure recessive strain to the same extent and at the expense of the hybrid element.—Miss M. **Wheldale**: The direct guaiacum reaction given by plant extracts. Previous work on oxidising enzymes has led to the interpretation of the direct blueing action in terms of the activity of a system consisting of an organic peroxide in conjunction with a peroxidase. The author finds that the power to give the direct action possessed by water-extracts of tissues is accompanied by another phenomenon, *i.e.* the formation of brown or reddish-brown pigments in the tissues on exposure to chloroform vapour. Both phenomena are characteristic of certain natural orders, but are absent from others or are characteristic of certain genera only in an order. When the direct action is not given, the plant extract will blue guaiacum on addition of hydrogen peroxide (indirect action), and the tissues do not show change of colour in chloroform vapour in the same period of time. The phenomenon of direct blueing of guaiacum is considered by the author to be the outcome of the presence of the dihydric phenol-pyrocatechin in the plants examined. Pyrocatechin is oxidised on the death of the tissues, and then acts as a peroxide, enabling the peroxidase, which is almost universally present, to transfer oxygen to the guaiacum. These conclusions are based on the following evidence:—(1) that pyrocatechin can be detected in plants (such as have been examined) which give the direct action and show change of colour in chloroform, whereas it cannot be detected in plants lacking these characteristics; (2) that solutions of both chemically prepared pyrocatechin and the actual plant product, after oxidation in air, will give a direct action with guaiacum and peroxidase only. The same result is not obtained with phenols having the hydroxyl groups in other positions. Hence the *direct* guaiacum reaction has, in all probability, no real significance as such in plant metabolism, but is merely the outcome of the presence of a certain metabolic product.—Dr. A. **Theiler**: Transmission of amakebe by means of *Rhipicephalus appendiculatus*, the brown tick. This is an account of experiments carried out at Pretoria, confirming the result arrived at by the Sleeping Sickness Commission during 1909, that the disease of calves in Uganda, known as amakebe, is in reality East Coast fever. It was arranged with the Government veterinary surgeon in Uganda, Mr. Hutchins, to send to Dr. Theiler nymphæ of *Rhipicephalus appendiculatus*, the brown tick, collected from calves in Uganda suffering from amakebe. On several occasions Mr. Hutchins forwarded ticks, which arrived at Pretoria alive and in good condition. The nymphs in transit moulted into the adult stage. Two experiments were performed to ascertain whether brown ticks, collected as nymphæ in Uganda from a calf suffering from amakebe, will transmit the disease when placed on susceptible calves in the

Transvaal. The first experiment, a bull calf, born and reared in Onderstepoort, was infested on January 23 with ten adult brown ticks, forwarded from Entebbe, Uganda, and received in the Transvaal on January 4. The ten ticks were found attached to the calf the following day. The animal died on the twenty-third day after tick infestation, and from the course of the disease and the *post-mortem* examination, a diagnosis of East Coast fever was concluded. Koch's bodies were found *post mortem* on microscopical examination of preparations of the lymphatic glands and spleen. The second experiment was carried out in a similar manner. On February 14 a calf was infested with ten adult brown ticks of the same batch, obtained from Uganda. On February 15 seven of the ticks were found attached. After an incubation period of thirteen days, a typical fever curve ensued. The animal died on the twenty-fourth day. During the course of the disease, Koch's bodies were found in the glands, and *Theileria parva* in the red cells of the blood. A diagnosis of East Coast fever was also concluded from the *post-mortem* examination in this case. Koch's granules were frequently found *post mortem* in the lymphatic glands and spleen.—S. J. **Meltzer**: Distribution and action of soluble substances in frogs deprived of their circulatory apparatus.—Dr. F. W. **Edridge-Green**: The discrimination of colour. If a definite portion of spectrum be isolated it will appear monochromatic, the size of the monochromatic region varying with the luminosity and wave-length of the light and the colour perception of the observer. Lord Rayleigh has expressed the opinion that he can discriminate between the colours in a monochromatic region even to the extent of distinguishing between the colours of the two D lines. The author does not find this possible when special precautions are taken to have a pure spectrum and to avoid the physiological effect of contrast through varying intensities of the areas to be compared. The monochromatic area may be magnified without altering its monochromatic appearance, the intensity of the light source being increased to compensate for the diminished luminosity. The monochromatic area may also be examined through a double-image prism, or be projected by means of a double-image prism upon a screen, so that the violet side of one area is adjacent to and just touches the red side of the other area. In this way the monochromatic area may be made as large as desired, the intensity of the source of light being increased as required. An arc light gives two very bright areas of colour. This method is the most favourable for the detection of any difference; the monochromatic areas, however, still remain monochromatic.

Royal Meteorological Society, May 17.—Dr H. N. Dickson, president, in the chair.—Dr. H. R. **Mill** and C. **Salter**: The frequency and grouping of wet days in London. The purpose of this paper is to place on record certain facts, derived from the long homogenous records of rainfall kept at Camden Square, bearing on a recent scheme for insurance against rain risks. Days with a rainfall exceeding ·20 in. only are dealt with, as this is the limit adopted in several of the policies of insurance. The discussion is, of course, strictly applicable to London only, but it will probably apply fairly well to other inland stations in the south-east of England. The authors have examined a number of instances in which an insurance under one or two of the forms of policy offered would have resulted in a claim had a person in London insured every day for the week commencing that day during the whole period of fifty-two years. The actual compensation yielded by each 1*l.* invested during each seven-day period from 1859–1910 would have been as follows:—

Policy	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
A ...	8/8	6/5	6/10	4/1	4/9	11/3	10/7	11/1	10/1	18/10	15/3	11/1	10/-
B ...	9/1	8/6	7/10	7/7	9/1	11/3	11/4	10/10	10/-	13/10	12/8	10/8	10/9

E. **Mawley**: Report on the phenological observations for 1910. The most noteworthy features of the phenological year ending November, 1910, as affecting vegetation were the continuous and heavy rainfall in February, a sudden change from cold to warm weather in the middle of May, the great dryness of September, and the heavy rains and low night temperatures in November. During the greater part of the year wild plants came into blossom behind their usual time, the departures from the average being greatest at the end of April and the beginning of May. Such early spring migrants as the swallow, cuckoo, and nightingale made their appearance at about their usual dates. The only deficient farm crops were wheat, barley, and peas. On the other hand, the yield of oats, beans, potatoes, turnips, mangolds, and hay were above the average, and more especially beans, turnips, and hay. The crop of apples, pears, and plums was much under average, while all the small fruits, except strawberries, which yielded well, were also rather under average.

EDINBURGH.

Royal Society, March 20.—Prof. T. Hudson Beare, vice-president, in the chair.—Dr. J. R. **Milne**: Measurements on the scattering of light by "ground" glass. Certain preliminary experiments on the scattering power of various kinds of ground glass were described, as well as the form of apparatus which had been designed for the purpose of the research.—Margaret B. **Moir**: The magnetic properties of certain steels at moderate and high temperatures. The experiments were made in the physical laboratory of Glasgow University. In every case the specimen was rendered neutral at the new temperature previous to carrying out the tests. It is essential that this point should be attended to, and much of the previous work on magnetisation at various temperatures left a good deal to be desired in this respect. One result of interest was the discovery of a transformation point for carbon steel in the neighbourhood of 200° C. The changes in susceptibility which accompany the transformation are very distinct in cast iron and high carbon steels, not so marked for medium carbon steel, and imperceptible for soft iron.—Dr. J. A. **Gunn**: The pharmacological action of harmine. In this paper the actions of harmine were shown to be qualitatively very similar to those of harmaline, previously described by the author.

PARIS.

Academy of Sciences, May 8.—M. Armand Gautier in the chair.—P. **Appell**: The linkages expressed by the non-linear relations between the velocities.—Ch. **Lallemand**: The survey of the levels of Alpine valleys, with especial reference to the water-courses.—A. Michel **Lévy** and A. **Lacroix**: The materials of the rhyolitic and trachytic eruptive explosions of the volcano of Mont Dore. Details and discussion of two complete analyses of the rhyolitic pumice and four of the trachytic pumice.—A. **Müntz** and A. **Lainé**: The phenomena of the purification of sewage by the soil and by bacterial beds. It has been shown in a recent paper by the authors that in bacterial beds the destruction of organic matter by direct combustion takes place, and that this effect is greater than the nitrification. A study has now been made of purification by soil under ordinary agricultural conditions, and it has been found that the conditions of purification are different; in the bacterial beds combustion preponderates and nitrification is a secondary phenomenon, in soil nitrification predominates. The conclusion is drawn that soil is much superior as a nitrifying medium to bacterial beds.—M. **de Forcrand**: The hydrates of rubidium and cæsium fluorides.—Paul **Sabatier** and A. **Mailhe**: The catalytic decomposition of formic acid. From the reactions already known, formic acid might be expected to split up under the action of catalytic agents in three ways, giving carbon dioxide and hydrogen, carbon monoxide and water, or formaldehyde, carbon dioxide, and water respectively. The change into carbon dioxide and hydrogen is produced by platinum sponge, reduced copper, nickel, cadmium, and the oxides of zinc and tin. The second reaction is furnished by titanium dioxide and by the blue oxide of tungsten. Many substances, including thorium oxide, give all three reactions simultaneously.—L. **Cailletet**: The origin of the carbon assimilated by plants. The plants used in these experiments, according to the conditions of illumination, could take their carbon either from atmospheric carbon dioxide or from the organic material contained in the soil, or from both at once.—C. **Juel**: Simple cubic surfaces.—H. **Larose**: Trigonometrical developments with non-orthogonal components.—Georges **Rémoundos**:

The minimum modulus of integral functions.—M. **Riquier**: The existence of integrals satisfying given conditions along a contour.—Michel **Plancherel**: The application of Laplace's series to the method of summation of M. de la Vallée-Poussin.—Louis **Roy**: Viscosity in the motion of flexible wires.—H. **Vergne**: A development in series and its application to the problem of liquid waves by emersion.—L. **Hartmann**: The mechanism of the permanent deformation in metals submitted to extension. A description of the application of the method previously published to aluminium, nickel, two ferro-nickel alloys, copper-nickel, and other alloys.—J. **Olive**: Experiments made with the installation for aërodynamical measurements of the aviation establishment of Vincennes. The installation has for its object aërodynamical measurements on apparatus of full size displaced in calm air. Results are given for a Wright aëroplane.—M. **Rabut**: Partial tunnelling under the Rue de Rome and Boulevard des Batignolles. In the extension of the width of the line it was necessary to cut under these streets, portions of which were then supported on brackets of reinforced concrete.—L. **Houllevigue**: A radiation emitted in the interior of incandescent lamps.—A. **Leduc**: The work of magnetisation.—H. **Woltereck**: The production of ammonia and the economy of nitrogen in peat. It is shown that the treatment of peat by steam alone produces only one-third the quantity of ammonia obtained under similar conditions by the use of a mixture of steam and air.—G. **Charpy** and S. **Bonnerot**: The gases contained in steels. A source of error noted in these experiments was the slow evolution of gas due to a reaction between the heated metal and minute traces of water given off in the mercury pump. Extra precautions against this water vapour gradually diminished the continuous evolution of gas, but it could not be completely stopped.—Ed. **Chauvenet**: The action of carbon oxychloride on artificial and natural sulphides. The action of carbon oxychloride upon nine sulphides of different metals has been studied. The temperature of the reaction was in no case higher than 450° C., and in each case the normal chloride was the sole product. Examples are given of the application of the reaction in quantitative analysis.—F. **Bodroux** and F. **Taboury**: The bromination of some hydroaromatic compounds. Cyclohexane, prepared by the Sabatier and Senderens method, is not sensibly attacked by bromine in the dark at the temperature of the boiling point of the hydrocarbon. In sunlight the action is regular, hydrobromic acid being evolved and a good yield of cyclohexyl bromide being produced. Ultra-violet light cannot replace sunlight in this reaction. Higher bromine derivatives were also prepared.—M. **Lanfry**: A dinaphthothiophene.—P. **Freundler**: Researches on the oxyindazoles.—G. **Gauthier**: The synthesis of tertiary α-ketonic alcohols. Cyanhydrins are first prepared by the interaction of hydrocyanic acid and ketones, and these treated with an alkyl magnesium iodide. Three examples of the application of this general method are given.—A. **de Schulten**: The crystallographic examination of some fluorides obtained by M. Henri Moissan and his pupils.—V. **Vermorel** and E. **Dantony**: An anticryptogamic colloidal copper solution. Full details are given for the preparation of the new solution, which possesses certain advantages over those in current use.—M. **Marage**: Contribution to the study of consonants.—N. A. **Barbieri**: The mobility of neuroplasma.—Pierre **Lesne**: The battle against the caterpillar *Zeuzera pyrina*.—E. **Bataillon**: Embryogenesis provoked in the virgin egg of Amphibia by inoculation with the blood or sperm of a mammal. Traumatic parthenogenesis and impregnation without amphimixia.—MM. **Bordas** and **Touplain**: The original acidity of milk. The original acidity of milk, using phenolphthalein as indicator, is due exclusively to the free casein.—M. St. **Mostowski**: The glycogenic property of dioxyacetone.—E. **Kayser**: Beer yeast juice.

May 15.—M. Armand Gautier in the chair.—H. **Deslandres** and V. **Burson**: The laws relating to the movements of the solar protuberances. A study of the displacement of the K_3 line. The variations observed appear to correspond with the assumption that the velocity of rotation increases with the altitude, at least in the layers immediately above the chromosphere. No light has been thrown on the question as to whether the displacements east and west are equal or unequal.—J. **Carpentier**: The ophegraph, designed by M. Guillery. An account of an instrument for drawing tangents to a given curve by mechanical means. By means of this instrument, given a curve representing a function, the curve of the first differential of this function can be obtained graphically.—A. **Blondel**: Harmonic functions determined by certain conditions at the contour.—A. **Chatelet**: Abelian bodies of the third degree.—Ch. **Bertin**: A table of positions for purposes of navigation.—Captain **Duchène**: Good control of the aëroplane in air in motion. A description of two additions to an aëroplane, one designed for preserving longitudinal equilibrium, the other for transversal equilibrium.—M. **Yvon**: Cataphotography. Remarks on a recent publication of M. Guillaume de Fontenay.—Guillaume **de Fontenay**: Cataphotography. Acknowledging the priority of M. Yvon.—M. **de Broglie**: A particular case of distribution of ionisation in a gas. A very thin superficial layer containing ions of both signs. In the case of the ionisation of air by sulphate of quinine at the surface of the salt during the variations in hydration, there is an infinitely thin layer containing a high density of ions of both signs.—L. **Décombe**: A physical interpretation of non-compensated heat.—H. **Pélabon**: The resistivity of the selenides of antimony. From measurements of the specific resistances of various fused mixtures of antimony and selenium it was hoped to get some evidence as to the existence of definite compounds of these two elements. It was found, however, that the differences in resistance caused by tempering or annealing were so large that no definite conclusions could be deduced from the experimental figures.—A. **Rosenstiehl**: Some historical data relating to osmotic pressure.—Marc **Landau**: The action of the ultra-violet rays upon lactic acid. The gas evolved was mainly carbon dioxide, with some carbon monoxide. Ethyl alcohol, together with traces of pyruvic acid and an aldehyde, were detected.—Camille **Matignon**: The presence of zinc nitride in zinc dust and in commercial zinc. Zinc nitride appears to be present in all commercial samples of zinc dust. It is also met with, although in extremely small quantities, in certain solid zincs.—Pierre **Jolibois** and Eugène L. **Dupuy**: The definite compounds of arsenic and tin. From the metallographic study of a series of alloys of tin and arsenic only two compounds could be clearly defined. These had the composition of Sn_4As_3 and SnAs.—G. **Darzens**: A new method for the esterification of alcohols by the hydracids. The alcohol is treated with thionyl chloride and a tertiary base (B) such as diethylaniline, quinoline, or pyridine, when the reaction

$$R.OH + SOCl_2 + B = RCl + SO_2 + B.HCl$$

takes place quantitatively. A similar reaction with $SOBr_2$ gives good yields of bromides.—A. **Petit**: The fixing of phosphoric acid by the organic matter of the soil. Soils rich in organic matter do not fix any appreciable amounts of phosphoric acid.—Paul **Becquerel**: The supposed production of new plant forms by the method of traumatisms. The author concludes that neither in his own experiments with Zinnia nor those of M. Blaringhem with maize have new forms been really produced.—H. **Hallopeau**: The region of primary invasion of syphilis.—Albert **Berthelot**: Researches on di-iodotyrosine and its possible utilisation in therapeutics. Experiments made with 3 : 5-di-*l*-iodotyrosine showed that it is well tolerated by man and by animals, and promises to be a useful means of introducing relatively large quantities of iodine into the body without prejudicial after effects.—Jules **Amar**: Walking on an inclined plane.—P. **Achalme** and M. **Bresson**: The influence of the viscosity of the medium upon diastatic actions. An increase in the viscosity of the liquid, produced by the addition of glycerol, exerts a reducing influence on diastatic action which is very great compared with the variations introduced by other factors. The full discussion of the theoretical bearing of these experiments is reserved for a later paper.—Armand **Juillet**: Comparative observations on the relations between the lungs and the aërial sacs in birds.—J. **Wolff**: Some phenomena of reduction of oxyhæmoglobin. If the colouring matter is repeatedly reduced by ammonium sulphide and oxidised by shaking with air, after twenty-five or thirty times the

blood pigment is entirely destroyed. When, however, a biological reducing agent, such as the coccus obtained from a maceration of cheese, is employed, the alternate reduction and oxidation can be reproduced almost indefinitely.—Augustin **Wroblewski**: The soluble ferments of the brain. The presence of catalase, peroxydase, and lipase was proved.—Gabriel **Bertrand** and M. **Javillier**: The influence of zinc and manganese on the mineral composition of *Aspergillus niger*.—Jules **Stoklasa**: The physiological importance of manganese and aluminium in the plant cell.—R. **Lehmann** and C. **Vaney**: Percentages and qualities of the skins attacked by larvæ of Hypoderma in the Lyonnaise district.—Jules **Chalande**: Segmentary division in the myriopods.—E. **Roubaud**: The biological and morphological variations in *Stomoxe mutin* in tropical Africa.—A. **Gruvel**: Contribution to the systematic study of the Palinuridæ.—Pierre **Kennel**: The adipo-lymphatic bodies of some batrachians.—A. **Dehorne**: Nuclear permutation in the conjugation of *Colpidium colpoda*.—G. **Le Cadet**: The registration of a seismic shock by the large Richard barograph at the central Observatory of Indo-China.

DIARY OF SOCIETIES.

THURSDAY, MAY 25.

ROYAL SOCIETY, at 4.30.—Experiments on the Compression of Liquids at High Pressures: Hon. C. A. Parsons, F.R.S., and S. S. Cook.—Energy Transformations of X-rays: Prof. W. H. Bragg, F.R.S., and H. L. Porter.—Spectroscopic Investigations in connection with the Active Modification of Nitrogen. I. Spectrum of the Afterglow: Prof. A. Fowler, F.R.S., and the Hon. R. J. Strutt, F.R.S.—An Optical Method of Measuring Vapour Pressures; Vapour Pressure and Apparent Superheating of Solid Bromine: C. Cuthbertson and Mrs. M. Cuthbertson.—The Vacuum-tube Spectra of Mercury: Dr. F. Horton.—The Production of Characteristic Röntgen Radiations: R. Whiddington.

ROYAL INSTITUTION, at 3.—Air and the Flying Machine. II. Conditions of Safety for Floaters and Fliers: Dr. W. N. Shaw, F.R.S.

ROYAL SOCIETY OF ARTS, at 4.30.—N.W.F. Province of India: W. R. H. Merk.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Heating of Cables with Current: S. W. Melsom and H. C. Booth.

SATURDAY, MAY 27.

ROYAL INSTITUTION, at 3.—Phases of Bird Life. II. Migration: W. P. Pycraft.

ARISTOTELIAN SOCIETY (at Oxford in conjunction with Mind Association).—A Symposium on the Relation of Psychology to Metaphysics: G. F. Stout and A. Smith.

MONDAY, MAY 29.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geographical Conditions affecting the Development of Canada: Prof. W. L. Grant.

ARISTOTELIAN SOCIETY, at 8.—A New Law of Identity: Miss E. E. C. Jones.

TUESDAY, MAY 30.

ROYAL INSTITUTION, at 3.—The Ancient Volcano of Charnwood Forest (Leicestershire): Prof. W. W. Watts, F.R.S.

WEDNESDAY, MAY 31.

INSTITUTION OF MINING AND METALLURGY, at 8.—Future Economies in Rand Reduction Plants: C. O. Schmitt.—The Roasting of Complex Ores in Gold Assaying: A. C. Hoare.—A Prospector's Method of Gold Assay: G. M. Austin.

THURSDAY, JUNE 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Experiments on the Restoration of Paralysed Muscles by means of Nerve Anastomosis: Dr. R. Kennedy.—The Mechanism of Carbon Assimilation. Part III.: F. L. Usher and J. H. Priestley.—The Action of Radium Radiations upon some of the Main Constituents of Normal Blood: Miss Helen Chambers and Dr. S. Russ.—The Pathogenic Agent in a Case of Human Trypanosomiasis in Nyasaland: H. S. Stannus and Dr. W. Yorke.—The Experimental Transmission of Goitre from Man to Animals: Capt. R. McCarrison.

ROYAL INSTITUTION, at 3.—Changes Effected by Light: T. Thorne Baker.

RÖNTGEN SOCIETY, at 8.15.—On a Possible Therapeutic Use of Strongly Ionised Air: C. E. S. Phillips.—Photographic Action of the Positive Brush Discharge: Charles W. Raffety.

LINNEAN SOCIETY, at 8.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—A Flame Test for the Estimation of Oxygen and Black-damp in Naked-light Mines: Dr. J. S. Haldane, F.R.S.—An Experiment on the Effect of Reversing the Main Air-current: James Bain and Dr. J. S. Haldane, F.R.S.—Notes on Contrivances Designed to Prevent Overwinding, with some Instances of their Failure: W. H. Pickering and Granville Poole.—The Otto-Hilgenstock Direct-recovery Process and its Application: Ernest Bury.

FRIDAY, JUNE 2.

ROYAL INSTITUTION, at 9.—Radiotelegraphy: Commendatore G. Marconi.

SATURDAY, JUNE 3.

ROYAL INSTITUTION, at 3.—Types of Greek Women: Dr. W. L. Courtney.

FORTHCOMING CONGRESSES.

MAY 30.—International Sanitary Conference (Prevention of Plague). Paris.

JUNE 28 and 29.—Conference on Education and Training of Engineers. London. President: Mr. Alexander Siemens, President of the Institution of Civil Engineers. General Secretary: Dr. J. H. T. Tudsbery.

JULY 18–22.—International Association of Seismology. Manchester. President: Prof. Arthur Schuster, F.R.S.

JULY 25–28.—British Medical Association. Birmingham. President: Dr. H. T. Butlin, Pres.R.C.S.

JULY 26–29.—First Universal Races Congress. University of London. President: Lord Weardale. General Secretary: G. Spiller, 63 South Hill Park, Hampstead, London.

JULY 29 TO AUGUST 5.—Congress of French Geographical Societies. Roubaix. President: Prince Roland Bonaparte.

JULY 30 to AUGUST 2.—Annual Meeting of the Swiss Society of Natural Sciences. Soleure. President: Dr. A. Pfaehler. Inquiries to Secretaries: Dr. Küng (German) and Prof. Brönnimann (French).

AUGUST.—Centenary of the Foundation of the University of Breslau.

AUGUST 12–18.—First International Congress of Pedology. Brussels. President: M. Alexis Sluys. Secretary: M. Vital Plas, 35 Avenue Paul de Jaer, Brussels.

AUGUST 13–20.—Prehistoric Society of France. Nîmes.

AUGUST 31 TO SEPTEMBER 6.—British Association. Portsmouth. President: Sir William Ramsay, K.C.B., F.R.S. Address for inquiries: General Secretaries, Burlington House, W.

SEPTEMBER 4–6.—Centenary of the University of Christiania. President of Festival Committee: Prof. Brögger.

SEPTEMBER 9–20.—International Congress of the Applications of Electricity. Turin. President of the Committee of Honour: H.R.H. the Duke of the Abruzzi. Honorary Secretary of the Committee: Signor Guido Semenza, Via S. Paolo 10, Milano. International Secretary: Col. R. E. Crompton, C.B., R.E., Crompton Laboratory, Kensington Court, W.

SEPTEMBER 24–30.—International Congress on Tuberculosis. Rome. Address for inquiries: Honorary Secretary of the National Association for the Prevention of Consumption, 20, Hanover Square, W.

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