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University Appeals.

A FEW weeks ago announcement was made that in a lightning campaign the sum of 1,580,000*l.* had been obtained as a centennial endowment fund for McGill University, Montreal. The amount subscribed exceeded what the campaign was started to raise, and it included contributions of one million dollars each from the Government of the Province of Quebec and the Rockefeller Foundation.

There have recently been three similar appeals for funds for university institutions in this country; but, whatever may be the ultimate result, they have not yet been marked by the ready and overflowing aid rendered to McGill University. In October last the University of Birmingham appealed for 500,000*l.* to relieve the financial strain under which it is working, and in December the University of Leeds, as well as the University Colleges of Newcastle-upon-Tyne—the College of Medicine and Armstrong College—each asked for a like amount to enable them to adjust themselves to the conditions in which they have been placed by the devaluation of monetary standards, greatly increased expenses, and an overwhelming influx of students. Scarcely a single university can now meet its financial obligations, and all of them need additional funds to provide accommodation in the form of lecture-rooms and laboratories and new members of the teaching staff to bring the classes within reasonable proportions.

It is not generally realised outside university institutions how greatly the number of students in them has increased since the war. In the year 1912–13 the number of university students in the British Isles was roughly 27,000, or just under six per ten thousand of the population. At the present time the number is more than 40,000, and is approaching one per thousand of the population. There are about as many ex-Service men alone undergoing some form of higher education in universities and colleges, with the assistance of Government grants, as the total number of whole-time university students in these islands before the war. To some extent, no doubt, the increase represents an accumulation of students who were prevented by active service from taking the university courses they had contemplated; but even allowing for this, there is decided evidence that a growing desire exists for the highest and best education the country can provide.

The fees paid by university students can never represent more than a moderate fraction of the total income. In the year 1913–14 the total income of colleges and institutions of university standing in England in receipt of grants from the National Exchequer was about 700,000*l.*, of which 28 per cent. was derived from tuition fees and 34 per cent. from the State. In Welsh institutions 27 per cent. of the total income came from fees and 55 per cent. from the State. (At that time, therefore, the greater part of university education in England and Wales could have been freed from all fees by an additional sum of about 200,000*l.*) Details are not available to show similar proportions at the present time, but it is probably correct to say that students' fees provide about 30 per cent. of the income of university institutions.

This contribution is much higher relatively than that made by students in State-aided institutions in the United States. At Cornell University in 1914–15 the fees were 20 per cent. of the income; at the University of California 10 per cent.; and at Oklahoma only 2 per cent. On an average, the proportion of tuition fees to the incomes of our universities is at least three times that of like institutions in America. It would be unreasonable, as well as detrimental to the best national interests, therefore, to suggest that our universities might look for additional income by increasing the charge for the education provided.

The sources from which the necessary funds must be obtained are private benefactions, local authorities, or the Treasury. It must be confessed that with regard to the first of these we are far behind the New World. In the three years 1916–19 the universities of the British Isles received in gifts from private bodies and individuals a little more than one and a half million pounds—almost exactly the amount that friends of McGill University recently collected in the same number of weeks as the result of their appeal for further endowment. The benefactions to university institutions in the United States amount annually, indeed, to at least ten times what is received from private sources in our islands for like purposes. It cannot be said, therefore, that the field of private benefaction here has been exhausted, but only that it has not yet been stimulated into action as it has been in the United States. Whatever the reason, our millionaires, with few exceptions, have not shown that belief in higher education which is common across the Atlantic, and of which every week brings us further examples.

These are difficult days in which to extract support for higher education from local ratepayers, yet something might be done to adjust the charge more evenly in some parts of the country. County authorities often leave the boroughs in which university institutions exist to bear the greater part of the burden, though students from their areas partake freely of the advantages offered. The time has come when a complete survey should be made of the present position as regards the provision of higher education in all parts of the country, the habitations of the students, contributions of local authorities, and related matters. It might then be possible to secure equitable payment in rates for benefits received.

Failing substantial gifts from private benefactors, and with the ratepayer unwilling to add to his commitments, universities must turn to the Treasury for further support if they are to continue to exist. The Civil Service Estimates for 1920–21 included a total grant of 1,000,000*l*. to be paid out of the Exchequer for the maintenance of university institutions in the United Kingdom. This grant is inadequate to enable the universities to fulfil efficiently the duties which have been placed upon them. The bulk of the students—more than 25,000 out of 40,000—are ex-Service men receiving maintenance grants from the Government. The State has undertaken to provide for the training of these students, and the universities ought not to be left to face the financial difficulties in which they are involved chiefly because of the additional provision they have to make for means of instruction. Assuming the expenditure to be as economical as efficiency will permit, it would seem but an act of common justice for the Treasury grant to be increased to meet it while the ex-Service men are under training. While we trust that the recent appeals will meet with most generous support from rich citizens, we suggest that the State should also accept more fully its responsibility for the desperate condition in which many university institutions now find themselves.

The Theory and Practice of Psycho-analysis.

(1) *The Elements of Practical Psycho-analysis.* By P. Bousfield. Pp. xii+276. (London: Kegan Paul, Trench, Trubner, and Co., Ltd., 1920.) Price 10*s*. 6*d*. net.

(2) *Psychoneuroses of War and Peace: Thesis Approved for the Degree of Doctor of Medicine in the University of London.* By Dr. Millais Culpin. Pp. vii+127. (Cambridge: At the University Press, 1920.) Price 10*s*. net.

(3) *A Manual of Psychiatry.* Edited by Dr. A. J. Rosanoff. Fifth edition, revised and enlarged. Pp. xv+684. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1920.) Price 22*s*. net.

THE subject of psycho-analysis is one that is looming very large on the psychological horizon at the moment, and as these three books have a considerable bearing on the matter, a few words on the general principles involved may not be out of place.

Meaning literally an analysis of the mind, the application of the term has come to be limited to a special technique originated and elaborated by Freud and his followers. It has long been known that the mind is capable of many activities which may be quite outside the consciousness of the individual concerned, and Janet, the French psychiatrist, pointed out that the curious losses of memory and other symptoms occurring in cases of hysteria were due to a splitting up or a dissociation of the mind. This dissociation was regarded as a purely passive disruptive process owing to the difficulty found by the individual in making a satisfactory adjustment to certain environmental factors. Freud, however, introduced the conception of an active process of splitting of the mind which he described as repression. His theory was to the effect that an unpleasant experience which, if retained in the memory, would disturb the equilibrium and peace of the conscious mind was liable to be repressed, and thenceforward to be retained in the unconscious mind with the limitation of being unrecallable to consciousness.

Such repressed ideas or memories still, however, had the power of influencing the stream of consciousness, and particularly if they were associated with the experience of a vivid, emotional reaction at the time of their original inception; it is as if the repressed idea took down with it into the unconsciousness a mass of emotional energy which, being unable to disperse through the consciousness by the normal channels of expression, remained a hidden focus of unrest and disturbance to the proper functioning of the mind as a whole. The technique of psycho-analysis was then adapted for the searching of the mind by a method of free association and by the examination of dreams so that the active repression was circumvented. The result was that the hidden idea, with its emotional attachment, technically a complex, was restored to the consciousness, and the emotion dispersed by proper expression and by the relief of the symptoms to which it had hitherto given rise.

Up to this point the mass of opinion is entirely in agreement as to the value of the Freudian conception, and the method of an unbiassed search for forgotten or repressed complexes by a psychological analysis of the mind is in common use by modern investigators in the subject. Unfortunately, however, Freud carried his theory to a stage to which a great deal of exception must be taken. He claims that all these repressed ideas are invariably associated with the experience of some sexual emotion, and by an ingenious system of thought he demonstrates conclusively to himself and his devotees that all experience is referable in terms of sexual satisfaction or dissatisfaction. Thus the sensations of the infant suckling at the breast are to be regarded as essentially sexual in their nature; the affection of a child for its parent is a manifestation of a homo-sexual tendency when it is directed to the similar-sexed parent, and is of hetero-sexual import if the affection be shown to the opposite-sexed parent.

Much use of the phenomena of symbolism is made by the Freudians in the interpretation of dreams as sexual representations, but for those readers who are interested in the matter, and who may look into some of the Freudian writings, it is only right to point out that a proposition such that the sexual organs of the male may be symbolised by any elongated object—*e.g.* a walking-stick, a Zeppelin, etc.—though quite defensible in the positive sense, may yet be quite indefensible when applied in the negative direction. Thus if a patient dreams that he has bought a new walking-stick, or that he is being chased by a Zeppelin, one cannot permit oneself to be satisfied with the deduction that here is undoubted proof of the sexual origin of the dream; yet on such grounds are many of the most advanced Freudian dogmas based.

Psycho-analysis, then, is the process by which all the symptoms and dreams of a patient are reduced to terms of sex, as opposed to the psychological analysis in which due regard is paid to the existence of other instincts, and bitter has been the conflict between the adherents of the two schools of thought. Of late there has been schism amongst the leaders of the psycho-analytic movement. Jung states that the sexual impulse is not the all in all of psychology, but that a more general "vital impulse" is at the root of all the trouble; Brill asserts that it is not the sexual instinct, but the fundamenal "desire for power" which, by its expression or repression, is the cause of all the psychological ills; Freud himself has said that there are other instincts, but that none but that of sex has yet been investigated. It may, therefore, be deduced that the psycho-analytic cult will gradually lose its virulence and a more rational view hold the field.

(1) It is, then, with no little surprise that one finds a book such as Mr. Bousfield's "Elements of Practical Psycho-analysis" being written at the present day. In his introduction the author says that it was written so that readers without any systematic study of psychology may easily grasp the psycho-analytic principles. This is a bad commencement; no one should attempt an examination of a debatable subject like this without some understanding of the modern views on the mind, and certainly no one should be allowed to practise the technique without a proper psychological training. However, apart from its aims, the book is purely a simplified and dogmatic child's version of the thorough-going Freudian views; the most indefensible assumptions are given as undisputed facts, and throughout the book only the sexual instinct appears to have any practical bearing on the matters under discussion. It is interesting to note that the author precisely dissociates himself from Freud on the very point of the acknowledgment of the existence of other instincts, which acknowledgment, as already stated, Freud has himself made; but the crowning feature of the book is the last chapter, in which the author attacks the Freudian acceptance of the theory of determinism. We hope that, for the sake of his own peace of mind, Mr. Bousfield will soon make the discovery that determinism has only a purely philosophic bearing on the question of psycho-analysis, and that a discussion on this point is out of place in an avowedly practical text-book. The last chapter, apart from the rest of the work, makes one wonder whether Mr. Bousfield does not belong, as do his anticipated readers, to the ranks of those who have had no previous systematic knowledge of psychology.

(2) It is with relief that one turns to a book such as the "Psychoneuroses of War and Peace,"

by Dr. Culpin. This is a work in which the Freudian conceptions are much used, but they are given in a manner which presents both sides of the case. Dr. Culpin is not childishly dogmatic; his reasoning is lucid and without partisanship; his results are given favourable or the reverse; and, above all, his book is enlightening. It makes one think for oneself whether one is a beginner or a scholar in psychology.

(3) "A Manual of Psychiatry," edited by Dr. A. J. Rosanoff, is, of course, a very different production from the two dealt with above. It is a comprehensive text-book, covering the whole ground of the field of mental disease, and, though one may not agree with it on all points, yet as a general text-book the subject-matter is handled very clearly, the practical details in the treatment of the insanities are sound, and the references indicate a careful and thorough familiarity with the writings of all the modern psychiatrists. A chapter is devoted to the Freudian teachings; they are inserted as excerpts from Freudian publications, no reference being made to the actual views of the author himself, or to any criticism which might be given. The chapters on the Stanford revision of the Binet-Simon tests for mental deficiency and the free association tests for use in analysis, with the very full "frequency of association" tables, are striking and useful innovations in a text-book of this kind.

The Teaching of Palæontology.

An Introduction to Palaeontology. By Dr. A. Morley Davies. Pp. xi+414. (London: Thomas Murby and Co., 1920.) Price 12*s*. 6*d*. net.

Invertebrate Palaeontology: An Introduction to the Study of Fossils. By H. L. Hawkins. Pp. xix+226+xvi plates. (London: Methuen and Co., Ltd., 1920.) Price 6*s*. 6*d*. net.

Palaeontology: Invertebrate. By H. Woods. Fifth edition. (Cambridge Biological Series.) Pp. viii+412. (Cambridge: At the University Press, 1919.) Price 12*s*. 6*d*. net.

IN pre-war days we were accustomed to rely overmuch on Germany for text-books of zoology and palæontology. In the latter science all that this country could show for fossil invertebrates was the useful examination-candidate's manual by Mr. Woods and one of the British Museum guides, which, though written for another purpose, was used as a text-book by some teachers. Now, thrown more on our own resources, we have not only a revised edition of the Cambridge book, but also a corresponding work from Dr. Morley Davies, of the Imperial College of Science, and a more general introduction by Mr. Hawkins, of University College, Reading. Apart from brief chapters on vertebrates and plants by Dr. Davies, each of these books deals only with invertebrates, so that it is easy to draw comparisons which may be profitable.

Mr. Woods and Dr. Davies both cater for university students, and both describe the phyla of the Invertebrata in succession, thus producing essentially zoological text-books, in which extinct forms take a predominant place. Mr. Hawkins deals rather with principles, not so much describing fossils as using them to explain the methods and conclusions of palæontological science. It is his book, not that of Dr. Davies, which really merits the title "An Introduction to Palæontology."

All the same, for the discipline of the schools it is the text-books that are necessary, and, while the value of Mr. Woods's method has been proved by an experience of twenty-seven years, we welcome the novel treatment by Dr. Davies. As becomes a teacher in the school of Huxley, he has introduced the more intensive study of selected types. In dealing with the Brachiopoda (with which, as the commonest of fossils, he selects to open), he does not, as does Mr. Woods, begin with the general anatomy of the phylum, but, map in hand, he guides his pupils to a pit in the Cornbrash and lets them collect those characteristic species *Terebratula intermedia* and *Ornithella obovata*. These are examined and their common characters noted; then closer examination brings out the points of difference, especially in the arm-loop. The features of these fossils are next elucidated by a study of modern forms, and on the way we are introduced to the conceptions of relation to environment, ontogeny, phylogeny, comparative morphology, chronology, and classification. At last the student, now or never thoroughly interested, passes to the systematic account, in which such common fossils as *Leptaena rhomboidalis*, *Productus productus*, *Conchidium Knighti*, and *Spirifer striatus* receive more detailed treatment. Is not this an admirable method? If only Dr. Davies had followed it more consistently throughout!

Both Dr. Davies and Mr. Hawkins deal with some technical matters of which students too often are left in ignorance. Such are the collection, preservation, and investigation of fossils, the rules of zoological nomenclature, and the terminology and nomenclature of rock-divisions and time-divisions. On these last thorny questions both authors are, in our opinion, sound, and these sections of Dr. Davies's book in particular should be an ever-present help to all working palæontologists.

Mr. Woods and Dr. Morley Davies are, as instructors of youth, chiefly concerned to get some facts into the heads of their pupils. They have not much space for philosophic discussion (what they have they make good use of), and none at all for that general talk which can brighten the way or inspire the reader to further effort. Whichever of them you choose to follow as guide, you will be well advised to take Mr. Hawkins with you as philosopher and friend. His drawings and photographs are admirable, and, considering the price of the book, are as much a credit to the publisher as to his own skill. They will greatly help the reader who has not at hand the more purely descriptive works, or whose acquaintance with fossils is not already that which seems demanded by some of the chapters. The chapter on materials explains the nature of fossils and distinguishes the various modes of preservation and their relation to different kinds of rocks. Thus it answers questions constantly asked by the casual finder of fossils. Is it, however, quite true that amber inclusa represent "the most perfect type of preservation"? Were this so, it should be possible to dissolve out the organisms and to remount them in a manner more convenient for study. He who attempts this will find that there is nothing to get out. What one sees in the amber is but an imprint—the ghost, as it were, of some insect, the material body of which has vanished. The preservation of chitin in some fine clays, as of the Oesel Eurypterus, is really more complete.

Again, to apply the term "cast" to an external imprint, and the term "mould" to an internal filling of some dissolved shell, seems to reverse the ordinary usage. Here Dr. Davies and Mr. Woods more nearly approach accuracy. There are four cases to distinguish: a single valve of a mussel may leave in the rock an external imprint or impression, and an internal imprint; the complete shell of a mussel or a snail, or the test of a sea-urchin, may have been dissolved away, leaving the complete external mould (from which a plaster cast can be taken) and the complete infilling of matrix (which is a natural cast of the interior).

The geological distribution and the succession of life-forms, which constitute the real basis of palæontology as an independent science, are attended to by Mr. Woods in paragraphs under the zoological divisions, and are summarised by Dr. Davies in a compact but clear appendix. Under the heading "Historical Biology" they make up the second half of Mr. Hawkins's book. Anyone who has attempted a similar history knows how hard it is to vary the phrasing, to bring out the broad masses, and to avoid a mere list of names. "Lucina and Corbis are common throughout the era. Cyclodonts are abundantly illustrated by Cardiidæ, Protocardia and Discors are especially frequent in the Eocene, Cardium itself is common in the Crags. Teleodonts are the predominant forms. Venus (pl. xvi., Fig. 1), Dosinia (pl. xvi., Fig. 2), Meretrix and Paphia have numerous species in the later Cainozoic; Tellina, Macoma, Psammobia and——" but, no! the pen denies its office. Let us rather turn back to the interesting chapters "Geological Palæontology" and "Biological Palæontology," where the author shows what light may be thrown by fossils on climatic and other conditions at diverse times and places, and on the problems of phylogeny, morphogeny, specialisation, degeneration, and orthogenesis.

The profound studies of Echinoidea by Mr. Hawkins entitle his opinions on those difficult questions to the utmost respect. But, dealing as we are here with educational books, we prefer to conclude with an opinion based on his successful work as teacher, an opinion with which examiners ought to agree. Recognition of species (fossil-spotting) should not be demanded of average students. "The chronological distribution of families and genera will give ample precision for elementary needs." "The most elementary student ought to know that Ammonites are not found in Cainozoic rocks; but he ought *not* to know the difference between *Dactylioceras commune* and *Peronoceras annulatum*. If the latter detail has been forced into his unprepared mind, some point of more general application and greater importance must have been omitted or ejected."

F. A. BATHER.

Sugar Technology and Fermentation.

(1) *The Sugar-beet in America.* By Prof. F. S. Harris. (The Rural Science Series, edited by L. H. Bailey.) Pp. xviii+342+xxxii plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1919.) Price 12*s.* net.

(2) *The Manufacture of Sugar from the Cane and Beet.* By T. H. P. Heriot. (Monographs on Industrial Chemistry, edited by Sir Edward Thorpe.) Pp. x+426. (London: Longmans, Green, and Co., 1920.) Price 24*s.* net.

(3) *The Carbohydrates and Alcohol.* By Dr. S. Rideal and Associates. (Industrial Chemistry.) Pp. xv+219. (London: Baillière, Tindall, and Cox, 1920.) Price 12*s.* 6*d.* net.

(1) THE beet-sugar industry in North America is of comparatively recent date, although it was undertaken nearly a century ago by men,

as the author remarks, "who had more enthusiasm than knowledge." It may now be said to be firmly established, thanks largely to the magnificent work carried out in the experimental stations of the United States Department of Agriculture. Prof. Harris has produced a compact and useful treatise on a subject which is of the greatest interest to us in the United Kingdom, and also to those in other parts of the Empire where the beetroot might be cultivated. The manufacture of sugar from beet presents numerous difficulties, and all who are interested in the subject would do well to study the present little volume. The text is clearly written, and the information it gives is concise and complete. A valuable feature is the list of books, periodicals, bulletins, and reports, in the English language, which is appended.

(2) Most teachers of specific branches of science prefer to write a book for the guidance of students in which the subject-matter is arranged in that particular manner and sequence to which they give preference. The book before us is one of that class. It is written by a sugar expert for the guidance of his students. We believe that Mr. Heriot is the only lecturer in Great Britain on sugar technology—a subject of such vast importance to the British Empire. The reviewer is the chairman of the Empire Sugar Supply (Technical) Committee, which issued a preliminary report in July, 1919. Information had been obtained from the Dominions, Dependencies, Colonies, and Protectorates of the Empire showing to date the production and consumption of sugar in the Empire, and the possibilities of increasing the production to such an extent as to render the Empire self-supporting as regards this commodity were considered. The report has been sent to members of the Government and to numerous other Members of Parliament and high officials. Up to the present, however, the only movement on the part of the Government has been the appointment of a committee of experts to visit India and report on the possibilities of extending sugar production in that part of the Empire.

The appearance of Mr. Heriot's book is a welcome sign that the teaching of sugar technology within the United Kingdom is now progressing. The problem of Empire sugar needs a sufficiency of trained scientific experts, for the industry is no longer one that can be left in the hands of rule-of-thumb workers. Its principles require a knowledge of agriculture, botany, chemistry, and engineering, which can only be gained at an institution such as that with which Mr. Heriot is connected.

The text of the book is divided into ten parts, covering well the whole field included under the title, whilst the numerous illustrations add much to its value. The first five chapters, dealing with scientific principles, cover but thirty-two pages, and they should certainly be extended in future editions. They are, by reason of their brevity, dogmatic rather than educational, and as an instance the opening chapter on the formation of sugar by plants may be cited. Nothing is said of plant respiration, whilst in the converse phenomenon, photosynthesis, formaldehyde is given as the first product. It is stated, without authority, that formaldehyde has been detected in minute quantities in the leaves of plants, but reference should have been made to a paper by Jörgensen and Kidd in 1917 in which it is shown that formaldehyde arises from chlorophyll in the absence of carbon dioxide.

Although a detailed description of analytical methods would be out of place in the present volume, chap. xv., covering twelve pages, is meagre—so much so as to make it of no value whatever. Under "reducing sugars," for example, the following may be quoted from the text: "A measured volume of Barreswill's (Fehling's) solution is diluted with water and boiled. The juice is then gradually added until the whole of the copper is precipitated as cuprous oxide. From the volume of the juice thus added, the reducing sugars per 100 of juice can be calculated."

The main portion of the book is devoted to technology, and here the matter is well chosen. Mr. Heriot has certainly added a useful volume to the literature of sugar manufacture, and one which was needed in our Empire, since it embraces the manufacture of sugar from both cane and beet.

(3) This book is one of a series the object of which is to give a "general survey" of industries "showing how chemical principles have been applied and have affected manufacture." "The subject," says the editor, "will be treated from the chemical rather than the engineering standpoint." The impossibility of giving more than an outline of the subject is admitted, but it is hoped to stimulate greater interest in certain industries to which the nation has paid insufficient attention.

Commencing with an introduction of fifteen pages dealing generally with the carbohydrates, cellulose, starch and its hydrolytic products, and the sugars, the remainder of the text is divided into six parts, each subdivided into sections. It deals with starch, dextrin, glucose, maltose, cane-sugar, beet-sugar, sugar refining, minor sources of sugar, caramel, malting, brewing, wine, potable and industrial alcohol, vinegar, acetic acid, acetone, and glycerin.

The task of writing such a book as that before us is no easy one, needing, as it does, the securing of collaborators having both practical and scientific knowledge of the various industries. Whilst it is not for us to criticise the qualifications of Dr. Rideal's collaborators, our reading of the book has led us to the conclusion that it is a condensed account of existing treatises rather than a succinct and original outline of the various chemical industries. References to the literature are given at the end of each part, and these, we submit, would have been better included in the text, so that the reader would know exactly where to find an expansion of any specific phase of the subject. References to journals such as that of the Society of Chemical Industry, without indicating definite papers, are of little use to those who are not specialists, but wish to glean further information on specific points.

The major portion calls for little comment on the score of accuracy, but there are some errors and mis-statements, and among them the following may be cited. Wheat is said in one place to contain 55–65 per cent. of starch, whilst in another place the average starch content is stated to be 68 per cent. The statement that the cheapest form of starch is that derived from the potato is inaccurate, and we can scarcely agree that wheat starch is used as a paste for bill-posting, etc.! The title "Cane Sugar" and "Beet Sugar" for the sections dealing with the manufacture of sugar from cane and beet respectively might tend to revive the fallacy that sugar from the two sources differs. Goldthorpe barley is a broad-eared, not a narrow-eared, two-rowed barley; it belongs to the variety *Hordeum zeocriton,* not to *Hordeum distichum.* The statement that by the malting process "the insoluble starch of the grain is converted into soluble fermentable sugar" is one long ago exploded.

As a general criticism of this book, we regret being unable to come to any other conclusion than that the editor has failed to achieve his object. We hope that in the near future, with the collaboration of his expert advisers, he will recast the volume so as to eliminate errors and to give a clear and concise outline of the chemical industries dealt with.

ARTHUR R. LING.

Our Bookshelf

Magic in Names and in Other Things. By E. Clodd. Pp. vii+238. (London: Chapman and Hall, Ltd., 1920.) Price 12*s.* 6*d.* net.

DEALING with the question of magic in names, Mr. Clodd expounds with interesting detail a chapter in folk-lore familiar to serious students, but well deserving treatment in a more popular form. His book is, in the main, a study of magic, or, to use the new word, "mana," "the sense of a vague, impersonal, ever-acting, universally diffused power" immanent in all things. His special subject, the name, is well defined in a quotation from Mr. Cornford which appears on his title-page: "Language, that stupendous product of the collective mind, is a duplicate, a shadow-soul, of the whole structure of reality; it is the most effective and comprehensive tool of human power, for nothing, whether human or superhuman, is beyond its reach." Hence the preliminary discussion of the mana in a man's hair or spittle, through which the magician can work evil against the owner, merges into a detailed consideration of the name. Evil can be worked against you by anyone who knows your name, and hence it is wise to have two names, one concealed, one for daily use. This leads to the more serious name of power, curses and charms, passwords and spells, the "mantram" of the Hindu, by means of which even the gods themselves can be coerced. The Mohammedan knows the Ninety-and-Nine Names of Allah, and by repeating them over and over again for days he gains magical power. This exposition, always clear and impressive, even if at times the religious views of the author are disclosed with undue emphasis, is supported by an accumulation of interesting facts drawn from a wide range of study of the thought of primitive peoples and of popular belief throughout the world. Folk-lore, as an expression of primitive psychology, has too long remained the possession of the expert, and any attempt to popularise it is welcome. This is Mr. Clodd's achievement, and his exposition of this chapter of popular belief proves the value of the study as a key to unlock the mind of man, which no historian or sociologist in the future can safely neglect.

The Civil Servant and his Profession. Pp. viii+124. (London: Sir Isaac Pitman and Sons, Ltd., n.d.) Price 3*s.* 6*d.* net.

THE Society of Civil Servants has organised a series of lectures on various aspects of the profession, and the book under notice contains five of the lectures which were given in March last, with an introductory address by Sir Cecil Harcourt Smith. The first lecture, by the late Sir Robert Morant, deals with the administrative side of the Civil Servant's profession; the second, by Lord Haldane, with the legal aspects; the third, by Sir Sidney Harmer, is on the subject of national museums and scientific research; the fourth, by Mr. E. F. Wise, treats of the relationship between the Civil Service and industry; and the last, by Mr. J. Lee, deals with the psychology of the Civil Servant. This collection of lectures will give the public some idea of the diversity, importance, and highly technical nature of the work which is performed by the staff of men and women who constitute the Civil Service.

The British Journal Photographic Almanac and Photographer's Daily Companion, 1921. Edited by George E. Brown. Pp. 840. (London: Henry Greenwood and Co., Ltd., n.d.) Price 2s. net.

THE sixtieth issue of this welcome annual appears only a week or two later than in pre-war time, and the edition is increased from 25,000 to 30,000. This indicates a gradual progress towards normal conditions. On the other hand, the volume is about seventy pages fewer than last year, and the price is increased. The obvious reticence of advertisers with regard to quoting prices, which we remarked on a year ago, still impresses one, though perhaps less strongly. The editor contributes a lengthy article on general photographic procedure which cannot fail to be of assistance to beginners. The usual "Epitome of Progress" is an excellent summary, extending to nearly 100 pages, of the notable events, business items, legal matters, novelties in apparatus and equipment (including raw materials used in photography), and new methods or modifications of them. After the extensive collection of formulæ follows "A History in Brief of Photographic and Photomechanical Processes," giving the year and sometimes the month and day of the chief events, beginning with Thomas Wedgwood's experiments, published by Davy in 1802. Of the other new matter, we are particularly glad to see that the editor has given a table which he calls "Corresponding Focal Powers and Focal Lengths." The focal powers are given in diopters, and the corresponding focal lengths in centimetres and in inches. Many lens problems are so very much more simple when calculated in diopters instead of in focal lengths that we hope this table will be extended in next year's issue, and that there will be added to it a few simple instructions as to its use.

C. J.

Physiology and Biochemistry in Modern Medicine. By Prof. J. J. R. MacLeod, assisted by Roy G. Pearce, A. C. Redfield, and N. B. Taylor, and by Others. Third edition. Pp. xxxii + 992 + 9 plates. (London: Henry Kimpton, 1920.) Price 42s. net.

A NOTICE of an earlier edition of this work appeared in NATURE of December 18, 1919 (p. 389). That a new edition should be required in a year's time shows that the book has been found to meet the purpose for which it was written. The opportunity has been taken to recast the section on the nervous system, which has been excellently done by Dr. Redfield adding to it an account of the fundamental principles of the physiology of muscle and nerve. These changes will add to the value of the book to those for whom it is primarily intended, particularly to the medical man who wishes to apply advances in physiology to his clinical practice. Recent work on such questions as the effects of deficient oxygen supply, on "vitamins," on the capillary circulation, and on wound shock has been duly incorporated. A good account of the problem of the carriage of oxygen and carbon dioxide in the blood, still a disputed one, will also be found. Although the price of the book seems rather high, it may reasonably be held that good value is obtained. It might be worth consideration, however, whether the omission of some of the coloured plates would not enable a wider circulation to be ensured by a lower price. The further such knowledge as that contained in the book is spread, the better will it be for the advance of medical science and practice.

W. M. B.

Letters to the Editor.

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

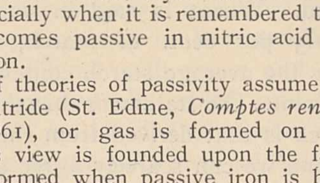
The Passivity of Metals.

CHROMIUM, iron, cobalt, nickel, copper, and bismuth are said to exhibit the phenomenon of passivity. These metals have electrode potentials varying from about Fe = +0·06 to Bi = −0·67 volt—that is, they are not very electro-positive. They also all exhibit dual valencies. This suggests that passivity may be due to an electrical double layer on the surface of the metal, especially when it is remembered that an anode of iron becomes passive in nitric acid of sufficient concentration.

The chief theories of passivity assume that a layer of oxide, nitride (St. Edme, *Comptes rendus*, vol. lii., p. 930, 1861), or gas is formed on the surface. St. Edme's view is founded upon the fact that ammonia is formed when passive iron is heated in dry hydrogen. But Finkelstein (*Zeit. phys. Chem.*, vol. xxxix., p. 91, 1901), from the results of his investigation of the polarisation capacity of passive iron, concludes that there can be no opaque layer on the surface, and he thinks that passive iron is ferric iron, whereas ordinary iron (active) is ferrous iron.

It is here suggested that passivity is produced by a layer of nitric acid or of nitrate ions firmly adhering to the surface of the metal. This view is not incompatible with either St. Edme's or Finkelstein's results. In fact, it seems as if there is considerable similarity between the surface of a passive metal and that of the disperse phase in a metal sol.

A consideration of the chemical forces yields the following model of the polarisation effects at the surface of a metal in an aqueous solution of an electrolyte, say iron in dilute nitric acid:



AB is the cross-section of a surface drawn between the liquid and the metal. Below AB is the Helmholtz electrical double layer, which we may conveniently regard as due to a layer of positive metal ions, and a layer of their valency electrons, two of which ions and their associated electrons are shown in the figure. The ions are represented in the ferric state, but this is not essential to the argument. Above AB, in the liquid phase, is a layer of molecules, which are polarised at a given moment in a regular surface lattice if the metal is pure. Obviously, the composition of this layer will depend upon that of the bulk of the liquid and upon the affinities of the iron ions for the nitric acid and the water. We may regard the nitric acid as ionised, but not so the water, because its ionisation is known not to be increased by the presence of dissolved electrolytes. Owing to the symmetry of the water molecule, it is impossible to say which H atom will break away and which will remain in the OH group in the event of ionisation.

Now it is highly probable that the chemical force, between ions even, is not wholly electrical, and we may assume that the nitrate ion and the water molecule will be attracted to their respective iron ions with forces which result in the setting up of an e.m.f. in the metal. If this e.m.f. is large enough, one of the metal ions will be discharged into the liquid momentarily as ferric nitrate, and in the model the atoms marked (*a*) will form water, the remaining H will be momentarily liberated, and positive current will flow as indicated by the arrows.

Two factors will make for passivity: a low electrode potential and homogeneity of the double layer above AB. Impurities in the metal will modify its electrode potential as well as the composition of the double layer. We find passivity a common property of the noble metals almost irrespective of the composition of the double layer, whereas with highly positive (active) metals passivity is never observed. In the case of intermediate metals passivity occurs only with certain kinds of double layers, and if these are unstable periodic action may result. Since the forces are not wholly electrical there is less chance for an electrostatic equilibrium—and consequent passivity—to be set up, and for this reason it seldom occurs with these metals.

A sufficient disturbance of the surface layer, by scratching, touching with a more electro-positive metal such as zinc, placing in a magnetic field, or heating, will, in conformity with experience, activate passive iron. It is significant that Smits and Lobry de Bruyn (Proc. K. Akad. Wetensch. Amsterdam, vol. xxi., p. 382, 1919) find that chlorine ions activate anodically polarised iron. Thus it seems that iron ions in the surface of the metal have a preferential affinity for Cl′ over NO_3'. W. HUGHES.

Bedford Modern School, January 10.

The Space-Time Hypothesis before Minkowski.

IT is, perhaps, not generally realised that the theory of space and time, to which Minkowski was led on experimental grounds, had been formulated on general principles sixty-five years previously by Hamilton, the Irish mathematician. The point is, however, of interest, not merely as a question of priority, but for the insight it affords into the philosophic basis of the theory, as well as for the useful mathematical methods it suggests.

It is curious, therefore, that there should be a lack of recognition that the world of Minkowski is in all points identical with the system of quaternions of Hamilton, and that the latter mathematician specifically regarded this system as a four-dimensional expression of space and time, in which space bears to time the relation which $\sqrt{-1}$ bears to unity, time being the scalar part of the quaternion.

Quotations may be given from Hamilton's letters and manuscripts, cited in his "Life" by Graves, which leave no doubt on this matter.

Thus, vol. ii., p. 478:

"Let me suggest one leading thought, which will perhaps sound paradoxical, that time and space are imaginary, each with respect to the other. . . . Any expression for the peculiar relations of space in the forms of time, or for those of time in the forms of space, must therefore involve a seeming contradiction . . . it will be a 'mathematical imaginary.' This seems to me to be the clue, the secret of the matter."

Vol. iii., p. 635:

"The mathematical quaternion . . . in technical language may be said to be 'time *plus* space,' or 'space *plus* time,' and in this sense it has, or at least it involves a reference to, four dimensions."

In another place:

"My real is a kind of fourth dimension equally inclined to all directions of space."

Many other allusions will be found which prove that this idea was fundamental in the views of Hamilton, and that he held to it with the greatest tenacity, although there were at that period no experimental considerations to justify it, and although De Morgan and other mathematicians seem to have discouraged it, or ridiculed it. At the same time it does not appear that Hamilton has given an analysis of space and time which exhibits with sufficient clearness the concept of direction in space as being peculiarly attached to the symbol $\sqrt{-1}$, and the concept of positive and negative unity as being similarly connected with the two directions of time, towards the future and the past.

It is, however, easy to supply such an analysis, the clue being given by noting that to define a number by the equation $x^2+1=0$ virtually defines it as "a unit which cannot be differentiated from its own negative by any *qualitative* distinction."

It indeed appears to have been in the thought of Hamilton, as it must occur to anyone who considers the matter, that the connection between a root of the equation $x^2+1=0$ and a direction of space is to be looked upon as more than a mere symbolism; but the general philosophic bearing of such considerations on the whole nature of space and time is scarcely appropriate for discussion here. It may, however, be remarked that they indicate a point of view in which time and three-dimensional Euclidean space lose their apparently contingent character, and approach the necessity of the laws of arithmetic, of which they appear as a kind of derivative.

It should be added that practical advantage might be derived by mathematicians from the application of the methods of quaternions to the theory of relativity, for, besides offering a convenient mode of development of the geometry of four dimensions, either Euclidean or hyperbolic, according as Tq or $\sqrt{Sq^2}$ is taken as the element of length, they suggest important possibilities in connection with the inversion of a linear quaternion function analogous to the physical applications by Tait of the linear vector function. E. H. SYNGE.

Dublin, January 6.

Heredity and Acquired Characters.

WILL you permit a statement from a humble student? Between twenty-two and twenty-seven years ago, while in Malabar, opportunity was taken by me to ascertain whether the arms of rowers on the backwaters and the arms of the toddy-drawers were longer in proportion to the height than in the case of the rest of the population, for here seemed to offer a test whether "inheritance of the effects of use" was evident. In both cases the men belonged to a caste which had not changed its occupation for many hundreds, perhaps some thousands, of years: the former indigenous, while legend attributed the ancient home of the latter to Ceylon, where they were occupied in the same way—climbing and tapping the palm-trees for toddy. The stretch of arms in rowing demands no explanation, but it may be mentioned that the rowers were not engaged in rowing as they might be in England, but often continuously for long periods. Thus on first acquaintance they rowed (eighteen of them) forty-six miles to where I was, halted an hour or so to cook and eat a meal, and rowed back again the same distance, covering the ninety-two miles within twenty-four hours—not at all as a feat, but just in the ordinary way of work.

The climbing of the palms in this region needs some remarks, because whereas toddy-drawers are usually sustained by a strap round the back to ease the strain on the arms, in Malabar the whole weight of the body is borne by the arms alone, legs straight, feet held together by a grummet, the hands embracing the stem. Climbing in this manner is fatiguing, and when he has reached the top the climber works for about a quarter of an hour preparing the spathe, changing his pots, and so on, all the while upheld by the arms, which are thus on the stretch for a considerable portion of each day. It seemed, therefore, worth while to examine by careful measurements with instruments for anthropological work whether the continual straining of the arms during many generations affected the length of arms in relation to length of body-height. The result was that it did not. The arms of the hereditary rowers and of the hereditary climbers are no longer in proportion to height than of those engaged in occupations involving no strain of the arms. Writing far from home, I am unable to give you measures. FREDERICK FAWCETT.

Algiers, January 12.

Popular Science Lectures on Natural History.

THE lectures to juveniles at the Royal Institution by Prof. J. Arthur Thomson have been undoubtedly a great success, and I cannot help thinking that there are others, especially among our young men fresh from the universities, who could give lectures of this kind to popular audiences. If so, can they be discovered? They may be difficult to find, for success in this field requires a rare combination of gifts. It is absolutely necessary for such a lecturer to possess, besides knowledge and enthusiasm, a good voice and manner; his speech must be fairly loud, good, and clear, and his personality distinctly pleasing, or he will fail to win his audience. Unfortunately, few scientific men are good public speakers. It is also much to be regretted that many writers on biology and natural history adopt a style so learned and pedantic that both young and old are repelled.

Huxley, the younger Buckland, Gosse, and Hugh Miller are gone, and few follow in their steps. How sadly are the themes of beauty, mutual aid (so well treated by Kropotkin), and symbiosis neglected by modern writers! Those who do treat of these subjects seem to deal with them in a cold, dry way. The leading idea in Prof. Thomson's lectures is conquest by animals of the elements, and no other lecturer or writer has developed the subject as Prof. Thomson has done.

In conclusion, may I ask whether it would be possible to arrange courses of lectures on the same lines in different parts of London? It seems a pity that such lectures should be confined to the Royal Institution. Eager South London audiences can be found for Shakespeare's plays, and I believe good lectures on natural history would also appeal to such audiences, especially if well illustrated and well delivered.

H. NEVILLE HUTCHINSON.

Royal Societies' Club, January 10.

Anglo-American University Library for Central Europe.

IN connection with the above library, we are endeavouring to supply the various university libraries on the Continent with the scientific journals they urgently need.

Among the periodicals for which we have received a pressing demand NATURE is frequently mentioned, and I very much hope that you will be good enough to publish this letter in your columns so that any of your readers having copies of your journal from 1914 onwards may hear of our appeal. Any numbers of the periodical which readers may feel they can dispense with will be gratefully welcomed.

The library is entirely non-political and non-sectarian, its sole object being to enable humanity at large to benefit in the future, as it has done in the past, from the research of European scholars. Such research has been brought almost to a standstill from the fact that European centres of learning have been cut off since 1914, first of all by the blockade, and more recently by the exceedingly unfavourable position of the foreign exchanges, from English and American thought.

I fervently hope that some of your readers may be able to help in supplying the literary needs of Central Europe. A copy of the prospectus of the library will be gladly sent to anyone desiring a fuller account of its work and objects. B. M. HEADICAR,
Hon. Secretary.

London School of Economics, Clare Market, London, W.C.2, January 21.

Greenland in Europe.

WHATEVER lapse may be imputed to the London school-book of 1812, noticed by Mr. MacRitchie in NATURE of January 13, p. 647, it is not shared by the Rev. J. Goldsmith's "Geography, on a Popular Plan, Designed for the Use of Schools, and Young Persons," in its fifth edition at the earlier date of 1808. For that author, in a very interesting account of Greenland, at p. 46 remarks that many so-called "ice islands" "are to be met with on the coasts of Spitzbergen, to the great danger of the shipping employed in the Greenland fishery." He further instances the peril to which "Lord Mulgrave" was thus exposed in 1772, when by an opportune rising of the wind his ships, "after labouring against the resisting fields of ice, arrived at the west end of Spitzbergen." At this critical time, however, "Lord Mulgrave" was Capt. Phipps. T. R. R. S.

January 20.

Electric Light and Vegetation.

MR. PENDRED's interesting observations on the growth of vegetation beside the electric lights in the Cheddar caves (NATURE, vol. cv., p. 709, August 5, 1920) reminds me of some observations described by Mr. E. Cheel in the *Australian Naturalist*, vol. ii., 1912, p. 117. Of a number of plane-trees growing about Sydney railway station some were close to the large electric lights, and Mr. Cheel noticed that the branches nearest the lights retained their leaves from a month to a month and a half longer than the more distant branches of the same tree and than the trees distant from the lights. When the new leaves were opening in spring a similar period elapsed between the dates of opening of those near the lights and those distant therefrom, the branches subject to illumination being that much later in getting their leaves. THOS. STEEL.

Sydney, New South Wales.

The Sparrowhawk.

By J. H. OWEN.

THE sparrowhawk, in a perfectly wild state, is one of our most interesting birds to study. During the nesting period, and especially through the latter part of the incubation period and the whole of the nestling period, it is comparatively easy to observe and photograph the bird. With patience, photographs can be obtained at the nest of the birds, old and young, for something like a fortnight after the young have left the nest. This is because the cock, and in some cases the hen, deposit the kills on the nest, which becomes a larder to a large extent, and the young return to the nest for a meal whenever they are in need of food.

The young are helped to procure food and partly trained by the old birds for a still further period before they are finally dispersed to seek their own living. If the nesting period be considered to start when the building of the nest is begun, and to end at the dispersal of the young, it is of great length. I have seen new nests, practically complete except for the lining of the cup and a few minor details, as early as February 17. I usually search for new nests during the second half of March, and find quite a lot of pairs building them. Birds that do not start during March appear to use old nests of pigeon, jay, hawk, or even magpie as foundations, but they are in a minority in the neighbourhood of Felstead, in Essex, for at least three-quarters of the nests I find are entirely new. Of course, weather conditions have considerable influence on the building of nests; in rough, boisterous, or wet weather and on foggy days operations cease. In a forward year, such as 1916, complete sets of eggs may be found before the end of April; in a normal year it is unusual to find such sets until between May 14 and 21. The bird lays, as a rule, on alternate days, but occasionally there is a period of seventy-two hours between eggs, and sometimes even more. The full set consists of four to six eggs, rarely of seven or more. Very old birds produce fewer eggs, which are less heavily pigmented as the age of the bird increases, while the eggs of a young hen are not so evenly or so heavily pigmented, as a set, as are those of a fully mature bird.

The incubation period varies somewhat, but can be put at approximately thirty-three days. The eggs usually take a long time to hatch, even after they are chipped; it is quite usual for two whole days to elapse after the egg is chipped before the chick emerges—I have known this period to be as long as four days. This is probably because the eggs are not moistened by the hen, the shell is very thick, and the membrane very tough. I have often watched a hen helping a chick to break free from the shell. In such cases I have seen the hen eat the shells, but I feel convinced now that this is not the usual method of disposing of them. Usually they are carried some distance from the nest and dropped.

Like the chicks of all birds of prey, those of the sparrowhawk are covered with short, thick, white down when hatched, and their eyes are open; but the plumage does not show until the bird is more than fourteen days old. The nestling period is about twenty-eight days, and by the end of that time the young birds have mostly acquired their juvenile plumage; but the down does not finally disappear until they are some seven weeks old. During incubation the nest gets flecked with down from the hen, and is a beautiful sight just before incubation ends, if the weather has been good. If the first set of eggs has been taken, the second nest never gets anything like so well flecked; the supply is limited, and has been used up. This may be a survival of what still happens in the nests of ducks and geese. When the young are hatched, this down disappears very quickly; it is partly removed by the weather, but largely by the hen, which probably mistakes it for the feathers of victims. The nest is kept particularly clean all through the incubation and nestling periods until just before the young leave the nest. Then the nest again becomes beautifully and liberally flecked with down; but this time it is shed by the young birds.

When the hen begins to lay, she lines the bottom of the nest with bits of bark, touchwood, and dead leaves, and during the incubation period she adds material, sometimes to the rim and sometimes to the well of the nest, with the object of making the nest stronger and more comfortable. During the nestling period more is added, this time probably partly for sanitary reasons, to keep the young off material contaminated by contact with dead, and often decaying, victims. Dr. T. Lewis has even seen the cock bird bring twigs to the nest during the nestling period.

The hen, in my experience, does all the incubating, and usually the cock procures food for her. This she eats on the larger limbs of trees in the neighbourhood of the nest tree. The cock brings it to some position upwind of her and calls. If she wants it she goes to him and takes it, and they remain together a short time; then he goes away. If, after two or three calls, she does not join him, he flies through the nest tree calling; if she still takes no notice he goes to a favourite feeding-place, not very far from the nest as a rule, eats what he wants, and flies off again. The hen normally sits back to wind (Fig. 1). The proximity of an observation hut upsets her, and she will place herself as near back to wind as possible while keeping the hut still in view. If, however, it rains she will, hut or no hut, turn her back to it. If it rains hard she will gradually move her wings out from her body to cover more completely the well of the nest, and finally get such a spread on them that the primaries are parted, and each acts as a watercourse from her back and wings.

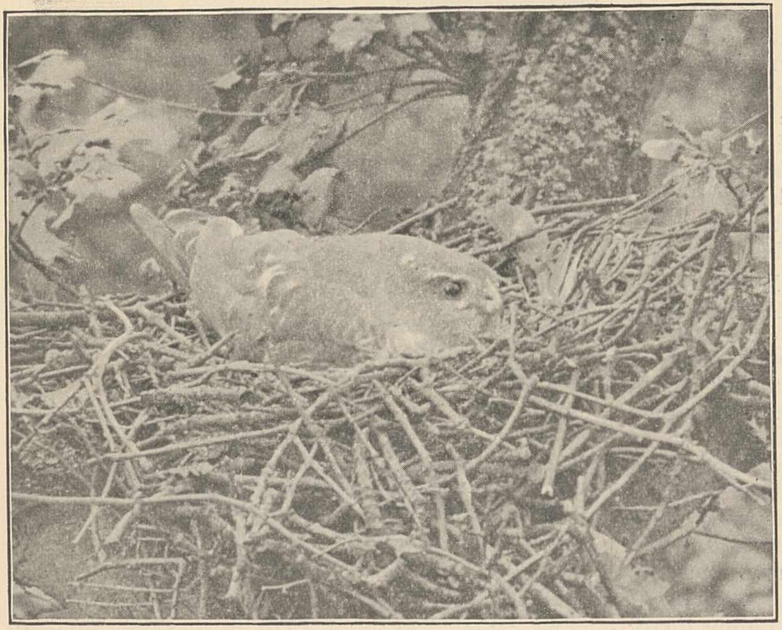


FIG. 1.—Incubating: normal position when easy in mind: very low in nest.

If it is very hot and the sun shines on the nest, she will get up from time to time and stretch or stand beside the eggs (Fig. 2). Sometimes she will preen herself, but she never stays off the eggs for long at a time. If she is very near hatching she will not relieve herself by more than a stretch, although she may be in agony from the direct rays of the sun. All she does is to rise slightly on the eggs and pant with her whole body.

For the first few days after the young are hatched she may be said generally to be covering them completely. As they get stronger and more vigorous they scramble from under her at will if the weather is fit. If it is raining, or the sun is directly on the nest, they have to go under cover. Later, when the weather is suitable, she may be on the nest, but the young may be all clear of her. At such times she will often shut her eyes and nod on the nest.

In wet weather she makes an umbrella of her body. She puts her back to the direction of the storm, the young collect, heads together, in the middle of the nest, and she shuffles over them. She usually opens and depresses her wings so far as the occasion demands. Of course, there are variations of position in this as in everything else. On one occasion, in a very heavy thunderstorm, the hen stood more between the young and the direction of the storm, and threw one wing over the young; then she gradually sank down until this wing was upheld by them (Fig. 3). In storms she usually crouches over the young, but gradually sinks lower until she is resting on them. Always, as she shuffles over them, she looks for the youngest nestling, and pulls it into the most protected position with her bill. Even when brooding is a thing of the past, the approach of a storm will bring her on to the nest very quickly, and she covers it immediately rain begins to fall. If she brings food to the nest she breaks it up first, but if the cock deposits food on the nest during the storm she takes no notice of it. When the storm passes away she will break such food up and then dry herself thoroughly on some branch from which she can watch the nest. She opens her wings and tail, and either faces the wind or has her back to it. She may get in a place where the sun can help the drying, but mostly she trusts to the wind. Sometimes her feathers are almost closed; at other times they are open to their widest extent; the amount of spread varies constantly. After drying is completed she preens herself thoroughly, pay-

FIG. 2.—Off the nest owing to sun: a pause and look round before returning.

ing particular attention to the flight and tail feathers.

Very interesting, too, is the sight of the hen making efforts to shield the young from the direct rays of a hot sun. When they are small enough

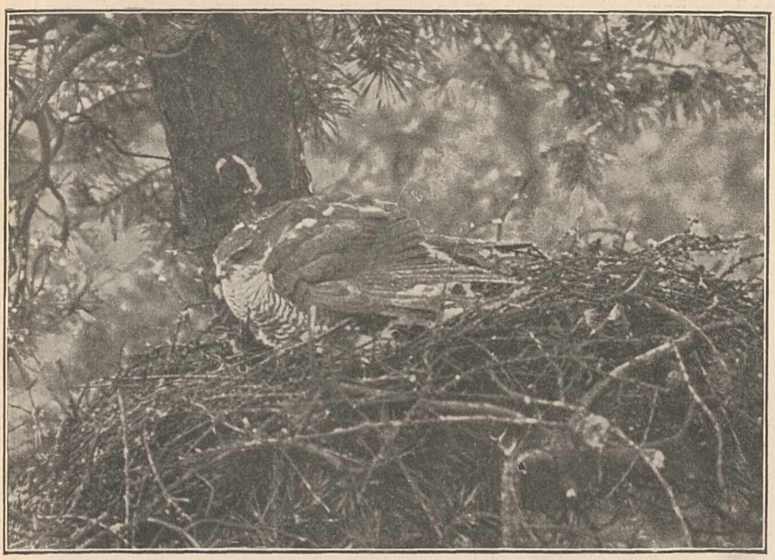


FIG. 3.—Broo ing in heavy thunderstorm.

for her to do so, she makes a sunshade of her wings and body that will protect them all. She first gets directly between them and the sun, and then she partly opens and depresses her wings, and moves forward until the young are completely in the shade. There she stays in a sort of crouch over them until the sun has moved behind some foliage. The whole time she is in great distress, for her entire body seems to pant, and her tongue works rapidly to and fro.

If the young are too big for her to shelter all of them completely, she does what she can. She gets between the sun and the middle of the nest, partly spreads her tail, and opens her wings slightly, standing with her feet apart. The young then take turns to make use of the shade her body affords (Fig. 4). She stays like that as long as it is necessary, and, as before, seems to suffer greatly from the heat the whole time.

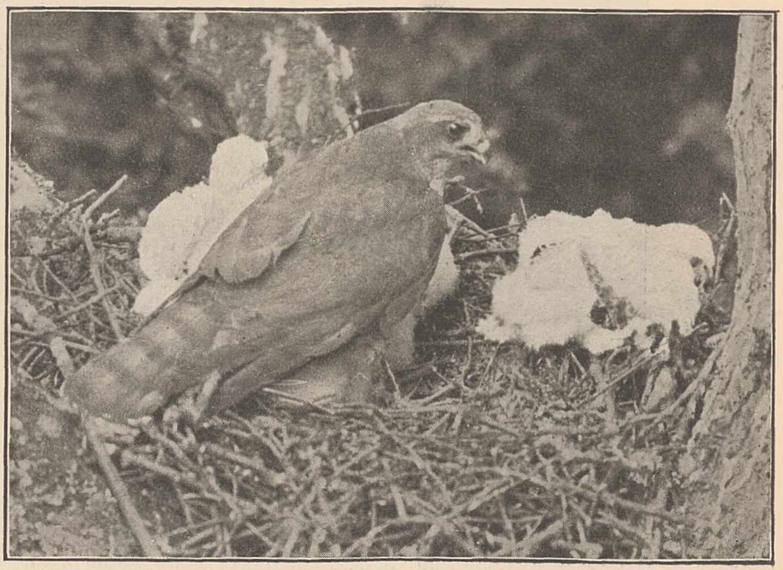


FIG. 4.—Standing with legs apart, tail slightly fanned and wings slightly opened for each nestling to make use of her shadow in turn.

The young do not foul the nest with excrement, so that the old bird has not to remove it. They back to the edge of the nest and eject it clear of the rim from a very early age. The branches all round and below the nest become almost white-washed during the nestling period unless rain comes to clear it away. When the nestlings are nearly ready to leave the nest, less care is taken about keeping it spick-and-span. They are able to feed themselves, and are allowed to do so. What bones they do not swallow are permitted to accumulate on the nest, and by the time the nest is finally deserted it may be covered deep with bones of victims, and many more bones will be found on the ground below the nest.

The cock is the procurer of food, but he takes no part in breaking it up. If the hen is killed during the nestling period he will continue to bring food so long as the nestlings are alive. If they are less than twenty days old they probably all die. If they are over that age they can tear enough food off to keep going, and the majority would survive. If the cock is killed, the hen perforce becomes the hunter, and provides food for the young and herself. I have heard, on very credible authority, that it is by no means uncommon in this case for the hen to get an unmated cock to help her.

There is only one brood in the year. A bird that is robbed lays again, but usually a smaller number of eggs, of which a far larger percentage prove infertile. If robbed again she will continue to produce eggs until July, when moulting normally commences.

The Institute of Human Palæontology, Paris.

ON December 23, 1920, the Institute of Human Palæontology in Paris was formally declared open by His Serene Highness Prince Albert of Monaco, its founder. The interest and active participation of the Prince in more than one branch of research have long been highly appreciated by the scientific world. The study of marine biology and oceanography already owed much to his valuable assistance and support when, more than twenty years ago, a visit to the Grimaldi Cave at Mentone first turned his attention to prehistoric archæology. Since that time all the more important cave explorations in Southern France and Northern Spain, which have enabled French archæologists to throw a flood of light on the character, art, life, and environment of prehistoric man, have been carried out under his auspices, at his expense, and frequently on lines suggested by him, while he has been responsible for the publication of the results in a manner and with a wealth of illustration which are not likely to be surpassed. Now, by the foundation of this institute as a headquarters in France for the systematic investigation of problems related to the origin and development of man, the Prince of Monaco has ensured the prosecution of this branch of scientific research in the most favourable conditions.

FIG. 1.—The Institute of Human Palæontology. Front elevation.

The Institute of Human Palæontology is situated in the Boulevard Saint Marcel. The building, which was nearing completion when war broke out, contains a large amphitheatre for lectures and meetings, a spacious library, and a number of rooms fitted up as laboratories, for examining and photographing the material furnished by excavation. Collections of specimens from the sites which have already been explored, as well as reproductions of the paintings and drawings found on the walls of the French and Spanish palæolithic caves, are exhibited in the building. An endowment of two million francs is attached to the Prince of Monaco's foundation, and an additional sum has been promised should it be rendered necessary by any further increase in the cost of living. The institute is under the direction of M. Marcelin Boule, assisted by a council consisting of MM. Salomon Reinach, Dislère, Verneau, and Louis Mayer.

Among those who were present at the opening ceremony were the President of the French Republic, M. Millerand, H.I.H. Prince Roland Bonaparte, M. Honnorat, then Minister of Public Instruction, the Belgian and Italian Ambassadors, the Argentine and Persian Ministers, M. Lacroix, secretary of the Academy of Sciences, the president of the Academy of Medicine, and representatives of the College of Medicine, the Collège de France, the Pasteur Institute, and the various scientific societies.

An inaugural address was delivered by the Prince of Monaco, in which he defined eloquently the broad aims of human palæontology. It was, he said, the prehistory of humanity. Only a few years had elapsed since men of science had recognised human handiwork in flints embedded in geological strata, and had seen in them man's first attempts at fashioning weapons for the chase and for defence. On these stones had been based a science which revealed our past and freed our judgment from the power of baseless philosophies and superstition. Investigation which traced the human species back to remote epochs revealed its relation to the animal world, from which it seemed slowly to have evolved. The prehistory of man began at that point when the human family was distinguished from other animals by a development of the brain which enabled it to diminish the part played by the muscles, and to employ moral force to carry on the struggle for existence: an artificial weapon took the place of the natural weapon, while, as shown by the paintings and drawings of the caves of Spain and Southern France, man was already capable of æsthetic emotion and sentiment.

FIG. 2.—The Institute of Human Palæontology. Sculptured group. Negresses and dead orang-utan.

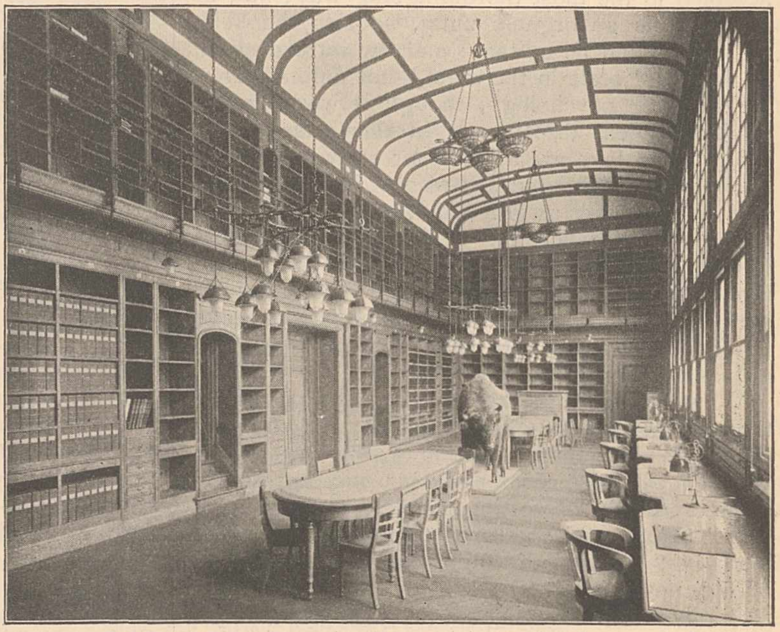


FIG. 3.—The Institute of Human Palæontology. View of library showing bison killed by the Prince of Monaco.

The lesson of the history of mankind was, on the one hand, that man, though favoured by the laws of the universe, was still nothing more than a plaything in the hands of the forces of Nature; on the other, it helped us to surmount the bounds of a narrow philosophy which would reject all idea of relationship between man and the other members of the living world, and would wish to debar us from a study which placed mankind in an appropriate rank in the life of the globe. In the Prince's own words: "C'est pour aider l'Anthropologie à franchir les barrières qui la séparent de la vérité complète que je fonde l'Institut de Paléontologie humaine en lui donnant toute l'indépendance nécessaire pour conduire notre esprit vers la lumière. Et je confie ses intérêts à des hommes qui servent la Science avec une sincérité capable de développer sa force et de protéger sa marche contre l'influence des interventions passionnées."

At the conclusion of the Prince's address, brief speeches were made by M. Honnorat, Minister of Public Instruction, M. Perrier, and M. Le Corbeiller, president of the Municipal Council, the last named speaking on behalf of the city of Paris. Lastly, M. E. Cartailhac, the veteran archæologist, expressed his joy at the creation of the institute, which, he said, had been his dearest wish throughout his career as an archæologist.

The Institute of Human Palæontology is the materialisation of a conception of the aims and methods of prehistoric archæology formed by the Prince of Monaco when first he turned serious attention to the subject. It is, in a sense, a pendant to the institute he has founded for the study of oceanography, for, as he said in his inaugural address, "L'Océanographie, qui embrasse les origines du Monde, m'a rapproché de l'Anthropologie qui renferme les plus profonds secrets de l'Humanité." The reward which the Prince will seek for his munificent benefaction will lie in the results which may be expected from the facilities for study and research which he has placed at the disposal of science; but this reward will in itself be only a further addition to the debt already owed to him by archæology. His Serene Highness Prince Albert has indeed erected "a monument more lasting than brass."

Obituary.

Dr. J. B. Crozier.

DR. JOHN BEATTIE CROZIER (born at Galt, Canada, on April 23, 1849; died in London on January 8) was a thinker who knew how to combine philosophic breadth with scientific substance. His first master in speculative thought was Herbert Spencer, but he soon began to deviate from what he took to be the materialistic outcome of Spencer's psychology. The fault he found was that Spencer, in investigating mind, failed to view it adequately except from the objective side, as correlated with the brain and nervous system. This correlation itself Crozier accepted in the most thoroughgoing way; but, as the body is an organic unity, so also, he held, must the mind be unitary; and, by introspection, he found a "scale in the mind," not unlike that of the Platonic psychology, though it was for him an independent discovery. In this scale, truth, beauty, and love are at the top; such feelings as honour, ambition, and self-respect in the middle; and such qualities as greed and, in general, animal appetite at the bottom. This led Crozier to a metaphysical doctrine (though he was inclined to repudiate the term metaphysics) according to which the higher attributes of mind are superior not only in quality, but also, correspondingly, in ultimate strength.

What this scale or order in the mind points to, though it does not actually prove it, is dominance of the universe by a Supreme Intelligence. This view Crozier arrived at early, as may be seen in some extremely interesting chapters of "My Inner Life" (1898), and preserved to the end, as is set forth in "Last Words on Great Issues" (1917). It did not amount, he frankly admitted, to a religious creed. Having no mystical turn, he set to work in a scientific spirit on the investigation of human history, where, if anywhere, verification might be expected. The clue was the newly demonstrated theory of biological evolution, in which his master was Darwin. In the history of civilised peoples, on a wide survey, he found laws of progress; and these he made it his purpose to bring out in his central and best-known work, "The History of Intellectual Development."

In this and his other books, which grouped themselves naturally around it, Crozier carried out with approximate completeness, with literary interest diffused over the whole, and in the end with considerable acceptance on the part of the public, the scheme he had set before himself in the beginning. Presiding over his studies of historical evolution was his other great leading idea, that of social consensus—no doubt more vividly realised through his occupation with the profession of medicine. As the individual mind, like the body, is an organic whole, so is a society considered mentally as well as in its physical interconnection; and, apart from society, the individual is unintelligible.

Quite rightly, in his latest book, Crozier claims to have anticipated much recent development of a general theory which he had already styled the "doctrine of the herd." His versatility went along with a capacity for close study and a gift of illumining social observation; and where he was not an expert he was ready to be corrected by experts.

By the death of MR. EDMUND J. SPITTA on January 21, at sixty-eight years of age, microscopical science has lost another earnest student and exponent. While in general medical practice for many years, Mr. Spitta found time to contribute to more than one branch of microscopy, and his retirement to Hove several years ago enabled him to devote the remaining years of his life to the subject. He took an active part in the proceedings of the Quekett Microscopical Club, of which he was a past-president, and of the Royal Microscopical Society, of which, as well as of the Royal Astronomical Society, he was a past vice-president. Mr. Spitta made some contributions to the subject of pond life, but it was particularly photomicrography and the optics of the microscope to which he directed his energies. So far back as 1898 he published, in collaboration with Mr. Charles Slater, an "Atlas of Bacteriology" containing more than a hundred plates of photomicrographs of bacteria. More recently he brought out his "Photomicrography," and many of his photomicrographs of diatoms are of great excellence. His book on "Microscopy," the third edition of which was published last year, is a general treatise on the construction, optics, and use of the microscope. To the Royal Microscopical Society Mr. Spitta contributed in 1911 a note on Winkel lenses and oculars and a report on the value of some Grayson's rulings, the latter entailing a considerable amount of work, and in 1913 he reported on a collection of lenses and other optical apparatus made by Joseph Jackson Lister, the father of Lord Lister, and presented to the Royal Microscopical Society on the death of the latter.

WE regret to learn of the death of PROF. FRÉDÉRIC HOUSSAY, professor of zoology at the Sorbonne since 1904, and dean of the faculty of science since 1919. Houssay's first piece of work, done under the direction of Lacaze Duthiers, was on the operculum and pedal glands of gastropod molluscs, and he presented this as a thesis for his doctorate in 1884. The same year he left for Persia as a member of the Dieulafoy mission, and returned in 1886. Soon afterwards he began a series of studies in vertebrate embryology, of which perhaps the best known is his contribution to the discussion on the vertebral nature of the skull (1890). After following the development of the skull of axolotl, he supported the view that the skull is segmental and represents ten segments. Houssay next turned to the study of dynamical morphology, and published on this subject two important works, "La forme et la vie" (1900) and "Morphologie dynamique" (1910). He devoted special attention to the functional significance of the form of the body, tail, and fins of fishes, studying the movements in relation to form and stability, and he published the main results in 1912 ("Forme, puissance, et stabilité des poissons"). Almost his last work was a continuation of the same line—a study of the flight of birds and the form of their wings, for which he made detailed measurements of 238 skeletons. We join with our French colleagues in regretting the loss of an ingenious worker and a courteous colleague.

WE regret to announce the death, on January 5, of CAPT. HAROLD STUART FERGUSON, at seventy years of age. Educated at Eton and Wimbledon, Capt. Ferguson passed into Woolwich and obtained a commission in the Royal Artillery, but after a few years' service in that corps he resigned his commission and sailed for India. He eventually became English tutor to the three Princes of Travancore, and when they no longer needed tutelage he was appointed second in command of the Nair Brigade of native troops maintained by H.H. the Maharajah of Travancore. From that time until his retirement in 1904 he held various appointments under the Travancore Government, including the directorship of the Trevandrum Museum and Public Gardens, where his great love of animals and birds ensured the very careful management of the wild creatures kept in captivity. His collectors at the same time brought in valuable collections of animals, birds, and plants. While in India he was elected a fellow of the Linnean Society, and on his retirement he interested himself greatly in the Zoological Society's Gardens at Regent's Park, and some time before his death he was elected a member of the council of the society. A man of science, a keen sportsman, and a charming companion, Capt. Ferguson died much regretted by a host of friends.

THE death is announced of PROF. CARL TOLDT, who held the senior chair of anatomy in the University of Vienna for twenty-four years. Prof. Toldt was born in Tirol in 1840, and with him disappears almost the last of the great general anatomists—men who worked at comparative as well as at human anatomy. He was well known for his "Atlas of Anatomy," which appeared in 1896, and soon ran through seven editions. He contributed many papers to anatomical literature, the best known being those which treat of the morphology of the mandible.

Notes.

AT the meeting of the Royal Society on March 3 a discussion on isotopes will be opened by Sir J. J. Thomson.

A WIRELESS Press message from Moscow on January 21 stated that Prince P. Kropotkin had contracted inflammation of the lungs, and a fatal issue was feared. Prince Kropotkin's many friends in this country will be glad to know that a later telegram encourages hope of recovery, and says that his illness is apparently due to bronchitis.

SIR FRANCIS YOUNGHUSBAND, president of the Royal Geographical Society, announced at the meeting of the society on January 24 that the chief of this year's expedition to Mount Everest will be Col. Howard Bury, while the actual reconnaissance of the mountain will be in the charge of Mr. Harold Raeburn, who will leave England for India in March.

THE Galton anniversary meeting will take place on February 16 at the Connaught Rooms, Great Queen Street, Kingsway, London, W.C.2. The Galton lecture will be given by Dr. W. Bateson, at 8.45 p.m., on "Common Sense in Racial Problems," and will be preceded by the Galton dinner, for which tickets may be obtained at the offices of the society, 11 Lincoln's Inn Fields, London, W.C.2

THE Department of Scientific and Industrial Research announces that the Research Association for the British Jute Industry has been approved by the Department as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. The secretary of the committee engaged in the establishment of this association is Mr. Frank S. Cathro, 1 Royal Exchange Place, Dundee.

THE following lecture arrangements have been made in connection with the Royal College of Physicians of London:—The Milroy lectures (on "Respiratory Efficiency in Relation to Health and Disease") will be delivered by Dr. Martin Flack on February 17, 22, and 24; the Goulstonian lectures (on "Glycæmia and Glycosuria") by Dr. G. Graham on March 1, 3, and 8; and the Lumleian lectures (on "Some Points in the Etiology of Skin Diseases") by Dr. A. Whitfield on March 10, 15, and 17. The lecture-hour in each case will be 5 o'clock.

THE physiological laboratory in the central offices of the University of London at South Kensington, of which the director is Prof. A. D. Waller, appears to be in some risk either of extinction or of mutilation by removal to another site. The London County Council, possibly under misapprehension as to the present status of the laboratory, threatens to withdraw the grant hitherto made, while the Senate of the University requires the rooms in July for its clerical staff. If the grant ceases the laboratory is to be closed. If it continues, or funds are provided from another source, the laboratory is to be accommodated elsewhere than on its present site. A letter of protest from Sir E. Sharpey Schafer has been published in the *Times*, and resolutions in favour of maintaining the laboratory in its present situation have been passed by various bodies of physiologists. It would be unfortunate if a valuable centre for research were dismantled in order to find room for work which could so much more easily be done elsewhere.

WE trust that an immediate inquiry will be instituted by the Ministry of Agriculture and Fisheries into the alleged effect of the discharge of oil from motor-propelled vessels at sea, to which Sir Arthur Shipley has directed attention in the columns of the *Times*. According to the *Naturalist* for January, gulls, razorbills, and guillemots have recently been picked up along the Yorkshire coast dead or dying, their plumage so saturated with oil that they were unable to fly or dive. Moreover, sedentary forms of rock-pool organisms are dying, and the inshore fisheries suffering in consequence, codling, coalfish, and other species haunting the inshore rocks being very scarce this year. It seems possible that unless remedial measures are taken disaster may overtake our fisheries.

THE United States Department of Agriculture has just issued a Circular (No. 135) directing attention to the fact that unless fur-bearing animals are rigidly conserved, the time is not far distant when many of the more valuable species will be exterminated. That this is no alarmist's cry is shown by the fact that both trappers and fur-dealers have urged the Government to take immediate steps to promulgate protection in the form of a close season and the infliction of penalties for furs taken out of condition. It is suggested that State Game Commissions and agricultural experiment stations should promote the raising of fur-bearers such as foxes, skunks, and musk-rats, and that other species less amenable to captivity should be conserved in sanctuaries.

IN the Kelvin lecture to the Institution of Electrical Engineers on January 13, Sir William Bragg gave an interesting and luminous account of the way in which the study of the properties of the electron has led to a better understanding of the structure of the atom. His concluding remarks indicate that the improvements he has been able to introduce into his X-ray spectrometer have enabled him to establish the fact that the atoms have different properties in different directions. This supports the theories of Lewis and Langmuir that some of the electrons constituting an atom do not participate in the orbital motion about the nucleus which is characteristic of the electrons of the Rutherford atom, as developed by Bohr and Sommerfeld, but, on the contrary, are restricted to certain portions of the outer surface of the system, in which they describe small closed orbits and so produce magnetic fields which serve as bonds of attachment between atoms.

IN co-operation with the Anglo-Batavian Society, the University of London has made arrangements for an interchange of lectures on medical subjects between London and the Netherlands. The first lecture of the series to be given by Dutch professors was delivered by Prof. Wertheim-Salamonson, of Amsterdam, on January 17 at the Royal Society of Medicine, the Vice-Chancellor of the University of London presiding. The subject chosen was "Tonus and Reflexes," one to which the lecturer has devoted much attention. The chief point discussed was the participation in reflexes obtained normally, but especially in some nervous affections, of that remarkable state of shortening into which voluntary muscles can be put by certain conditions—a state in which no electrical changes are to be detected and, as it appears, very little, if any, chemical or thermal changes take place. The lecturer was inclined to attribute the phenomena to effects through the sympathetic supply of muscle. The next lecture will be given by Prof. Boeke, of Leyden, on February 16, the subject being "The Modes of Termination of Nerve-fibres in Muscle."

A DISCUSSION, in which a number of kinema experts participated, took place before the Illuminating Engineering Society on January 18 on "The Use and Abuse of Light in Studios for Kinema-film Production." The making of films by artificial light involves the use of illuminations vastly higher than those usual in ordinary lighting, and cases have been mentioned of alleged injury to the eyes of actors arising from exposure to very powerful lights at close quarters. The subject is being considered by the Ministry of Health Committee on the Causes and Prevention of Blindness, the chairman of which, the

Right Hon. G. H. Roberts, made a few remarks at the meeting. Eye-troubles have been attributed to the glare of the intense visible light from certain illuminants, and it has also been suggested that the presence of a high proportion of ultra-violet rays may be an influential factor. It seems evident that the region of the spectrum best suited to film production needs further investigation. Possibly ultra-violet rays of very short wave-length, such as may be liable to affect the eyes, might be excluded without prejudice to photographic effect. The view was expressed by several speakers that the use of very powerful unscreened arcs in studios is rarely necessary, and that the best results are obtained by adopting screening and diffusing devices yielding conditions resembling natural lighting. The Illuminating Engineering Society has prepared a list of queries for circularisation which should yield useful information on these points.

WE have received the following communication from the U.S. National Research Council:—Dr. Henry A. Bumstead, professor of physics and director of the Sloane Physical Laboratory at Yale University, and for the past half-year on leave from the University as chairman of the National Research Council of Washington, D.C., died suddenly on the train on the night of December 31 while returning to Washington from Chicago, where he had been in attendance at the meetings of the American Association for the Advancement of Science and affiliated societies. The following resolution was unanimously adopted at a special meeting of the Interim Committee of the National Research Council held on January 3: "That the National Research Council learns of the death of Dr. Henry A. Bumstead, chairman of the Council, with great sorrow and a profound sense of loss. Dr. Bumstead in his association with the Council had revealed to its officers and members not only a high capacity for administration and a most loyal fidelity to the aims and work of the Council, but also a sweetness of disposition and personal attractiveness which had won for him the devoted and affectionate regard of all his colleagues in the Council. In his death the Council and the scientific world lose a man of most eminent attainments, highest character, and lovable personality. The National Research Council extends to the bereaved wife and family its deepest sympathy and condolence, and wishes to express to them its full appreciation of the great value of the services which Dr. Bumstead rendered it in the period of his association with it and the great loss which it suffers by his untimely death. But may we all remember that 'that life is long that answers life's great ends.'"

PROF. E. WESTERMARCK publishes in *Acta Academiae Aboensis*, part i., an important paper on "The Belief in Spirits in Morocco," the result of several expeditions into that country. It is mainly concerned with an elaborate account of the Jinn or underground spirits which interfere in every phase of human life. Men have been taken to their kingdom or have cohabited with the Jinniya or female spirits. Prof. Westermarck describes in detail the nature and doings of these spirits, prophylactic measures adopted against them, remedies for troubles caused by them, and measures for bringing them under control. He disputes the views of Robertson Smith, who regarded the belief in them to be a survival of totemism; nor can they be regarded originally as the spirits of the dead. Prof. Westermarck regards the conception of the Jinn to be "a generalisation on a much larger scale. These spirits seem to have been invented to explain strange and mysterious phenomena which suggest a volitional cause, especially such as inspire men with fear; but Robertson Smith's theory that their special haunts are places most frequented by wild beasts cannot be accepted. In their present form their original home was Arabia, whence they migrated to Morocco, where the general scheme of belief was mixed up with the local animistic beliefs of the Berber tribes."

THE American Museum of Natural History has arranged for a third Asiatic Expedition in co-operation with the American Asiatic Association and *Asia*. The Chinese Government has been invited to delegate to the expedition men who have had preliminary instruction in various branches of science, so that they may assist and, at the same time, be trained in modern methods of scientific exploration. In return for such help and facilities a duplicate set of the collections will be deposited in Peking to form the basis of a Chinese national museum. To aid this, the American Museum undertakes to train selected Chinese in museum work. It is proposed that the field work shall last for five years. From headquarters in Peking parties will work in the interior of China, Central Asia, Manchuria, and Kamchatka. The zoological collections will help to furnish a hall of Asiatic life in the American Museum of Natural History, where are already the specimens obtained by Mr. R. C. Andrews, the leader of the first and second Asiatic Expeditions. In *Natural History*, the journal of the museum, Mr. Andrews dwells on the fragmentary nature of our knowledge of this region. Some exaggeration is allowed for in propaganda, but when Mr. Andrews says, in italics, "Knowledge of the fossils of Eastern Asia rests almost entirely upon the report on a small collection of teeth and fragmentary bones purchased in the medicine-shops of Tientsin and described by a German named Schlosser," then we recognise that several fragments of knowledge have failed to catch the eye of the writer.

REPORT No. 10 of the Industrial Fatigue Research Board forms a preliminary account of some of the investigations now being undertaken by Messrs. J. Loveday and S. H. Munro into the boot and shoe industry. A historical sketch of the industry is given, and a detailed description of modern processes follows. The daily variations of output of various groups of workers in five factories are then recorded. As in almost all other industries, the Saturday output was found to be low (sometimes only 77 per cent. of the average), but the chief interest of the observations lies in the comparison between the skilled workers with a large output and the relatively unskilled, who showed an output 10 to 50 per cent. smaller. It was found that the former maintained a much more uniform output, and usually they improved slightly from day to day until they reached their acme on Friday. The relatively unskilled workers, on the other hand, showed a more irregular output, which generally fell off after the second or third working day of the week, and sometimes after the first working day. Another section of the report affords striking evidence of the value of rest-pauses. A firm which desired to increase its output without adding new machinery determined to make the experiment of working the double presses with a team of three girls, each operative working forty minutes in each hour and resting twenty minutes, instead of with two girls working continuously throughout the day. In a short time it was found that the total output from the presses had increased 44 per cent., *i.e.* the girls were producing individually nearly as much as they had been able to do previously, but in two-thirds the time.

A COPY has reached us of the first number (January) of the *Journal of Industrial Administration*, the official organ of the Institute of Industrial Administration, which was founded in the spring of last year. The scope of the journal is, it is announced, to be wider than that merely of reporting the proceedings of the institute on the lines usual with professional societies; its editor indicates that his chief aim will be to make the publication "a medium for the pooling of the experience of those interested in the administration of industrial enterprises, so that it may serve the urgent purpose of assisting in the policy of practical education for members." A prominent feature is to be the special section devoted to the discussion by correspondence of the problems connected with industrial administration; the object of this section is to provide members resident in any part of the world with a medium for exchanging views on administrative questions affecting their occupation on an open platform, and in a manner which will, whilst assisting members individually, conduce to the greatest usefulness of the institute. Particulars are given of instructional courses, open to members and non-members, to be held in London; these courses begin on February 2, and deal with production estimating and production costing. The journal contains an abstract of an address on "The Industrial Question" given by Viscount Haldane, O.M., at the inaugural meeting of the institute held on October 23 last. The editorial offices have been established at 110 Victoria Street, S.W.1.

AN important paper by Lord Lovat on recent progress in British forestry appears in the Journal of the Royal Society of Arts for January 7. It begins with a short account of the movement leading to the passing of the Forestry Act in August, 1919, which created the Forestry Commission and empowered this body to expend 3,500,000*l.* in afforestation during the ensuing ten years. Lord Lovat further points out the part which private landowners should play in this great national work, and discusses at some length the relations between forestry and such subjects as hill pasture, land given over to sport, small holdings, and soldier settlements. The paper concludes with an authoritative statement of the operations of the Forestry Commission during its first year. A good beginning has been made; 69,000 acres of land have been acquired and extensive nurseries started, in which there are growing already 129,000,000 seedlings and transplants.

THE burning coal-seams that are a conspicuous feature in the coalfields of the western United States lead G. Sherburne Rogers (U.S. Geol. Surv., Prof. Paper 108–A) to remark that a pile of coal exposed to the direct rays of the sun would be liable to become heated and finally to ignite. From his observations in Montana he concludes that "the physical factors promoting spontaneous combustion are a finely divided condition of the coal, a slight increment of heat from an outside source, and a sufficient volume of coal to retard loss of heat by radiation." The absorption of oxygen by coal when warmed generates further heat, and the process is thus self-accelerating. Parr and Francis are quoted as showing that at 120° C. to 140° C. a critical stage arises, when the occluded oxygen combines with some of the hydrocarbons, producing carbon dioxide and water, accompanied by a rapid rise in temperature. Ignition occurs at 350° C. to 450° C. The fine dust of lignite, it appears, may ignite at 150° C., and of gas-coal at 200° C. The burning of coal-seams in the west is associated with the cuts formed by small and rapid streams. The metamorphic effects of the heat on the overlying rocks have been studied by the author, and include the production of spherulitic glass and of holocrystalline diopside-plagioclase slag.

THE November and December issues for the past year of the Journal of the Franklin Institute contain an important paper on the annealing of glass by Messrs. L. H. Adams and E. D. Williamson, of the geophysical laboratory of the Carnegie Institution of Washington. In order to supply the information demanded by the American glass manufacturers as to the proper method of annealing, the authors have determined the rate of disappearance of an initial stress in glass at any temperature. They find that the reciprocal of the stress increases with the time at a uniform rate which depends on the kind of glass and the temperature at which it is maintained. A table of rates for common glasses at various temperatures is given. As a result of their investigations the authors recommend that glass, and especially optical glass, should be annealed by raising the temperature in about $1\frac{1}{2}$ hours to the value specified in one of the tables as suitable for that glass. This temperature is about 50° C. less than that in common use at the present time. The glass is maintained for four hours at that temperature and then allowed to cool, at first slowly, then rapidly, so that the cooling is over in about three hours, and the whole process lasts only eight hours. This is more effective than the old process, involving greater heating and slow cooling, which lasted twenty hours.

PARTICULARS have reached us of the Elmendorf paper-tester, which indicates the resistance offered by a sample of paper to tearing. A compound pendulum of weight P and equivalent length l is swung always from the same initial angle, and in the course of its downward swing it tears a suitably cut sample of paper held partly by a clamp secured to the pendulum and partly by the fixed support carrying the axis. The pendulum rises on the far side to an angle ϕ_1. When swung without tearing the paper it rises to an angle ϕ_2. The difference in the potential energy of the pendulum at the angles ϕ_1 and ϕ_2 is the work done in tearing the paper, and is equal to $Pl(\cos\phi_1 - \cos\phi_2)$. If the length of tear is d and the tearing resistance to be determined R,

$$R = \frac{Pl}{d}(\cos\phi_1 - \cos\phi_2).$$

In its present form the pendulum has the shape of a segment of a circle pivoted at the centre and calibrated round the circumference. It is held in its initial position by a spring stop. A light pointer mounted frictionally on the axis is set initially against the stop, where it is held until the pendulum commences its return swing; then it moves with the pendulum, and so the extent of the swing is recorded. The calibration can be such that R is read direct. The apparatus can be seen at the office of Messrs. R. J. Marx, 133–39 Finsbury Pavement, E.C.2.

AMONG the announcements of Mr. John Murray is "The Life of Alfred Newton," by A. F. R. Wollaston, in which the many activities of this former professor of zoology in the University of Cambridge will receive attention. The work will also contain a chapter describing Cambridge in the middle of last century, by Sir Arthur E. Shipley, and personal reminiscences of Prof. Newton by Dr. H. Guillemard.

ERRATA.—Dr. T. J. J. See sends the following corrections of values given by him in his letter on the measurement of the angular diameter of Betelgeux printed in last week's issue of NATURE, p. 663 :—Lines 16 and 24, "orbit of Venus" should be "orbit of Mars." Lines 33–35 should read : "Sirius, which is itself twenty-fivefold more luminous than our sun. Accordingly, Betelgeux gives about 6500 times the sun's light."

Our Astronomical Column.

PONS-WINNECKE'S COMET.—The reappearance of this periodical comet is expected shortly, and the ensuing perihelion passage is likely to occur at nearly the same time of the year as in 1869, when it was on June 29, and in 1892, when it was June 30. On the former occasion the comet was first seen on April 9, and on the latter March 18. The following is an ephemeris :—

1921		Perihelion June 21 R.A.	Decl. N.	Perihelion June 13 R.A.	Decl. N.
		h. m. s.	° ′	h. m. s.	° ′
Feb.	3	13 26 10	19 8	13 45 16	17 8
	11	13 36 11	20 48	13 58 4	18 31
	19	13 45 32	22 51	14 11 0	20 17
Mar.	7	14 2 0	28 16	14 37 8	24 59

The date of perihelion passage is a little uncertain, so that for purposes of sweeping two series of positions are given, one on the assumption that it will occur on June 21 and the other on June 13. The comet will probably be rediscovered in February or March, and the meteoric shower connected with it, should it recur, may be expected on the night following June 27.

THE MAGELLANIC CLOUDS.—Dr. E. Hertzsprung has a paper on these clouds in Monthly Notices (vol. lxxx., No. 9). It is based on Mr. R. E. Wilson's measures of the radial velocity of nebulæ (Lick Obs. Pubs., vol. xiii.). On the whole, Mr. Wilson found low velocities for the gaseous nebulæ. There were, however, notable exceptions in the cases of seventeen nebulæ in the greater cloud, which showed average recessions of 276 km./sec., and one in the lesser cloud which showed 168 km./sec. It was a reasonable inference that the clouds were external to our galaxy; indeed, this was already thought probable on other grounds. On studying the individual motions it was seen that they showed a steady upward tendency as one went southward. Mr. Wilson suggested in explanation a rotation of the cloud; Dr. Hertzsprung points out that it is simpler to assume that the variation is a perspective effect, due to different parts of the cloud being at different angular distances from the apex of motion. He applies analysis to the observations, and finds as the most probable solution that the velocity of the greater cloud (corrected for the solar motion) is 608 km./sec. towards R.A. 4h. 31m., S. decl. 4° 42′ (galactic long. 168°, S. lat. 30°). The single nebula observed in the lesser cloud gives a result consistent with the two clouds having the same motion. The greater cloud is 63·7° from the apex, which gives a velocity of 560 km./sec. at right angles to the line of sight. Taking the distance as 10,000 parsecs, this implies an angular velocity of somewhat more than a second per century, the position angle being 348° and 55° for the greater and lesser clouds respectively.

It will be remembered that Dr. Hertzsprung was one of the first to give a trustworthy estimate of the distance of the clouds, based on methods quite similar to those applied later to the globular clusters by Dr. Shapley.

INVESTIGATION OF THE EINSTEIN SPECTRAL SHIFT.—Bulletin No. 64 of Kodaikanal Observatory contains a full account of a second investigation of this effect by Mr. J. Evershed. Mr. Evershed's former result (Bulletin No. 39) indicated considerably more than half the shift predicted by Einstein. In view of Dr. St. John's much smaller result, he planned a more extensive research, using the Anderson 6-in. grating, which was carried out in the spring of 1918. The spectrum of the sun both near the centre and near each pole was compared with the carbon arc. The results are corrected for solar and terrestrial rotation and the earth's radial velocity. The lines used are not the same as those of Dr. St. John, but the strongly marked triple carbon bands extending from 3876·59 to 3881·78. The mean values of the shift, sun *minus* arc, are :

Sun's centre ... +0·0037 Å.
(omitting one discordant day)
Sun's north limb ... +0·0071 Å.
Sun's south limb ... +0·0100 Å.
Einstein's value ... +0·0082 Å.

Mr. Evershed notes that the late Mr. Pocock found a similar discordance between the measures at the sun's north and south limbs.

The Forestry Department of Edinburgh University.

So far back as 1887 a lectureship in forestry was inaugurated at Edinburgh University. The courses given were mainly attended by students taking the University degree in agriculture. It was a far-sighted step to take at that time, since it is a great advantage to the scientific agriculturist to have some acquaintance with the aims and objects of the forester with whom he has so commonly to work side by side on the countryside. On the closure of the forestry branch at the Coopers Hill College in 1905, the training of the Indian forestry probationers was left in the hands of the universities. Recognising the altered conditions and the growing demand for the trained forest officer—for the Colonial Office was now beginning to require qualified men—Edinburgh University, which is pre-eminently a scientific and Empire university, instituted an ordinance for the degree of B.Sc. in forestry in 1909.

FIG. 1.—Forestry and Agricultural Building, University of Edinburgh.

Under this ordinance full courses in all the branches of pure forestry are given, and at least six months' practical work in forestry is required of the student for the degree. The subjects for the forestry Preliminary Examination for matriculation to the University are English, mathematics, Latin, and French or German, thus ensuring that the future forest officer shall have that acquaintance with modern languages which is indispensable to him.

During his first year the student takes the first science courses in pure science of the University in botany, zoology, natural philosophy, and chemistry. In the second and third years the forestry subjects proper, together with the allied science branches, including geology and surveying, are taken. In order to make full provision for the allied sciences, which form so important a branch of the training of the future forest officer, special lectureships in forest botany, forest mycology, forest zoology, forest engineering, and forest chemistry were inaugurated, as also a course in Indian forest trees. Students for the agricultural degree of B.Sc. have the option of taking the introductory forestry course, which is one of the courses under the forestry ordinance. More recently courses in tropical forestry and in Indian geology have been sanctioned. The fact that all the branches of applied science are dealt with by specialists in their individual subjects is of great importance in properly equipping the forest officer for his future life-work. In the past it has often occurred, both in Continental schools and in this country, that one lecturer was maintained, in order to save expense, to deliver courses in forest botany and forest entomology, with, perhaps, geology or another subject thrown in. The students' time-table for the degree is well filled up. The terms, three in the year, are of ten weeks each, and the hours, from 9 a.m. to 5 p.m. five days a week, are taken up with lectures, tutorials, and laboratory work. A part of most Saturdays is devoted to excursions, whilst the vacations are occupied, to the limit desirable in the interests of the student, with the practical courses in forestry.

In order to give full effect to the ordinance, the University had to make provision in the important question of buildings, laboratories, and so forth, and in this matter the department may claim to be second to none in the country. New buildings were erected containing a large lecture hall to accommodate 130 students, and several museums, including a sylviculture museum, a protection museum, a wood and economic products museum, and a museum for Indian and Colonial timbers. Then there are laboratories, a workshop fitted with a circular saw, a planing machine, and a lathe for the instruction of students, rooms for the members of the staff, a students' room, and a library. Additional rooms for the museum and laboratory of the lecturer in forest zoology were also provided in the building. These various parts of the building are fitted up with valuable collections of specimens, serving as object-lessons for the training of the students.

This accommodation was just completed before the outbreak of war. The site and building cost 19,500*l.*, and at present prices it is easy to reckon that its value to-day is nearer 40,000*l.* than 20,000*l.* The equipment and fittings cost about 2000*l.*, and the same remark applies to them. It is difficult to make even a guess at the value of the specimens which fill the museums. Towards this outlay, which is exclusive of museum specimens, the University furnished 15,200*l.*, the Development Fund contributing 6300*l.* The other expenditure on the forestry department proper for the period of years 1910–11 to 1919–20, to which allusion is made, on salaries, etc., amounted to 8800*l.*, of which 6600*l.* was furnished from the University funds and 2200*l.* from State funds; so that out of a total outlay during the period of 30,300*l.* the University provided 21,800*l.* as against 8500*l.* received from the State. In addition, the University paid from its own funds the salaries of the lecturers conducting the applied science subjects, forest botany, and so forth. Last year a chair in forestry was instituted and endowed within the University with the help of a grant from the Development Fund.

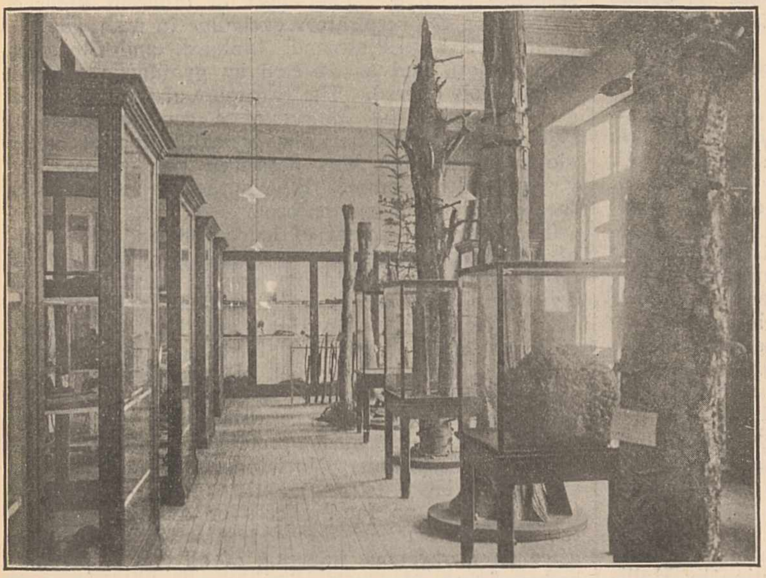


FIG. 2.—Protection Museum, Forestry Department, University of Edinburgh.

For the practical work, through the courtesy of their proprietors, Edinburgh University has had the use of the woods on the estates of the Duke of Atholl, Col. W. Steuart-Fothringham of Murthly, the Earl of Mansfield of Scone, and Viscount Novar of Novar and Raith, and of the Speyside Woods. The students are taken out to these areas and instructed in nursery work, in planting and felling, in sylviculture, and in the protection, utilisation, and scientific measurement of the woods. Arrangements have recently been made with the War Office by which a forest garden has been established on the War Office estate at Dreghorn, situated a few miles from Edinburgh, where a fine large nursery is being laid out; and the Stobs estate of several thousand acres, also belonging to the War Office, has been made available for practical work by the students, the University in return advising on the management of the woods of these estates. The Forest of Dean is used for advanced practical work, and the visits which were made to Continental forests before the war are now being resumed.

At the outbreak of war there were 50 students in the department; last year 168 students took forestry courses in the University, and this year the number has reached 170. The 40 students who have taken the forestry degree since 1911 are now serving in the Indian Forest Service and in the various Colonial Forest Services (South Africa, Canada, and New Zealand), in the Home Forestry Service, and in the Home universities. At the present moment there are in Edinburgh University sixteen Indian forestry, nine Colonial Office, and ten South African probationers—a total of thirty-five.

The University may thus be considered to have met a national need in placing itself in a position to give a full scientific training to the forest officers of the Empire.

The International Physiological Congress, 1920.

SUMMARY OF PAPERS.

SINCE more than two hundred papers and demonstrations were given at the above congress, which was held in Paris in July, a mere mention of the more outstanding communications is all that is possible in this summary. For a general account of the congress Prof. Fraser Harris's article in NATURE of September 16 may be consulted.

Of new apparatus, those described by Hess (Zürich) and Wilson (Cairo) may be specially mentioned. The former demonstrated a cardio-phonograph, a viscosimeter, and stereoscopic photographs. The latter exhibited a stethograph, a portable ergograph, a micro-nitrometer, a colorimeter, and a chronograph with electro-magnetic signal. The pursuit-meter described by Miles (Boston) for detecting the influence of nutrition, fatigue, industrial conditions, etc., on neuro-muscular co-ordination, and the demonstration (without the aid of the microscope) by Fredericq (Liége) of cilia, spermatozoa, etc., in motion, by means of intense illumination, were of particular interest. Philippson (Brussels) demonstrated an apparatus for showing the precise moment of coagulation of an organic liquid; another for recording modifications in the viscosity of fluids; and a method for measuring the electrical resistance of cells and tissues. The crescograph shown by Bose (Calcutta), which is claimed to magnify growth and other movements ten million times, was closely examined and much criticised. Mention may also be made of the display of well-made physiological apparatus by several French and Swiss firms.

Morpurgo (Turin) showed a number of artificially united rat-pairs (so-called Siamese twins). He finds that when two animals of different size are united the weaker dies from inanition, as a result of failure to hold its own in the joint distribution of nutritive substances. Rochon-Duvigneaud (Paris) finds that the foveæ in the retina of birds may be central, ex-central, or double; since complete decussation occurs at the optic chiasma, each has a unilateral connection. A communication by Minkowski (Zürich) dealt with the course of the optic fibres in man and other mammals.

Botazzi (Naples), by very slowly varying its temperature, finds that mammalian striated muscle (diaphragm) shows a distinct shortening at 0° C. (cold-contracture) and another, already well known, at 45° (heat-contracture). He believes that these changes, which are reversible, are due to the sarcoplasm. Heat rigor (63° C.), which is irreversible, he regards as due to contraction of the connective-tissue. Parnas (Warsaw), in his communications on muscle physiology, supported a view which is opposed to that of A. V. Hill on the question of the fate of lactic acid during the relaxation phase, favouring the combustion theory. Langley (Cambridge) suggested that muscle atrophy after denervation is due to fatigue (fibrillation), resulting from the irritation set up in the neural region of the muscle. He also spoke upon nerve suture and regeneration. The conditions of industrial fatigue were dealt with in a paper by Lee (New York).

The question of fat metabolism in its broadest aspect was the subject of a communication by Halliburton (London), the vitamine problem being specially considered. Gosset, Camus, and Monod (Paris) described a method for obtaining permanent biliary fistulæ in the dog. Both Foa (Parma) and Lombroso (Messina) dealt with the metabolism of fats in the liver; they showed that their destruction is much greater during digestion than during fasting. Lombroso also discussed the action of enterokinase upon the proteolytic activity of pancreatic juice. Brinkman (Groningen) showed that the cholesterol-phosphatide quotient controls the permeability of cell-membranes, those of erythrocytes in particular, and pointed out that this factor is all-important in the pathology of anæmias. The question of intermediary metabolites and their relation to heat production was dealt with by Graham Lusk (New York), who found that in the dog 58 grams of glucose increased heat production by 4·3 Calories, while 50 grams of glucose *plus* 8 grams of lactic acid caused an increase of 4·8 Calories. When lactic acid was replaced by 3 grams of acetic acid, the increase observed was 7·3 Calories. This last result is similar to that obtained when fat and glucose are metabolised together, and suggests that acetic acid may be an intermediary metabolite of fat, but not of glucose. E. and May Mellanby (London) showed that the cause of rickets is probably want of fat-soluble A vitamine in the diet. When this is lacking the development of bones and teeth is defective.

With intact kidneys a small dose of uræmic blood causes intense diuresis, while a large dose arrests the flow of urine. After denervation no result is obtained. This was demonstrated by Pi Suner and Bellido (Barcelona).

Macleod (Toronto) showed that in decerebrate cats the respiratory centre can be stimulated during slight anoxæmia without any decided change in the CO_2 tension or the H-ion concentration of the arterial blood; greater degrees of anoxæmia cause paralysis of the centre. Krogh (Copenhagen) demonstrated that the respiration of aquatic animals is not influenced by CO_2, but only by the amount of oxygen. The same author, employing the frog's tongue, finds that capillaries can be caused to dilate independently of the influence of the arterioles supplying the part. Waller (London) described a ready method of deterining the CO_2 output under varying conditions of work; he also demonstrated the electrical emotive response in man. The effect of different kinds of exercise on the respiratory exchange in man was also dealt with by Liljestrand, Linhard, and Stenstrom (Stockholm), and as affected by gymnastic exercises by Langlois (Paris). The transport of CO_2 by hæmoglobin formed the subject of a communication by Buckmaster (Bristol). The crystallisation of hæmoglobin of the bat was described by Amantea and Kryszkowsky (Rome); these authors also dealt with the physiology of spermatozoa.

The glycogen-content of leucocytes and the nature of amœboid movement were discussed by de Haan (Groningen); amœboid movement is stated to be dependent partly on viscosity (colloid) and partly on HCO_3 ($NaHCO_3$). De Haan and Feringa produced evidence of the apparent formation of eosinophil leucocytes from lymphocytes. Doyon (Lyons) demonstrated that incoagulability of the blood after peptone injections is due to an antithrombic substance of nuclear origin—a nucleo-protein—containing 3 per cent. of phosphorus. Nucleinate of soda was also shown to be a strong anti-coagulant. Gautrelet (Paris) found no fatal effects or any alteration in the viscosity or the H-ion concentration of the blood after an intravenous injection of oil (1 c.c. per kilo. body-weight).

Sharpey Schafer (Edinburgh) proved that the pulmonary blood-vessels are supplied by vaso-motor nerves by showing that stimulation of the depressor nerve causes a fall in pulmonary pressure independently of the aortic system. He also exhibited cats in which both cervical sympathetics had been cut at an interval of a few weeks, showing paradoxical contraction of the pupil and dilatation of arterioles on the side of the first section. The mechanism of paradoxical dilatation of the pupil following cocainising of the cervical sympathetic was also discussed in a communication sent by Byrne (New York).

Feenstra (Utrecht) confirms the work of Zwaardemaker on the inter-availability of potassium and other radio-active salts in Ringer's solution. Dubois and Duvillier (Lille) showed that after section of the cervical cord double vagotomy may still produce cardiac acceleration provided the blood-pressure is sufficiently high. Wertheimer and Boulet (Lille) showed tracings to demonstrate that in frogs poisoned by $BaCl_2$ it is possible either to provoke or to arrest heart-block by an induction shock, according to the phase of the normal rhythm at which the heart is stimulated. Barry (Cork) showed in the toad's heart that reversal of action may take place (ventricle beating before auricle) during recovery from the effect of nicotine. Einthoven (Leyden) described experiments which appeared to show that the positive electrical change during vagal stimulation described by Gaskell in the tortoise auricle is due to mechanical stretching by contraction of the lung. De Boer (Amsterdam) reported the results of his study of the effects of varying rates of conduction on the form of the ventricular electrogram. He also described a method for obtaining delirium cordis in the frog-ventricle. Danielopolu (Bucharest) records observations upon the effects of various conditions—clinical and experimental—upon the human electro-cardiogram.

In a communication by Heger (Brussels) the cause of the relative hypertrophy of the right ventricle which occurs in man and animals acclimatised to residence at a high altitude is ascribed to a persistent pulmonary hyperæmia.

Anaphylaxis was the subject of communications by Kopaczewski (Paris) and Pesci (Turin).

Communications dealing with the central nervous system were few in number. Among them was one by Amantea (Rome) on the effect of application of strychnine to the sensori-motor region of the cerebral cortex on experimentally excited epilepsy; one by Camus and Roussy (Paris) on polyuria produced by lesions at the base of the brain; and one by Lafora (Madrid) on the functions of the corpus callosum.

According to Abelous (Toulouse), cholesterol is manufactured in the spleen, which organ may be stimulated to increased production in this direction by secretin. A paper by Rothlin (Zürich) was devoted to the effects of adrenalin and β-iminazolethylamine (active principle of secretin) on gastric secretion; the former inhibits, and the latter, if injected subcutaneously or intramuscularly, stimulates. Quantitative studies on the adrenalin output of the adrenal glands was the subject of a communication by Stewart (Cleveland). Bazett (Oxford), as the result of cross-circulation experiments, finds that adrenalin is of little importance as regards pressor reflexes, but that it functions by maintaining a normal tone in the arterioles or capillaries. Negrin y Lopez finds that after "piqûre" and double vagotomy the blood-pressure always rises, but if the animal has been adrenalectomised a fall occurs. Gayda (Turin) finds that tadpoles fed with thyroid give off more heat than normal ones.

Pézard (Paris) confirmed the experience of others that castration leads to the appearance of the opposite sex-characters in fowls. Athias (Lisbon) showed that after total castration pituitrin always contracts the uterus, while adrenalin does so only in the rabbit and hedgehog; it inhibits contraction of the uterus of the dog and cat.

There were also presented many communications dealing with problems of chemical physiology and with the action of particular drugs the contents of which do not lend themselves to a short summary.

R. K. S. LIM.

Liquid Fuel from Coal.

By PROF. JOHN W. COBB.

A PAPER entitled "Coal as a Future Source of Oil-fuel Supply," which has a very special interest at the present time, was read by Sir Arthur Duckham at a meeting of the Institution of Petroleum Technologists held at the Royal Society of Arts on October 19, 1920. It marks the recognition of a new state of affairs which is rising out of the enormous increase, actual and contemplated, in the use of liquid fuel and the by no means unlimited supply of natural petroleum. America is already concerned with the conservation of its own supplies of the latter, and there is every necessity for a careful and extended examination of any method which appears to be practicable for producing liquid fuel from solid deposits.

The demands that have to be met are of various kinds, and require products differing widely in the degree of their refinement. One extreme is encountered in providing for the delicate mechanism of the motor-car engine, and the other in meeting the grosser requirements of a steam boiler, particularly in the raising of steam for the propulsion of battleships and other sea-going vessels.

The Scottish shale industry is old-established, and an example of the practicability of obtaining oils by retorting, but the proved quantities of suitable oil-producing shale in this country are not very great. Sir Arthur Duckham has addressed himself to a discussion of what may be done by way of treating coal so as to obtain the best value in oils and tars. In reviewing possible lines of development he expresses the belief that the industrial future of this country lies in the conversion of the coal at the pit's mouth into liquid and gaseous fuels. "Liquid fuels will be recognised as the medium for providing energy for all transport by land, sea, or air with the exception of electrical transport for congested areas, while gaseous fuels will be used direct for the great majority of heating purposes and for the generation of electricity." He points out that "full experience has been gained in America of the transmission of gas over long distances," and then that "there is no question that, starting in the big industrial districts which lie near the coalfields, gas can be supplied in sufficient quantities and can economically replace solid fuel." In this way the author emphasises the production of gas, oil, and tar together from coal as being the right direction in which to go, and proceeds to discuss the various technical and commercial considerations which should influence the choice of process and plant for the purpose.

In this Sir Arthur Duckham is completely at home, and, although primarily a gas engineer of assured reputation, he displays no reverence for traditional and accepted methods when these appear to him to be only second best. He is, however, compelled to lament at an early stage the impossibility of supplying financial or thermal balance-sheets with any degree of confidence. This difficulty is inevitable at any time with unproved processes, and at the present time there are peculiar difficulties on the financial side which are not confined to the problem he is discussing, but apply to all schemes involving extensive reconstruction.

In order to deal in turn with established methods, the author reviews the position of gasworks, coke-ovens, and gas-producers. He describes the evolution of gas-making as it is conducted for the purpose of public supply, pointing out how "it started as a low-temperature process, and gradually became, with the improvement of materials of construction and advanced knowledge, a high-temperature process." He indicates the extent to which gas undertakings have been hampered by "antiquated and restrictive legislation," based upon the conditions of the past, and indicates quite rightly that the recent removal of these restrictions should make for rapid development.

The form of gasworks plant which meets with Sir Arthur's approval is evidently the continuous vertical retort with steaming, increasing the temperature about the bottom of the retorts and highly superheating the steam before it enters. The hot waste gases from the plant are to go through waste-heat boilers, so raising the quantity of steam required for steaming the retorts in return for a small extra capital expenditure and the cost required to drive the fan on the outlet boilers. The author points out in this connection what is so frequently ignored by the less informed advocates of low-temperature carbonisation, that in the continuous vertical retort a really fractional distillation can be attained. "The products of distillation are driven away as made, and have to pass through no higher temperature than that at which they are evolved, whilst if water-gas is made at the same time in the retort by steaming, this process protects the hydrocarbons and gives a greater quantity of a lighter quality tar." The weakness of gasworks practice, from the author's point of view, is that the coal has to be conveyed to the gasworks and the coke removed from it.

In dealing with coke-ovens it is argued that they meet a definite but limited demand for a specific article, namely, hard coke for blast-furnace work, and that on this account the erection of coke-ovens for supplying gas- and tar-oils to meet national needs is not feasible.

The author turns aside for a moment to indicate the possibility of using much more coke-oven gas for town supply, and points out that the chief difficulty in the way at present is the variation in its quality. That difficulty is not, however, insuperable.

He expresses, too, a belief that gas will in the future be used instead of coke in the smelting of iron-ore, but it is possible that in coming to that conclusion the high output and efficiency of a modern blast-furnace plant have not been taken sufficiently into account.

Sir Arthur does not regard gas-producers very favourably, though he admits their power of giving a large supply of heat-units in the form of gas at a low cost. His main criticism is that the tar-oils recovered are not valuable. "The condition in which they come from the plant makes them difficult to work up, and, according to the tar distillers, the final products do not compare at all favourably in value with the final products from other methods of destructive distillation of coal." In justice to the gas-producer it may be pointed out, however, that most of the criticisms under this head might be applied equally well to products of other processes of low-temperature distillation, and often mean simply that the tar is very poor in aromatic constituents, different from gasworks tar, and cannot be worked conveniently along with it.

In speaking of low-temperature carbonisation the author makes the pertinent observation that its advantages are too obvious. He goes on to indicate that the difficulties it presents are very real, and, of course, it cannot attain his ideal because so much of the fuel is finally left in the solid form.

The whole of these considerations and criticisms of the shortcomings of different processes have been leading up to a proposal of something different—total gasification in some form of plant which differs from a gas-producer in that air is not used for gasification of the fixed carbon, and, therefore, nitrogen in quantity is not present in the gas. "The principle of this process is the partial carbonisation of coal in a vertical retort superimposed on a water-gas generator, the retort being heated externally by means of the products of combustion of the producer during the blow period, and internally by the passing of the water-gas made up through the charge in the retort."

This comprehensive survey ends with the formulation of an ideal system of manufacture to meet the demands for liquid and gaseous fuels. It is to gasify coal completely, preferably in one vessel, recovering in a liquid form the maximum amount of volatiles in the coal (working with any coal) and preserving the resulting ammonia. It would be of the combined vertical retort water-gas-producer type, with recuperators, waste-heat boilers, and mechanical arrangements making for labour-saving and for high thermal and chemical efficiency. It is to the treatment in some such plant as this that the author looks for increasing our home-produced oil-fuel supplies, and no doubt he is willing to take his share in the skilful design and careful experimental work involved.

Sheep Panics.

A SHEEP panic on the night of December 10–11, in which the sheep broke their folds in twenty parishes in an area extending some twenty miles in the highest part of Cambridgeshire, has been attracting attention. These panics have often occurred, for sheep are notoriously timid and nervous animals. On November 3, 1888—an intensely dark night, with occasional flashes of lightning—tens of thousands of folded sheep jumped the hurdles and were found scattered the next morning. Every large farm from Wallingford to Twyford was affected, and those on the hill country north of the Thames most so. Again, on the night of December 4, 1893, another very remarkable panic among sheep occurred in the northern and middle parts of Oxfordshire, extending into adjoining parts of the counties of Warwick, Gloucester, and Berks.

Various causes for these panics have been suggested, but only one reasonable explanation has been satisfactorily adduced. The 1893 panic was, at the time, fully investigated by Mr. O. V. Aplin, who published in the Journal of the Royal Agricultural Society the result of his inquiries and the conclusions he drew from the extensive evidence collected. The conclusion arrived at was that the cause of the panic was simply thick darkness. Very few people, probably, have ever been out in a really dark night, and it is impossible for anyone who has not had this experience to imagine what it is like and the sense of helplessness it causes. That a thick darkness of this kind was experienced in the early part of the night of the recent panic (at a time agreeing with that at which, so far as was known, the sheep stampeded) was proved by abundant evidence. One report said that it was between 8 and 9 p.m. when such a thick and heavy darkness came on that a man could not see his own hand. Another witness wrote that a little before 8 o'clock there was an extraordinary black cloud travelling from north-west to south-east, which appeared to be rolling along the ground. The darkness lasted for thirty or forty minutes, and during that time it was like being shut up in a dark room. Later in the night—long after the panics—there were several flashes of lightning.

Mr. Aplin states that animals probably see perfectly well on ordinary dark nights, and we can imagine a bewilderment coming over them when they find themselves overtaken by a thick darkness in which they can see nothing. Folded sheep (and it was the small folds that the sheep broke most) in moving about would knock against their feeding-troughs and one another, and the first one that got a fright from this and made a little rush would probably come into collision with one or two others, and it would need nothing more to imbue the whole pen with the idea that there was some cause for fear. Then they would all make a rush, and their terror and the momentarily recurring incentives to, and aggravations of, it in the shape of collisions would only subside when the sheep had broken out and were in the open, clear of one another and of their troughs and hurdles.

If this is the explanation of the panic, then it is easy to understand why folded sheep are so much more likely to suffer than those lying in open fields. The heavy, oppressive atmosphere accompanying the thick darkness, the susceptibility of sheep to atmospheric disturbance, and their nervous and timid dispositions would all tend to increase the fright the sheep experienced. The cause of the panic being a cloud rolling along so low down as (apparently) to touch the ground, the tops of the hills and the high-lying ground would naturally be most affected; and this is observed to be the case, although locally the usual direction followed by thunderstorms has indicated a line along which sheep stampeded on nearly every farm.

The Work and Discoveries of Joule.[1]

By SIR DUGALD CLERK, K.B.E., F.R.S.

THE greatest generalisation in the early history of physical science was made late in the seventeenth century by Sir Isaac Newton when he enunciated the laws of motion and deduced from them the existence in space of attraction between planets and the sun. Mechanical science has been built up on Newton's fundamental propositions and discoveries. The discovery by Joule in the middle of the nineteenth century of the mechanical equivalent of heat and his suggestion and determination of the existence of an absolute zero, together with the adaptation of Carnot's cycle of 1824 to the theory of heat as a mode of motion, provide generalisations of equal importance to Newton's law of gravitation, and from them fundamental thermodynamic laws are deduced: the equivalence of energy in different forms, conservation of energy and dissipation of energy. Joule's discovery, in fact, called the modern science of thermodynamics into existence.

Manchester has been the home of many highly distinguished men—great scientific men, great inventors, and great masters of industry and business—but it is fortunate indeed in its connection with two of the greatest discoverers in the history of the world, Dalton and Joule. Joule read his first paper before the Manchester Literary and Philosophical Society in the year 1841 upon the subject of "The Electric Origin of the Heat of Combustion." He contributed a long series of papers from that year until 1879, a period of thirty-eight years, and he dealt with a great variety of subjects, including experimental investigations on the phenomena of the voltaic current, the determination of the specific heat of bodies, heat and constitution of elastic fluids, mirage, freezing point of thermometers, galvanometers, dip circle, solar photographs, duty of electro-magnetic engines, magnetic storms, polarisation of platinum plates, mercurial air-pumps, and telescopic oscillations.

The debt of the practical engineer to Joule and his great associates is very real, but the science of thermodynamics did not supply the fundamental laws from which heat-engines were invented and developed. The steam-engine had been developed by Newcomen, Smeaton, and James Watt long before the birth of the science of thermodynamics. What is true of the steam-engine is true also of the hot-air engine and the internal-combustion engine; all the known types of heat-engine at present in use were invented before the year 1850, and practical experimental examples of both hot-air and internal-combustion engines were then in operative existence. Thermodynamics supplied the laws of the conversion of heat into mechanical work by which these engines are governed; it explained the relative perfection of engines already in existence, but it did not create these engines. It performed the very important service of dispelling the errors of thought which hindered the future advance of heat-engines. Such errors as to the theory of the regenerator and the theory of compression and expansion in all steam and internal-combustion engines, held by the most eminent engineers and scientific men so late as from 1845 to 1853, were rendered impossible by the splendid work of Joule, Kelvin, Rankine, and their Continental colleagues. The knowledge of thermodynamics has thus an increasing effect upon instructed engineers of the present generation. It is quite obvious that although the origin of heat-engines cannot be ascribed to Joule's work, yet the improvement and final development towards a maximum conversion of heat into mechanical work are rendered possible to the engineer of to-day by his great discoveries. Engineers and engine-designers are most grateful to Joule, and look back on his achievements as those of the utmost intellectual and practical importance.

Giant and Dwarf Stars.[2]

THE amount of light received from a star determines its *apparent magnitude* (m), the ratio for two stars differing by one magnitude being 2·512. The *absolute magnitude* (M) is what the apparent magnitude would be if the star were at the standard distance of 10 parsecs, which corresponds to a parallax of 0·1″. If π is the parallax of a star in seconds of arc,

$$M = m + 5 + 5 \log \pi.$$

In this equation m is not difficult to measure, and hence if π or M is determined the other can be found.

Russell took all stars for which fairly accurate values of π were available, and from the above equation computed M. Then, plotting M as ordinate and type of spectrum as abscissa, he found that (1) all white stars are far brighter than the sun; (2) range of brightness increases with redness; (3) all faint stars are red; and (4) all red stars are very bright or very faint.

Adams and Kohlschütter found that the relative intensity of selected lines in the spectrum of a star depended on the absolute magnitude from measurements on the spectrum. M being determined, the

[1] Abstract of the first Joule Memorial Lecture delivered on Tuesday, December 14, 1920, to the Manchester Literary and Philosophical Society.

[2] Abstract of a lecture delivered before the Royal Society of Victoria, Melbourne, on October 14, 1920, by Dr. J. M. Baldwin, Government Astronomer.

equation gives π, and thus the parallax can be measured spectroscopically. This work brought out very clearly the division of the red stars into a very bright group and a very faint group, with no stars of intermediate brightness.

The absolute magnitude depends on mass, density, and surface brightness. The only information as to mass is obtained from binary stars, and for these the total range in mass is only from nineteen times that of the sun to one-quarter that of the sun.

The surface brightness for stars with similar spectra must be nearly equal, and thus the average red star of the bright group, which gives out 1000 times as much light as the average red star of the faint group, must have 1000 times the surface and 30,000 times the volume of the latter. Hence the terms "giant" and "dwarf." If the masses are equal the densities will be in the ratio 30,000 to 1.

For special classes of stars the relative surface brightness can be obtained, and it is found that the very white stars give out 500 times as much light per unit-surface as the very red stars. For the giant stars the density increases from the red stars to the white, while for the dwarf stars the density increases from the white stars to the red. As the giant stars contract and get hotter the increase in surface brightness nearly balances the decrease in surface, and the stars remain nearly constant in brightness, as is actually found to be the case. After a limiting density is reached cooling follows further contraction, and both the surface brightness and surface decrease together, and a rapid diminution of light is the result. This also is confirmed by observation.

University and Educational Intelligence.

LONDON.—Among the proceedings of the Senate on January 19 are the following:—

Miss Philippa Chicheley Esdaile, D.Sc. (Manchester), has been appointed as from February 1 to the University readership in biology tenable in the Household and Social Science Department of King's College for Women. Miss Esdaile has held a zoological research studentship and an honorary research fellowship in the University of Manchester, where she has also been assistant demonstrator in the Zoological Department. In 1914 Miss Esdaile was elected to a research fellowship at University College, Reading, and from 1915 to 1920 she was acting head of the Department of Zoology at Bedford College during the absence on war service of Dr. Marett Tims. Since last August she has been senior lecturer on zoology at Birkbeck College. She is the author of various publications, especially on salmon-scale research.

The following doctorates were conferred:—*Ph.D. in Philosophy:* Mr. N. K. Datta, an internal student, of University College, for a thesis entitled "The Vedanta: Its Place as a System of Metaphysics." *D.Sc. in Mathematics:* Mr. S. R. U. Saveer, an external student, for a thesis entitled "On the Instability of the Pear-shaped Figure of Equilibrium of a Rotating Mass of Homogeneous Liquid."

A resolution was adopted expressing the gratification with which the Senate had heard of the anonymous donation of 20,000*l.* made to the authorities of the Middlesex Hospital Medical School for the endowment of the University chair of physiology there tenable.

A LECTURE on "Agricultural Botany" will be given by Prof. R. Biffen at King's College, Strand, W.C.2, on Saturday morning, February 5, at 11 o'clock, in connection with the London County Council's lectures for teachers. The chair will be taken by Sir A. Daniel Hall.

THE War Work Council of the Y.M.C.A. in the United States of America has recently made a grant of 1,960,000 dollars for the fund out of which it provides scholarships and other educational assistance for ex-Service men. The grant makes the funds available for this purpose amount to 6,100,000 dollars. Free scholarship awards representing an expenditure of 2,367,895 dollars have been given to 38,582 former Service men, and in all the sum of 5,050,000 dollars has been apportioned to scholarships.

A COURSE of nine public lectures on "Problems of Modern Science," to be given on Wednesdays at 5.15 p.m., began at King's College on January 19 with a lecture by Prof. J. W. Nicholson on Mathematics. The other subjects and lecturers in the course are as follows:—January 26, Astronomy, Prof. J. B. Dale; February 2, Physics, Prof. O. W. Richardson; February 9, Chemistry, Prof. S. Smiles; February 16, Geology, Prof. W. T. Gordon; February 23, Biology, Prof. A. Dendy; March 2, Botany, Dr. R. Ruggles Gates; March 9, Physiology, Prof. W. D. Halliburton; and March 16, Anatomy, Prof. E. Barclay-Smith. The lectures are free, and cards of admission can be obtained from the Lecture Secretary, King's College, Strand, W.C.2. A stamped addressed envelope should be enclosed.

WITH commendable promptness the Association of Science Teachers has published a new edition of the "Book List" which was issued about a year ago. Sections on zoology, natural history, and astronomy have been added in the present volume, in which the old list has been extended and revised in many ways. The compilation should be of great assistance to those who are responsible for the selection of science books for use in class, for reference by both pupils and teachers, or for general school libraries. Its special value lies in the fact that the books included are in every case recommended by teachers who are exceptionally well qualified to judge of their suitability. "Book List, 1920," may be obtained at the price of 2*s.* from the Hon. Secretary, Association of Science Teachers, 10 Gresley Road, London, N.19.

FIGURES compiled by the U.S. Bureau of Education showing the public expenditure on education and the incomes of the various colleges, etc., in the United States are issued in *School Life* for December 1 last. The figures for 1918 and previous years are taken from the annual report of the Commissioner of Education; those for 1919 and 1920 are estimated. Throughout the period investigated, from 1870 onwards, the yearly increase in expenditure on education has grown successively larger. In 1870 the charge for elementary schools was 2 dollars per head of the population; it is now 9.50 dollars per head. The income of colleges, universities, and technical schools for 1920 was two and one-third times as much as it was in 1910 and thirty-six times what it was in 1870. The total sum which it is estimated was spent on education in the United States during 1920 is 1,224,000,000 dollars; this sum is approximately half the world's expenditure for educational purposes, although the people served represent only one-seventeenth of the world's population.

PART I. of the Indian Bureau of Education Publication entitled "Selections from Educational Records" has been received. It consists of reprints of a number of documents relating to education in India for the period 1781–1839, which illustrate the gradual growth of the feeling of responsibility for Indian education in the minds of Englishmen. The records which have been utilised come mainly from the Government of India, though a few have been obtained from the record offices of the larger States. They therefore give a general survey of the whole topic rather than detailed descriptions of conditions at any one place. The arrangement is chiefly chronological, but in places documents dealing with the same subject have been brought together irrespective of their real sequence. Brief narratives have been inserted between some of the records in order that the reader may have the less difficulty in following the train of events which led to the production of the various documents.

THE Department of Industrial Administration at the College of Technology, Manchester, has now been running for more than two years, and, judged by the prospectus of classes for the 1920–21 session, it has successfully organised a very elaborate and complete scheme of teaching. It offers a full-time course in industrial administration, which includes a series of forty-two lectures by the director, Prof. Stanley Kent, and others, a short course of laboratory work in industrial fatigue, and visits to works in the neighbourhood. Still more elaborate is the six months' course of training in welfare work, which is designed to supplement the University course on social study. The part-time student is offered two evening courses, each of twenty-six lectures, whilst shorter courses of a more technical nature are offered in engineering and in the cotton industry. Also Prof. T. H. Pear is giving a course of lectures in industrial psychology. In order to ensure that the Department should be kept in close touch with practice, a number of experts have been invited from time to time to deliver public lectures. Some of these lectures have been reprinted and issued in volume form, and they were very favourably reviewed in the columns of NATURE a few months ago. Again, the department is undertaking advanced research work on a diversity of subjects, which include psychological problems of industry, the working conditions in various industries, and technical questions dealing with machine- and hand-cutting tools.

THE annual report of the Royal Technical College, Glasgow, for the year 1919–20 contains not only an account of its activities during the past year, but also a brief summary of events and conditions at the institution during the war period. The most important of the latter was the recognition of the college as a school of university standing by the Treasury University Grants Committee: a preliminary recurrent grant of 3000*l.* and two non-recurrent grants of 6000*l.* and 4000*l.* respectively to meet special expenditure arising out of the war were made. The balance-sheet of the college still shows a deficit, however—the income is 54,084*l.* and the expenditure 57,490*l.*—in spite of the fact that students' fees already bring in 30 per cent. of the total income and annual grants of 1000*l.* each have been received from the Bellahouston Trustees and the Carnegie University Trust. The number of students attending courses during 1919–20 rose to 5690, of which 1135 were day and 4555 evening pupils—figures which exceed those for 1913–14 by 466 and 213 respectively. To meet this influx while the staff was much under strength the first-year courses were triplicated. A summary giving the number of enrolments in each department of the college shows that for full-time students chemistry is the great attraction, while of the evening students the majority attend courses in mechanics. The latter are designed to provide for the higher studies which can be developed from the series of affiliated evening classes conducted by the neighbouring county education authorities in conjunction with the college. A Ferguson research fellowship in chemistry of the value of 200*l.* per annum has been founded by the trustees of the Ferguson Bequest Fund.

Calendar of Scientific Pioneers.

January 27, 1823. Charles Hutton died.—A labourer's son and largely self-taught, Hutton became professor of mathematics at the Royal Military Academy, Woolwich. From Maskelyne's experiments he calculated for the first time the mean density of the earth.

January 27, 1851. John James Audubon died.—Of French descent, Audubon was born at New Orleans, and devoted his life to the study of the birds of North America.

January 27, 1873. Adam Sedgwick died.—The contemporary of Murchison and Lyell, Sedgwick was "one of the greatest leaders in the heroic age of geology."

January 28, 1687. Johann Hevel or Hevelius died.—Seven years before the end of the disastrous Thirty Years' War, which nearly extinguished the study of science in Germany, Hevelius built an observatory and set up a printing press at Danzig, and by his subsequent labours earned for himself the reputation of "the greatest observer after Tycho Brahe."

January 29, 1859. William Cranch Bond died.—The first director of Harvard Observatory, Bond in 1848, simultaneously with Lassell, discovered Hyperion, one of the satellites of Saturn; and on November 15, 1850, observed the "Crape" ring, a dusky ring within the inner portion of Saturn's bright ring.

January 30, 1888. Asa Gray died.—Born in 1810, Gray for many years occupied the chair of natural history at Harvard and wrote numerous works on the flora of North America.

February 1, 1873. Matthew Fontaine Maury died.—A naval officer and first director of the Naval Observatory at Washington, Maury became the foremost hydrographer of his day.

February 1, 1903. Sir George Gabriel Stokes died.—Lucasian professor at Cambridge for fifty-four years, secretary and president of the Royal Society, Member of Parliament, and foreign associate of the Institute of France, the influence of Stokes in the world of science was scarcely less than that of Kelvin. His own investigations referred mainly to the motion of fluids and to optics. He was a pioneer in the discovery and development of spectrum analysis, discussed the nature of fluorescence, and is regarded as the virtual founder of the modern science of geodesy.

February 2, 1704. Guillaume Antoine de l'Hospital, Marquis de St. Mesme, died.—His "Analyse des Infiniments Petits" (1696) was the first treatise on the infinitesimal calculus.

February 2, 1907. Dmitri Ivanovitsch Mendeléeff died.—Mendeléeff was born in 1834 at Tobolsk, in Siberia, and from an exile he gained his first knowledge of science. In 1850, his father being dead, the family removed to Petersburg, where at the age of thirty-two, having established a reputation as an investigator, he was made professor of general chemistry in the University. Three years later, in March, 1869, before the Russian Chemical Society, he enunciated the "periodic law." Foreshadowed by Newlands and others and confirmed by Lothar Meyer, this great generalisation, connecting the properties of the elements with their atomic weights, made his name widely known, and by it he was able to predict the existence of elements hitherto unknown but afterwards discovered.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, January 20.—Prof. C. S. Sherrington, president, in the chair.—Sir Robert **Hadfield**, S. R. **Williams**, and I. S. **Bowen**: The magnetic mechanical analysis of manganese steel. Tests were made on six rods quenched in water, when they are in the non-magnetic condition, and three were afterwards annealed, which rendered them magnetic. The changes in length of the rods when subjected to magnetic fields were determined (Joule effect). In the case of the rods in the magnetic condition the change was an increment for all field strengths. No change in length could be detected for the non-magnetic specimens. The effect on the intensity of magnetisation when subjected to longitudinal stress (Villari effect) was investigated. An absolute method of measuring the intensity of magnetisation when comparatively small was adopted, and for all field strengths the application of tensile stress increased the intensity of magnetisation of the magnetic specimens. The non-magnetic rods showed no change in intensity of magnetisation by being stretched. They showed an intensity of magnetisation about 1/36th of that of the specimens in the magnetic condition, due entirely to oxidation of the skin of the rods.—Dr. W. S. **Tucker** and E. T. **Paris**: A selective hot-wire microphone. The instrument consists of an electrically heated grid of fine platinum wire placed in the neck of a Helmholtz resonator. The effect of a sound having the same frequency as that natural to the resonator itself is to produce an oscillatory motion of the air in the neck of the resonator, which in turn causes changes in resistance of the platinum-wire grid. The total resistance change comprises a steady fall in resistance due to an average cooling of the grid, and a periodic change due to the to-and-fro motion of the air. Two methods of using the microphone are described: (1) A bridge method, and (2) an amplifier method. Curves are given showing the sharpness of resonance as measured by the bridge method. Results of experiments on cooling the grid by low-velocity air-currents are described. The principal resistance changes to be expected when the grid is cooled by an oscillatory air-current are: (1) A steady drop due to an average cooling; (2) a periodic resistance change of the same frequency as that of the sound; and (3) a periodic resistance change of frequency twice that of the sound. Further deductions are that the steady change of resistance is proportional to the *intensity* of the sound, while the periodic resistance change in (2) is proportional to the *amplitude*.—E. A. **Milne** and R. H. **Fowler**: Siren harmonics and a pure-tone siren. The ordinary siren can be regarded as a point source of air of variable flux, the flux being proportional to the area of the orifice exposed by the holes in the disc. The relative intensities of the harmonics for a siren with circular holes and a circular orifice are calculated, and it is concluded that a fairly pure note should be obtained from a siren of this type, in which the distance between the centres of adjacent holes is twice the diameter of the holes. If the original is rectangular in section, the holes can be so shaped that the area of the orifice exposed varies exactly as the sine of the displacement.—L. V. **King**: The design of diaphragms capable of continuous tuning. Continuous tuning is achieved by the application of air-pressure (or suction). The diaphragm is constructed from a single piece of metal, and consists of a thick, undeformable, central disc connected by a thin, cencentric, annular portion to a heavy, circular rim fitted accurately on a rigid mounting. The application of air-pressure over the interior of the diaphragm alters the tension of the thin annular portion, so that the rigid central portion vibrates about the static equilibrium position with a different pitch. To realise sharp tuning and high sensitivity, diaphragms of this type should be made with almost optical precision in the form of accurate solids of revolution.

Royal Meteorological Society, January 19.—Mr. R. H. Hooker, president, in the chair.—Mr. R. H. **Hooker**: Presidential address: Forecasting the crops from the weather. Mr. Hooker remarked that forecasts of the harvest fell into two main groups, viz. those which predicted the recurrence of good and bad crops in cycles, and those which computed the actual amount by which the yield was improved or damaged by the weather during or shortly before the growing period. He outlined the evolution of the methods of ascertaining relationships between the weather at different seasons of the year and the subsequent harvest. Originally writers such as Gilbert and Lawes could only examine the meteorological conditions in years of exceptional abundance or scarcity. A great advance was made when Sir Rawson Rawson and, later, Sir Napier Shaw, from the study of an entire sequence of crops and previous weather conditions, suggested formulæ from which the crop might be calculated, while still wider possibilities were opened by the methods of correlation. Mr. Hooker emphasised the necessity of taking the past weather into account in predicting the harvest, as it was abundantly clear, from comparison with actual forecasts in India and elsewhere, that the weather was responsible for developments in the plant which were not visible to an observer surveying the young crops in the fields; and, although much work still remained to be done, the time was ripe for using such statistics to confirm or modify the results of direct observation of the growing plants.

ROME.

Reale Accademia nazionale dei Lincei, November 7.—Signor V. Volterra, vice-president, in the chair.—S. **Pincherle**: Certain functional equations.—O. M. **Corbino**: Electronic theory of electric conductivity in magnetic field.—F. **Millosevich**: Paternoite, a new mineral from Calascibetta, Sicily. This is a borate of magnesia containing chlorine, similar in appearance to stassfurtite, and found in the saline deposits of Monte Sambuco.—B. **Longo**: The "flowerless apple" (*Pyrus apetala*, Mönch). This plant only produces small aborted pistilliferous flowers, and does not present any trace of stamens. These flowers possess carpels disposed in two planes, some of which contain more or less imperfect ovules. By fertilising with the pollen of other kinds of apples the author has obtained actual seeds, which it is proposed to try growing.—A. **Denjoy**: "Sur une classe d'ensembles parfaits discontinus."—O. **Onicescu**: Spaces admitting infinitesimal translation along lines of zero length.—A. **Clementi**: A new hypothesis regarding the physiological significance of protamines and histones in nuclear exchanges.—The president, Signor Volterra, directed attention to the cost of printing scientific publications, and urged the necessity of State aid for this purpose. The losses by death sustained by the Academy during the last session include Senators Righi and Celoria and Profs. Cuboni, Beccari, Rajna, and Giglioli.

MELBOURNE.

Royal Society of Victoria, October 14.—Prof. A. J. Ewart, president, in the chair.—D. K. **Picken**: A generalisation of elementary geometry. The subject of this paper was an outstanding defect of generality in elementary geometry associated with the ambiguity (equal or supplementary) in certain fundamental angle theorems. The appropriate principle of generality was first arrived at by the author in a paper on Simson's line read to the Edinburgh Mathematical Society in May, 1914. Later consideration had made it clear that the principles in question are basic to the elementary geometry of the straight line, of parallels, and of the circle, and are of wide applicability in the geometrical theory dependent upon these.—Dr. J. M. **Baldwin**: Giant and dwarf stars (see p. 711).

SYDNEY.

Linnean Society of New South Wales, November 24.—Mr. J. J. Fletcher, president, in the chair.—G. H. **Hardy**: Revision of the Chiromyzini (Diptera). A study of the genus Metoponia and its allies, following on Miss Irwin-Smith's study of the larva of *M. rubriceps*, Macquart.—J. **Mitchell**: Some new Brachiopods from the Middle Palæozoic rocks of New South Wales. From rocks of Upper Silurian age at Bowning, Hatton's Corner, and near Molong, one genus and four species are described as new.—Vera **Irwin-Smith**: Nematode parasites of the domestic pigeon (*Columba livia domestica*) in Australia. The only Nematode hitherto recorded from this host in Australia is *Ascaridea columbae*, Gmelin, from both New South Wales and Queensland. Records of two further species are added, and a new generic name is proposed for *Strongylus quadriradiatus*, Stevenson.—J. H. **Maiden**: A few notes on the botany of Lord Howe Island (sixth paper). This brief paper supplements existing information in regard to hybrid Howeas, which have been under cultivation in the Sydney Botanic Gardens for a number of years. There are notes on indigenous plants hitherto unrecorded, of which *Adiantum formosum*, R. Br., is the most important. A number of records of introduced plants are also given.

Books Received.

The Child's Path to Freedom. By N. MacMunn. Second edition. Pp. 163. (London: G. Bell and Sons, Ltd.) 2*s*. 6*d*. net.

A Concise Geometry. By C. V. Durell. (Cambridge Mathematical Series.) Pp. viii+319. (London: G. Bell and Sons, Ltd.) 5*s*. net.

My Electrical Workshop. By F. F. Addyman. Pp. viii+249. (London: Wireless Press, Ltd.) 7*s*. net.

A Text-book of Practical Chemistry. By G. F. Hood and Major J. A. Carpenter. Pp. xii+527. (London: J. and A. Churchill.) 21*s*. net.

The Fundamental Processes of Dye Chemistry. By Prof. H. E. Fierz-David. Translated by Dr. F. A. Mason. Pp. xiv+240+xiv plates. (London: J. and A. Churchill.) 21*s*. net.

Volumetric Analysis for Students of Pharmaceutical and General Chemistry. By C. H. Hampshire. Third edition. Pp. iv+124. (London: J. and A. Churchill.) 7*s*. 6*d*. net.

Farm Crops Laboratory Manual and Note Book. By F. W. Lathrop. Pp. 118. (Philadelphia and London: J. B. Lippincott Co.) 4*s*. 6*d*. net.

Oil Firing for Kitchen Ranges and Steam Boilers. By E. C. Bowden-Smith. Pp. ix+102. (London: Constable and Co., Ltd.) 9*s*. net.

The Science of Ourselves. (A Sequel to "The Descent of Man.") By Sir B. Fuller. (Oxford Medical Publications.) Pp. ix+326. (London: Henry Frowde and Hodder and Stoughton.) 16*s*. net.

Die Anaphylaxie. By Prof. Ch. Richet. Autorisierte Uebersetzung von Dr. J. Negrin y López. Pp. iv+221. (Leipzig: Akademische Verlagsgesellschaft.)

Association of Science Teachers. Book List. Second edition, 1920. Pp. 47. (London: Association of Science Teachers.) 2*s*.

The Absolute Relations of Time and Space. By Dr. A. A. Robb. Pp. ix+80. (Cambridge: At the University Press.) 5*s*. net.

Modern High-speed Influence Machines. By V. E. Johnson. Pp. viii+278. (London: E. and F. N. Spon, Ltd.) 14*s*. net.

The Repairing Optician: A Beginner's Guide to the Optical Workshop. By J. Fray. (Oxford Technical Manuals.) Pp. viii+183. (London: Henry Frowde and Hodder and Stoughton.) 8*s*. 6*d*. net.

Handbook of Metallurgy. By Prof. C. Schnabel. Translated by Prof. H. Louis. Third edition. Vol. i.: Copper–Lead–Silver–Gold. Pp. xxi+1171. (London: Macmillan and Co., Ltd.) 40*s*. net.

Co-ordinate Geometry (Plane and Solid) for Beginners. By R. C. Fawdry. Pp. viii+215. (London: G. Bell and Sons, Ltd.) 5*s*.

The Theory of Functions of a Real Variable and the Theory of Fourier's Series. By Prof. E. W. Hobson. Second edition. Vol. i. Pp. xvi+671. (Cambridge: At the University Press.) 45*s*. net.

Exploitation du Pétrole par Puits et Galeries. By Paul de Chambrier. Pp 106. (Paris: Librairie Dunod.)

Cotton Spinning. By W. S. Taggart. Vol. i. Seventh edition. Pp. liii+362. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

College Botany: Structure, Physiology, and Economics of Plants. By Dr. M. T. Cook. Pp. x+392. (Philadelphia and London: J. B. Lippincott Co.) 12*s*. 6*d*. net.

Standard Method of Testing Juvenile Mentality by the Binet-Simon Scale and the Porteus Scale of Performance Tests. By N. J. Melville. Second edition. Pp. xi+162. (Philadelphia and London: J. B. Lippincott Co.) 12*s*. 6*d*. net.

Soil Alkali: Its Origin, Nature, and Treatment. By Prof. F. S. Harris. Pp. xvi+258. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 13*s*. 6*d*. net.

West African Congress and Government on Native Lines. By R. E. Dennett. Pp. 31. (London: The *African World*.)

Memoirs and Proceedings of the Manchester Literary and Philosophical Society, 1918–19. Vol. lxiii. (Manchester.) 12*s*.

Annuario publicado pelo Observatorio Nacional do Rio de Janeiro. Para o Anno de 1921. Anno XXXVII. Pp. xviii+443. (Rio de Janeiro.)

The Journal of the Institute of Metals. Vol. xxiv., No. 2. 1920. Edited by G. Shaw Scott. Pp. xiv+547+xl plates. (London: Institute of Metals.) 31*s*. 6*d*. net.

Annals of the Solar Physics Observatory, Cambridge. Vol. iv., part 1. The Spectrum of Nova Geminorum II. By F. J. M. Stratton, under the direction of H. F. Newall. Pp. viii+71+2 plates. (Cambridge: At the University Press.)

Bibliotheca Chemico-Mathematica. Catalogue of Works in Many Tongues on Exact and Applied Science, with a Subject Index. Compiled and annotated by H. Z. and H. C. S. Vol. i. Pp. xii+428+plates. Vol. ii. Pp. 429–964+plates. (London: H. Sotheran and Co.) 3*l*. 3*s*. net.

Schriften der Naturforschenden Gesellschaft in Danzig. Neue Folge. Fünfzehnten Bandes Erstes und Zweites Heft. III. Teil., Wissenschaftliche Abhandlungen. Pp. iii+190. (Danzig.)

Great Britain in the Latest Age: From Laisser Faire to State Control. By A. S. Turberville and

F. A. Howe. Pp. vii+342. (London: J. Murray.) 7s. 6d. net.

Wireless Telegraphy and Telephony: An Outline for Electrical Engineers and Others. By L. B. Turner. Pp. xii+195+xxiv plates. (Cambridge: At the University Press.) 20s. net.

Devonian Floras: A Study of the Origin of Cormophyta. By Dr. E. A. Newall Arber. Pp. xiv+100. (Cambridge: At the University Press.) 17s. 6d. net.

Domestic Fuel Consumption. By A. H. Barker. (The Chadwick Library.) Pp. x+159. (London: Constable and Co., Ltd.) 14s. net.

A Text-book of Inorganic Chemistry for University Students. By Prof. J. R. Partington. Pp. xii+1062. (London: Macmillan and Co., Ltd.) 25s. net.

Meteorological Office. British Meteorological and Magnetic Year Book, 1917. Part iv.: Hourly Values from Autographic Records, 1917. Pp. 91+iii plates. (M.O. 229f.) (London: Meteorological Office, Air Ministry.) 12s. 6d. net.

Diary of Societies.

THURSDAY, JANUARY 27.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. A. Harden: Biochemistry (Vitamines).

ROYAL SOCIETY, at 4.30.—K. Sassa and Prof. C. S. Sherrington: The Myogram of the Flexor-reflex evolved by a Single Break-shock.—Sir Almroth Wright: "Interaction" between Albuminous Substances and Saline Solutions.—Dr. S. Russ, Dr. Helen Chambers, and Gladwys M. Scott: The Local and Generalised Action of Radium and X-rays upon Tumour Growth.

NEWCOMEN SOCIETY (at Iron and Steel Institute), at 5.—R. Jenkins: Rise and Fall of the Iron Manufacture in Sussex.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section), at 5.30.—Dr. G. L. Pardington: Advancing Years and Balneotherapy (Presidential Address).

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—G. A. Juhlin: Temperature Limits of Large Alternators.

LONDON DERMATOLOGICAL SOCIETY, at 6.—Dr. W. K. Sibley: Acne (Chesterfield Lecture).

CONCRETE INSTITUTE, at 7.30.—J. A. Howe: Geology in Relation to Building Stones.

WIRELESS SOCIETY OF LONDON (at Royal Society of Arts), at 8.

SOCIETY OF ANTIQUARIES, at 8.30.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—T. Walker: Obstruction After Suprapubic Prostatectomy and an Open Operation for its Prevention.

FRIDAY, JANUARY 28.

ASSOCIATION OF ECONOMIC BIOLOGISTS (at Imperial College of Science), at 2.30.—Dr. L. Lloyd: Greenhouse White Fly and its Control.—W. B. Brierley: Personal Impressions of Some American Biologists and their Problems.

ROYAL SOCIETY OF MEDICINE (Study of Disease in Children), at 5.—Dr. P. Parkinson: A Case of Patent Ductus Arteriosus.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. Keith: The Principles of Craniology applied to Clinical and Racial Problems.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—Prof. H. Nagaoka: The Magnetic Separation of the Neon Lines and Runge's Rule.—Capt. E. V. Appleton: A Method of Demonstrating the Retro-active Property of a Triode Oscillator.—Dr. D. Owen and R. M. Archer: The Quickness of Response of Current to Voltage in a Thermionic Tube.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—J. W. Wardell: Manufacture of Portland Cement.

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.30.—Dr. A. S. M. MacGregor: Some Features of Current Small-pox in Glasgow.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir James Dewar: Cloudland Studies.

MONDAY, JANUARY 31.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. W. S. Handley: The Pathology and Treatment of Lupus.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—J. W. Simpson: Presidential Address to Students and Distribution of Prizes.

ROYAL SOCIETY OF ARTS, at 8.—A. E. L. Chorlton: Aero Engines (Howard Lectures).

MEDICAL SOCIETY OF LONDON, at 8.30.—Dr. A. Feiling: Multiple Neuritis.—Dr. F. G. Crookshank: Handprints in Mongolian and Other Imbeciles.

TUESDAY, FEBRUARY 1.

ROYAL SOCIETY OF ARTS (Colonial Section), at 4.30.—Dr. G. C. Creelman: Modern Agriculture.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Brevet-Major G. le Q. Martel: Bridging in the Field.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—P. King: The Cinematograph Camera: Various Models and General Description of Same.

WEDNESDAY, FEBRUARY 2.

ROYAL SOCIETY OF ARTS, at 8.—A. F. Baillie: Oil-burning Methods in Various Parts of the World.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. W. G. Howarth: Muscocele and Pyocele of the Nasal Accessory Sinuses.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (Annual General Meeting) (at Chemical Society), at 8.—Presidential Address.—F. W. Smith: Extract of Red Squill (*Scilla maritima*) as a Rat Poison.—W. Lowson: The Composition of Harrogate Mineral Waters.

THURSDAY, FEBRUARY 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. A. Herdman: Oceanography (Great Exploring Expeditions).

ROYAL SOCIETY, at 4.30.—*Probable Papers*.—Dr. G. B. Jeffery: The Field of an Electron on Einstein's Theory of Gravitation.—Dr. M. N. Saha: A Physical Theory of Stellar Spectra.—W. F. Darke, J. W. McBain, and C. S. Salmon: The Ultra-microscopic Structure of Soaps.—Dr. J. Mercer: Linear Transformations and Functions of Positive Type.

LINNEAN SOCIETY, at 5.—Miller Christy: Wistman's Wood, Dartmoor; Specimens of Slides.—Dr. Agnes Arber: Leaf-tips of Monocotyledons.—T. A. Dymes: Seedlings of *Ruscus aculeatus*, with Remarks on their Germination and Growth.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Major G. Dobson: The Use of Meteorology to Aviation and *Vice-versa*.—Wing-Comdr. H. W. S. Outram: Ground Engineering.

CHEMICAL SOCIETY, at 8.

FRIDAY, FEBRUARY 4.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—On Gravity at Sea: Opened by Prof. G. W. Duffield, and continued by Sir S. G. Burrard, Dr. H. Jeffreys, Dr. J. W. Evans, and Dr. A. M. Davies. Chairman: Sir Arthur Schuster.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. C. W. G. Bryan: The Early and Late Effects of Injuries of the Diaphragm, with Social Reference to Wounds jointly involving Thoracic and Abdominal Viscera.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. A. D. Waller: The Electrical Expression of Human Emotion.

SATURDAY, FEBRUARY 5.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—Lecture.

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