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The Status of the Naval Engineer.

ON November 20, 1925, the Admiralty issued a Fleet Order which, while to some extent affecting all branches of the Navy, has raised serious questions regarding the future status of the officers of the engineering branch. Hitherto there have been five branches in the service, but this order brought into being thirteen separate categories. Some of these, however, such as the dental branch, the schoolmaster branch, and the wardmaster branch, are but small sections of the personnel. The branch principally affected is the engineering branch, and the situation created by the order was felt to be so adverse to the best interests of the service that Lord Weir, Sir Charles Parsons, Sir John Thornycroft, and Sir Archibald Ross jointly addressed a letter to the press on the subject. This letter has been followed by other communications and articles, and on January 14 a deputation representing the Institutions of Civil Engineers, Mechanical Engineers, Naval Architects, and Electrical Engineers, and also the North-East Coast Institution of Engineers and Shipbuilders, waited upon the First Lord of the Admiralty (the Right Hon. W. C. Bridgeman) to place their views before him. So far no account of this deputation has been made public, but we can scarcely think that representations made by such a responsible body will be disregarded.

There have been engineers in the Navy now for more than a hundred years, and in the struggle of the engineer officers for adequate recognition there have been many memoranda, petitions, and deputations, but never before have the four founder engineering institutions taken so notable a step as that referred to, and their action can be taken as significant of the importance of the questions raised. It is therefore only right that the main points at issue should be made as clear as possible, so that whatever the results of the deputation, the whole position may be judged impartially.

It may, however, be said that no reasoned opinion on the engineering question can be formed without a knowledge of the past, and thus a few brief historical notes will be of use. Steam vessels appeared in the Navy so long ago as 1820. At first they were small dispatch vessels, and the engineers were mechanics of little or no education. By 1837 the steam frigate had been evolved, engines had become larger, and the engineers were given warrant rank. With the coming of the screw and its adoption in the old line-of-battleships, the steam department grew apace, and in 1847 engineer officers were raised to an equality with the masters and assistant masters who then

comprised the navigating branch. Even at that time there was a scheme for training boys for naval engineering duties, but this did not amount to much, and when the Crimean War was in progress, recruits had to be sought for over a wide area. By the 'sixties the boys had become engineer students, who were taught in the Dockyard Schools, and some of these passed to the Royal School of Naval Architecture and Marine Engineering at South Kensington. The officers so trained were the best marine engineers of the day, but when they entered the service they found themselves subjected to all sorts of disabilities as to pay, half-pay, promotion, retirement, accommodation, and relative rank. It is not surprising to know that these unsatisfactory conditions led to great discontent.

A new and promising chapter was opened in 1875 with the appointment of a committee of three executive officers and two engineer officers, Admiral Cooper Key being chairman, to report on the best method of staffing the engine-rooms of the Fleet. That committee was one of the ablest which ever investigated the matter. The members went into the question thoroughly and made valuable recommendations, many of which were adopted. But the most vital recommendation, that engineer officers should in the future belong to the military branch and not to the civil branch, but not to succeed to command, was shelved, and in the failure to adopt that salutary reform is to be found the cause of most of the agitation and dissatisfaction which disturbed the domestic peace of the Navy for more than a quarter of a century, and have again been revived by the recent order.

One of the outcomes of the Cooper Key Committee was the opening of, first, H.M.S. *Marlborough*, and then of Keyham College, as training schools for engineers. Though the latter was starved financially, it had a fine record of success as a technical college, and nearly all the engineer officers who held responsible positions at the Admiralty, in the dockyards, and in the Fleet during the War were men who had passed through its portals.

As it was in the 'sixties and 'seventies, so it was in the 'eighties and the 'nineties. Ships' machinery grew more and more complex, the engineer officers' duties were increased by the addition of new types of machinery, but for all that the Admiralty refused to recognise the engineer as a combatant, and, however absurd it may seem, the officers concerned with the upkeep and running of such vessels as the *Terrible* and *Powerful* were of civilian status.

Through this and other causes the competition for entry into Keyham College, which should have been keen, became almost negligible, and the avenues of entry into the engineering branch had to be thrown open wider and wider while the standard of attainments of the candidates became lower. In spite of this, the numbers forthcoming were insufficient and the staffing of the engine-rooms at the end of last century became so difficult as to constitute a national danger.

This was the position when, through the initiative of the late Mr. D. B. Morison, the engineering institutions of the north took up the question of reform and focussed public attention upon it. Papers were read at Newcastle, Glasgow, and elsewhere, and in 1901 a deputation representing the shipbuilding and engineering world was received by the Admiralty.

The result of this propaganda, together with the difficulties of the authorities in obtaining engineers, was somewhat unexpected. At the end of the year 1902 the Navy was startled with the oft-quoted Selborne Memorandum. Issued by the First Lord, this was really the work of the late Lord Fisher. By that memorandum, the entry, training, and careers of naval officers were reformed from top to bottom. Deck officers, engine-room officers, and marine officers were to be entered together, trained together, serve together, and their duties were to be interchangeable. In the words of the memorandum, every naval officer was to be "a seaman, a gunner, a soldier, an engineer, and a man of science." That scheme, it may be remarked, never had any considerable body of engineering opinion behind it, and many engineers declared it to be impracticable, as experience has indeed shown it to be.

While, however, the Selborne plan of naval training has had to be modified almost out of recognition, it had two excellent features, common entry and equality of status, and these were its chief legacies. The commanders (E.), the lieutenants (E.) who have passed through Dartmouth, were all, until November last, executive officers like lieutenants (G.), (T.), and (N.) who have specialised in gunnery, torpedo, and navigation. They had the same commission, they wore the same uniform, but by becoming engineers had forfeited the right to command. They in fact represented the engineer as suggested by Admiral Cooper Key in 1876 as belonging to the military branch, not the civil branch, but they were not to be allowed to succeed to command.

It may be asked, What became of the older engineer officers who were already in the Navy when the Selborne scheme was introduced? What difference did the new plans make to them? Practically none. It is true they were given semi-military titles such as engineer commander and engineer lieutenant, but they remained members of a civilian branch. The

engineer officers who fought in the Bight of Heligoland, who lost their lives at Coronel, and those who drove the *Inflexible* and *Invincible* into action at the Falklands, all fought as civilian officers.

The removal of this anomaly was the result of war. At the end of 1914 the Admiralty made all engineer officers part of the military branch, and thus for the first time recognised their importance. Many were the tributes paid to the engineering branch during the War, and when military status was conferred, Lord Fisher telegraphed to Mr. Morison: "The unapproached efficiency of our engineers in the Navy merited this tardy recognition of their all-important part in the present splendid fighting condition of our whole fleet, and this has been combined with an unswerving loyalty to a changing system which they one and all recognised to be for the public benefit and the good of the Navy." The effect of the new order was felt right throughout the service. The engineer officers were proud of the distinction conferred upon them, and it has been their aim ever since to uphold the highest traditions of the branch to which they were admitted.

It will be seen that the position attained by the naval engineer has only been gained through a long process of evolution. But to-day he unfortunately stands shorn of the military status so tardily given. The Fleet Order of November, by a stroke of the pen, abolishes the military branch and creates a new executive branch from which all engineer officers are excluded. Is it any wonder that parents of young officers, officers themselves throughout the Fleet, and the engineering profession generally, regard the action of the Admiralty as a grave breach of faith? To criticism, the reply is made that the executive officers might equally complain that with the abolition of the military branch they have been deprived of military status. Such a reply is altogether untenable. In a fighting service there must always be a military branch. You may call it by another name but you cannot get rid of it, and to-day the new executive branch stands in the place of the old military branch while the engineer officers are practically reduced to civilian status again.

After all these years, it is indeed high time that the entry, the training, the status, and the appointment of engineers should be placed upon a sound and permanent basis, and Mr. Bridgeman can do the Navy no higher service than by removing these things from the realm of uncertainty, and thus preventing the recurrence of the deplorable controversies which have marked the progress of the naval engineer in the past. The first step, however, is the restoration of military status.

Steel and the Nation.

Metallurgy and its Influence on Modern Progress: with a Survey of Education and Research. By Sir Robert A. Hadfield. Pp. xvi+388+71 plates. (London: Chapman and Hall, Ltd., 1925.) 25*s*. net.

THE author of this handsome volume has played an active part in the metallurgical world, as the head of a famous firm of manufacturers, as an inventor and investigator, and as the president of several technical societies. He has received many public honours, and has been prominent in the life of his city and of the industrial community. Above all, he is personally acquainted with most of the leaders of industry, of physical science, and of education in this and several other countries, and has kept in close touch with related movements, so that he brings to the task of writing a book on metallurgy an exceptionally wide range of experience. From time to time, in presidential and other public addresses, he has reviewed the progress of science and invention, the scope and objects of education, and similar subjects, and it is the material of those addresses, expanded and supplemented by other matter, which has been recast into the form of the present volume, which is well and lavishly illustrated.

The work is not easily classified, being in part a history of metallurgical and engineering industries and of the sciences on which they are based, in part a detailed account of the nature and properties of certain selected systems of alloys, and in part a review of the place of science in the community and of the forms of education best suited to a nation which depends on manufactures for its existence. The metallurgy considered is that of steel, the non-ferrous metals being ignored. The author has written of those things in which he is himself interested, and has made no attempt to construct a systematic treatise.

After a preliminary sketch of the history of the subject, the influence of carbon on iron is considered, leading up to an account of the development of alloy steels. Next follows a description of the two alloys with which the name of Hadfield is chiefly connected, the remarkable manganese steel which was the first of the alloy steels to be investigated thoroughly and still remains unique in its curious combination of toughness and resistance to wear, and the silicon iron which is now in general use for electrical transformers, having a high permeability with a high resistance. The history of these two inventions and of their gradual adoption by the industries is told at length in an interesting fashion, with many personal reminiscences of the men who were associated with the work. The story is most instructive in regard to the importance

of research for industry. Other steels are dealt with more briefly, this section containing an account of armour-piercing projectiles, treated in a popular manner, with comparisons with other moving masses in regard to the energy content. Some striking facts concerning steel castings are also included.

Another section of the book is devoted to the subject of fuel economy, and contains some more technical matter in the form of curves and calculations intended to assist the metallurgist in the efficient design and use of furnaces. Stress is laid on the importance of correct design, and on the value of scientific investigations into the flow of gases in that connexion, the pioneer work of Groume-Grjimailo being corrected by the calculations of later workers. The name of Wheeler has been overlooked in this review of fuel economy, although his contributions to the subject are among the most important.

The last portion, dealing with the facilities for technical education and research, is perhaps the least satisfactory, being a collection of paragraphs of very unequal importance, and so failing to produce the right effect of perspective. It is largely devoted to an account of the leading technical and professional societies, beginning with the Royal Society, and as such is of considerable interest, being supplemented by biographical notes on the men who have been chiefly responsible for their growth, but there is only a brief mention of the institutions for the training of metallurgical students, giving an inadequate survey of the facts on a matter which might be expected to receive full attention in such a work. In describing institutions specially designed for research in metallurgy, a detailed list of the apparatus included in the equipment of the Japanese Institute at Sendai is given, without mention of the fact that equally if not more important installations are to be found elsewhere, as, for example, in the National Physical Laboratory, the University in the author's own town of Sheffield, and the Bureau of Standards at Washington, whilst other great laboratories, such as the Metallographic Institute of Stockholm and the Kaiser-Wilhelm Institute at Düsseldorf, produce work of probably equal importance. The omission of the last-mentioned reminds one that the author, in his effort to show that the value of German research in chemistry and the allied sciences has been overrated, almost completely ignores Germany, Wedding and Ledebur being practically the only German metallurgists whose work is mentioned.

Whilst it is legitimate and useful to direct attention to the originality and sound character of English and French research, and to the remarkable industry of the Japanese workers, the effect of such a presentation is to produce a wrong impression, and students of metallurgy at the present day for the most part acknowledge gratefully the value of German research. The great advances in the study of high temperatures due to the labours of the staff of the Geophysical Laboratory of Washington also deserve recognition. Should the author have occasion to revise his work, this defect could easily be remedied, as the information is readily accessible. The lists of distinguished investigators which appear in various parts of the book appear to have been drawn up somewhat at haphazard, and some omissions are certainly quite accidental. Thus, on p. 16, the names of Newlands and Lothar Meyer are omitted from the list of workers on the classification of the elements, whilst lower, under radioactivity, the name of Curie appears without any indication that it covers two investigators. On p. 174, the preparation of the early high-speed tool steels is attributed to Maunsell White alone, Taylor not being mentioned, whilst on p. 292 Ramsay alone is referred to in an account of the discovery of argon, Lord Rayleigh being omitted. Such slips are clearly accidental, and might have been remedied during the reading of the proofs.

The author's enthusiasm for his subject, and his conviction of the value of research, are obvious throughout. As an appendix, he includes a verse translation by L. P. Sidney of an eighteenth-century Latin poem, "Ferrum," by a French Jesuit named de la Sante, containing much curious metallurgical information. The poem was translated into French by Floris Osmond, but has not hitherto appeared in English.

All who are interested in the future of industry should read this book, since the history of alloy steels is typical of modern progress in manufacture, and its lessons have a much wider application than might be supposed from its specialised character.

Medicine in the Middle Ages.

(1) *History of Medicine.* (Oxford Medical Publications.) By Prof. Dr. Max Neuburger. Translated by Ernest Playfair. In two vols. Vol. 2. Part I. Pp. viii + 135. (London: Oxford University Press, 1925.) 7*s.* 6*d.* net.

(2) *The Evolution of Anatomy: a Short History of Anatomical and Physiological Discovery to Harvey; being the Substance of the Fitzpatrick Lectures delivered at the Royal College of Physicians of London in the Years 1923 and 1924.* By Dr. Charles Singer. Pp. xii + 210 + 22 plates. (London: Kegan Paul and Co., Ltd., 1925.) 12*s.* 6*d.* net.

(1) WE have had to wait a long time for the second instalment of Prof. Neuburger's "History of Medicine": but it is well worth waiting

for. Even though it is only a part of the second volume that he gives us now, it covers the most interesting and romantic phase of the history, a period that few writers could have interpreted with such competence and recognised authority.

In particular, Prof. Neuburger's literary skill gives the book its distinctive character. His lucidity and sense of style make his writing a pleasure to read, and Dr. Playfair has happily transferred these qualities into idiomatic English.

"Western Medicine in the Early Middle Ages is, strictly speaking, hardly a subject for the historian of science who would present a coherent picture of progressive events—at the utmost sidelights can be thrown upon medical conditions and literature, in as far as the very scanty information at our disposal makes this possible. Inadequacy of scientific principles, total stagnation of investigation, practice devoid of any lofty outlook, stereotyped and primitive, these are the characteristics of this era's healing art, an art which in its manifestations is almost reminiscent of the earliest stages of medical evolution. Gloomy as is the impression left upon the mind, the close connection of medicine with civilisation as a whole and its historic destiny, come unmistakably to the fore, and its fate in this mournful period is bound up more intimately than usual with the spirit of the times."

To deal adequately with this difficult problem called for the wide and exact scholarship and industry which Prof. Neuburger has devoted to his task. He has given us a graphic picture of how Europe gradually emerged from its five centuries of lethargy and acquired from Arabic sources a second-hand acquaintance with Greek medicine. The revival of classical learning completed the process of making Europe the heir to the knowledge of antiquity and the learning of the Greeks.

The present instalment of Prof. Neuburger's book deals with the obscure period of the early Middle Ages, the state of medicine in the eleventh and twelfth centuries, the coming of Arabic influence into western science, and the effects of this upon the development of medicine in the thirteenth century and the later Middle Ages, elucidating the circumstances in which the development of modern scientific methods and the reliance upon direct observation and experiment were introduced.

It is difficult to give a summary of this fascinating work. Every one interested in the history of science will have to read the whole volume for himself. The history contains ample references to authorities, and includes an extremely useful historical survey of literature. It is full of interesting side-lights on the history of civilisation, with which only a man of exceptional knowledge and human sympathy could have illuminated the history of medicine. We may perhaps be permitted to give an illustration of these qualities. Describing the emancipation of science from the shackles of scholasticism—a process which can be seen happening in the case of anthropology in our own day—Neuburger gives this graphic picture of Roger Bacon's unhappy experience as a pioneer before the times were ready for his reforms:

"Since Albertus Magnus remained without a true successor in the domain of natural science, and never broke the bonds of the prevailing mode of thought, but only succeeded in providing the possibility of a reconciliation within certain limits between unbiassed observation of facts and scholasticism, it cannot be a matter of surprise that the premature movement in favour of the emancipation of scientific investigation from dialectic oppression, on an exact foundation upon a basis of observation and experience by the aid of mathematics and experiment, should find no support, but should be met by misunderstanding, even by embittered enmity. It was the English Franciscan, Roger Bacon, who once more initiated this movement, a truth-seeker and pioneer of comprehensive knowledge and intuitive perception, a thinker of unyielding austerity of thought, who paid for his great superiority over his age with a lifetime's martyrdom, but whose name can never be erased from the annals of the intellectual development of mankind so long as the light of scientific freedom shall shine." (P. 58.)

"Unfortunately the fruitful and almost unique influence of this great man, who aimed at a reform of science and education, was only too early interrupted. Envy and unpopularity which followed on the heels of initial admiration and which grew as the result of certain utterances of Bacon's upon the ignorance of eminent scholars and upon the immorality of the monks, suspicion which caused his incomprehensible scientific researches and superior knowledge to be looked upon as devilish arts, culminated eventually in serious charges which, though for a while repelled, finally found credence amongst his superiors, after Bonaventura had succeeded to the generalship of the Franciscan order. Bacon was taken in 1257 from Oxford to the House of the Order in Paris, where he had to submit to various penalties and was placed under strict supervision, whilst from this time onwards he was deprived of freedom to commit to writing his ideas and discoveries. A last ray of hope penetrated to the investigator thus doomed to silence when the newly elected Pope Clement IV., who in earlier days had been friendly inclined to him, in 1266 extended to him in profound secrecy the permission to elaborate his views and plans for reform and to submit them by way of justification." (P. 59.)

(2) In the Fitzpatrick lectures delivered by Dr. Charles Singer to the Royal College of Physicians in 1923 and 1924, the substance of which is now published under the title of "The Evolution of Anatomy," an interesting sketch is given of the history of anatomy from the earliest times. Men of the Upper Palæolithic period showed their knowledge of the heart in the cave pictures of France and Spain, which seem to indicate that already they had formulated theories of the life-giving power of blood. The Egyptians and the Babylonians struggled

in the dark for many ages before the Greeks got rid of the trammels of hieratic obstruction that prevented the free development of knowledge and rational methods. Dr. Singer's story really begins with the Greeks and follows the history throughout the intervening centuries until our own William Harvey introduced a new epoch in scientific medicine and experimental physiology.

Dr. Singer's book is a comprehensive and lucid story well adapted for the use of medical students and of the general reader who wants an easily understood account of the chequered career of medical science.

One of the outstanding features of the book is the interesting collection of reproductions of ancient anatomical figures; in particular, the illustrations from the "Epitome" of Vesalius. For the teacher of anatomy who cannot devote much time to the teaching of history in the course of his normal work, this book will be particularly welcome, as it provides a body of important information to which every medical student should have easy access. It reveals the age-long struggle that was necessary to acquire the knowledge of human structure and the facilities for studying practical anatomy with complete freedom which the student enjoys to-day. Dr. Singer's book should bring these facts home to him, and also impress upon him a feeling of gratitude and respect for the men who by their own sacrifices secured these liberties.

G. ELLIOT SMITH.

The Witch Cult.

Witchcraft and the Black Art: a Book dealing with the Psychology and Folklore of the Witches. By J. W. Wickwar. Pp. 320. (London: Herbert Jenkins, Ltd., 1925.) 8*s.* 6*d.*

INTEREST in the occult is perennial and widespread; but the appeal of the witch is especially strong to all those who cherish their little superstitions but do not take them too seriously. Although real belief in the witch is no doubt dying, it is dying slowly. Reports of cases in country courts in which witchcraft is involved in some way or another are of sufficient frequency to show that it still has a strong hold on the countryside. Quarrels over bewitched cattle, sometimes followed by assaults in which the witch was "scored above the breath," that is, scratched on the forehead, as a protective measure, point to an identity of mental attitude in the modern peasant and his ancestors as far back as we can go in the records of popular and primitive belief.

Mr. Wickwar's "Witchcraft and Black Magic" is a popular account of witchcraft, in the main historical, but written throughout from the point of view of the student of the lore of the folk and the underlying survivals of primitive religion and magic. "Witchcraft," he says, "had its real inception in a period of fear, wonder and sacrifice common to all primitives." He deals with the belief as it existed in England only, excepting for one chapter in which he briefly recounts the rise and progress of witchcraft prosecutions on the Continent, which resulted in an appalling death roll in France, Germany, and northern Italy. Mr. Wickwar traces the history of the cult from the third to the eighteenth century, when the mania of the sixteenth and seventeenth centuries had died down and the attitude of the more enlightened members of the community had become such as is indicated by the change in the law relating to witchcraft brought about by the Act of George II. in 1735. By this Act the real existence of witchcraft ceased to be recognised, and it was relegated to the realm of superstition and fraud. Prosecutions for witchcraft were abrogated, and *pretence* to practise witchcraft became the indictable offence.

The history of the witchcraft belief is extremely interesting, but its exact interpretation is by no means clear. Miss Murray has suggested that witchcraft was a genuine cult, a survival of a primitive ritual practised by the covens—the assembly of twelve witches with their leader—and connected with fertility rites. Pagan rites certainly survived after the introduction of Christianity, as was recognised by St. Augustine according to the records of the Venerable Bede, and documents of the seventh, eighth and following centuries refer to survivals of pagan ritual which might well be the basis of a witchcraft cult. Walter Mapes also describes a ceremonial attributed to an heretical sect in which the procedure is similar in certain elements to a witches' sabbath. In most of the early cases of witchcraft, however, the delinquents are guilty of magical practices rather than witchcraft in the strict ritual sense. Such, for example, was the attempt by Lady Cobham against the life of Henry VI., and of the Duchess of Bedford, who wished Edward IV. to marry her daughter.

When witchcraft became a form of heresy under the Bull of Innocent VIII., in 1484, the head and front of the offending was not merely the employment of magical means to accomplish some end, but the renunciation of the Church, the voluntary execution of a covenant with the devil, and the entry into the communion of witches. Mr. Wickwar accounts for the difference by holding that in the course of its history between the third and the seventeenth centuries the character of the belief changed. He accepts the view that witchcraft was a really existing cult which had survived from a primitive form, though at a later stage he appears at times to write not quite consistently when dealing with the part played by the Church in conducting the great prosecutions of the fifteenth, sixteenth,

and seventeenth centuries. Granting the survival of a great deal of primitive belief in medieval and modern times, a careful examination of the character of the evidence in the great witch trials makes it difficult to accept the survival of a real cult, notwithstanding the undoubted fact that *belief* in its existence had persisted. How real was the latter is shown by the literature extending from the "Malleus Maleficarum" of 1489 to the writings of Webster, Glanville, and Hutchinson, when in the course of the controversy, belief in witchcraft was both a heresy and a test of orthodoxy. This is one of the most interesting and instructive chapters in the history of religion and literature.

Mr. Wickwar's history of the witch touches upon all its more important features, including lycanthropy, the familiar, the flight of witches, and their sabbaths. He describes the most striking of the cases which came to trial in a way which carries the reader with him, while he successfully skirts the more repellent features of the subject. There are a few slips here and there, probably due to misprints; otherwise Mr. Wickwar's work is commendably accurate.

The Theory of Measurement.

The Theory of Measurements. By Dr. Lucius Tuttle and Prof. John Satterly. Pp. xii+333. (London: Longmans, Green and Co., 1925.) 12*s.* 6*d.* net.

THIS is a text-book for university students taking the ordinary course; its scope is indicated by the following abbreviated list of chapter headings: Weights and measures, significant figures, logarithms, the slide rule, graphic representation, interpolation, measurements and errors, least squares. In their preface the authors defend and, in our opinion, justify the novel practice of separating the study of the principles of measurement from that of its applications. They are pioneers, and as such deserve our gratitude; but gratitude must not prevent a careful scrutiny.

Our chief criticism is that the title is misleading and indicates a serious fallacy which pervades the book. The authors have no theory of measurements. They show no signs of having considered what is common to all measurement and what peculiar to special forms of it, in what conditions measurement is possible, or what accuracy means. Doubtless a thorough inquiry into these matters would be unsuitable for elementary students; but it has been justly said that the writer of a text-book should know more about what he omits than about what he includes; we are certain that if the authors had thought more deeply on these fundamental questions, they would have selected and arranged their material very differently.

In particular, they would not have devoted so large a proportion of their space to errors and adjustments or conveyed throughout the impression that these are the things that really matter in measurement. They are of primary importance in observational sciences, which cannot select their material, or in sciences which can hope to attain only statistical laws. In the experimental sciences, which most concern university students, these things are altogether subsidiary. In them the criterion of good measurement is not whether it provides material suitable for the computer, but whether it makes his work unnecessary. It is far more important to the physicist to be able to get a sharp galvanometer spot and know why all electrical magnitudes should be referred to resistance than to be able to handle least squares and know the relative advantages of various expressions of deviation. Rayleigh, a master of measurement and quite capable of handling the most abstruse analytical methods if he had found them valuable, never, we believe, used any method of adjustment more complicated than the taking of an arithmetic mean. Yet our authors have the hardihood —we had almost said impudence—to offer their students a set of Rayleigh's measurements and suggest that they "reject" some of them by Chauvenet's criterion. In this chapter their full error stands revealed. No wise and honest experimenter "rejects" an observation. He may reject the record of an observation on the ground of clerical error; but a really discrepant observation is more valuable than any other. It is always an indication of the limits of the method; it is often the clue to unexpected avenues of research.

However, we recognise that our authors are merely following an evil tradition, and that their fault here is only that they have failed to advance on their predecessors. But even if their general outlook is accepted, their selection and, still more their order, is open to criticism. On what grounds, other than historical, should all statistics be regarded as "applications to biology"? If angles are measured in Chap. iii., why should areas be relegated to the last chapter? If numerical methods of adjustment are discussed at all, surely some method of smoothing other than free-hand drawing might be described. If over-estimate of accuracy is a danger, surely under-estimate is equally serious; the slide-rule may be "sufficient for the great majority of practical calculations," but it is certainly not for many simple laboratory experiments; there is no instrument the student is more liable to abuse. Much more should be said about computation. Few students can add; and the most important fact about "physical arithmetic" to be instilled into them is that it must be right. Accuracy can be acquired by practice alone, but the lack of it so often leads to a preference of graphic methods over simple numerical methods, both

quicker and more satisfactory, that no space devoted to aids and checks would be wasted. Calculating machines other than the straight slide-rule are not mentioned, and tables are regarded as books to be read rather than as instruments to be handled. Lastly nomograms, theoretically interesting and practically most useful, are dismissed in a short paragraph.

We hope then that the authors will try again. They have aimed at writing a book that has long been needed, and their attempt is the best, because it is (so far as we know) the only one in the language. If they can make their execution equal to their design, if they will really justify their title, they will indeed deserve the thanks of all who desire reform in the teaching of physical science. NORMAN R. CAMPBELL.

Our Bookshelf.

Technical Education: its Development and Aims. By C. T. Millis. Pp. vii + 183. (London: Edward Arnold and Co., 1925.) 6*s*. net.

ONE of the chief lessons we may learn from a study of the past is that society is neither "in rigid repose with certain . . . institutions rooted like oak-trees in the centre round which all group themselves as best they can," nor is it in such a fluid state that its institutions may ruthlessly be torn down. Roots there are, but they are not eternal, and, although they are not to be pulled up hastily or thoughtlessly, there are among them those which are removable when they no longer fit life's changing conditions.

Mr. Millis's book—and particularly that part of it which reminds us of the debt we owe to the pioneers of technical education—makes us realise this very clearly, and directs our attention to some of the causes which are gradually forcing all concerned with education to examine their theories and practices so that education shall not be divorced from life. Slowly we begin to understand that careers in industry and commerce are worthy of as careful preparation as are those in the "professions." In secondary schools the need of "modern" sides is being felt: enlightened employers, recognising the decay of the apprenticeship system, are seeing that the means of producing an intelligent and adaptable workman already exist within our system of technical education, and would therefore improve and extend that system.

That there is a national urge to examine these questions may be seen from the fact that they are already receiving attention by the Balfour Committee, the Board of Education's Consultative Committee, and the recent Committee set up by the Boards of Education and Trade. An unofficial committee under the chairmanship of the Right Hon. Lord Emmott is also examining the relationships between technical education and other forms of education and industry. In view of these signs of the times, whether one agrees with Mr. Millis's conclusions concerning technical education or not, his book is a distinct contribution to the discussion of questions which are bound to be much to the fore in the coming reconstruction of our ideas both educational and industrial.

Grundfragen der vergleichenden Tektonik. Von Prof. Dr. H. Stille. Pp. vii+443. (Berlin: Gebrüder Borntraeger, 1924.) 22·50 gold marks.

THE most valuable part of this important work is the very full account, occupying some 200 pages, of all the epochs of mountain-building since the close of the pre-Cambrian. A very clear picture of the geological structure of Europe is brought out, starting with the primeval Europe of the pre-Cambrian shields, and continuing through the main tectonic subdivisions built up by the successive phases of Caledonian, Hercynian, and Alpine movements. Altogether about twenty definite phases are recognised. Three of these are grouped as Caledonian (Ordovician to Lower Devonian); five as Variscan or Hercynian (Upper Devonian to Permo-Triassic), and the rest as Alpine (Kimeridgian to recent). The broad periodicity often referred to in text-books clearly cannot be accepted except for limited areas. Dr. Stille continues to hold the view that earth-movements are mainly due to the contraction of the outer crust, a theory that is at present subject to very severe criticism from various sources. But although the author says nothing of the possibility of expansion, and little about isostasy, he maintains, in opposition to Suess, that upward movements have occurred not only relatively to downward movements, but also with reference to the centre of the earth. It is a great pity that the details of igneous activity have not been included with those of earth-movements. The task of compiling all the information must have been a heavy one, but a little more work would have sufficed to make the book a storehouse of petrological data of the utmost value. As it is, we are indebted to Dr. Stille for the most complete account that has yet appeared of the earth-movements of Palæozoic and later times.

Electric Vehicles. By Charles W. Marshall. Pp. xii +96+25 plates. (London: Chapman and Hall, Ltd., 1925.) 9*s*. 6*d*. net.

THE class of electric vehicle which has proved most successful in Britain up to the present time is the lorry of from 1 ton to 5 tons capacity. The author has had extensive experience of the working of electric battery vehicles belonging to the Glasgow Corporation, and he quotes test figures which are very interesting and instructive. He compares the cost for electric, petrol, and steam motors and shows that the electric vehicle is cheapest to run, provided that the load capacity lie between 2 and 5 tons. For loads of less than 2 tons, the petrol vehicle is the most economical. But electric vehicles are preferable in every way to horse-drawn vehicles. The average consumption of energy for a ten-mile run is generally about a unit. It is rightly pointed out that electric vehicle builders are greatly handicapped in their endeavours to induce private firms to use electric vehicles by the fact that most electricity authorities have no vehicles of this type themselves. It would pay the municipal electric authorities if all the city work at present being done by horses were done by electric vehicles. For each horse displaced a night load on their station of about one kilowatt for seven hours would be obtained. Valuable data are given which should enable engineers to come to a decision.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Radiation arising from the Mutual Annihilation of Protons and Electrons.

THE recent work of Millikan (*Science*, 62, 444, 1925) has added to our list of radiations, some of far shorter wave-length than any hitherto discovered. By extrapolation of A. H. Compton's formula for absorption (*Phys. Rev.*, 21, 483, 1923), it has been estimated that these new rays have a range of wave-lengths between 0·0004 and 0·00067 Ångström. (Had the analogous formula developed by Jauncey (*Phys. Rev.*, 22, 233, 1923) been used, the values would have been between 0·0022 and 0·0029.) It is suggested in Millikan's article that "the computed frequencies of these rays also correspond closely to the energy involved in the simple capture of an electron by a positive nucleus."

It seems worth while looking into the possible ways in which the capture of an electron by a proton can be effected, and considering how it can be done with the minimum sacrifice of what are usually considered to be basic principles. In attempting to speculate on the origin of extremely high frequency radiation according to the line of thought indicated, it may be well to set down what principles we should endeavour to retain. These are :

(*a*) Conservation of energy.
(*b*) Conservation of momentum.
(*c*) Conservation of charge.
(*d*) Reversibility of process considered.
(*e*) Velocities never to exceed the velocity of light.

(*a*), (*b*), (*c*), and (*e*) need no comment. As to (*d*), a word of explanation may be necessary. From considerations involved in the discussion of Klein and Rosseland's "collisions of the second kind" and implied in Einstein's derivation of Planck's formula, and particularly from the work of R. H. Fowler and E. A. Milne on the equilibrium of ions, atoms, excited atoms, and radiation, it has appeared necessary to demand that each elementary process involving the emission or absorption of radiation and a change of state of the atom, etc., must be individually reversible. It seems desirable in the speculations now under consideration to favour the solution in which the reversibility is not too difficult to realise.

We shall now consider various ways in which a quantum can be produced by the mutual annihilation of an electron and a proton on collision in which the energy of the quantum is supplied by the mass energy annihilated.

The conservation of energy requires that the energy, $h\nu$, in the quantum of radiation generated, should be equal to the combined energy of the proton and electron, $Mc^2 + mc^2$, where M and m are their respective masses.

$$h\nu = Mc^2 + mc^2.$$

If we make no attempt to see that any of the other principles enumerated above are satisfied, we can at once proceed to calculate the wave-length. Neglecting m in comparison with M, we have

$$\lambda = \frac{h}{Mc} = 1{\cdot}3 \times 10^{-13} \text{ cm.} = 1{\cdot}3 \times 10^{-5} \text{ Å.U.}$$

This is apparently what Jeans has done (NATURE, December 12, 1925, p. 861), for this value is identical with his. It will be observed that this value is thirty times less than the minimum wave-length of the new high frequency radiation as estimated by Millikan.

In the foregoing, conservation of momentum is ignored completely. If we attempt to secure conservation of momentum, then the momentum of the quantum must be equal to that of the disappearing electron and proton. Let us assume that, after collision, the quantum is moving along the OX axis, and that, before collision (which occurs at the origin), the proton and electron are moving respectively with velocities v_1 $(=\beta_1 c)$ and v_2 $(=\beta_2 c)$ and in paths making angles of ϕ and θ with the OX axis. If M and m be their masses, the conservation of energy requires

$$\frac{Mc^2}{\sqrt{1-\beta_1^2}} + \frac{mc^2}{\sqrt{1-\beta_2^2}} = h\nu. \quad . \quad . \quad (1)$$

The conservation of momentum requires

$$\frac{M\beta_1 c}{\sqrt{1-\beta_1^2}} \cos\phi + \frac{m\beta_2 c}{\sqrt{1-\beta_2^2}} \cos\theta = \frac{h\nu}{c}, \quad . \quad . \quad . \quad (2)$$

and

$$\frac{M\beta_1 c}{\sqrt{1-\beta_1^2}} \sin\phi = \frac{m\beta_2 c}{\sqrt{1-\beta_2^2}} \sin\theta. \quad (3)$$

On multiplying (2) by c, and comparing with (1), it is quite evident that both equations cannot be satisfied simultaneously, since $\cos\theta$ and $\cos\phi$ cannot exceed unity and β_1 and β_2 are necessarily less than unity. There is also a great difficulty in imagining the reverse process, which would evidently require a single quantum to disappear spontaneously, without apparent cause, and a proton and electron to appear in its place. The disappearance of the quantum on collision with some object is conceivable, but its sudden disappearance at some instant, without anything to mark that instant as different from any other instant, is contrary to our notions of cause and effect.

If we consider a three-body collision, between *two* electrons and *one* proton, resulting in a quantum and one electron, we can find a solution which satisfies all the conditions (*a*) . . . (*e*). Let us suppose (as a special case) the two electrons and the proton to be initially at rest before collision and the surviving electron to go off with a velocity v $(=\beta c)$ after collision. The energy and momentum equations are

$$mc^2 + mc^2 + Mc^2 = h\nu + \frac{mc^2}{\sqrt{1-\beta^2}},$$

$$0 = \frac{h\nu}{c} + \frac{m\beta c}{\sqrt{1-\beta^2}}.$$

Solving, we find

$$h\nu = \tfrac{1}{2}Mc^2 \frac{\left(1 + 4\frac{m}{M} + 3\frac{m^2}{M^2}\right)}{\left(1 + 2\frac{m}{M}\right)},$$

or, neglecting quantities of the order of m/M,

$$h\nu = \tfrac{1}{2}Mc^2,$$

whence

$$\lambda = 2{\cdot}6 \times 10^{-13} \text{ cm.} = 2{\cdot}6 \times 10^{-5} \text{ Å.U.},$$

and

$$\beta = 0{\cdot}999998.$$

Reversibility of the process in this case is easily visualised, for the quantum would disappear only on collision with an electron of energy $(1/2)Mc^2$ (neglecting quantities of the order of m/M). It is evident that the generation of high frequency radiation can result from a three-body collision without violating any of the principles enumerated above. (The quantum and recoil electron will, of course, travel in opposite directions, but there is nothing to determine the orientation of the line in space.)

We can generalise this three-body encounter by supposing that, before collision, one electron is moving with *any* velocity in *any* specified direction, with respect to the direction of motion of the resulting quantum. It turns out that in this case the quantum can have any energy between $(1/2)\,Mc^2$ as a lower limit and infinity as an upper limit. A three-body collision between *two* protons and *one* electron resulting in a quantum and one proton will also satisfy all the specified principles (*a*) . . . (*e*). In this case, the energy and momentum equations are

$$Mc^2 + Mc^2 + mc^2 = h\nu + \frac{Mc^2}{\sqrt{1-\beta^2}},$$

$$0 = \frac{h\nu}{c} + \frac{M\beta c}{\sqrt{1-\beta^2}}.$$

Solving, we get

$$h\nu = \tfrac{3}{4}Mc^2 \text{ (approx.)},$$

from which

$$\lambda = 1{\cdot}7 \times 10^{-13} \text{ cm.} = 1{\cdot}7 \times 10^{-5} \text{ Å.U.}$$

and

$$\beta = 0{\cdot}6.$$

It is very evident, therefore, that a three-body type of collision is much more satisfactory than a two-body type—as a possible explanation of the origin of the high frequency radiation.

It has been suggested that formation of the helium nucleus from four protons and two electrons will give rise to a high frequency quantum. The value of λ can be shown to be 0·0018 Å.U. It may also be shown that this process will satisfy the conservation of momentum and, moreover, that the reverse process is easily realised, being merely the break-up of a helium nucleus on the impact of the quantum.

It is evident that if we consider the possibility of collisions involving nuclei of atoms other than hydrogen, there is a wider field for further investigation and speculation.

A. LL. HUGHES.
G. E. M. JAUNCEY.

Washington University,
St. Louis, U.S.A.,
January 4.

Three Fundamental Frequencies.

IT is possible to equate the quantum and the relativity expressions for energy, and thus to obtain three interesting and fundamental frequencies, with their corresponding wave-lengths.

The well-known quantum expression is $h\nu$, where h is Planck's constant and ν the frequency equal to c/λ, where λ is the wave-length.

On the other hand, the relativity form of energy is mc^2, where c is again the velocity of light and m is the mass under consideration.

We have then $h\nu = mc^2$ or $hc/\lambda = mc^2$,

whence

$$\lambda = \frac{h}{mc} = \frac{6{\cdot}55 \times 10^{-27}}{3 \times 10^{10} m}$$

$$= 2{\cdot}18 \times 10^{-37}/m.$$

In the first place, put $m = 9{\cdot}0 \times 10^{-28}$ gm., the mass of an electron, and we have $\lambda = 0{\cdot}0242$ Å.U., which would be the wave-length due to the complete disappearance of the mass of a slow electron when, if ever, it reappears as radiation.

If, however, m is given the value of the mass of the hydrogen atom ($1{\cdot}64 \times 10^{-24}$ gm.), we find λ is $1{\cdot}33 \times 10^{-13}$ cm. This is the wave-length of the cosmic radiation to which Jeans refers (NATURE, December 12, 1925, p. 861), when he contemplates the disappearance of the equal charges and of the unequal masses of the proton and electron, and their reappearance as the most penetrating radiation of which we have at present any conception.

Finally, we can give to m the value derived from the congestion of four hydrogen atoms, each with atomic weight 1·008, into a single helium atom, with 4 as atomic weight. The available mass convertible into radiation is now $4 \times 0{\cdot}008 \times 1{\cdot}64 \times 10^{-24}$ gm. or $0{\cdot}032 \times 1{\cdot}64 \times 10^{-24}$ gm. This gives the wave-length λ a value of 0·0004 Å.U., or 4×10^{-12} cm. This is the wave-length of the penetrating radiation referred to by Millikan as of cosmic origin in a recent contribution to *Science* (November 20, 1925, p. 445).

To sum up—

$\lambda = \dfrac{h}{mc}$ leads to three basic wave-lengths,

Electron.	H atom.	He from H.
$m = \dfrac{1}{1800}$	1	0·032

$\lambda = 0{\cdot}024$ Å.U., 0·000013 Å.U., 0·0004 Å.U.,

where m is expressed in terms of the mass of a H atom $1{\cdot}64 \times 10^{-24}$ gm., and Å.U. denotes the Ångström unit or 10^{-8} cm. The reversals of such transformations, when each radiation changes into its corresponding mass, are readily conceived and may indeed occur in Nature under conditions at present unknown, for indeed such changes are not yet within our experience.

M. HOME.
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January 5.

New Mutations in *Gammarus chevreuxi*, Sexton.

SINCE the publication of the account of the first mutations in *Gammarus chevreuxi* (*Journ. Mar. Biol. Assoc.*, vol. 11, No. 3, 1917) a number of new mutations have appeared. Most of these, like the first, are connected with the eye, particularly with its colour and shape, but the most striking of all the new departures is a change in the colour of the *body*.

In the normal *G. chevreuxi* the body is pale green in colour with two bright red patches on each of the pleon-segments, and bars of brown pigment on the antennæ. The fully adult female looks much darker than the male, owing partly to a difference in the green colour, bluish in the female, yellowish in the male, and partly to the dark green, almost blackish, tint of the gonads which show through the transparent cuticle. The eggs, which are dark green when first laid, gradually change to yellow as the embryos form, and then to a deep orange colour just before the young are hatched. In the new mutation the animals are a translucent pearly-white, with no tinge of colour in the body. The gonads show as opaque white stripes, and the eggs in the brood pouch during the whole period from deposition to hatching can only be seen by transmitted light.

We have now three distinct new stocks producing mutations, the stocks having originated from three independent black-eyed pairs brought in from the wild. In all three stocks, as in the original mutating stock, red-eyes appeared which were recessive to black-eyes. We had therefore first to ascertain whether we were dealing with different and distinct mutations, or simply with re-appearances of the old form. To do this, we cross-mated the red-eyed recessives of the four stocks in as many ways as possible. Whichever way the mating was made *the offspring were black-eyed*, thus proving beyond doubt that the mutations of the new stocks are distinct from each other and from the mutations of the original stock. The reversionary blacks, as we call

this F_1 generation, have been back-crossed to the parent stocks, as well as mated *inter se*, and give in F_2, as would be expected, blacks, and reds of different constitutions.

Two of the new stocks show some specially interesting features. In the first we have two distinct kinds of red-eyes, one the bright red eye, with the usual brilliant scarlet pigment, and the other a very dark red, almost black at birth. The exceptional feature of the latter is that the dark red colour *lightens* as the animal grows older. Sometimes the eye becomes a brilliant red, indistinguishable from the bright red-eye; at other times the periphery of the eye lightens, and the centre remains dark. But however great the change may be in the colour of the eye, the constitution of the animals remains unaffected, for those which have lost all the dark pigment, and those which have retained the most of it, give the same results in the offspring.

In the second stock referred to, in addition to a new red-eye mutation, the white-body mutation described above arose, and connected with it, or linked to it, new eye-colours appeared, namely, the permanent white and the changeling white. The eyes and bodies of both these on hatching are white, the eyes are as large as in the normal animals, perfect in shape and in the reticulation of white pigment between the lenses, possessing also the deep-seated retinal cells but lacking the coloured pigment usually contained in them. The albinos of the original stock also had eyes which were white and lacking in colour, but in their case the absence of colour appears to be due to the degeneration of the eye, and the normal body-colour was unchanged.

It has proved impossible so far to separate the permanent whites from the changeling whites at birth with absolute certainty, though sometimes the changeling-eyes, especially those arising from a mating of white-eye and coloured-eye, have a more creamy tint than those of the permanent whites, a tint approaching primrose colour.

The permanent whites never develop any colour in the body, the gonads or the eggs, but the eyes appear to be of at least three kinds: the pure white, which never shows the slightest tinge of colour; the flushed white, which has a very faint trace of colour, palest pink or purple in two or three ommatidia in the centre of the eye; and purple white, in which a part of the eye, usually the lower portion, is a faint purple-lilac tint.

The changeling whites arose from a mating of white female and red male. They are practically indistinguishable from the permanent whites on hatching, but rapidly develop colour as they grow, both in the body and in the eyes, until in the adults it is impossible to see any difference between the changelings and the normal red-eyed animals; their bodies are green, the gonads and eggs dark green, and the eyes bright red.

We have had more than 25,000 young from this stock, consisting of:

(1) Black-eyes, normal body-colour, which, mated together, give either (*a*) all black, (*b*) black and red, or (*c*) black, red and white young.

(2) Black-eyes, white-body, giving black and white.

(3) Red-eyes, normal body, giving either (*a*) all red, or (*b*) red and white in the proportion of 3 : 1.

(4) Changelings, which give (*a*) red and white in the proportion of 3 : 1 when mated together; (*b*) black, black and red, or black, red and white when mated with the different blacks; and (*c*) all black when mated with recessives from any of the other stocks.

(5) Permanent whites, which give (*a*) all white when mated together; (*b*) black and white when mated with blacks carrying red, or with blacks carrying red and white; and (*c*) all black when mated with recessives from any of the other stocks. When, however, these permanent whites are mated with reds or changelings of their own stock we get the remarkable result that the reciprocal crosses are quite different; thus, any red male of the stock mated with a permanent white female (white gonads) gives all white-eyed young, consisting of whites and changelings, but the reciprocal cross, white male by red female (dark gonads), gives either all red-eyed young if the female is pure red, or reds and whites if the red female carries white (the one mating of this kind gave 25 reds and 42 whites). Similarly white male by changeling female (dark gonads) gives half reds and half whites (the actual figures are 131 reds, 130 whites), whereas the reciprocal cross, changeling male by white female, gives all white-eyed young, consisting of whites and changelings.

We propose to reserve any discussion of the theory of these different matings until the results have been carried further and the numerical details can be published.

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Do we—don't we—what do we—know?

I ESCAPE from Wonderland to find myself in a land still stricken, where Nature has to be taken in lumps. The effect is a little shocking, to one who has been preaching the use of The Looking Glass. Reflexion at the end of the year, indeed, always, tells me that I am a miserable sinner but NATURE (December 19), in a review article on electrical precipitation, makes me out to be a reprobate of a truly awful type. According to one J. S. G. Thomas, whose acquaintance I, unfortunate, do not enjoy, I have dared to "question Simpson's theory" of the development of electricity in thunder clouds, proposed in 1909. Could any crime be more heinous than that of which I am declared guilty: that of bringing in hydrone in explanation of the thunder storm? Apart from the fact, that I have dared no explanation, it is a little difficult to leave the said fair one out, with water, water, everywhere. Even in water, the fundament does do something, I presume.

I do unfortunately find myself unable, at present, to bow to the august authority of a stately meteorologist who says that thunder is made by splitting hairs — in the form of rain drops. Following my friend Paul of Tarsus—overrated person though he be and the unfortunate prototype of that threatening pest of our society, the metaphysician and psychologist, who knows nothing of hydrone and talks only in terms of thinks—I do but suggest that it were well to prove (prüfen) the thesis and only hold fast that which is good. No doubt, I am unduly obsessed (as Mr. Wells would say) by or at or with notions derived from the toyings of one Faraday, perhaps an out-of-date philosopher, with a hydroelectric machine devised by a northern namesake of mine.

I am well aware, that the doctrine—"theory" we have no right to call it, as it does not cover the facts—is in accord with the spirit of the times. We live in an age of "splits." A double Bass is only to be found in an orchestra here and there. The road to Mandalay no longer offers any attraction: you can't satisfy at the end, so much glass is being sold, with little beer—glass with scarce "a glass" in it. Still, I have yet to learn that Jupiter Pluvius is overcome

by modern methods of "Sparsamkeit" and that he makes noise by shivering his timbers.

If thunder were made of split drops, should there not be much more of it? Moreover, the thunder-storm rains "magnums," never "splits." I believe no bar-parlour will accept the "split" explanation. Meteorologists, I shall be told, don't frequent such places. More's the pity: they would gain sense of humour, if not of proportion. They would begin lower down. When I challenge Sir Oliver Lodge and my friend Prof. Millikan of Pasadena to tell me what happens when I rub my stylo on my coat sleeve—well, they hesitatingly murmur something about rubbed-off electrons. I am not taking any at present; the more as I read in a report of the Physical Society, that a piece of flannel may be a happy hunting ground for an explorer with a piece of sealing wax: apparently you can pick up + electricity here and − there, as Tom Tiddler did both gold and silver: for why? As Mr. Belloc has it:

> Here you may put with critical felicity
> The following question: What is Electricity?
> Molecular Activity, say some,
> Others, when asked, say nothing and are dumb.

Even thunder showers are only sometimes negative, I've heard say. My feeling is, that we may leave Sirius and its dense companion and instead rub our coat sleeves in wonder. We may then make ourselves of some use in this poor loose world, where the protons are supposedly encumbered and overclad with electrons. We are allowing the mathematicians to postulate all sorts of might-be's—and doing far too little to solve the really live problems.

NATURE is again across my path, on the same date (December 19), in a letter on a surface catalytic action in photochemical processes. I will not stop to consider if a "catalytic" action be ever otherwise than a "surface" effect—I have done so in my contribution to the Solvay Chemical Conference (NATURE, August 22, p. 294). I would merely direct attention to the paragraph:

"It is a well-established fact that pure hydrogen and oxygen can combine when subjected to radiation of short wave-length," etc.

Is it *a well-established fact* that pure hydrogen and oxygen can combine, etc.? Do hydrogen and oxygen—the things we so call and know—ever *combine*? Do not their molecules interact and then only when coupled with certain loose companions? Was I not at great pains, not long ago, in NATURE, to direct special attention to H. B. Baker's immortal work, often repeated, showing that hydrogen and oxygen do not interact? Is so-called research but a game, like dominoes, to be played without reference to other people's games? What is the use of "research work," undertaken at great expense of private time and public money, if subsequent workers pay no attention to results already obtained, recorded and discussed *ad nauseam*? Such statements necessarily reflect upon the competence of workers. That a mercury surface should exercise the influence described is in no way surprising—indeed, it is to be expected from Lavoisier's observation, that mercury is easily oxidised even when merely heated to the boiling point in air. Let us burn our books, if we cannot use them: they do but encumber our shelves, if left unconsulted and unconsidered.

Lastly, I am across the Huxley lecture (NATURE, December 26). Sir Oliver Lodge has a great name and his opinion counts for much with the public, because of his position in science. Surely, we have the right to ask him to dissociate himself from our body before saying in public: "And what of man? If his death is the end of him, the value of his existence may be doubtful. But if, *as I know* (my italics), that is not the end of him, then there may be infinite progress in store." We of the body scientific know, that we can very rarely say: *I know*, least of all when speaking of the great problem that has exercised the mind of man throughout the ages. Better that we hold on to the advice long since given by the poet:

> O man! hold thee on in courage of soul
> Through the stormy shades of thy worldly way—
> . . . . . .
> Who telleth a tale of unspeaking death?
> Who lifteth the veil of what is to come?

HENRY E. ARMSTRONG.

P.S.—On Friday evening (Jan. 22) I listened to an exquisitely clear exposition by Sir Wm. Bragg of his latest X-ray work. At the close, he spoke of quartz and demonstrated the development of an electric charge when the crystal is compressed or heated—attributing this to intramolecular displacements of the oxygen and silicon atoms. I have ventured to point out, that quartz is an electrolytic conductor of very high resistance—"so are we," say Stylo and Flannel—owing to the presence of traces of silicate. *Argal*: the effect may be simply one of frictional electricity

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The Boskop Skull.

DR. BROOM'S strictures in NATURE of December 19, 1925, on my paper on the Boskop skull, seem to call for some comment on my part.

I am charged, and I hold, unjustly, with inconsistency in regard to my suggested affinities of this "Proto-Bushman"; for my first reference to this theme is obviously expressed in general terms only. Merely in anticipation of what is presently to follow, I remark:—"A careful study of all the essential features of the skull of the Boskop man seems to show . . . that he was a *derivative* of Cromagnon man (italics mine), and the progenitor of the Bushman."

With this brief forecast I leave the subject, of set purpose, as is shown by the continuation—"But before these relationships . . . can be profitably considered . . ." This anticipatory reference, then, can scarcely be interpreted as contradictory to the passage which follows on the next page:—

"The Proto-Bushman is supposed (in my Phylogenetic Tree) to have arisen out of the Neoanthropic 'flux' which was to give rise to . . . the Grimaldi people (and) the Cromagnards. . . ." Only by "quibbling" can these statements be considered as inconsistent, either with one another, or the "Tree" to which Dr. Broom refers.

In regard to the size of the brain of this skull, Dr. Broom remarks in his paper (published by the American Museum of Natural History), "If . . . we make a cast of the brain in plaster, and restore it into at least approximately its original condition, and then measure its size, *as I have done* (italics mine), I feel quite confident the capacity will be found to be more than 1900 c.c." This is highly probable. But I venture to doubt whether any anthropologist would "restore" the skull as Dr. Broom has done.

If we keep to the facts, to begin with, we shall start with a skull no more than 205 mm. in length and 150 mm. in breadth. There is not the slightest justification for Dr. Broom's measurements. In this I have the support of Dr. Haughton, who first described the skull. Having most carefully studied and measured this calvaria I am positive on this point.

I am also quite satisfied with the formula I used in estimating the cranial capacity; and this formula has the approval of no less an authority than Dr. Duckworth. In no test to which I have subjected it have I obtained a disagreement, as between it and other tests, of more than 30 c.c., which is a long way from the 200 c.c. cited by Dr. Broom.

Dr. Broom notes that I had a great deal to say "on the easy problem of the cranium." But if one may judge by his own efforts he has much underestimated this "easy problem." It is further noteworthy that Dr. Haughton, Prof. Elliot Smith, and Sir Arthur Keith have also attempted this task, and have each arrived at a different result. But this by the way.

Dr. Broom is deeply pained and surprised at my failure to realise the immense importance of the fragment of the lower jaw found with this calvaria. On this *alone*, according to his own statement, he decided that the Boskop man must be assigned the rank of a distinct species. This conclusion is curious. All of us who examined this fragment, while it was at the British Museum, regarded it as of no importance at all!

In Dr. Broom's paper he enters at great length into the problems which this fragment presented to him; and he arrives at some strange results. There is no need to discuss these at length. Suffice it to say that Dr. Haughton's interpretation of this fragment needs no amendment. He regarded its much worn stump of a tooth as answering to m. 2, and the remains of a socket enlarged by an abscess, as the socket of pm. 1. Dr. Broom, however, has convinced himself that this socket lodged the canine. Had he been more careful in his estimation of the distance between this socket and the remains of m. 2, he would have been less impressed by this fragment.

This jaw, however, even as restored by Dr. Broom, affords no warrant whatever for assigning to this skull the rank of a new species. Save that the teeth are unjustifiably spaced, it differs in no wise from that of a modern Bantu jaw. I can show him its counterpart. Properly restored, this jaw will resemble, much more nearly, that of a Bushman.

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Discharge of Electricity through Gases.

THE value of photographs of the Stark effect in the analysis of discharges through gases was emphasised by Prof. R. Whiddington in a recent review of the subject (NATURE, October 3, 1925, p. 506).

Discharge tubes of the type first used by Lo Surdo have a small diameter near the cathode. Owing to this fact an intense beam of light traverses Crookes' dark space, where high electric fields are developed. These fields are accurately determined from the Stark effect for any Balmer or other suitable spectral line.

Various field distributions in this interesting region have been reported by different investigators. Anderson found the field to be a maximum at the cathode surface and to decrease with distance therefrom in a nearly *linear* manner. Nyquist first observed a rapid *decrease* in the field *very close* to the cathode. Takamine's photographs show a rapid *increase* in the same region.

The last distribution is characteristic of the simplest tube of a few millimetres diameter with cathode fitted closely to the wall. Starting with this, I have repeatedly obtained first Anderson's (see Fig. 1) and then Nyquist's type by successive enlargements of the original tube very near the cathode. These modifications permit a broadening of the ionic stream with corresponding decrease in current density and field strength. Control of distribution is of some practical importance in the establishment of the highest electric fields obtainable with a given source of high potential.

As a correlating fact, it may be mentioned that when the Lo Surdo tubes I have used operated properly, they did not contain striations. Thus there is no conflict between Whiddington's interpretation of his experiments on striated discharges and the sharpness of Stark components. The sheets of positive ions which, in his opinion, fly through the tube at regular intervals, might be expected to have a very disturbing effect on the electric fields near the cathode. I have often observed well-defined striations in Lo Surdo tubes containing hydrogen and helium. The analysis at such times is quite useless from the point of view of the Stark effect. The blurred lines indicate the presence of weak and variable fields.

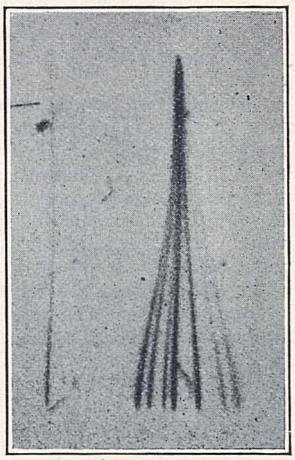

FIG. 1.—Perpendicular components of parhelium line group λ4144 in electric fields (single prism spectrograph).

Normal Stark-Lo Surdo photographs, on the other hand, leave one with the impression that the field at a point in the Crookes' dark space can remain constant for hours. A careful examination for a Doppler effect showed that the parhelium atoms which emitted λ4144 in Fig. 1 were not moving as a body toward the cathode with any appreciable velocity. These atoms were suspended, therefore, in a field which was probably due largely to neighbouring charges moving with relatively high velocities. Yet the width of each Stark component does not exceed that reasonably expected from the use of a wide slit, from imperfect focussing of the light on the slit, and from a few other disturbing factors.

J. STUART FOSTER.

McGill University,
Montreal, January 4.

The Study of Volcanic Activity on Vesuvius.

ON January 7 I had the good fortune to witness one phase of a minor eruption of Vesuvius in the company of Prof. Malladra, the distinguished director of the Vesuvian Observatory, and I shall be grateful if you will allow me the hospitality of your columns to direct the attention of all our younger geologists and mineralogists to the exceptionally favourable opportunities now presented by the mountain for the study of volcanic phenomena. The great crater left after the violent eruption of 1906 has been gradually filling up, and its floor is now within some 250 feet of the rim. On this floor stands an eruptive conelet, the apex of which is not far below the level of the rim of the 1906 crater, from which its explosions and ejections can be well observed.

The streams of lava which flow from time to time from fissures in the sides of the conelet, and by their successive outpourings are gradually raising

the level of the crater floor, can be studied either from the same point of vantage, or else, at quite close quarters, after a scramble to the bottom of the crater by an easy path. On the floor of the crater there can also be studied the chemical changes produced in the lava by the action of hot gases forcing their way up from below, and typical specimens of the products can be readily collected.

These favourable conditions are likely to persist for the next two or three years at least. When, however, the 1906 crater has once been refilled, the activities of the mountain, though likely to become more awe-inspiring and formidable, will be less convenient for study than at present. Further, the presence in London of the admirable Johnston-Lavis Collection of Vesuvian specimens, maps and literature, now conveniently arranged and made accessible for study at University College, affords the English student a unique opportunity of making himself acquainted with the past history of the volcano, either before or after a visit to the locality itself.

In conclusion, it may be not out of place to mention that Messrs. Cook and Son, who work the Vesuvian railway, maintain a comfortable hotel immediately adjacent to the Observatory (Hotel Eremo), at which visitors who stay more than a day or two are received on very favourable "en pension" terms, and from which a large part of the mountain can be conveniently explored. ARTHUR HUTCHINSON.

The Mineralogical Laboratory,
Cambridge, January 25.

The Mathematical Tripos.

IN his address to the Mathematical Association, Prof. G. H. Hardy urged the desirability of abolishing the mathematical tripos at Cambridge. May I direct attention to the disastrous results to which such a step might lead in other directions.

New universities are springing up all over England, and they are vying with each other in trying to give as many honours degrees as possible. These are purely examination qualifications, and the professor or lecturer teaching the students has generally no voice in the question as to whether the candidates are to pass or fail. These universities are frequently too poor to be able to keep more than one overworked professor and assistant, who know that unless they can get a good show of "firsts," or even honours people of any class, they will be looked on with disfavour by their colleagues.

No amount of "getting up" questions likely to be "set" or "doing papers" or "working examples and getting the right answer" or "revision" will, however, produce a mathematician, though it may and often does discourage someone that might become one. To my mind the essential requirement for the training of real mathematicians is that they should have followed discourses of lectures given by a large number of real mathematicians, each a specialist in a particular branch of the subject. In my Cambridge days I acquired my mathematical knowledge from about a dozen lecturers, and I am not sure whether the number of qualified lecturers in mathematics (good, bad, and indifferent) runs into two or three figures. I was one myself until I was forced to find employment elsewhere.

Apart from Cambridge there are very few universities possessing a sufficient mathematical staff to qualify any student for an appointment above the standard of an inferior schoolmaster.

If, however, the tripos were abolished, the Cambridge mathematical school would lose the best chance it has of attracting the degree seekers and trying to ram a little decent and intelligent teaching into their over-crammed brains. Personally I should be very sorry if the word "Tripos," which by usage has become the registered trade mark of the University of Cambridge, were abolished. It is in my opinion very unfortunate that they voluntarily surrendered an even more valuable proprietary name in the trade mark "Senior Wrangler" when it was in their power to use this designation as the brand of the best mathematicians of the year, when tested by any method whatever, including research work, even if this test is more or less covered by the Smith's prizes.

Therefore let Cambridge consider seriously before taking any step that will reduce its power of keeping students away from the honours examinations at cheap and nasty new universities. G. H. BRYAN.

Plâs Gwyn, Bangor,
Carnarvonshire.

Domestic Lighting and Heating.

IN the issue of NATURE of December 19, p. 910, an account is given of a house, where heating, cooking, hot water, lighting and power are obtained solely from electric energy. The yearly bill is something like 43*l*. for a ten-roomed house, and, considering that a judicious selection of the several agents available for lighting and heating would perform the same office for less than half the cost, with only very little labour as an offset, but with considerably more comfort, it may be asked where the advantage of the "all-by-electricity" system lies. "There is nothing to do but to operate a tumbler switch." When this has been said, apparently all has been said, for there is nothing tempting in the complicated and costly installation described in Prof. S. Parker Smith's paper, nor in the denial involved by the abolition of the open coal fire (with its appalling waste and its bright cheerfulness!) and of the direct open window ventilation, barred, evidently, by the small supply of heat which can be derived from an electric fire. Unfortunately, these two features, open coal fires and open windows, are essential features of British comfort and British health, and few would shirk the trouble of laying a coal fire with their own hands to spend a long evening by, if the alternative was the simple operation of a switch, and the resulting cheerless glow! I sincerely sympathise with any one who would follow the "simply-a-switch" lure and have but an electric fire to heat in winter a 14 × 22 feet room with a nice spacious window at each end admitting surreptitious draughts in proportion to the amount of light they let in.

The proper solution is not in the direction advocated by Prof. Parker Smith; it is in adjusting one's way of living with the view of a combination of maximum comfort, minimum labour and minimum cost. It is found in the use of a "living room" with an open coal fire (which burns but one scuttleful of coal a day, and, when desired, can be made to last all night, thereby saving the trouble of laying it in the morning). This fire does not require a special domestic servant, nor would its abolition enable one to be dispensed with. A "Sentry" boiler burning small coke (about 2*s*. 6*d*. per week) heats the kitchen and supplies hot water; it burns day and night for five or six weeks on end, requiring only a thorough raking morning and evening. The cooking is done by gas. In the warmer part of the year, hot water is obtained by means of geysers. The other rooms are heated by good gas fires which need but 15 to 20 minutes to bring an icy cold room 17 × 17 feet to a pleasant warmth. The lighting is done by electricity. The result is a comfort which it would not

be possible to obtain with an all-electricity scheme. As to the yearly bill, in 1925 it was 18*l.* 11*s.* for a spacious ten-roomed house, this being divided as follows: coal 4*l.* 14*s.*, coke 3*l.* 16*s.* 6*d.*, gas 6*l.* 5*s.* 6*d.*, electricity 3*l.* 15*s.*; well under half the figure quoted by Prof. Parker Smith!

M. GHEURY DE BRAY.

40 Westmount Road,
Eltham Park, London, S.E.

Parthenogenesis in *Methoca ichneumonides* Latr.

IT is well known to collectors of Hymenoptera that the males of the Thynnid, *Methoca ichneumonides* Latr., are extremely rare, whereas the females are sometimes relatively abundant. Neither sex is common and the insect is described by Sharp as "very rare." It has been suggested that the males have been overlooked by collectors, that their life was short, and that their scarcity was only apparent. Recently I have been able to rear these insects in captivity, and my experiments show clearly that parthenogenesis does occur, a fact which readily explains the scarcity of the males.

In July 1924 I caught a number of females of this species near Woking and a single male at Oxshott. These females were provided with Cicindela larvæ, which they stung so as to paralyse them, and on which they afterwards oviposited in the usual way. From the eggs laid by these females a single female emerged in July of the following year. This female was provided with Cicindela larvæ and she was seen to oviposit, although she had never had access to a male. In October 1925 I observed that five Methoca cocoons had developed from the ovipositions of this virgin female.

Although I was unable to observe any eggs on the Cicindela larvæ after oviposition by this female, owing to the position of the larvæ in their burrows, there can be no doubt that the cocoons were derived from the eggs laid by this female, and not from eggs laid on the larvæ before their capture. The Cicindela larvæ which I provided for the oviposition were all healthy, lively specimens, taken from open burrows, whereas it is well known that larvæ which have been parasitised by Methoca are very lethargic and incapable of co-ordinated movements of their appendages, the last pair of legs being totally paralysed. After oviposition the Methoca closes the mouth of the burrow of the larvæ, but all the larva I provided were taken only from open burrows.

It will be July 1926 before these cocoons produce imagines, when I hope to be able to decide the sex of the inmates. I have opened one cocoon and found the inmate to be still in the larval condition. I hope to carry out further breeding experiments next year and to obtain sufficient material for cytological work.

So far as I am aware this is the first recorded instance of parthenogenesis in the solitary Vespoidea.

H. T. PAGDEN.

Christ's College, Cambridge,
January 13.

The Geological Congress and Museums.

THE *Compte rendu* of the Geological Congress held in Belgium in 1922 has just been received at the British Museum (Natural History). From it I learn that there were made in the rules of organisation, previously formulated in London, certain changes that call for comment. An attempt, possibly unintentional, seems to have been made to restrict the invitations and the list of those competent to serve on the council to purely professional geologists representing official surveys. But this was exposed and defeated by the restoration of at least the universities and geological societies to the list. Museums, however, were quite definitely in so many words eliminated from official representation. I beg to raise, and I hope to lead, an energetic protest against this slur on establishments that are a powerful means of promoting geology. Setting aside the Geological and Mineralogical Departments of the British Museum, which in the past have numbered men of rare and world-wide distinction among their officers, I may instance the American Museum of Natural History, the president of which is this year the recipient of the highest honour that the Geological Society of London can bestow, and the geologists and palæontologists of which have of late thrown light not merely on the past history of the Americas but of the Mongolian Desert.

Museums *qua* museums are, let us admit, no more deserving than certain bodies which bear the name of "University" or of "Geological Society." But every geologist will agree that there are many among them doing admirable work for his science. I am astonished that this indignity should have been proposed and supported by my friends E. de Margerie and R. W. Brock, men not wholly unfamiliar with the work of museums.

Perhaps I may explain that the personal question does not enter into this protest, since I can, in another capacity, take a seat on the council.

Circumstances no doubt conspired to render the Brussels Congress less representative of the geologists of the world than it might have been. We may, therefore, hope that this question will be taken up again at the International Geological Congress to be held at Madrid during the last week of May, and that on future occasions an official welcome will again be extended to delegates from the leading museums.

F. A. BATHER.

Department of Geology and Palæontology,
British Museum (Natural History).

Cirrus at a Lower Level than Alto-cumulus.

ON Sunday, January 24, at about 09·15, the sky was nearly covered with a sheet of alto-cumulus; this had a straight edge, there being quite clear sky low down in the east. In the northern and western parts of the sky and up to the zenith there were numerous streaks of cirrus uncinus, that is, cirrus streaks with the ends upturned; these were without a doubt below the alto-cumulus. All the clouds were moving from about north-west; the apparent motion of the cirrus was faster than that of the alto-cumulus. The upturned ends of the cirrus were to the southward, the streaks trailing away to the northward. The cirrus appeared dark against the clouds above it. The height of the alto-cumulus was measured with a range-finder. Three separate observations were made on different patches of cloud, at angular altitudes of 30°, 22°, and 20°; the heights obtained were 10,500 ft., 10,140 ft., and 10,260 ft. These are in very fair accordance, and there is, therefore, not much doubt that the height of the alto-cumulus sheet was between 10,000 and 10,500 feet; the cirrus must, therefore, have been lower, but how much lower it is impossible to say. The best development of the cirrus was at the time I have named, but some cirrus was seen below the alto-cumulus until about mid-day.

I have long been led to believe that cirrus may occur at a very much lower level than that usually given in text-books on meteorology, but I have never before come across such a very definite case.

C. J. P. CAVE.

Stoner Hill,
Petersfield.

The Sennar Dam and the Gezira Irrigation Project.

IN the Sudan, immediately south of Khartum, lies an extensive plain, known as the Gezira Plain, constituting the triangular tract of land enclosed between the two branches of the Nile—the White Nile and the Blue Nile, which unite at Khartum. Some fifteen or twenty years ago this area, comprising considerably more than 3,000,000 acres, was a barren waste. To-day, a substantial part of it is under cultivation and covered with crops.

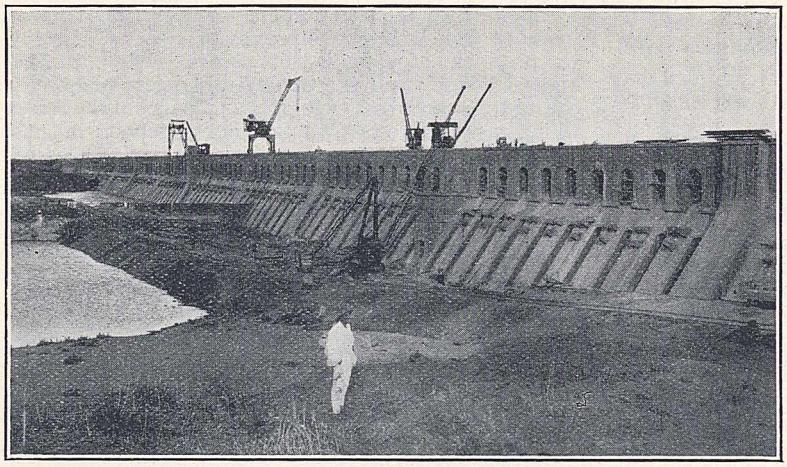

FIG. 1.—Sennar Dam. General view of the works taken from the downstream of the Dam on the west bank on May 1, 1925.

It was Sir William Garstin who, in recent years, first envisaged the idea of rendering this sterile tract cultivable. He put forward the suggestion at the beginning of the present century, and the possibilities of a system of artificial irrigation attracted favourable attention. After due consideration, the project ultimately materialised in accordance with plans prepared by Sir Murdoch Macdonald.

The scheme provided, in the first instance, for the construction of a dam across the Blue Nile at Makwar, a little village a few miles south of the more important town of Sennar. It was not, however, until 1913 that the necessary financial arrangements were completed, enabling the work to be begun in 1914. Suspended more or less during the War, operations were actively resumed thereafter, and the dam, as announced in NATURE of January 30, p. 167, was officially opened by Lord Lloyd on January 21, although the constructional work was actually completed last June, and the irrigation scheme has been in operation since the autumn.

Broadly speaking, it may be said that the area which has been canalised and rendered cultivable is equal to the county of Bedfordshire. The total length of main canals is about one thousand miles, and the length of the subsidiary canals is considerably greater. The surface soil is loess (black cotton soil), and the excavation was carried out by drag-line excavators.

The dam itself is an immense structure 3025 metres (nearly two miles) in length, built of granite rubble masonry, which has been founded on an outcrop of gabbro. It is substantially built and contains 422,440 cubic metres of stone and cement. The maximum height of the dam is 39·5 metres and the foundations are carried 10 or 12 metres down below the river bed. The central portion of the dam across the river channel, 1800 metres in length, is pierced by 80 sluices, each 8·4 metres high and 2 metres wide. Above this are 72 small spillways, 2 metres high and 3 metres wide, while at each end of the sluice dam there are 20 large spillways, 5 metres wide and 2 metres high. The main canal head regulator, on the western bank, consists of fourteen sluices, 3 metres wide and 5 metres high. The Sudan Government Railway is laid across the dam, and is to be extended at a later date so as to connect up with the existing line at Kassala and so to communicate with Port Sudan.

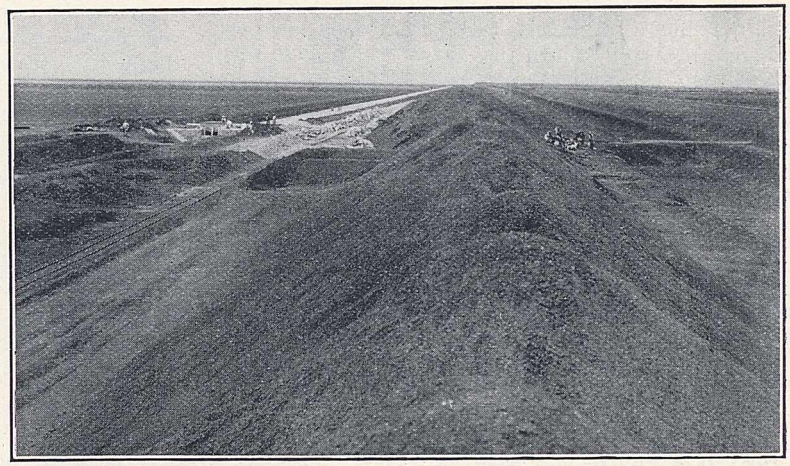

FIG. 2.—Gezira canalisation, March 10, 1925. View of main canal at Kilometre 80 from the Dam, showing a branch canal on the left, and on the right an area already developed and under cotton, and watered by pumps on the river.

The reservoir formed by the dam is capable of containing 636 million cubic metres of water, or, after

allowing for evaporation, 485 million cubic metres. In the cycle of seasonal flow, the reservoir will be filled during November, when the river is free from silt, and the impounding water will be used for irrigation from the middle of January to the middle of April. This reservoir will enable the whole of the natural supply of the upper Nile to be transmitted into Egyptian territory, only that portion of the water being retained in the Sudan for irrigation purposes which would otherwise pass off during flood into the Mediterranean. The present cultivable area lies at a distance of 57 kilometres from the dam and is served by a main canal, 114 kilometres in length. In the process of cultivation, crops will be grown in rotation. Of the 300,000 acres now irrigated, one-third will be assigned to cotton cultivation each year, and 100,000 acres to other crops, of which one-half will be maize, the staple food of the cultivator, and one-half lubia, a leguminous bean suitable for cattle fodder. The remaining 100,000 acres will lie fallow.

The full development of the scheme for the irrigation of the Gezira Plain involves the construction of another dam across the White Nile at Gebel Aulia, about thirty miles south of Khartum. The object of this dam, the construction of which is not yet commenced, is to ensure the summer water supply of Egypt.

The whole project is a remarkable manifestation of the benefits to be derived from the regularisation of forces of Nature, which in their unrestrained condition cause barrenness and waste, but when skilfully controlled add immeasurably to the resources at the disposal of mankind and bring comfort and prosperity in their train.

The consulting engineers for the scheme during the last two years have been Messrs. Coode, Fitzmaurice, Wilson, and Mitchell, who have courteously supplied the photographs reproduced herewith. The contractors were Messrs. S. Pearson and Son, Ltd., represented by Sir Frederick Hopkinson. The chief resident engineer for the Sudan Government was Mr. O. L. Prowde. The cost of the dam structure has been about 5,600,000*l.*, or, including the canalisation works, 8,500,000*l.*, but with preliminary expenses and other outlays the total cost of the project, so far, to the Sudan Government is in the neighbourhood of 13,000,000*l.*

Smokes as Aerial Colloids.

By Prof. R. WHYTLAW-GRAY.

CONSIDERING the rapid growth of colloid chemistry, it is remarkable that systems of finely divided matter suspended in gases have attracted so little attention from workers in pure science. This is all the more surprising because, on first consideration, such systems appear to be the simplest of all forms of disperse material, and it might be contended that just as the principles of the older chemistry originated from a study of gases, the investigation of aerial suspensions might throw a new light on the many complexities of the colloid state.

Apart from researches in physics which deal with the motions of individual particles mainly of microscopic dimensions, and centre around the question of unit electronic charge, much of the literature in this field is of an applied character, such as, for example, the cause and prevention of dust explosions in coal mines and factories, electrical precipitation, filtration, and settling, and the pathological effects of silicious and other dusts. Information on the stability of smokes, their electrical character and constitution, the size and nature of the aggregates formed on flocculation, is inadequate and meagre, so that the inquirer, unless he is prepared to make experiments himself, is perforce compelled to deduce the properties of these systems from first principles. This is the method followed by Dr. W. E. Gibbs in the very interesting survey of the subject delivered before the Chemical Engineering Group of the Society of Chemical Industry on October 9, and entitled "Aerosols in Industry."

From the literature available, Dr. Gibbs concludes that a close parallelism exists between these systems and the better known hydrosols. Thus smokes in general should owe their stability to the particles all carrying a charge of the same sign, and loss of charge should bring about flocculation or coagulation. The existence of an iso-electric point is assumed, and this it is stated can be reached by adsorption either of gaseous ions or of smoke particles of opposite electric sign. Stability is believed to be enhanced by adsorption from the medium of a protective gas sheath which diminishes the chance of adhesion or coalescence of the smoke particles on collision. It must be confessed that this is an attractive working hypothesis which is supported by the work of Rudge on the charges carried by dusts and also by many observations which have been recorded in the literature.

It seems but a step to go from aerosols to aerogels, and from protection to peptisation, and to assume, as the present writer did some years ago, that the counterpart of all the main characteristics of suspensoid colloids can be discovered in these aerial systems. This, indeed, may prove ultimately to be the case, but in the present state of our knowledge, more is to be gained from a study of the differences than by the pursuit of an analogy which is based on scanty experimental evidence.

Before this view can be tested, it is essential to be able to determine the degree of dispersion in aerosols and to trace how this varies under different experimental conditions. In the case of dusts, many methods are available for estimating the total weight of suspended matter and the number of particles in a given volume, but with the more highly disperse systems consisting mainly of units near the limit of the microscope, to which alone the term aerosol is really applicable, recourse must be had to the ultra-microscope and to special methods of filtration. An attempt along these lines has been made by the present writer and his colleagues. During the last few years a number of fine oxide smokes, composed of non-volatile materials, have been examined in some detail, and it has been shown conclusively that these differ sharply from hydrosols in two fundamental points at least.

(1) These smokes even when dilute are continually undergoing spontaneous aggregation. In contradistinction to the stable metallic sols, they are unstable coagulating systems. No exception to this behaviour has been found, and a non-coagulating aerosol, if capable of existence, has yet to be discovered.

(2) The charged particles in these smokes are never all of the same sign. Usually the oppositely charged units are present in equal numbers so that the smoke as a whole is neutral. Uncharged particles are invariably present and in some cases far outnumber the charged.

The aerosol, then, is not a stable suspension of the primary particles condensed from supersaturated vapour, but is largely a collection of aggregates of a wide range of complexity the proportions of which depend on how far coagulation has proceeded, *i.e.* on the age of the smoke. A corresponding condition in hydrosols is only found during the process of quick coagulation after the addition of an electrolyte.

Whilst the agitation of the particles under molecular bombardment brings them occasionally in close proximity, it is difficult to decide whether electric forces may not play an important part in rendering the collisions effective and so causing aggregation. Analogy may, however, be misleading, and so far no marked difference has been noticed in the rates of coagulation of slightly and highly charged smokes.

A quantitative study of coagulation from the point of view of Smoluchowski's theory is much easier to realise experimentally with aerosols than with hydrosols, for whilst with a gold sol of suitable dilution the process is completed in a few minutes, a dilute smoke alters comparatively slowly and permits the changes to be followed for several hours. It has been found possible, too, with these systems to estimate the size distribution at different periods, for not only does the brightness of the aggregate as seen in the field of the ultra-microscope increase with size, but the rate of fall increases also, so that the desired result can be attained either by a statistical classification of the particles by their brightness or their rates of fall, provided that these can be correlated with the radii with sufficient accuracy.

Now whether the radii calculated by means of the Stokes - Cunningham equation from the observed rates of fall are even approximately correct depends on the structure of the complexes. If these are compact and formed by the true coalescence of the primary units, the calculated radii will not be much in error even if the particles are irregular in shape and not truly spherical. If, however, the complexes or aggregates consist of units not actually in contact but separated from each other by minute interspaces filled with air, the mean density of the aggregate will be much smaller than that of the primary particles from which it is formed, and unless this is taken into account the radii deduced will be found to be much too small.

It is clearly necessary to know, to a first approximation at least, the mean densities of these composite particles. Millikan's oil drop method for determining the value of the unit electronic charge requires a knowledge of the density of the suspended droplet; conversely, the density of a suspended smoke particle, provided that it is roughly spherical in form, can be calculated from its rate of fall under gravity in conjunction with its rates of rise in a known electric field when carrying different charges. If the number of charges on the particles is known and the value of the unit charge is substituted in the equations, the mean density of a smoke complex can be deduced.

Considerations which cannot be discussed here make it probable that the rate of fall of these complexes is represented closely by the Stokes - Cunningham equation, provided the structure is not too loose and that the packing is close. Experiments along these lines have been made recently in my laboratory, and it appears that the composite particles in smokes of magnesium oxide, mercuric chloride, mercury and silver, possess densities varying from one-sixth to one-eleventh of that of the material in bulk, whilst coagulation in paraffin oil smoke gives particles of normal density, *i.e.* true coalescence takes place and homogeneous spheres are formed.

It seems probable, therefore, that any smoke formed by high temperature volatilisation must contain large numbers of these aggregates, and it is not surprising that the use of such particles by Ehrenhaft and others for finding the electronic charge should lead to erroneous values.

From the foregoing, it follows that the true radii of the majority of smoke particles are very much larger than has been supposed, and even in fine smokes usually exceed 3×10^{-5} cm., so that in many cases the supposed ultra-microscopic particles are really of microscopic dimensions. Recently, with a suitable optical system, it has been found possible to resolve these complexes when suspended in the air, and when this is done, the interesting fact emerges that the constituents, though closely joined together, are capable of independent Brownian motion. The smoke particle thus appears to be a system of primary units in dynamic equilibrium under the opposing forces of Brownian agitation and electrical or cohesional attraction.

It is probable that many of the properties of smokes can be explained by this structure of the complex aggregates, such as the low density of electrically precipitated smokes, and the fact that in some cases such material is peptised by weak acids or alkalies to form colloidal solutions as observed by Kohlschutter and Tuscher: the large amount of air carried down by zinc oxide fume and by carbon black pointed out by Gibbs; the immediate resolution of the large flocks of some smokes into their constituent particles on wetting; as well as the apparent stability consequent on their slow rate of diffusion and settling so marked in many fine industrial smokes.

Much work of a fundamental character is needed to elucidate the many aspects of these systems. Next to nothing is known definitely of the conditions under which ions are caught from the air and the particles acquire electric charges. The same may be said about the adsorption of gases by this type of finely divided material and also of its catalytic activity. Again, the investigation of systems composed of liquid droplets or of solid units of appreciable vapour pressure has scarcely been attempted. Indeed, the whole field of aerosols presents many interesting features and its further exploration is likely to yield results of much interest and importance.

Obituary.

PROF. CAMILLO GOLGI.

PROF. CAMILLO GOLGI, member of the Italian Senate for a number of years, Nobel Prizeman in 1906, died on January 21. Though almost eighty-four years of age, he had preserved until a short time ago the astonishing lucidity of his marvellous mind, and when I saw him last in January 1924 he was still taking part in the public life of his country and scientific activities of the University of Pavia, where he had obtained his medical degree in 1865 and had become extraordinary professor of histology in 1875. Towards the end of that year he went as professor of anatomy to the University of Siena to return a few months afterwards to Pavia, where he occupied the chair of general pathology and histology until 1918, the year of his retirement from active teaching.

Son of a distinguished medical practitioner and for some time a pupil of Mantegazza, Bizzozzero and Lombroso, Golgi spent the first years of his career in the Home for Incurables of Abbiategrasso in the Province of Milan, where he went as chief resident physician. Abbiategrasso was in those days a village remote from any centre of scientific activity, and one can easily imagine how inadequate must have been the means of investigation with which young Golgi had to content himself. It was, however, in Abbiategrasso that he wrote his early papers on the history of pellagra, the etiology of mental alienations, the structure and development of Psammomata, the changes of the lymph-vessels of the brain and the structure of the neuroglia, which even now can be consulted with profit. But it was in that Hospital that he discovered his chromate of silver method by means of which nerve cells, with all their processes and the finest ramifications of the latter, can be seen singled out and intensely stained black against a transparent yellowish background. At a time when histological technique was in its infancy, and the structure of the central nervous system looked like an impenetrable mystery, Golgi's discovery revealed the existence of an unforeseen world. A first hint of the new method was given in his paper on the grey substance of the brain (1873). However, the so-called slow process was fully described only in 1875, and the bichromate and mercury chloride method in 1878. The rapid process was first published in his paper on the structure of medullated nerve-fibres (1880). All of them and the mixed process were again minutely described in the last chapter of his monumental work "Sulla fina anatomia degli organi centrali del sistema nervoso," published between 1882 and 1885.

By means of Golgi's methods the microscopic anatomy and physiology of the central nervous system were placed on the sound foundation on which they at present rest. He had since 1873 observed the long- and short-axoned nerve cells with which now every medical and science student is familiar, and the collaterals arising from the axon of the cells of the I type. Already in 1874 he had described the large nerve cells of the granule layer of the cortex cerebelli which bear his name, and pointed out that the "granules" are in fact minute nerve cells. In 1875 he had been able to give a first description of the structure of the olfactory bulb, and to show that both the olfactory fibres and the protoplasmic processes of the mitral cells arborise within the olfactory glomeruli. But it was only in his main work that he set forth definitely the results of his fundamental studies on the morphology and relations of nerve cells, the central origin of nerves, the architecture of some cerebral convolutions, the structure of the cortex cerebelli and hippocampal region, with the addition of fresh observations on the morphology, connexions with blood-vessels and histogenesis of neuroglia cells.

Golgi's description of the diffuse network (*rete nervosa diffusa*) was the anatomical corollary of these investigations and of those on the structure of the spinal cord (1880 and 1890). As he observed in various papers and again in his lecture at Stockholm, his diffuse network consists essentially of the collaterals of the axis-cylinder of the long-axoned cells, the complicated arborisations of the axis-cylinder of the short-axoned cells, and the collaterals and arborisations of the axis-cylinder of the motor and sensory nerve-fibres which reach any given region of the nervous system from others. He always considered the diffuse network, not as a working hypothesis, but as a well-defined anatomical entity linking together the different parts and functions of the nervous system. He was, however, extremely keen on pointing out that it is immaterial whether the thin filaments composing the network actually anastomose with one another or are simply superimposed to form thick interlacements. In other words, the continuity of the innumerable and non-insulated nerve-fibres which permeate the grey substance was in no way necessary to his conception of the united action of whole groups or layers of nerve cells or even entire regions of the central nervous system. For these reasons he persistently refuted the neurone theory, though based on the results of his methods, and could never agree to the individual action of nerve cells postulated by this doctrine.

Mention can only be made of other discoveries, such as the sensory end-organs of tendons (1880), the exact course of uriniferous tubules (1889), and the secretory canaliculi of the oxyntic cells of the gastric glands which Golgi succeeded in impregnating at the same time as Erik Müllar (1893). The pericellular investment and the internal apparatus of nerve cells were described in the same paper in 1898 and the neurofibrils of the superficial portions of nerve cells in 1900. In 1908 he published his arsenious acid method for the demonstration of the internal apparatus, and, by showing (1909) that this cell organ may in glandular epithelia become shifted from its ordinary position, he anticipated the results of recent investigations regarding the important part that the apparatus probably plays in secretion.

Of Golgi's researches in the field of pathology, it will suffice to recall his observations on malaria (1885–1893). After Laveran's discovery, Golgi gave a masterly description of the parasites of the tertian and quartan fever and their non-sexual cycle of development. By showing that the beginning of fever in malaria coincides with the sporulation phase, taking place at intervals definite for each species of the parasite, he led the way to the rational use of quinine in the struggle against this scourge of humanity.

C. DA FANO.

MR. C. M. DOUGHTY.

WE regret to record the death on January 20 of Mr. Charles Montagu Doughty, the famous traveller in Arabia and poet, at Sissinghurst, Kent, at eighty-two years of age. Mr. Doughty was born on August 19, 1843, at Theberton, Suffolk. He was educated at Portsmouth, and later, on failing to enter the Navy, with which he was closely connected through his mother's family, he went to King's College, London, and Caius College, Cambridge. He took his degree, however, from Downing, to which he had migrated from Caius, obtaining second-class honours in natural science (geology) in 1865. During his career as an undergraduate he had shown a taste for antiquarian exploration, which he continued after taking his degree, spending some years in travelling and study. In 1866 he published a short pamphlet on the Jöstedal-Brae glaciers of Norway, where he had spent a year as an undergraduate. In 1870 he went to Holland, where he acquired Dutch and Danish, thence to Italy, Spain, and Greece, crossing over to Palestine a year later.

In 1876 Doughty began his journeys in Arabia upon which his reputation as a traveller and scholar chiefly depends, and for which he had prepared himself by familiar intercourse with the Arabs and expeditions to Egypt, the Sinaitic peninsula, and Petra. He had been attracted by accounts of Nabathæan and Himyaritic monuments at el-Hejr, near Medain Salih. Disguised, but not very successfully, as an Arab, under the name Halil, he set out with a pilgrim caravan from Damascus in 1876, and for nearly two years he was alone among free Arabs, living their life in the desert and in the oases. From the notes made by him the first chart of the superficial geology of the Arabian peninsula was compiled, and he first described the main hydrography of the northern half of the peninsula in communications to *Globus*; but he had become interested in the life of the people, and it is this side of his studies which gives the attraction and value to his great work, "Travels in Arabia Deserta," which was not published until 1888, and then only in a comparatively limited edition.

Partly owing to the fact that his interests were diverted into other channels, recognition of the great value of Doughty's work came late. In 1908 Oxford made him a Doctor of Letters, *honoris causa*. A little later Caius College elected him an honorary fellow, and in 1920 his University of Cambridge gave him an honorary degree. In 1912 he received the gold medal of the Royal Geographical Society, and in 1922 he was elected an honorary fellow of the British Academy. It was, however, only during the War that his work came fully into its own, his book being made the chief guide and work of reference for our military and political staff operating in Arabia.

WE regret to announce the following deaths:

Dr. Walter D. Hunter, chief of the section of insects affecting southern field crops of the Bureau of Entomology of the U.S. Department of Agriculture, who was known for his work on the cotton boll weevil, on October 13, aged forty-nine years.

Mr. B. N. Peach, F.R.S., formerly district geologist on H.M. Geological Survey, on January 29, aged eighty-three years.

News and Views.

AN article on "Primitive Law and Order" by Dr. B. Malinowski, which appears as a Supplement to this issue of NATURE, raises broad questions of vital interest to anthropological investigation and theory. Taking as his starting-point some of the social and economic activities of the natives of the Trobriand Islands, Dr. Malinowski has asked what is the binding force, the sanction, to use the legal phrase, responsible for their punctual and faithful performance. The conventional answer of current theory he finds by no means satisfactory. The communistic ideas which have been attributed to the Melanesians do not cover the facts. Dr. Malinowski has no difficulty in showing that the "communistic canoe" is, as a matter of fact, not communistic at all. Nor is any greater measure of reality to be attributed to the unquestioned obedience which primitive man is supposed to yield to custom backed by taboo and religious belief. Primitive man is no less unscrupulous than his civilised brother in evading his obligations if he can do so with impunity. Dr. Malinowski has put his finger on an inconsistency between theory and fact which has appealed to some, at least, both in the field and in the study. It has given rise to an uneasy feeling that an observer, not necessarily superficial, may have found by unconscious selection among the multifarious activities of the daily life of a primitive people, very much what he set out to seek. An apparently hasty conclusion has inevitably followed. Dr. Malinowski has attacked the problem by a new method and from a new point of view. He has taken certain concrete cases in primitive economics and social organisation and, by a searching analysis of the facts, shows that the conditions are such that no terms such as 'communism' or 'individualism' can be considered appropriate. The relations of individuals engaged in any economic or social activity depend upon a system of mutual obligations or reciprocities which might be regarded as something analogous to a system of 'civil' as opposed to 'criminal' law. Those who follow Dr. Malinowski's convincing argument can scarcely fail to endorse his plea for the application of his method and point of view to fields other than that in which he has employed them himself.

IN 1885 a forest school for the training of the upper subordinate staff of the Indian Forest Service was established at Dehra Dun. In 1906 the Forest Research Institute was inaugurated during Lord Curzon's Viceroyalty. It was placed at Dehra Dun and the old school was given the status of a college, and courses were instituted for training members of the Provincial Forest Service. Research work proceeded slowly at first, since no accommodation was available. Grants were made and a fine Research Institute building was opened in 1913, it being considered at the time that ample accommodation had been

provided for research for at least twenty years. The Institute grounds covered 47 acres, the land costing R. 1,68,000, and the buildings, including workshops, R. 5,08,000. The War period witnessed a great development. The forces on the eastern fronts had to depend mainly on India for their requirements in timber, fuel, fodder, and so forth. Great calls were made on the Institute, especially on the economic and utilisation side. By the end of the War, the Government of India recognised that the Institute had already outgrown the accommodation provided in 1913. A large project was accordingly drawn up. An area of 1300 acres was purchased a few miles outside Dehra Dun and plans for a new Institute building, laboratories, workshops, officers' quarters and offices were prepared, the new scheme being estimated to cost R. 1½ crores.

THE most urgent need at Dehra Dun was for new economic laboratories for timber testing, impregnation, seasoning, paper pulp, etc., and for up-to-date machinery. These latter were all erected and at work before the close of 1924; one wing of the new Institute building was also under construction. To some extent the work was checked under recommendations of the Inchcape Retrenchment Committee, which considered that much of the research work could be left to private enterprise. Under the new Reforms Act, a certain section of Indian opinion wished to have the training of the probationers for the Imperial Forest Service carried out at Dehra Dun, and both the Legislative Assembly and the Council of State passed resolutions to this effect, so far at least as Indians were concerned. Under these proposals, the old Research Institute building was to be adapted for educational purposes. The *Times* of January 23 published a telegram from Delhi stating that the Finance Committee has sanctioned a sum of 833,000*l.* to be spent on the Research Institute. The wording of the telegram is somewhat ambiguous, but it appears to imply that the money has been granted for the development of both research and education in the above-described directions.

THE problem of checking cruelty to animals is one which particularly interests men of science, partly because cruelty is so often due to laxity of thought, and partly because the doctrine of evolution has discredited the view that animals are senseless automata and of importance only in so far as they affect man's welfare. Indeed, the fanatical hostility which Darwinism has encountered is largely attributable to an exaggerated contempt for them, and to consequent resentment at being connected with them by descent: it was, perhaps, not by coincidence that Charles Darwin and Russel Wallace were both earnest champions of the animals' cause. But if animals are far better off in Great Britain to-day than they were a hundred years ago, and than they still are in France, Italy, and most other countries, the improvement must be attributed largely to specific educational work such as that which has been fostered by the Royal Society for the Prevention of Cruelty to Animals. That work needs, however, to be extended, for we still meet with cruelty which arises, sometimes from vice, but more often from apathy and lack of imagination. A key to further extension appears to lie in the hands of university students, many of whom become teachers in after life, and accordingly an attempt is being made to provide machinery (in the University of London in the first instance) for directing the attention of students to the whole problem. To ventilate the proposal, the Students' Union of Birkbeck College is arranging a historical lecture on the subject on Friday, February 12, at 8.15 P.M., and at this, we understand, all readers of NATURE will be welcome. It is hoped that a large number of students and members of college staffs will support the attempt: they should send their names to Capt. C. W. Hume at Birkbeck College, London, E.C.4. We understand that the movement is already assured of the guidance of several experienced veterinary surgeons and biologists.

A WEEK or two ago a case of assault on an alleged witch, which came before a magistrate at Tipton, attracted no little attention; but the trial at Melun, in France, of a case of assault on a priest, is even more remarkable. Abbé Desnoyers of Bombon, the victim of the assault, was set upon and beaten by a party of men and women with the object of driving out the diabolic possession which had enabled him to interfere with the miraculous manifestations of an image of the Virgin, the object of a cult of which a Mme. Marie Mesmin, an illiterate former concièrge of Bordeaux, was the head. The accused arrived at the court wearing black veils and spectacles, said to be as a protection against photography, but more probably as a protection against malevolent spells, as it was only with difficulty that they were persuaded to remove them while giving evidence. One of them identified the Abbé with Satan himself, and stated that he had sent diseases to Bordeaux by means of birds, by which he himself (the witness) had been affected, as well as Mme. Mesmin. He also said that the Abbé could inflict death on any one he liked within twenty-four hours, with or without suffering. He possessed dolls in which pins were stuck to injure his victims, and transmitted spells by birds. Mme. Mesmin had cried out between 12 and 2 o'clock in the morning, "The Abbé Desnoyers is killing me; get rid of him." It is interesting to note exactly the same accusations being made in the twentieth century as were made in the witchcraft trials in England and on the Continent in the sixteenth and seventeenth centuries. One of the prisoners said a priest sold to the devil was all-powerful. This was fully in accord with the remarkable frequency with which in France witchcraft has been connected with priests, the case of Grandier in the seventeenth century being, of course, the best-known instance.

"THE Arrival of Man in Scotland" was discussed by Dr. James Ritchie at the meeting of the Edinburgh and Lothians Branch of the Royal Anthropological Institute, held on January 19. Dr. Ritchie stated that the first men of whom evidence has been found reached Scotland at or shortly after the period of

the 50-feet beach, when the sea stood at a considerably higher level than it does now, and the Firth of Forth penetrated inland far beyond Stirling. Along its margin in the Carse of Falkirk are many kitchen-middens, and in Oransay and a few other prehistoric settlements on the west coast, clear evidence has been found of the presence of a people of Azilian culture. They appear to have reached Scotland during a period of moist climate, perhaps some 9000 years ago. The Azilian men had no domestic animals and were unfamiliar with even the simplest agriculture. They lived solely by hunting and fishing, a large proportion of their food being made up of the common shell-fish of the sea-shore. They were sparsely scattered, probably never exceeding sixteen to the square mile. Vegetation was very similar to that of modern times except for the extensive forests and broad marshes. But many animals long extinct in Britain roamed in the forests or bred in the marshes or plains. Of the larger forest creatures, elk or moose, reindeer and the extinct wild ox or urus were common. The beasts of prey included the brown bear, the lynx (found only near Inchnadamph), and the wolf. Amongst smaller animals were the extinct northern vole, the lemming, and the beaver. Birds were represented by the great auk on the sea coast, by the forest capercailzie, the bittern, the crane, and the great bustard, all of which have since died out.

THE third annual meeting of British zoologists was held on January 9 in the rooms of the Zoological Society of London. Fifty-seven zoologists were present, and Prof. Graham Kerr occupied the chair. Among the more important contributions were the following: Dr. Bather referred to the importance of writers on zoological subjects following the generally accepted rules of zoological nomenclature and systematic work, and the view of the meeting was clearly that he should write a short paper to make the rules more readily accessible to workers. Prof. Stanley Gardiner spoke on the importance of entomology and moved "that this meeting of British zoologists, recognising the importance of entomology as a growing branch of zoology, both from a scientific and from a practical standpoint, urges greater provision in the British and other Museums and extended teaching and research facilities in the universities." This was carried unanimously, as was also a further resolution, "That this meeting of British zoologists represents to the Prime Minister and the Trustees of the British Museum the urgent need for an extension, both in space and in staff, of the Entomological Department of the British Museum." Prof. Douglas Laurie reported upon the progress towards the establishment of a diploma in zoology and also upon the progress of the library co-operation scheme. A discussion upon "the desirability of linking together the biological sciences," opened by Mr. C. Pantin, raised the question of the advances in modern zoological teaching and brought out views upon the physiological aspect as opposed to the morphological in the training of the student. The next meeting will be held on January 8, 1927.

THE *Times* of February 1 had an article on "The Rainfall of 1925," by Mr. R. Corless, superintendent, British Rainfall Organisation, Meteorological Office. The rainfall, as a whole, was only slightly above the average value, but the distribution of the fall presented some interesting and remarkable features. Over part of Hampshire, including the Isle of Wight, the year was the wettest since 1868 or before, but June was absolutely rainless. Other areas without rain in June included the western part of Cornwall and of Pembrokeshire, a tract at the head of the Bristol Channel, and several smaller areas on the south coast and in the Midland counties. At St. Martin's, Guernsey, it was the first rainless calendar month in an 82 years' record. Over England generally, the drought set in about May 30 and ended on July 1. A map is given showing the rainfall over the whole of the British Isles. The most striking feature of the map is said to be that the area in the south of England extending from Newhaven to Weymouth had an excess of the average for the year amounting in some cases to 40 per cent. At Ventnor the total fall was 41·25 in., and was the highest value since observations began in 1839, except for a total of 42·05 in. measured in 1852. The totals for Brighton and Yapton (near Littlehampton) were the largest ever recorded in 51 and 60 years respectively.

AT the meeting of the Illuminating Engineering Society on January 21, Mr. Eric Farmer, of the Industrial Fatigue Research Board, read a paper dealing with the lighting of coal mines, in the course of which he described experiments illustrating the benefit of screening the filaments of miners' lamps, preferably by a translucent coating on the inside of the protecting glass cylinder. Dr. H. S. Elworthy contributed data showing an apparent benefit, in cases of nystagmus, of a yellow-tinted glass, and for this several explanations were offered. It was suggested that this colour aids the miner in distinguishing bluish shale from black coal, that it is favourable to definition, and that the fact of the periphery of the retina being relatively insensitive to yellow light at low illuminations may help to check movements of the eyeball characteristic of nystagmus. There was a general recognition of the need for higher candle-powers, and a lamp operating with a 4-volt battery and yielding four times as much light as the ordinary lamp, though nearly twice the weight, was exhibited. The need for a standard specification for bulbs used in miners' lamps was pointed out, and it was emphasised that the demand for a life of 1000 hours is excessive for 2-v. lamps, resulting in a poor efficiency and feeble light. Prof. Thornton, in a written contribution, suggested the possibility of ordinary methods of electric lighting in mines, based on the use of special cables fed by a low voltage high frequency alternating current, such as had already been found practicable for signalling purposes.

AT the anniversary meeting of the Royal Anthropological Institute held on January 26, the following officers for the ensuing year were elected: *President*,

Mr. H. J. E. Peake; *Vice-Presidents*, Mr. C. O. Blagden, Prof. Percy Newberry, and Mr. R. W. Williamson; *Honorary Treasurer*, Dr. F. C. Shrubsall; *Honorary Secretary*, Mr. E. N. Fallaize; *Honorary Editor*, Mr. H. J. Braunholtz.

PROF. G. B. BROWN, Watson Gordon professor of fine arts, University of Edinburgh; Prof. A. S. Eddington, F.R.S., Plumian professor of astronomy, University of Cambridge; and Prof. T. Okey, professor of Italian, University of Cambridge, have been elected members of the Athenæum under the provisions of Rule II. of the Club, which empower the annual election by the committee of a certain number of "persons of distinguished eminence in science, literature, or the arts, or for public services."

IT was announced at the ordinary scientific meeting of the Chemical Society held on January 21 that the Council had received with sincere regret that afternoon the resignation of Dr. Arthur W. Crossley from the office of president, owing to ill-health. Prof. H. Brereton Baker has been nominated by the Council to the office of president. The annual general meeting of the Society will be held this year at Manchester on March 25, the annual general meeting being held in the University at 4 P.M., and the dinner in the Midland Hotel at 6.30 for 7 o'clock.

PROF. J. BARCROFT will deliver a lecture entitled "Hæmoglobin" before the Chemical Society on Thursday, February 11, at 8 P.M., in the Chemical Laboratory at University College, Gower Street, London, W.C.1. The lecture will be followed by demonstrations by Dr. Hartridge and Dr. Roughton, of a method of measurement of rapid velocity constants; by Dr. Keilin, of cytochrome in animal and vegetable tissues; by Prof. Barcroft and Dr. Hecht, of a method of measurement of equilibrium constants; by Mrs. Kerridge, of a glass electrode; by Mr. R. Hill, of porphyrins of the heavy metals; and by Mr. G. S. Adair, of measurements of osmotic pressure of hæmoglobin.

AT a meeting of the British Mycological Society held at University College, London, on January 23, Mr. Chaston Chapman dealt with the advantages to be gained by the foundation of a National Institute of Industrial Micro-biology, and the following resolution (proposed by Mr. F. T. Brooks and seconded by Prof. Dame Helen Gwynne-Vaughan) was put to the meeting and carried unanimously—"That the members of the British Mycological Society at their meeting held at University College, London, on January 23, 1926, are of the opinion that it is most desirable that a National Institute of Micro-biology should be established in this country."

DENMARK now possesses a sanctuary for the native fauna and flora, in an estate transferred to the University of Copenhagen, by the munificence of a private citizen. The property is that called "Strodam," near Hillerod, some 30 miles north of Copenhagen, and south of Elsinore. It comprises about 300 acres, and is to be a perpetual sanctuary for native animal and plant life to be preserved in the interest of natural science. The donor is Mr. Axel Jarl, whose family are well known for their munificence for any object of national benefit. Zoologists and botanists both of Denmark and other countries are indebted and will be grateful to Mr. Jarl for his practical if sentimental tribute to his native land.

ARRANGEMENTS are proceeding for the International Archæological Congress in Syria and Palestine which is to be held under the patronage of the two High Commissioners at Beirut in April next. Invitations have already been sent to a large number of representative bodies to appoint delegates to the Congress, and a revised programme of proceedings has now been issued. The work of the Congress will be arranged in three divisions, first ethnological and prehistoric, second ancient history, and third medieval and modern. Delegates are, however, asked to assemble in Jerusalem on April 2 for a special programme covering the week preceding the opening of the meeting at Beirut. It is hoped that they will be able to visit all the principal sites of archæological interest including Byblos, Sidon, Baalbek, Palmyra, Tiberias, Beisan, Megiddo, Jerusalem, and Jerash. After the close of the Congress on April 23, a visit will be paid to Petra, lasting from April 24 until April 28.

WE have received the third number of *Brighter Biochemistry*, the illustrated journal of the Biochemical Laboratory, Cambridge. It maintains the high standard of humour reached by its predecessors. Although the topical allusions have mainly a local sign, yet any one who is acquainted with the work of this School can derive great enjoyment from them. The illustrations both in the case of past and present personages are, we hope, rather legendary than actual portraits. In the section entitled "Dunnsday Boke" readers will find a full account of the manners and customs of the community. Copies, 2*s*. 6*d*. each, may be obtained from the editors at the Sir William Dunn Institute of Biochemistry, Tennis Court Road, Cambridge.

THE first photographic lens interferometer, designed and made by Messrs. Adam Hilger, Ltd., and supplied to a British firm, is now installed at the Leicester works of Messrs. Taylor, Taylor and Hobson, Ltd., for the testing and control of their optical designs and products. The first problem which the research staff of the firm had to solve was to eliminate mechanical strains introduced by ordinary methods of mounting the component glasses. Such strains have been found in high-class anastigmats of all makes, and though slight in themselves, they introduce considerable want of symmetry in the interference patterns. The strains can be eliminated by a simple geometric mounting of the component lenses, for which Messrs. Taylor, Taylor and Hobson have applied for patent protection. The firm hopes to exhibit the system at the forthcoming Optical Convention.

MR. HERBERT SPENCER'S trustees are publishing through Messrs. Williams and Norgate, Ltd., an

addition to Herbert Spencer's "Descriptive Sociology." The work, which will deal with Ancient Egypt, has been written by Sir Flinders Petrie and will be issued at an early date.

AMONG the spring announcements of the Cambridge University Press are "Science and the Modern World," by Dr. A. N. Whitehead, which embodies a study of the mentality of successive epochs during the past three centuries in so far as it has been influenced by the development of science; "The Quantum Theory of the Atom," by G. Birtwistle, dealing with the evolution of the quantum theory from its inception by Planck down to the most recent work on the reaction of the atom to radiation fields; and "Population Problems of the Age of Malthus," by G. Talbot Griffith, being a study of economic conditions and their effect on the birth, marriage, and death rates at the time when Malthus wrote his "Essay on Population."

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: Inspectors under the Ministry of Agriculture and Fisheries for the purposes of the Diseases of Animals Acts, 1894 to 1925—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (February 15). A tutor and lecturer on methods of teaching science (especially physics and chemistry) at the London Day Training College—The Principal, London Day Training College, Southampton Row, W.C.1 (February 22, on Form H.2/1). A Vice-Principal of the Somerset Farm Institute, Cannington, near Bridgwater—The Principal (February 22). A senior lecturer in the department of logic and metaphysics of the University of Glasgow—The Secretary, University Court, the University, Glasgow (February 24). A secretary to the Royal Horticultural Society—The Treasurer, Royal Horticultural Society, Vincent Square, S.W.1 (February 27). A man to take charge of the A.I.D. Chemical and Physical Testing Laboratory at the R.A.F. Stores Depot, Kidbrooke, S.E.—The Secretary (S.2), Air Ministry, Adastral House, Kingsway, W.C.2.

Our Astronomical Column.

RECENT SUNSPOT AND MAGNETIC "STORM."—On January 26, the largest magnetic disturbance for five years was recorded by the magnetographs at the Royal Observatory, Greenwich. The disturbance commenced at 16½h., rose to a considerable maximum, and subsided soon after 5h. on the following morning. The greatest range shown during the disturbance by

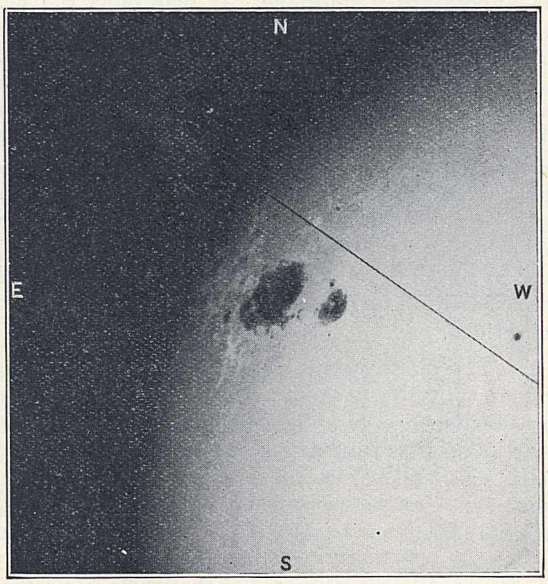

FIG. 1.

the magnetic needle recording magnetic Declination was one degree. The photographic traces of North Force and Vertical Force also showed considerable deflexions. Press telegrams announced a remarkable display of the aurora borealis seen from Norway and North America on the night of January 26.

At the time of commencement of the magnetic "storm," the great spot, which had been a prominent object on the sun's disc since January 18, was about 27° west of the central meridian. The spot was first seen from December 22 to January 3, when it was also of great size, but no disturbances of any consequence were recorded by the magnetographs during this period. Mr. J. Evershed, observing with his spectroscopic instruments at Ewhurst, Surrey, noted large disturbances in the chromosphere over the spot when seen close to the west limb on January 4 (R.A.S. report, *The Observatory*, February 1926).

The accompanying photograph (Fig. 1) was taken on January 20 at the Royal Observatory, Greenwich, and shows the large spot (latitude 22° N.) two days after its reappearance on the sun's disc. The spot is followed by bright faculæ in which a few scattered spots can be seen. Preceding the great spot by 9° of solar longitude is a smaller one, which has formed whilst this part of the sun was turned away from the earth. It is probably separate from the great spot disturbance, but the Mount Wilson polarity determinations will throw light on this point.

Details of position and area of the large spot will be found in NATURE of January 9 and 30.

PHOTOGRAPHIC STELLAR PHOTOMETRY.—The application of photography to stellar photometry has at present scarcely progressed beyond the experimental stage. Various methods have been used by different observers, and it is therefore of some interest to receive details of those in use at the Yerkes Observatory, as described by J. A. Parkhurst and Miss Farnsworth in the *Astrophysical Journal*, vol. 62, p. 179. The stellar images were taken in sharp focus, and were compared in a Hartmann microphotometer with an artificial scale of images, formed at equal intervals of about half a magnitude by giving a series of exposures, in logarithmic ratios, on a chosen star. The scale values were obtained independently on each plate by using coarse wire objective gratings, and comparing the first order spectra obtained in this manner with the central image. Both photographic and photovisual magnitudes were measured—the latter by using Cramer isochromatic plates with colour filters. The reduction to international magnitudes was effected either by means of duplicate exposures and comparison with stars of the North Polar Sequence, or indirectly by comparison with Harvard or Potsdam stars included on the same plate, reducing the latter magnitudes to photographic by correcting for colour index. The results of this work during 1914–1924, together with further details, are promised in a forthcoming publication of the Yerkes Observatory.

Research Items.

EARLY MAN IN RUSSIA.—In a recent number of the Russian *Anthropological Journal*, Prof. A. P. Pavlow, of Moscow, records the discovery of the fronto-parietal portion of two human skulls in a Pleistocene deposit near the village of Oundory, on the lower Volga. He describes them as in the same mineralised condition as the bones of the mammoth, woolly rhinoceros, reindeer, camel, and other Pleistocene mammals with which they were associated. A human humerus, in the same state of preservation, was found with them. The brow-ridges in the skulls are not strongly marked, and Prof. Pavlow concludes that the new specimens may be referred to the same race as the skulls from Combe-Capelle, Brünn, and probably Předmost. He thinks the much-discussed skull from Galley Hill may be placed with them.

A CEREMONIAL "MASK" FROM NEW GUINEA.—In *Man* for January, Mr. T. A. Joyce figures a remarkable ceremonial object of indeterminate use from the Sepik River. It is here called a mask, a similar object having been described by Otto Reiche ("Ergebnisse der Südsee Expedition 1908–10," vol. 2, Pt. 1, p. 401) as the earliest form of mask, but no details as to its use were given. The present example has been presented, with other objects, to the British Museum by Mr. Schreibner of Dutch New Guinea. It shows no attachments suitable for a human head such as would be necessary for a mask. It resembles a shield, long-oval in shape, and is composed of basket work, of coiled technique, supported by a stout rim of split bamboo, and has a kind of "backbone" consisting of a wooden stick fastened to the reverse surface in a longitudinal section. The face is plastered with clay in which the ornamentation is set. At the top is a human skull secured by cane lashings, ornamented with cowrie shells, and furnished with a long artificial nose, similarly decorated. Below the skull are semicircular rows of shells and pigs' tusks simulating a necklace. The rest of the surface is decorated with series of pigs' tusks, coix seeds, crocodile teeth, fragments of shell, and two broken bits of china. The rarity of ethnographical specimens from the Sepik River gives these objects an exceptional interest.

THE REGIME OF THE NILE.—In a large and well-illustrated monograph on the Lake Plateau Basin of the Nile (Ministry of Public Works, Egypt, Physical Dept. Paper No. 21), Dr. H. E. Hurst makes some interesting additions to our knowledge of the origin of Nile water. From December to May the White Nile is the main source of Nile water, contributing in April so much as 80 per cent. In flood time, however, the Blue Nile may contribute so much as 72 per cent. and the Atbara so much as 26 per cent. Of the two streams of the White Nile, the Bahr el Gebel is more important than the Sobat. From early April to the middle of July the former supplies 50 per cent. of Nile water. Taking into account the time of travel of the water, it appears that the period of low water at Aswan, mentioned above, corresponds with November 8 to February 25 at Mongalla in the Sudan. Gauge measurements have shown that the contribution of the lake sources during that time is about 94 per cent. of the discharge of the Bahr el Gebel. The corresponding time at the tail of the swamps and the Sobat mouth is February 22 to June 11, when the discharge from the swamps is 73 per cent. of the total White Nile discharge. At Khartoum, where the critical period begins about a month later, the White Nile contributes about the same percentage of the total discharge. Hence Dr. Hurst calculates that during the period of water shortage in Egypt, nearly 50 per cent. comes from the equatorial lakes. This gives them a somewhat greater value to Egypt than was formerly accepted.

MOLLUSCA FROM THE MOLUCCAS.—A "Report on a Collection of recent Shells from Obi and Halmahera (Moluccas)" and surrounding islands, by Dr. C. H. Oostingh, has been published by the Geological Institute of the Agricultural University, at Wageningen (Communications, No. 9). It is a bulky list of just on 300 species almost exclusively marine, without descriptions, but with ample and properly compiled synonymy (which is rare) and distribution for each. It is further accompanied by an excellent and full bibliography giving the most recent information as to the dates of publication of the more important works cited. Any one, therefore, working at the fauna of the region in question will find the work indispensable, whilst probably wishing that the little outline map of the Moluccas on p. 5 had been commensurate in value with the rest of the volume, and that an index to the genera had been added, since there is no hint given as to whose classification, if any one's, has been followed: it cannot be a very recent one since the pearl oyster has been left in the genus Pteria, from which it has long been removed.

CARIDEA IN THE INDIAN MUSEUM.—Dr. Stanley Kemp, in his concluding (seventeenth) note on Crustacea Decapoda in the Indian Museum (*Records Ind. Mus.*, vol. 27, Pt. iv., 1925), brings together observations on members of eight families of Caridea, and provides synoptic tables, where necessary, of the characters of the genera and species. In addition to matters of taxonomic interest, the author directs attention to the occurrence in females of the genus Leptochela of dimorphism correlated with the breeding season. All the females with a tricarinate carapace were found to be either ovigerous or to have just liberated their young. The females with smooth carapace were not ovigerous, and showed no sign that they had recently borne eggs. Dr. Kemp concludes that the female moults immediately before the extrusion of her ova, the carapace in the course of this moult developing longitudinal carinæ. After the eggs have hatched, another moult occurs and the carapace resumes its original smooth condition. Dimorphic females have been found in three species, and it is not unlikely that they occur throughout the genus. The occurrence of luminous organs in two shallow-water genera of Pandalidæ is noteworthy, as such organs have hitherto been known among Caridea in deep-sea species belonging to the family Hoplophoridæ. The discovery of a species of Palæmonetes in a lagoon and in a backwater in south India is interesting, as no member of this genus was known between Mesopotamia and the coasts of China. Dr. Kemp suggests that the marked discontinuity in the distribution of the genus is more apparent than real, for this is an inconspicuous animal which will no doubt be found in many additional localities.

THE ORIGIN OF THE BANANA IN AMERICA.—The question of the original home of the banana has given rise to much difference of opinion, though most botanists have assumed that it lay in the Indo-Malayan region. It has been suggested that the banana was introduced into America by way of the Canary Islands and Hayti about the year 1516. However, a few early writers, such as Humboldt, have pointed out that it was cultivated along the Orinoco

and Beni rivers by the aborigines at the time of their first exploration. There is, therefore, historical evidence that the banana was indigenous in America. Dr. E. W. Berry has now been able to throw fresh light on the problem by the identification and description of fossil banana seeds from Tertiary beds in Colombia (*Am. Journ. Sci.*, Dec. 1925). The exact horizon cannot as yet be stated, but Dr. Berry favours an Oligocene age. The independent cultivation of the banana by the natives of America long before the advent of Europeans thus appears to be proved, though it cannot yet be argued that South America was the actual region of origin.

PARASITISM OF THE DODDER.—At the present time when there is so much controversy on the rôle of xylem and phlœm in the transport of food in the plant, there is renewed interest in the method by which a total parasite like the dodder attaches itself to its host, as presumably this connexion must provide for the transport of food materials from host to parasite. Considerable interest therefore attaches to the conclusion reached by John Thomson (*Trans. of the Roy. Soc. of Edinburgh* 54, Part II. No. 5) that in the sucker of the dodder no phlœm whatever accompanies the xylem and penetrates into the host tissues. This conclusion is directly at variance with the earlier conclusions of Peirce and Thoday (Sykes) (*Annals of Botany* 1893 and 1911), but it is in complete agreement with a recent paper by Zender (Inst. de Botanique, Université de Genève, Series 10 Fasc. 8, 1924), and there seems little doubt that the earlier observers, who were not in agreement as to the position of the phlœm, were in error in reporting its presence. Thomson's further conclusion that the sucker makes little or no special attachment to the phlœm is surprising even for the one species he has examined, *Cuscuta reflexa* (Roxb.), in view of the very special haustorial-like attachments to the phlœm described and figured by Zender in other species; but continental work on the anatomy of Cuscuta is somewhat neglected in Thomson's paper, and in the absence of any comparison of technique and results by the latter author, it is difficult to reconcile the discrepancies between the two accounts of the union between parasite and host.

OXYGEN AND ROOT GROWTH.—*Publication No. 368* by the Carnegie Institution, upon the "Physiological Features of Roots," by William Austin Cannon, gives good reasons for introducing two new terms into the consideration of the oxygen relation of roots. The least oxygen partial pressure at which root growth is observed is termed the lower critical concentration and is valid only for a given species when growing at a given temperature; similarly an upper critical pressure is defined, which is the minimal oxygen pressure at which, at the given temperature, normal growth can take place. The oxygen demands of the root system increase very greatly with rising temperature, and while both these critical concentrations may be low for low temperature, at high temperatures the upper critical pressure in particular rises considerably. For many plants the range between upper and lower critical pressures may be very considerable, and represents a range, therefore, over which oxygen concentration is considerably limiting root activity. Whilst for some very aerobic root systems the higher critical concentration at high root temperatures may practically approximate to the normal oxygen content of the air, other root systems, like those of Salix and species of Baccharis, etc., may show a much lower upper critical concentration and continue to grow at very low oxygen concentration indeed. Another interesting feature of this monograph is a chapter contributed by Edward Elway Free upon experiments with small oxygen concentrations in which helium was used as an inert diluting gas to see if nitrogen could safely be treated as without action save as diluting the oxygen. At first experiments seemed to indicate that the nitrogen was more toxic than the helium to the root systems; this difference disappeared, however, when both gases were completely freed from oxygen, and it turned out that small oxygen concentrations seemed more readily available to the root system when the diluting gas was helium. This effect is traced with great possibility to the greater density of the nitrogen, which leads to the result that the small oxygen content is diffusing much more rapidly to the root surface through helium than through nitrogen.

MAGNETITE GARNET ROCKS FROM ADELIE LAND.—In the Scientific Reports of the Australian Antarctic Expedition (Series A, vol. 3, Geology, Pt. 5. Sydney, N.S.W.: Alfred James Kent, 1925. Price 2*s.*), A. L. Coulson describes a series of schists and gneisses collected from the glacial moraines of Cape Denison. The specimens are characterised by an abundance of either magnetite or garnet or both. About half of them—containing dominant magnetite—correspond closely with Grubenmann's Group XI. of the crystalline schists. Others, however, contain garnet and magnetite in roughly similar proportions, together with quartz, felspar, and biotite, and their chemical characters are widely different from those of any group of schists hitherto defined. It is suggested that these new types of garnet-magnetite rocks are probably derived from sediments the composition of which has been modified by igneous emanations. As the garnet is an aluminous variety, it seems probable that the original sediments were argillaceous, for in the analogous skarn-rocks of Scandinavia derived from limestones, the characteristic garnet is andradite. That igneous emanations have played an important part in the development of the series is further suggested by the occurrence of a specimen containing abundant tourmaline. This rock is also rich in cordierite containing well-formed pleochroic haloes, and its mineral assemblage indicates beyond doubt that it is a sedimentary derivative. The petrological history of the whole assemblage of specimens has been clearly and convincingly elucidated, and the report is a valuable contribution to our growing knowledge of Antarctica.

THE MEASUREMENT OF GEOLOGICAL TIME.—At the annual meeting of the Lake Superior Mining Institute on August 13 last, Prof. A. C. Lane presented the report of the Committee of the National Research Council on "The Measurement of Geological Age by Atomic Disintegration." Apart from the very careful work of Ellsworth in Canada, no very definite results have yet emerged, most of the active members being still engaged in developing methods. An example of one of the most promising of these is the concentration of the radioactive minerals, such as zircon and allanite, from a Palæozoic pegmatite near Boston. By a further concentration, allanite alone was separated, and its analysis by Ellsworth yielded a lead-ratio, $Pb/(U + 0{\cdot}354Th)$, of 0·043, a definitely Palæozoic ratio. Another new result is a ratio of 0·084 from an analysis of polycrase from Brazil by E. P. Henderson. This agrees fairly well with results on presumably late pre-Cambrian minerals from Central Africa and Ceylon. The Committee has in hand further work which will enable an age comparison between Keweenawan and pre-Huronian granites to be drawn. It is

pointed out that the most pressing needs are to test the hypothesis of Kirsch that thorium may be derived from "thorio-uranium," and to discover whether consistent lead-ratios can be obtained from minerals rich in thorium. The evidence at present available, and already discussed by Holmes and Lawson, does not support the Kirsch hypothesis, but suggests that thorium minerals tend to lose part of their lead just as all radioactive minerals necessarily lose part of their helium content. The Committee is to be congratulated on laying the foundations of this comprehensive research cautiously and securely. In its next report it should be able to clear up much of the present confusion of ideas due to the competition of conflicting hypotheses.

OPTICAL GLASS MANUFACTURE.—Interesting biographical details of Pierre Louis Guinand (1748–1824), who played an important part in the early development of the art of making optical glass, are given by M. Paul Ditisheim in the *Bulletin de la Société Astronomique de France*, April 1925. The advances in optical designing made by Moor Hall, by Dolland and by Ramsden had produced a demand for homogeneous pieces of flint glass of much larger size than had been previously required. The prolonged and laborious investigations of Guinand were largely responsible for enabling this demand eventually to be met. The methods he adopted are still considered essential in the present-day manufacture of optical glass. After developing his process at Les Brenets, in Switzerland, Guinand was engaged in 1805, by Reichenbach and Utzschneider, a firm of instrument-makers, to establish a glass factory at Benediktbeurn near Munich. Here he worked for just over eight years, producing glass for more than 5000 achromatic objectives. He worked in conjunction with Fraunhofer, whom he had instructed in the process of glass-making. Fraunhofer was put in charge of the works in 1811, and two years later Guinand returned to Les Brenets, where, with his son Aimé, he recommenced manufacture. In 1823 he placed at the disposal of the Astronomical Society of London a disk of flint glass of $7\frac{1}{4}$ in. diameter. This was worked and mounted by Tulley, a London optician, and its performance called forth unstinted praise from Dolland, John Herschel and other members of the Society. Guinand died in 1824. In 1828 his son Henri, in partnership with G. Bontemps and others, introduced his processes into France. In 1848 Bontemps entered the service of Messrs. Chance Brothers of Birmingham, who were thus enabled to compete with the French firms, and have since then uninterruptedly continued the manufacture of optical glass.

A PHOTOGRAPHIC SPECTROPHOTOMETER FOR THE ULTRA-VIOLET.—A method of measuring the rotatory power of liquids for ultra-violet rays is described by Messrs. A. Cotton and R. Descamps in the *Comptes rendus Acad. Sci. Paris*, Jan. 4. Light which has passed through the polariser, a trough containing the liquid and the analyser, along an axis *xx*, is deflected at right angles to this axis by a train of prisms. It falls on a photographic film bent into a cyclindrical form with *xx* as the axis of the cylinder, forming upon it a series of images of a short slit for the different ultra-violet lines of the mercury arc lamp employed for illumination. The analyser and the train of prisms are mounted together, so that they form a system which can be rotated about the *xx* axis. The light spots move over the photographic plate, which registers their intensities for different positions of the analyser, making it possible to determine the angle at which each of them is extinguished. In the instrument as constructed, the first prism of the train also acts as the analyser, being made of Iceland spar; the second prism is of quartz, and the necessary lenses and the trough walls are transparent to ultra-violet rays.

BLACK AND WHITE GLOBULAR LIGHTNING.—In the *Comptes rendus Acad. Sci. Paris*, Jan. 4, M. E. Mathias collects accounts of a number of cases where non-incandescent bodies were seen to explode, in some cases causing injury or death. These balls of globular lightning were black, white or grey, and in the opinion of the author were due to a ball of ordinary globular lightning, the incandescence of which was hidden by a mantle of cloud or smoke, which in some cases clung to the surface of the ball, and in others formed a torn mantle around it. It is suggested that this smoke was due to the actual burning by the incandescent mass of organic substances such as cellulose. In one case, described by Zurche and Margollé, a number of luminous balls, and also grey balls, were seen to emerge from a waterspout or "tornado" at d'Arsonval (Pas-de-Calais), both kinds exploding with a loud detonation, sending out pieces of branches which the tornado had torn from the trees. The clinging mantle sometimes formed is ascribed to electrostatic attraction between the incandescent centre and the surrounding smoke.

DETERIORATION OF ALUMINIUM ALLOYS.—From time to time Prof. Ernest Wilson has communicated to the British Association the results of exposure tests made at King's College, London, on a series of light aluminium alloys in the London atmosphere. The experiments, which have been in progress for twenty-four years, are now brought together in a paper published in the *Journal of the Institution of Electrical Engineers* (No. 347). Aluminium alone, or alloyed with copper or with copper and manganese, shows a steady deterioration in electrical conductivity throughout the period, whilst the alloys containing copper and nickel, copper and zinc, or copper, nickel and zinc, often show a decided increase in conductivity after periods varying from five to ten years. The specimens kept in the laboratory for control also exhibit a small increase, and this process may be accelerated in the exposed specimens, or possibly the differential corrosion may have the effect of removing some of the impurities. The alloys containing copper and nickel are remarkable for their permanence, some of them being almost as good mechanically as when new. A microscopical examination would perhaps throw light on the nature of the changes which affect the conductivity, there being evidently a change of an internal kind which is distinct from the diminution of conductivity due to corrosion.

CONDUCTIVITIES OF HYDROGEN AND POTASSIUM CHLORIDE.—The *Journal of the Chemical Society* for December contains an account of the electrical conductivities of hydrogen chloride and potassium chloride in water and water-acetone mixtures, by T. K. Brownson and F. M. Cray. The measurements were made with great care and the results are of importance, since accurate work in the region of non-aqueous solvents is not too abundant. A minimum conductivity (equivalent) with hydrochloric acid was found with solvent containing 85 per cent. of acetone, and a minimum equivalent conductivity of potassium chloride was found with solvent containing 40 per cent. by volume of water. The Ostwald dilution law does not hold fully in any acetone-water mixture investigated, but as the acetone content increases it gives values more nearly approaching a constant at all dilutions.

Annual Report of the Smithsonian Institution.

THE annual report of the Secretary of the Smithsonian Institution, which was submitted to the recent meeting of the Board of Regents, revealed a wide range of activities for the year. The scientific expeditions in which the Institution took part penetrated into many corners of the earth. After researches extending over six years, Dr. Walcott discovered fossils in the Lyell limestones of the Canadian Rockies which fixed the limestones as of Upper Cambrian age. In China the Institution's zoological collecting expedition under the auspices of Dr. W. L. Abbott collected 50 boxes of insects, birds, mammals and reptiles, in spite of the murderous Bolotsi aborigines who infest the Province of Szechwan. Another expedition in China, under the direction of Mr. C. W. Bishop of the Freer Gallery of Art, Smithsonian Institution, examined a number of large mounds, including two tombs of the Han Dynasty (206 B.C. to A.D. 221). The work brought to light Chinese cultural objects dating from prehistoric times to the Han period, including stone axes, jade chisels, chariot fittings, mirrors.

In Panama and Costa Rica the Smithsonian botanical expedition under Mr. Paul C. Standley collected material for a report on the plant life of these little-known areas. Mr. John L. Baer, Smithsonian anthropologist, lost his life while with the Marsh expedition in Panama.

The Bureau of American Ethnology, which grew out of Smithsonian work begun in 1850 and is still directed by the Institution, conducted a number of important researches among the American Indians. The aboriginal Indian culture is fast disappearing, and every effort is made by the Bureau to secure as much as possible of this ancient lore before it is lost for ever. The Chief of the Bureau, Dr. J. Walter Fewkes, brought to light some rare copper ornaments while excavating mounds near Muscle Shoals, Alabama, which will be submerged when the Wilson Dam is completed. Dr. Fewkes also directed repair work on the tower of the famous "Mummy Cave House" in Arizona, one of the finest examples of primitive architecture in the south-west. Mr. J. P. Harrington continued his work of excavation of the Burton Mound Indian village, Santa Barbara, California. Large collections have resulted from his work, and Mr. Harrington is preparing for publication a monograph on the archæology of this interesting region. Miss Frances Densmore continued her researches in Indian music; the original phonograph records by means of which she obtained these songs from the Indians are preserved by the Bureau.

The year has been a most important one in the researches carried on by the Astrophysical Observatory of the Institution. Four papers were published during the year which summarise the work of the Observatory during the past twenty years on the sun's radiation and its connexion with weather on the earth. Experimental forecasts based solely on the variations in the solar radiation have been continued for the City of New York. These are still largely experimental, and the staff of the Observatory is now engaged in revising the methods of measuring and recording the sun's radiation. The observatory station on Mt. Harqua Hala, Arizona, has been removed to Table Mountain, California, to obtain better atmospheric conditions.

The National Museum, another outgrowth of Smithsonian activities, which the Institution still directs, received during the year more than 350,000 new specimens. Among the most interesting of these were a series of slabs from the Grand Canyon containing a splendid series of fossil footprints; casts of certain of the famous finds of primitive man; and collections of California Indian baskets; insects from the late Colonel Thomas L. Casey, and mineral specimens, including axinite crystals, from Colonel Washington A. Roebling. The Fukushima Company of New York has loaned for exhibition to the Museum a crystal ball weighing 110 pounds and measuring 13¼ inches in diameter, which is said to be the largest of its kind known.

The attendance at the National Zoological Park again exceeded all previous records, the total reaching 2,518,265. Mr. Victor J. Evans made the outstanding gift of the year in a young male chimpanzee.

The report also directs attention to the urgent need of a suitable building to house the National Gallery of Art, which is now crowded in the National Museum to the detriment of the art and museum exhibitions. Congress has already provided a site in the Smithsonian park for a building, and through private subscription 10,000 dollars has been obtained for the preparation of preliminary plans.

The International Exchange Service, created by Secretary Joseph Henry, for the interchange of scientific and governmental documents with foreign nations and learned societies, handled during the year a total of 468,731 packages. A total of 2325 boxes of publications were sent to 64 foreign countries.

Owing to financial difficulties encountered by all international enterprises since the War, the International Catalogue of Scientific Literature, of which the Smithsonian administers the United States Regional Bureau, has not yet resumed publication of the seventeen annual volumes formerly published. Smithsonian publications reached a total of 155 volumes and pamphlets for the year. Of these the Institution proper published 68 items. The total of copies distributed reached 171,865.

In discussing his annual report, Dr. Walcott directed attention to the fact that the past year has marked a crisis in the financial affairs of the Institution. He pointed out the disparity between the extent and magnitude of the research and publishing activities of the Smithsonian Institution and its annual income of 65,000 dollars. Only 6000 dollars of this sum has been available for research and explorations, and the Institution has only been able to carry on the quantity of work done through the generosity of private individuals. In spite of this generosity, the Institution's publications have been reduced to a third of what they were before the War, and some series, such as the "Contributions to Knowledge," have been suspended altogether. Furthermore, the Institution has been unable to embark upon the larger projects in fundamental research which have been typical of its past history.

For these reasons the Institution has determined on several steps to increase its resources. One of these is to issue a series of popular scientific books to be known as the Smithsonian Scientific Series, similar in plan to the Chronicles of America series, issued by the Yale University Press. Another plan has been recently announced to the public in the nature of an appeal for an addition of 10,000,000 dollars to the Smithsonian's endowment. The decision to go before the American people has been made because of the fruitfulness of the original bequest of the Englishman, James Smithson, who founded the Smithsonian, because of the Institution's position as the pioneer of American research, because of the national scope of its activities and the national character of the benefits it confers in "the increase and diffusion of knowledge."

Research at the University of Sydney.

THE various centres engaged in productive scientific work are continually confronted with the problem of how best to bring the results to the notice of their colleagues. In chemical circles there seems to be a great effort made to confine publication, in the main, to certain well-known journals, to which all chemists will then naturally turn. So long as other channels exist for the chemical "cubist" to express himself in the possibility that he may be the conservative leader of the chemical theorists of the next generation, this is possibly a practical solution, at any rate for the countries where science is now well established.

Overseas universities and research centres frequently adopt the plan of issuing the work of their members, either as reprints from journals, or in local publications, and circulating this to other centres throughout the world with the view of receiving other publications in exchange. Such exchanges are probably growing in favour as a method of building up a library. The University of Sydney began thus to issue reprints in 1894, and in 1922 it much enlarged the scope of the scheme, deciding to issue these reprints in various sections dealing with different subjects. A number of these volumes has recently reached us, and though we cannot attempt a complete survey of their contents, we are glad to direct attention to a few of the valuable papers in them.

Series 6 is devoted to geological and geographical papers and vol. 1 includes twenty memoirs, by members of the staff and scholars of the University, mostly on the geology of New South Wales. The paper of most general interest is the lecture by Sir Edgeworth David on the antiquity of man in Australia, with special reference to the Tasmanians. He adopts the view that the Australians and Tasmanians come from different stocks, and in reference to the Talgai skull quotes Sir Arthur Keith's view that it is Tasmanian in affinity, though that view is not expressed in Sir Arthur Keith's last discussion of this skull. Prof. Griffith Taylor's presidential address to the Geographical and Historical section of the Australasian Association discusses the bearings of Australian geography on national problems, and adopts the conclusion that owing to the ethnologic superiority of the Chinese to the European, their entry and intermarriage with the Australians would improve the stock. Prof. Benson discusses the correlation of the Australian Carboniferous with the European, and remarks that the Burindi Series has some Viséan affinities. Prof. L. A. Cotton describes the Kurrajong earthquake of August 1919. Mr. W. R. Browne, in addition to a paper on igneous rocks in South Australia, gives a valuable account of the petrology of the country around the Broken Hill mining field. G. D. Osborne and W. R. Browne describe a beautiful glacially striated pavement of Carboniferous age in New South Wales.

The first volume of Series 9 (Medical Sciences—Non-clinical) of the "Sydney University Reprints" consists of a number of papers most of which have appeared in various publications such as the *Journal of Anatomy*, the *Australian Medical Journal*, and the like. One, dealing with the diet of the Australians, by Dr. H. S. Halcro Wardlaw, is an official publication of the New South Wales Board of Trade. Dr. Wardlaw has also reprinted here a valuable paper on the energy consumption of Australian students. Among these contributions to science by members of the University of Sydney, which range in date from 1921 to 1924, we welcome several by the late Dr. J. I. Hunter, whose premature death has been a great loss to science; these include a study of a Neanderthoid Australian skull, written in conjunction with Mr. A. St. N. Burkitt, and a further contribution to the controversy on the relation of the Piltdown jaw and cranium, in which he reviewed Dr. Hrdlička's conclusions, which were largely based upon a study of the teeth, and gave a brief forecast of the results of the reconstruction at which he and Elliot Smith had arrived in their joint study of the cranium. The paper on the Neanderthoid Australian skull mentioned above is worthy of special attention, as it is not so well known as it deserves. The skull was that of a female and showed a remarkable combination of primitive character in the cranium, combined with more delicate characters in the facial region, which was both orthognathic and leptorrhine. It had an enormous development of the supraciliary ridges, and glabella, a well-developed bregmatic eminence, and a marked development of the torus occipitalis. Added to these primitive features was an extremely low sloping forehead, while the maximum occipital point coincided with the inion. Certain features showed a resemblance to Pithecanthropus.

Vol. 1 of Series 12 (Social Science—Economics, Education, History, Philosophy, and Psychology) contains ten reprints, all short, varying from three to twenty-four pages, but there is no shame in brevity and these scholarly little articles are a valuable contribution to general philosophic and psychological knowledge. Among so many varied papers it is difficult to make a selection for special note. Some of the articles are more descriptive, others more constructive, and high in the first category comes Prof. E. E. Anderson's stimulating account of "The Present Religious Situation"—a careful consideration of the nature of religious development. Sir John Macpherson's analysis of "The Influences which cause Fluctuations in the Production of Insanity" shows the enormous complexity of the subject, and the need for careful scrutiny of seemingly accurate statistics, and Prof. B. Muscio shows his characteristic originality and freedom from scholastic bias in his thoughtful contribution on "The Meaning of Philosophy." These reprints bear the same relation to the usual scientific treatise that a magazine of short stories bears to a novel, and, like a magazine, the volume is pleasantly readable.

Vol. 1 of Series 13 consists of twenty-three papers published in various journals during the years 1920–1924 by workers in the Department of Zoology of the University of Sydney. The series includes the late Prof. W. A. Haswell's last two papers—on Astacocroton—a new type of acarid parasitic on the gills of crayfishes, and on the structure of the proboscis of the syllid worms, and two papers by Prof. L. Harrison on the breeding habits and the pigmentation of the eggs of some Australian frogs. Mr. E. A. Briggs, lecturer in zoology, contributes two papers, one of which describes in detail a new species of crawling medusa, and Miss E. E. Chase, demonstrator, gives an account of a new avian trematode. The two Macleay fellows of the Linnean Society of New South Wales, Miss M. Henry and Miss V. Irwin-Smith, are responsible for the remaining papers. Four by Miss Henry are contributions to a monograph of the fresh-water Entomostraca of New South Wales, and those by Miss Irwin-Smith are accounts of nematode worms, especially from lizards, and of the life-history of brachycerous Diptera. The Department of Zoology in Sydney has from its institution played a worthy part in scientific research, and the volume affords good evidence that no time

was lost after the conclusion of the War in resuming investigations.

Vol. 1 of Series 2 contains botanical papers published between 1921 and 1924. To the botanists in a new country falls the duty of widening our horizon as to botanical conditions, and these papers are valuable examples of such literature. They include ecological studies of Australian vegetation by Marjorie I. Collins, of mangrove and salt marsh vegetation and arid and semi-arid regions; studies of Australian parasitic flowering plants, and of Australian examples of symbiosis (mycorhiza and root-nodules) by J. M'Luckie, also notes upon the life-history and structure of Australian Phanerogams and ferns by Prof. Lawson, P. Brough, and Jessie Steele. M. M. Williams has a brief note upon interesting brown seaweeds, including the one apparent parasite in the group, *Notheia anomala*.

Series 11 covers mathematics, physics, and astronomy, and vol. 1 contains seven papers dealing mainly with physical questions. They show that the University is not restricting its research work to the industrial problems which arise in the colony, but is taking its part in the solution of scientific questions the interest of which is world wide. Mr. E. H. Booth deals with the ions produced in air which has bubbled through water, a process which bears on the problem of how the earth maintains its negative charge. Dr. G. Harker shows that the vapour arising from a boiling solution has a temperature higher than that from the pure solvent boiling under the same conditions. Prof. Carslaw solves a problem on the cooling of a sphere with a core and shows that in the Mathematical Tripos of 1904 the candidates were asked to prove something which was untrue, while a paper by the late Prof. Pollock gives an interesting account of the physics of the stethoscope.

Vol. 1 of Series 3 is a collection of papers published in the various chemical journals by workers in the chemistry departments of the University. These show that research work is being actively prosecuted. Physical chemistry measurements include those of the molecular solution volumes of various organic substances in ethyl alcohol, which show that several of the solutes are associated in the liquid state; the development of the miscibility tests for eucalyptus oils in which the oils are added to methyl alcohol-water mixtures and the critical solution temperatures determined; the decrease in the values of the reaction constant in the decomposition of hydrogen peroxide by colloidal platinum when different concentrations of protective colloids are added, and the action of soaps as protective colloids for gold hydrosols, in which it is shown that although the stabilisation is very pronounced the coagulating influence of the sodium ion of the lower soaps begins to outweigh the protective action. A number of the reprints deal with organic chemistry: the preparation of organic compounds of arsenic of the type $R_1R_2R_3As$, $RAsI_2$ where R_1R_2, etc., indicate similar or dissimilar alkyl or aryl groups; studies in the formation of ring compounds by condensation of aromatic amines and diketones, etc.; researches on the phellandrenes and a number of contributions to the chemistry of piperitone. In addition, investigations have been carried out on the active principle of trees of the kind to which belong the dreaded "ordeal" or "doom tree" of the African pygmies.

Voltaire and Medicine.

IN the second part[1] of his paper on "Voltaire and Medicine," read before the Section of the History of Medicine of the Royal Society of Medicine on December 16, the president, Dr. J. D. Rolleston, gave some account of Voltaire's allusions to anatomy and physiology, his advocacy of inoculation against small-pox, and his interest in the history and ravages of syphilis, a knowledge of which he had derived from Astruc's work on venereal diseases. He also referred to the attention paid by Voltaire to other matters connected with public health, his acquaintance with medical jurisprudence and particularly his sceptical attitude toward historical cases of poisoning, in many of which he showed that death was more probably due to some acute infection, and his remarks on various diseases of social importance, such as mental disorders, convulsive hysteria at the tombs of saints and ecclesiastics, alcoholism and the King's evil.

Several passages in his works show that Voltaire had paid some attention to anatomy. He commences his article on "Man" in the "Dictionnaire Philosophique" by saying that in order to learn the physical aspects of the human race, one must study works of anatomy or the article of M. Venel in the "Dictionnaire Encyclopédique," or rather follow a course of anatomy. In his article on "Anatomy" in the same work, he remarks that "Ancient anatomy bears to modern anatomy the same relation that the rough geographical charts of the sixteenth century do to the topographical maps of to-day." In the "Histoire du Docteur Akakia" Maupertuis is condemned for his advice to neglect anatomy. Voltaire, however, fully realised that much was yet learned in human anatomy. In Chap. 35, entitled "Incertitudes en Anatomie" of the essay "Des singularités de la nature," he exclaims, "In spite of all the help that the microscope has given anatomy, and in spite of the great discoveries of so many skilful surgeons and physicians, what interminable discussions have arisen, and in what uncertainty we still remain!"

Although physiology was still in its infancy in the eighteenth century, Voltaire seems to have been well abreast of the knowledge of his time. In the "Dictionnaire Philosophique" he alludes to the uncertainties current in connexion with circulation, digestion, generation, and muscular tonicity, and refers to the pioneer work of Borelli, Keil and Jurin in cardiac physiology. He exposes the errors of Descartes regarding digestion and circulation, and heaps ridicule on the casuist Sanchez and the philosopher Maupertuis for their extraordinary views on generation and embryology.

Voltaire's interest in public health was shown not only by his desire to control small-pox by inoculation, and syphilis by a league of nations to combat the disease—a project not realised until the formation of the Union internationale contre le péril vénérien in 1923—but also by his allusion to other epidemic diseases, especially plague and malaria, and his condemnation of the insanitary condition of the Paris hospitals, in which overcrowding and cross infection were rife. He also showed his concern for public health in his references to the abuses connected with the administration of military hospitals, the congested state of the Paris cemeteries and the practice of burial in churches, as well as by his proposal to found maternity hospitals for unmarried women.

[1] See NATURE, December 19, 1925, p. 919.

University and Educational Intelligence.

CAMBRIDGE.—Plans have been prepared for the proposed building which is to house the Departments of Pathology and Animal Pathology. These are now exhibited. It is laid down that the total cost of designing, building, maintaining, and equipping the structure shall not exceed the sum of 115,000*l.*, which is being provided by the Rockefeller Trustees (100,000*l.*) and the Development Commissioners (15,000*l.*). The proposed site is in the south-west corner of the area purchased from Downing College for the erection of the science schools.

DURHAM.—The Council of Armstrong College, Newcastle-on-Tyne, conferred the honorary title of reader in Genetic on Dr. J. W. H. Harrison, lecturer in zoology.

Mr. J. F. Duff has been appointed lecturer in education in succession to Mr. W. O. Brigstocke, who has received a similar appointment in the University of Liverpool. Dr. T. Iredale has been appointed lecturer in chemistry, in succession to Dr. V. G. Jolly, who has gone to an industrial post. Dr. Iredale is an Australian, and a graduate of the Universities of Sydney and London. Since 1921, when he first came to England, he has been carrying out research and demonstrating in chemistry in University College, London.

EDINBURGH.—Intimation has been received that His Majesty in Council has approved of Ordinance No. 142, Edinburgh No. 47 (Foundation of the Abercromby chair of archæology).

At a meeting on January 25, the Court agreed to take steps to commemorate in a suitable manner the two-hundredth anniversary of the institution of the Faculty of Medicine of the University, which will occur in the course of the present year.

Dr. and Mrs. Inglis Clark have presented to the Department of Chemistry a valuable quartz spectrograph and appurtenances in memory of their son Charles Inglis Clark, B.Sc., of the University of Edinburgh, who was killed in the War.

LONDON.—The following doctorates have been conferred: *D.Sc.* (*Botany*), on Miss V. M. Grubb (Bedford and Westfield Colleges) for a thesis entitled "The Spermatia of the Florideæ"; *D.Sc.* (Chemistry) on Mr. E. de B. Barnett (University College) for a thesis entitled "Action of Nitrogen Dioxide on Anthracene Derivatives and the Bearing on the Mechanism of Nuclear Substitution"; *D.Sc.* (*Chemistry*), on Mr. H. Phillips (Battersea Polytechnic) for a thesis entitled "The Optical Properties of *n*-Alkyl *p*-Toluenesulphinates"; *D.Sc.* (*Physics*), on Mr. E. P. Metcalfe (University College) for a thesis entitled "(1) On the Selective Absorption of Light by Luminous Gases and certain Consequences resulting therefrom, and (2) On Ionisation in various Gases"; *D.Sc.* (*Psychology*), on Mr. E. H. Magson (University College) for a thesis entitled "How we Judge Intelligence"; *D.Sc.* (*Cytology*), on Mr. R. J. Ludford for a thesis entitled "Studies in Normal and Pathological Cytology," and other papers.

Applications are invited for the Graham scholarship in pathology, value 300*l.* per year and tenable for two years. The latest date for the receipt of applications is February 28. Particulars can be obtained from the Academic Registrar, South Kensington, S.W.7.

MANCHESTER.—On January 20 Mr. W. H. Moberly, the Vice-Chancellor elect, was entertained at dinner by the teaching staff. More than a hundred members from all Faculties attended the dinner, which was held in the Refectory and was organised by the Association of University Teachers. The president, Prof. W. M. Calder, welcomed Mr. Moberly in a happy and informal speech, and the Vice-Chancellor elect in reply spoke of his pleasure at the reception he had received.

This function brought home to members of the University the fact that in a few short months Sir Henry Miers will be leaving, and the Faculty of Science will see his departure with great regret. The Science Departments are grateful to him as professor of crystallography for the active and invaluable department which he created. He has stimulated great interest in his subject, and graduate students have attended his lectures and laboratory with enthusiasm. The Departments of Physics, Chemistry, and Metallurgy owe much to his work, and it is hoped that it will be found possible to continue the department in some form.

Losses from death have been unusually heavy. Mr. James Grant, Dr. Edmund Knecht and Prof. William Myers of the Faculty of Technology, and Mr. C. B. Dewhurst, Clifton lecturer in engineering, all passed away last term, to the great sorrow of the University.

Dr. Henry Stephen, lecturer in chemistry, is leaving to take up the post of professor of organic chemistry at the University of the Witwatersrand, Johannesburg. Dr. G. N. Burkhardt has been appointed lecturer in chemistry.

Prof. F. E. Weiss, Harrison professor of botany in the University, has been elected an honorary member of the Botanical Society of Geneva.

APPLICATIONS are invited by the Battersea Polytechnic for Tate and Morgan scholarships in engineering, science, domestic science, hygiene, and art for the session 1926–27. The scholarships vary in value from 20*l.* to 30*l.* per annum with free tuition, and are tenable for two or three years. The latest day of entry is April 17 next. Full particulars are obtainable from the Principal.

AT the present time seventeen Ramsay Memorial Fellowships in chemical science are being held in the universities and colleges of the United Kingdom. The list of awards for the present session, with the institution selected by the fellow for his research, is as follows: *British Fellowships*, Mr. George A. Elliott (University College, London), Dr. H. Raymond Ing (Oxford), Dr. S. W. Saunders (University College, London); *Glasgow Fellowships*, Mr. James D. Fulton (since resigned), Mr. T. Corlett Mitchell (Cambridge); *Canadian Fellowship*, Dr. Donald McKay Morrison (Cambridge); *Danish Fellowship*, Mr. Kai J. Pedersen (Bristol); *Dutch Fellowship*, Mr. W. G. Burgers (Royal Institution, London); *French Fellowship*, M. Marcel Mathieu (Royal Institution, London); *Greek Fellowship*, Dr. N. Ekonomopoulos (University College, London); *Italian Fellowship*, Dr. Paolo Misciattelli (Oxford); *Japanese Fellowship*, Dr. Seisi Takagi (University College, London); *Norwegian Fellowship*, Mr. Leif Lindemann, 1924–25 (Sheffield), Mr. Karl Sandved (Imperial College of Science and Technology, London); *Spanish Fellowship*, Senor Fernando Calvet (Oxford); *Swedish Fellowship*, Mr. Erik Rudberg, 1924–25 (King's College, London), Mr. Gunnar Hagg (commencement of work deferred until October 1926); *Swiss Fellowship* (vacant during 1925–26). The total value of the annual amount of the fellowships that is awarded is approximately 460*l.*, of which about 310*l.* is provided by grants from dominion and foreign sources.

Contemporary Birthdays.

February 1, 1843. Sir John Isaac Thornycroft, F.R.S.
February 5, 1866. Sir Arthur Keith, F.R.S.
February 6, 1860. Sir Archibald Denny, Bart., M.Inst.C.E.
February 6, 1835. Rev. Thomas R. R. Stebbing, F.R.S.
February 6, 1852. Dr. Conwy Lloyd Morgan, F.R.S.
February 7, 1877. Prof. Godfrey H. Hardy, F.R.S.
February 7, 1840. General Sir Charles Warren, G.C.M.G., F.R.S.
February 8, 1868. Lord Rothschild, F.R.S.
February 8, 1872. Sir Max Muspratt, Bart., M.Inst.C.E.
February 9, 1860. Sir Hugh Reid, Bart, M.Inst.C.E.
February 9, 1871. Prof. Edward C. C. Baly, C.B.E., F.R.S.

Sir JOHN I. THORNYCROFT, naval architect and engineer, son of Thomas and Mary Thornycroft, both of whom were sculptors, was born at Rome. He was educated at a private school and at the University of Glasgow, coming there under the guidance of Sir William Thomson (Lord Kelvin) and Prof. Rankine. Setting up in business he founded the world-known firm established at Chiswick. Early in his career he designed and built the steam launch *Nautilus*, which proved a complete success. The *Lightning*, the first torpedo boat for the British Navy, was built at Chiswick; it was a pioneer in the design and construction of high-speed craft. Sir John also founded the extensive motor works located at Basingstoke. Here large numbers of motor lorries were constructed for war service, as well as high-speed motor boats.

Sir ARTHUR KEITH, Hunterian professor in the Royal College of Surgeons, was born at Old Machar, Aberdeen. He was educated at Aberdeen, University College, London, and Leipzig. Author of many illuminating and critical contributions to anthropology, he was president of the Royal Anthropological Institute, 1912–14. A lecturer of distinction, Sir Arthur gave a noteworthy discourse before the Royal Society of Medicine in November last, on "The Nature of Man's Structural Imperfections."

Sir ARCHIBALD DENNY, shipbuilder and marine engineer, of the firm of Messrs. William Denny, Bros., Ltd., Dumbarton, was educated, in the first instance at Dumbarton Academy, afterwards in Switzerland, later entering the Royal Naval College, Greenwich. It may be recalled that in 1877 the British Admiralty sanctioned the admission of one young constructive officer of the Imperial Japanese Navy as a student of naval architecture for two years at the Greenwich College. In 1879 a student of marine engineering was similarly sanctioned. Denny was at the College in 1879 with the first of these students—one Miyabara, who afterwards became an Admiral.

Rev. THOMAS R. R. STEBBING, the distinguished zoologist, who celebrates his ninety-first birthday this week, and to whom we proffer our heartiest congratulations, is a Londoner, the fourth son of the Rev. Dr Henry Stebbing, F.R.S., who was acting editor of the *Athenæum* for many years after its foundation in 1828. Thomas Stebbing was educated at King's College School, London, and the University of Oxford. He was a tutor of Worcester College, Oxford, 1865–67, becoming an honorary fellow in 1908. Mr. Stebbing's zoological work has been concerned principally with the Crustacea. He carried to completion a monumental report upon the Amphipoda of the *Challenger* Expedition.

Dr. LLOYD MORGAN, emeritus professor of psychology in the University of Bristol, was born in London. Educated at the Royal Grammar School, Guildford, he passed into the Royal College of Science, London. For a number of years he was a science lecturer in an institution in South Africa, returning in 1884 to take up the professorship of zoology and geology in University College, Bristol. Many interesting studies in biology and psychology have proceeded from his facile pen.

Prof. G. H. HARDY is Savilian professor of geometry in the University of Oxford (since 1919). Educated at Winchester, he graduated at Trinity College, Cambridge. He was Cayley Lecturer in the University, 1914–19. Prof. Hardy's recently delivered address as retiring president of the Mathematical Association, with its plea for the abolition of the Mathematical Tripos, has attracted considerable attention. He is a Royal medallist of the Royal Society.

General Sir CHARLES WARREN celebrates his eighty-sixth birthday on Sunday, and we tender our very hearty congratulations. Educated at Cheltenham College, he passed into Sandhurst and Woolwich, entering the Royal Engineers in 1857. From 1867 to 1870 he conducted a series of excavations in Palestine, chiefly round the walls of the enclosure of the Temple of Jerusalem. The results of these early archæological studies were detailed in "Underground Jerusalem" (1876); "The Temple of the Tomb" (1880); and, in conjunction with Capt. Conder, "Jerusalem" (1884). Special Commissioner to settle the boundary of the Orange Free State (1876), he was deputed, in the following year, to arrange the land question which affected West Griqualand. Returning to England in 1880 he became instructor of surveying at Chatham. Sir Charles Warren's active military services are, of course, well known. They refer to Zululand, Bechuanaland, and Suakim.

Lord ROTHSCHILD has been for many years a trustee of the British Museum. Born in London, he was educated at Bonn and Magdalene College, Cambridge. Author of numerous works in zoology, Lord Rothschild has brought together large and valuable collections, which receive ample display and elucidation in his beautiful museum at Tring.

Sir MAX MUSPRATT is well known in fields of industrial chemistry. Born at Liverpool, he was educated at Hemel Hempstead, Clifton College, and abroad. He entered the works of the United Alkali Co. in 1895, of which combine he has been successively director and chairman. Vice-president of the Federation of British Industries, he is chairman of the Association of British Chemical Manufacturers. Sir Max was Lord Mayor of Liverpool in 1917.

Sir HUGH REID was born at Manchester. He was educated at the City High School, and graduated at the University of Glasgow. Managing Director of the North British Locomotive Co., Ltd., he is joint inventor of the Reid-Ramsay steam turbine electric locomotive. During the War he was a member of the Glasgow and West of Scotland Munitions Committee of Management. In 1917 he received the freedom of the City of Glasgow.

Prof. EDWARD C. C. BALY was educated at Templegrove School, Aldenham, and University College, London. From 1908 until 1910, he was assistant professor of chemistry and lecturer in spectroscopy at University College, leaving to become Grant professor of inorganic chemistry in the University of Liverpool.

Societies and Academies.

LONDON.

Royal Society, January 28.—A. C. **Seward**: The Cretaceous plant-bearing rocks of Western Greenland. The paper deals briefly with the geology of the localities visited, and, more fully, with the plants collected on the coasts of the Nûgssuak Peninsula and on the south-east coast of Disko Island. The fossils obtained include many species previously described by Heer. The Cretaceous plants are regarded as a single flora; Heer's threefold division (Kome, Atane, and Patoot series) is not accepted. Several species of ferns and gymnosperms, generally characteristic of the oldest Cretaceous floras and closely allied to Jurassic types, are found associated with representatives of Angiosperms that are strikingly modern. The Greenland Cretaceous flora seems to be Wealden-Cenomanian in age. It is considered that several deciduous dicotyledons were evolved in Arctic regions, where, in Cretaceous days as now, a short summer with continuous sunshine alternated with a long period of semi-darkness. From their Arctic home the flowering plants spread to the south.—W. L. **Balls** and H. A. **Hancock**: Measurements of the reversing spiral in cotton hairs. The spirals in the cell wall of cotton hairs may be dexter or sinister, and their reversals are apparently predetermined during growth in length. Genetic and ordinary environmental influences do not affect the statistical peculiarities of the reversals. The final adult length of the hair and the time taken in reaching that length do affect the reversal distribution. Nearly all the seed hairs of Gossypium begin to grow on a sinistral spiral. The angle of the helix varies around two modal values, but local variations are quite unaffected by inversion from dexter to sinister.—R. H. **Burne**: A contribution to the anatomy of the ductless glands and the lymphatic system of the angler fish (*Lophius Piscatorius*). The thymus body lies free beneath the mucous membrane of the pharynx, connected with the branchial cavity by a tube. This tube is not a duct, but more nearly resembles the crypts characteristic of the mammalian tonsil. The thyroid body is occupied by a large lymph sinus, into which lymph passes through valved openings from ventral and branchial lymphatics, and from which it is conveyed to the heart by the inferior jugular. Distributed to the mucous membrane of mouth and pharynx, and to the skin of the forepart of the body, is a system of "fine" vessels, similar in structure to small arteries. These vessels are not part of the blood vascular system, but connect by their terminal branches with the ordinary lymphatics. They are probably an afferent system of lymphatics.—I. **Gordon**: The development of the calcareous test of *Echinus miliaris*. All elements of the permanent skeleton which are laid down in the larva are traced back to a single spherical granule. This granule, with two exceptions, becomes a triradiate spicule even in the formation of a tetraradiate spine. The exceptions are in the development of (*a*) the base of a typical echinoid spine where it becomes hexagonal (a modification of the triradiate symmetry), and (*b*) the component parts of a tooth. The development of the tetraradiate spine, the simple and the compound tube-feet discs, and the blade of a pedicellaria is new. The large buccal plates arise interradially, and there are two sets of buccal tube-feet—(*a*) five primary ones with simple discs; (*b*) five secondary ones with compound discs, which are at first ordinary ambulatory tube-feet.—F. G. **Gregory** and L. **Batten**: A critical statistical study of experimental data on the effect of minute electric currents on the growth rate of the coleoptile of barley. A statistical analysis has been made of the data on which results described by Blackman, Legg, and Gregory for the effect of electrification on the growth of the coleoptiles of barley are based. Corrected data for the controls and four electrified sets show *positive* results, and, taken together, provide markedly significant evidence of the physiological effect of the discharge.—H. M. **Fox**: Chlorocruorin: a pigment allied to hæmoglobin. Chlorocruorin is a polychæte blood pigment. It is red in concentrated, green in dilute, solution. It exists in oxidised and reduced forms, having spectra analogous to oxy- and reduced hæmoglobin. The oxygen affinity is less than that of hæmoglobin. Specific chlorocruorins differ in oxygen affinities; some are unsaturated at atmospheric pressure. Whereas hæmoglobin and a number of related pigments all contain the same hæmatin nucleus, chlorocruorin has a different hæmatin.

Geological Society, January 6.—W. N. **Edwards**: Fossil plants from the Nubian sandstone of Eastern Darfur. The plant-remains described were found by Mr. G. V. Colchester at Jebel Dirra, 75 kilometres east of El Fasher, in Darfur. They occur in highly silicified quartzitic sandstone, belonging to the Nubian Sandstone, and are the first fossils to be found in that formation in Darfur. The species identified, which probably grew in dune conditions, are *Weichselia reticulata* (Stokes and Webb), *Frenelopsis hoheneggeri* (Ettingshausen), *Dadoxylon ægyptiacum* Unger, and indeterminable fern-fragments. The beds in which they occur are thus assigned to the Lower Cretaceous, or possibly to the base of the Upper Cretaceous.—Vincent G. **Glenday** and John **Parkinson**: The geology of the Suk Hills (Kenya Colony). The Suk Hills lie in the northern part of Kenya Colony, midway between Mount Elgon and the southern half of Lake Rudolf. Sekerr, their highest point, reaches an elevation of nearly 11,000 feet. With insignificant exceptions, the rocks are of Eozoic age, and fall into two groups: a series of completely metamorphosed sediments, probably including ashes, and microcline-orthogneisses. The former group so closely resembles the Turoka series from the border of Tanganyika Territory that they cannot be separated, the whole being contemporaneous in general terms. The second group seems to be intrusive into the first.

PARIS.

Academy of Sciences, December 7.—A. **Lacroix** and Const. A. **Kténas**: The modern lavas of Fouqué Kameni (Santorin). A comparison of the complete analyses of lavas of different dates (1925, 1869, 1866, 1846) shows that the composition has remained almost unchanged.—André **Blondel**: The mechanics of the resonance of torsion of crank shafts.—M. Kamerlingh Onnes was elected a foreign associate in succession to the late Sir Archibald Geikie, and R. A. Millikan was elected correspondent for the section of physics in succession to the late Sir James Dewar.—— de **Séguier**: The divisors of the finite direct Abelian products.—— **Fatou**: A property of certain multiform analytical functions.—Armand de **Gramont**: A precision inverter permitting no articulated system.—R. **Chambaud**: The theory of thick circular arches.—D. **Riabouchinsky**: Some cases of irrotational movements in three dimensions.—Thomas Martin **Lowry** and Bawa Kartar **Singh**: The rotatory dispersion of nicotine. The results are given for three specimens of nicotine for 27 wave-lengths. The dispersion of nicotine was found to be simple.—Jean **Barbaudy**: The dehydration of aqueous alcohol by fractional

distillation in the presence of benzene.—A. **Boutaric** and Mme. Y. **Manière**: The influence of the hydrogen ion concentration on the velocity of flocculation of some negative colloids.—P. **Vaillant**: The influence of an electrostatic charge on the superficial conductivity of a plate of rock salt.—P. **Lebeau** and A. **Damiens**: An easy method for the preparation of fluorine. As electrolyte the compound KF . 3HF, melting at 56° C., is used. This is placed in a copper or nickel vessel, forming the negative electrode, the positive electrode being a nickel rod 8 mm. in diameter.—Marcel **Godchot** and Pierre **Bedos**: Monochlor-*o*-methylcyclohexanone.—I. **Pouget** and D. **Chouchak**: The radioactivity of the mineral waters of Hammam Meskoutine (Algeria).—N. A. **Critikos**: The seismic phenomena produced before and after the eruption of the volcano of Santorin.—M. **Bridel** and C. **Charaux**: The ferment extracted from the seeds of various species of Rhamnus or rhamnodiastase. Details are given for preparing this ferment from the seeds of *Rhamnus utilis*. It is of interest in that it produces a partial hydrolysis of glucosides, some of the glucoses remaining combined in the form of complex glucides.—Mme. H. **Gauthier-Lièvre**: Some observations on the algæ of Algeria in their relations with the *p*H.—L. **Plantefol**: The forms of growth of *Hypnum triquetrum*.—Raymond **Jacquot** and André **Mayer**: The equilibrium of the cellular constituents and the intensity of the oxidations of the cell. Imbibition and oxidations. The case of seeds.—René **Hazard** and L. J. **Mercier**: The action of the base tropine (tropanol) on the circulation.—P. **Reiss**: The development of the interior *p*H of the egg of the sea-urchin during fecundation and division.—Jules **Wolff** and Lucien **Grandchamp**: Some observations on the oxidisability of the iron contained in wine. The ferrous salts normally present in wine may be rapidly transformed into ferric salts under the influence of an oxydase, thus causing the phenomenon of *casse*.—L. C. **Maillard** and H. **Wunschendorff**: The formation of complexes between proteins and the hydrates of trivalent metals. The method of removing albumen by alums.—L. **Fournier** and P. **Mollaret**: The double hyposulphite of gold and sodium in the treatment of syphilis. The antisyphilitic action of this double salt is fairly energetic in large doses, but the general reactions and frequent skin troubles produced by the treatment present a serious obstacle to the use of this product in the treatment of human syphilis.—Stefan **Jellinek**: Death by electricity, practical results resulting from electropathological studies.

December 21.—L. **Lecornu**: Elastic transmissions. Reply to some criticisms by A. Blondel.—Maurice **Hamy**: The photography of stars in full daylight. An account of some results obtained by a method described in a previous communication. Photographs were taken at varying levels up to a maximum of 3274 metres. At this height, about midday, the extreme limit of photographic impression visible on the negatives, at 90° from the sun, was about the 6·5 magnitude.—A. **Desgrez** and J. **Meunier**: The mineral elements associated with oxyhæmoglobin from the blood of the horse. The metals were detected and roughly determined by the spectrograph. On the product from the first crystallisation, the hæmoglobin contains potassium, sodium, calcium, lithium, and minute traces of manganese. The second crystallisation reduces the marked preponderance of potassium without sensible variation of the calcium.—Félix **Mesnil**: The sensibility of trypanosomes of human origin to normal human serum.—Maurice de **Broglie** and Jean **Thibaud**: The total reflection and variation of the refractive index of the X-rays in the neighbourhood of an absorption discontinuity of the mirror. The measured values for the refractive index agreed within the limits of the experimental error with those calculated by the theory of Drude from the dispersion of electromagnetic waves. Thus the optical properties of the X-rays are identical with those of ordinary light and follow the same laws. This supports the undulatory character of the X-radiations, whilst their photo-electric phenomena bring out their corpuscular or quantic aspect.—Amé **Pictet** and Alfred **Georg**: New syntheses of isomaltose and gentiobose. Lævoglucosane is readily converted into dilævoglucosane, and the latter, by regulated hydrolysis with hydrochloric acid, gives a mixture of glucose and isomaltose. In the preparation of isomaltose by the condensation of glucose according to Fischer's method, there is formed a small quantity of gentiobiose.—E. **Mathias**: Contribution to the study of fulminating material: thermic heterogeneities. Discussion of the nature of ball lightning.—C. **Sauvageau**: The *bromuques* of Antithamnion. In a recent communication the author has indicated the presence of free bromine in the colourless refractive cells of *Antithamnionella sarniensis*, and has proposed the name of *bromuques* for these organs. Five species of Antithamnion, dried and pressed, have also been found to give the bromine reaction. Hence the *Blasenzellen* or gland-cells of Antithamnion act as organs for accumulating bromine.—René **Garnier**: A new method for solving the problem of Riemann.—Paul **Lévy**: The ratio between an integral series and its greatest term.—J. **Renaux**: A method of special perturbations.—Jean **Chazy**: The advance of the perhelion of Mercury.—Th. **Vautier**: The propagation of air waves produced by sparks or by percussion caps.—Mlle. Paule **Collet**: The constant paramagnetism of solutions: The atomic coefficient of magnetisation of chromium, whether deduced by the ascension method from a solution of potassium bichromate or from the attraction method using the solid salt, is the same.—Hippolyte **Copaux** and André **Copaux**: A method of estimating coloured gases, based on the use of the photo-electric cell, and its application to the case of nitrous vapours. The light, after passing through a column of the gas, falls on a photo-electric cell, and the deflexions of the galvanometer are plotted against the percentage of nitrogen peroxide. With gases containing between 0·2 and 0·7 per cent. of nitrogen peroxide, the latter can be determined with an accuracy of 0·02 per cent.—René **Dubrisay**: The application of capillary measurements to the study of mixtures of fatty acids. Measurement of the surface tension at the surface of separation of benzene solutions of mixtures of fatty acids and their alkaline aqueous solutions is shown to be a useful means of identifying certain acids and their mixtures.—A. **Kling** and A. **Lassieur**: The hydrogen exponent of water. In view of the fact that recent values for the *p*H of water range from 5·8 to 7·0, the authors have redetermined this constant with many precautions (distillations in platinum, no access of air containing carbon dioxide, etc.), finding for pure water *p*H = 5·8. This deviation from neutrality (*p*H = 7·07) may be attributed to the fact that water has a real acidity, or it may be that the current methods of measuring *p*H are faulty.—J. **Cournot** and K. **Sasagawa**: The variation with temperature of the resistance of ordinary mild and hard steels to shock by traction.—C. **Matignon** and J. **Cathala**: The action of phosgene upon glucina. The preparation of beryllium chloride. The use of sulphur chloride for the preparation of anhydrous beryllium chloride, on account of the difficulty of separating the sulphur chloride, leads to

an impure product. Carbonyl chloride, now a commercial product, gives good yields of anhydrous beryllium chloride, when passed over beryllium oxide heated to 1000° C. in quartz vessels.—A. **Raynaud**: The bromination of zinc in the presence of various organic solvents.—A. **Cornillot**: The constitution of the chloro-derivatives of the phthalonic series.—Jacques **Bourcart** and M. E. **Denaeyer**: The lithological characters of the lavas of Ahaggar, Central Sahara (Jacques Bourcart expedition, 1922–1923).—R. **Furon**: Geological observations on the Kabul valley (Afghanistan).—Ch. **Maurain** and L. **Eblé**: The propagation of seismic waves in limestone.—Jean **Lecarme**: The ultra-violet radiations of the sun at great altitudes. Using a method of measuring the intensity of the ultra-violet radiations depending on the decomposition of oxalic acid in the presence of uranyl sulphate as a catalyst, measurements have been carried out at various altitudes, the highest being at the Mont Blanc Observatory (4350 metres). It was noted during these experiments that whilst the solar radiation produced a rapid decomposition of the oxalic acid, the effects due to the light of the mercury arc were scarcely sensible. From this it would appear that the solar ultra-violet energy is greater than that of the ordinary mercury arc, although the biological effects are less intense.—O. **Munerati**: Is there an after-ripening in recently plucked cereals?—Ch. **Kilian**: Observations on the postembryonic development of *Drosera rotundifolia*.—Mlle. Panca **Eftimiou**: On *Exoascus deformans*.—Lucien **Daniel**: Heredity in *Helianthus tuberosus Dangeardi*.—Em. **André**. Contribution to the study of the oils of the chaulmoogra group. The oils of seven different Flacourtiaceæ, each regarded in the country of origin as possessing curative properties against leprosy, have been extracted and their chemical and physical constants determined. These possess one character in common, the deviation to the right of the plane of polarised light.—Marcel **Baudouin**: Radiographs for the diagnosis of the nature of the human work executed on the teeth in ethnography.—R. **Bonnet**: The influence of variations of external temperature on the magnitude of the specific dynamic action in the Polkilotherms.—André **Mayer** and L. **Plantefol**: The influence of the electrolytes of the medium on the gaseous exchanges of the mosses.—E. Fauré-**Fremiet** and Robert **Wallich**: A physical factor of cellular movement during the cultures of tissues *in vitro*.—A. **Dorier**: The faculty of encystment in water of the larva of *Gordius aquaticus*.—L. **Rapkine** and M. **Prenant**: The reaction of the blastocœlian liquid in the pluteus of the sea urchin in the first phase of development.—Lucien **Cavel**: The nitrogen losses in the purification of sewage by the method of activated sludge.—G. **Mouriquand** and M. **Bernhein**: New researches on the relations between age and the appearance of troubles of avitaminosis C.

Official Publications Received.

Wisconsin Geological and Natural History Survey. Bulletin No. 65. Educational Series No. 8: The Geography of Southwestern Wisconsin, By W. O. Blanchard. Pp. viii+117. Bulletin No. 66, Economic Series No. 22: Limestones and Marls of Wisconsin. By Edward Steidtmann; with a Chapter on the Economic Possibilities of Manufacturing Cement in Wisconsin, by W. O. Hotchkiss and E. F. Bean. Pp. x+208+6 plates. Bulletin No. 67, Educational Series No. 9: A Brief Outline of the Geology, Physical Geography, Geography and Industries of Wisconsin. By W. O. Hotchkiss and E. F. Bean. Pp. iv+60. (Madison, Wis.)

Notas geofisicas y meteorologicas publicadas por el Observatorio Nacional de San Bartolomé de Bogotá. Numero 2: Los Huracanes de las Antillas. Por Rev. Simon Sarasola. Pp. vii + 173. (Bogotá, Colombia.)

Memoirs of the Department of Agriculture in India. Chemical Series, Vol. 8, No. 5: Nitrogen Recuperation in the Soils of the Bombay Deccan, Part 1. By D. L. Sahasrabuddhe and J. A. Daji. Pp. 53-68. (Calcutta: Government of India Central Publication Branch.) 4 annas; 5*d*.

Journal of the Royal Society of Western Australia. Vol. 11, 1924–1925. Pp. xiii+168+iii. (Perth.) 21*s*.

Institut de France: Académie des Sciences. Annuaire pour 1926. Pp. 380. (Paris: Gauthier-Villars et Cie.)

Bulletin of the National Research Council. Vol. 10, Part 3, No. 53: Transactions of the American Geophysical Union, Sixth Annual Meeting, April 30 and May 1, 1925, Washington, D.C. Pp. 80. (Washington, D.C.: National Academy of Sciences.) 1 dollar.

International Geodetic and Geophysical Union (Union géodésique et géophysique internationale): Section of Terrestrial Magnetism and Electricity. Bulletin No. 5: Transactions of Madrid Meeting, October 1924. Edited by Louis A. Bauer. Pp. viii+180. (Baltimore, Md.: Johns Hopkins Press.) 3.50 dollars.

Commonwealth of Australia: Institute of Science and Industry. Bulletin No. 29: Natural Enemies of Prickly Pear and their Introduction into Australia. By W. B. Alexander. Pp. 80+13 plates. (Melbourne: H. J. Green.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 77: Anatomy of Hendersonia, a Primitive Helicinid Mollusk. By H. Burrington Baker. Pp. 273-303+plates 7-10. (Philadelphia.)

Union of South Africa: Department of Agriculture. Reprint No. 4, 1925: Weeds of South Africa, Part 3. By K. A. Lansdell. Pp. 34+5 plates. (Pretoria: Government Printing and Stationery Office.) 3*d*.

The Welsh Journal of Agriculture: the Journal of the Welsh Agricultural Education Conference. Vol. 2. Pp. 303+9 plates. (Cardiff: University of Wales Press.) 2*s*. 6*d*.

Diary of Societies.

SATURDAY, FEBRUARY 6.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—Dr. D. McKenzie: Report on a Case of Temporo-sphenoidal Abscess.—F. W. Watkyn-Thomas: Report on a Case of Necrosis of the Petrous Bone.

ASSOCIATION OF WOMEN SCIENCE TEACHERS (Annual General Meeting) (at St. Paul's Girls' School), at 10.30 A.M.—Educational Films, chiefly Scientific, shown by the Visual Education Society.—At 2.30.—Miss Coward: The Teaching of Hygiene in Schools; Short Papers on the same subject.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry and Wales and Monmouthshire Junior Gas Association) (at University College, Singleton Park, Swansea), at 2.30.—C. A. Seyler: The Microscopy of Coal.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Walford Davies: The Triad and the Perfect Fourth (1).

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—Miss L. E. Cheesman: Insect Collecting in the Society Islands.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at Grand Hotel, Manchester), at 4.—J. G. Robinson: A Day in the Foundry (Lecture).

HULL ASSOCIATION OF ENGINEERS (at Technical College, Hull), at 7.15.—Fuel Oil and its Applications (Lecture).

MONDAY, FEBRUARY 8.

ROYAL IRISH ACADEMY, at 4.15.

BIOCHEMICAL SOCIETY (at Lister Institute), at 4.30.—H. Chick: Sources of Error in the Biological Method of Investigating Fat-soluble Vitamins.—P. Hirsch: The Serum Diagnosis of Malignant Growths with the Interferometer.—P. C. Raiment: The Oxidation of Uric Acid with Hydrogen Peroxide.—I. S. Machsan and D. Hoffert: The Synthesis of Fat by the Living Organism.—N. Wright: The Action of Hypochlorites on Amino Acids and Proteins.—R. H. Marriott: The Action of Sodium Sulphide on Hair.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Prof. H. Briggs: The Wheatstone Bridge as the Means of Measuring Linear and Angular Dimensions at a Distance, and its Application to Borehole Surveying.—Prof. E. T. Whittaker: On the Adjustment of Sir J. J. Thomson's Theory of Light to the Classical Electro-magnetic Theory.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Prof. F. F. Roget: A Philosophic Exponent of Latin Culture, Alexandre Vinet: Protestant Divine and Literary Critic (1797–1847).

ROYAL SOCIETY OF MEDICINE (War Section) (at Central Medical Board, Royal Air Force, 3 and 4 Clement's Inn), at 5.—Demonstration: The Medical Examination of Candidates for Aviation, with Particular Reference to the Physiological and Ophthalmological Tests Employed.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. Tudor Edwards: The Surgical Treatment of Phthisis and Bronchiectasis.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Bedford College for Women), at 5.30.—Prof. J. Johnstone: Failure of Mechanistic Conceptions of Life: Neo-vitalism.

INSTITUTION OF STRUCTURAL ENGINEERS (Students' Meeting), at 6.—H. K. Dyson and others: Discussion.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Chamber of Commerce, Birmingham), at 7.—T. D. Carpenter: Modern Chassis Frame Design and Body Mounting.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—R. J. Mitchell and others: Discussion on Modern Applications of Ball and Roller Bearings.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—Prof. S. P. Smith: An All-Electric House.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section), at 7.—E. C. Peters: Submerged Combustion and Submerged Flame Burners.

SURVEYORS' INSTITUTION, at 8.—E. M. Konstam: The Rating and Valuation Act, 1925.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.

MEDICAL SOCIETY OF LONDON, at 8.30.—H. W. Carson, Dr. A. F. Hurst, and Dr. T. W. Eden: Discussion on Right Iliac Fossa Pain.

TUESDAY, FEBRUARY 9.

MANCHESTER GEOLOGICAL AND MINING SOCIETY, at 4.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. E. K. Rideal: Surface Action (2).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Dr. F. Challenger, J. Haslam, R. J. Bramhall, and J. Walkden: The Sulphur Compounds of Kimmeridge Shale Oil.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Bedford College for Women), at 5.30.—Prof. L. J. Russell: Modern Science and the Nature of Matter.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: Report on the Additions to the Society's Menagerie during the months of November, December, 1925, and January 1926.—R. I. Pocock: (1) The External Characters of an Adult Female Chinese Pangolin (*Manis pentadactyla*); (2) The External Characters of a Young Female Rodent, *Dinomys branickii*, exhibited in the Society's Gardens.—Dr. R. Broom: On the Mammalian Presphenoid and Mesethmoid Bones.—W. N. F. Woodland: On the Genera and Possible Affinities of the Caryophyllæidæ—a Reply to Drs. O. Fuhrmann and J. G. Baer.—H. G. Jackson: Wood-lice from Spain and Portugal, with an Account of Benthana, a Subgenus of Philoscia.—Crustacea.—R. A. Wardle: The Respiratory System of Contrasting Types of Crane-fly Larvæ.—R. A. Wardle and Elizabeth A. Taylor: The Cephalic Skeleton of Contrasting Types of Crane-fly Larvæ.—Dr. H. C. James: The Anatomy of a British Phytophagous Chalcidoid of the Genus Harmolita (Isosoma).

INSTITUTION OF CIVIL ENGINEERS, at 6.—P. W. Bertlin: Construction of the New Entrance to Tranmere Dock.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at College, Loughborough), at 6.45.—R. C. Clinker: The Constants of an Electric Circuit.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Scientific and Technical Group.—L. F. Davidson: Conditions governing the Behaviour of the Silver Bromide Grain during Development. Part II.—S. O. Rawling: A Note on Stopping Development in Plate Testing.—Dr. Walter Clark: Note on a Small Mercury Vapour Lamp for Laboratory Use.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Birmingham University), at 7.15.—A. W. Knapp: The Drying of Vegetables.

INSTITUTE OF BRITISH FOUNDRYMEN (Burnley Section) (at Municipal College, Burnley), at 7.15.—H. Shackleton: A Talk on Foundry Work.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—Prof. S. P. Smith: An All-Electric House.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—Sir David Prain: Presidential Address.

INSTITUTION OF MECHANICAL ENGINEERS (Swansea Branch).

WEDNESDAY, FEBRUARY 10.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Annual General Meeting) (at Holborn Restaurant), at 2.30.—H. G. Cathcart: Engineering Services in Hospitals and Asylums.

INSTITUTE OF HYGIENE, at 3.30.—Sir Harry Baldwin: The Dental Problem in relation to School Children.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. L. Abel: The Treatment of Cancer of the Œsophagus.

EUGENICS EDUCATION SOCIETY (at Royal Society), at 5.30.—Dr. H. F. Humphreys: Evolution of the Prehistoric Races.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at London University Club), at 5.30.—Hon. Bertrand Russell: Causal Laws.

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—W. A. Willox: British Railway Permanent-way Maintenance.

RADIO SOCIETY OF GREAT BRITAIN (Informal Meeting) (at Institution of Electrical Engineers), at 6.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.—Dr. E. V. Telfer: Nomograms.

GLASGOW UNIVERSITY ALCHEMISTS' CLUB, at 7.30.—Sir John Russell: The Feeding of Plants: Old and New Ideas.

ROYAL SOCIETY OF ARTS, at 8.—Prof. J. C. Drummond: Modern Views of Vitamins.

LEEDS PHILOSOPHICAL SOCIETY, at 8.—Prof. D'Arcy W. Thompson: The Labours of Hercules and their Astronomical Significance.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—E. A. Ollord: A General Survey of Chromium Plating.

INSTITUTION OF STRUCTURAL ENGINEERS (Lancashire and Cheshire Branch).—Prof. A. E. Richardson: The Relation of Architectural Design to Structure.

THURSDAY, FEBRUARY 11.

BRITISH SCIENCE GUILD (Conversazione) (at Carpenters' Hall, Throgmorton Avenue), at 4.30.—Addresses on The Scientific Approach in Administrative Problems; The Use and Abuse of the "Conference" Instrument; Losses from Avoidable Fires; Losses from Timber Disease.

ROYAL SOCIETY, at 4.30.—H. G. Thornton and N. Gangulee: The Life Cycle of the Nodule Organism *Bacillus radicicola* (Beij) in Soil and its Relation to the Infection of the Host Plant.—C. E. Walker: The Meiotic Phase in certain Mammals.—J. Needham and Dorothy Needham: Further Micro-Injection Studies on the Oxidation-Reduction Potential of the Cell Interior.—Dr. J. W. H. Harrison and F. C. Garrett: The Induction of Melanism in the Lepidoptera and its subsequent Inheritance.—J. Gray: The Mechanism of Ciliary Movement. V. The Effect of Ions on the Duration of Heat.—N. H. W. Maclaren: The Early Development of Cavia: Note on Associated Remains of previous Placentation.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. J. L. Myres: Who were the Greeks? (2).

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Royal Anthropological Institute), at 5.30.—H. J. Laski: Internationalism.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—T. Carter: The Engineer: His Due and his Duty in Life.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—F. W. Preston: The Nature of the Polishing Operation.—W. M. Hampton: The Annealing and Re-annealing of Glass, Part III.: The Determination of Annealing Temperatures; Part IV.: The Annealing of Glass at Low Temperatures.

ROYAL TECHNICAL COLLEGE CIVIL ENGINEERING SOCIETY (at Royal Technical College, Glasgow), at 7.30.—J. G. Smith: Construction of Kirkcaldy Sea Wall and Esplanade.

CHEMICAL SOCIETY (at University College), at 8.—Prof. J. Barcroft: Hæmoglobin (Lecture), and Demonstrations by Drs. Hartridge and Roughton, Dr. Keilin, Prof. Barcroft and Dr. Hecht, Mrs. Kerridge, R. Hill and G. S. Adair.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section).—W. N. Burbridge: Rubber Softeners.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

FRIDAY, FEBRUARY 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—Annual General Meeting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. H. W. B. Cairns: Neoplasms of the Testicle.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Royal Anthropological Institute), at 5.30.—Prof. T. H. Pear: Sleep and Dreams.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

WOMEN'S ENGINEERING SOCIETY (at 26 George Street, W.1), at 6.30.—Miss E. M. Kennedy: Some Problems of the Machinery Market (Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (jointly with Institutions of Civil and Mechanical Engineers) (at City Council Chamber, Birmingham), at 7.—C. O. Silvers and others: Road Transport and its Possible Developments.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—G. C. Hodsdon and others: Discussion on Refrigerating Machinery.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 7.30.—S. E. Dawson: The Application of Special Cast Irons in the Engineering Industry.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—W. H. Patchell: A Visit to some Power Stations in the U.S.A. in 1925 (Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne), at 7.30.—E. Berg: Electrical Propulsion of Ships.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—P. G. Doyne: Ocular Torticollis.—L. Rea: Plastic Repair of Perforations of the Cornea.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. R. Robinson: The Chemistry of Blue and Red Colouring Matters of Flowers.

INSTITUTION OF MECHANICAL ENGINEERS (Leeds Branch).—A. P. Hague: The Choice of Steels for Engineering Work.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow).—H. J. Young: Grey Iron Castings for Special Needs.

SATURDAY, FEBRUARY 13.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, at 2.30.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Walford Davies: The Triad and the Perfect Fourth (2): Their Uses from Hucbald to the Present Day.

BRITISH PSYCHOLOGICAL SOCIETY (at Bedford College for Women), at 3.—Dr. E. H. Magson: Judgments of Intelligence based upon Interviews.—R. J. Bartlett: Indications of a Logarithmic Law in Learning.

SCOTTISH JUNIOR GAS ASSOCIATION (at Royal Technical College, Glasgow), at 7.—A. Philip: Municipal Gas Undertakings: Finance and Accounting.

MINING INSTITUTE OF SCOTLAND (at Edinburgh).

PUBLIC LECTURES.

SATURDAY, FEBRUARY 6.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—W. J. Perry: The Quest for Gold and Pearls in Ancient Times.

MONDAY, FEBRUARY 8.

UNIVERSITY OF LEEDS, at 5.15.—Prof. A. Harden: The Carbohydrate Metabolism of Micro-organisms.

KING'S COLLEGE, at 5.30.—Dr. F. A. P. Aveling: The Human Will (4): Modern Views—Theoretical.

TUESDAY, FEBRUARY 9.

KING'S COLLEGE, at 5.30.—Miss Hilda D. Oakeley: Philosophy and History (2): Theories of Croce and Gentile.

FRIDAY, FEBRUARY 12.

UNIVERSITY COLLEGE, at 5.—Dr. G. Martin: The Theory of Fine Grinding.

MUNICIPAL TECHNICAL SCHOOL, BIRMINGHAM, at 7.15.—Dr. J. Newton Friend: Historical Chemistry: Joseph Priestley.

BIRKBECK COLLEGE, at 8.15.—Capt. F. Maccunn: Educational and other Methods of Promoting the Humane Treatment of Animals.

SATURDAY, FEBRUARY 13.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: Sea-Shells and their Makers.