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Evolution and Theology.

THE recently published correspondence between the Bishop of Birmingham and the Archbishop of Canterbury has not been without interest for students of the natural sciences, since it sheds some light upon the attitude of the authorities of the English Church towards the results of scientific research. We are of course not concerned in these columns with spiritual faith or denominational belief, but it is appropriate to make clear the attitude now presented by leaders in the Church towards progressive scientific knowledge, and the best method of doing this may be to quote certain relevant passages from the correspondence in question. In parenthesis, and as a sign of the new spirit which now prevails between leading representatives of science and theology, it is sufficient to mention that Sir Arthur Keith, president of the British Association, is to take the chair on Monday next at a lecture to be delivered by Dean Inge on the subject of "Scientific Ethics."

Dr. Barnes's first letter to the Archbishop, occasioned by the outburst at St. Paul's Cathedral on Oct. 16, contains the following observations:

"One cause of the weakness of the Church has arisen from the apparent determination of teachers to ignore scientific discovery. Though all competent biologists accept man's evolution from an ape-like stock, the theological consequences of such belief are still seldom stated. I set myself years ago to expound these consequences and to show why they did not seem to me to upset the main Christian position."

To this the Archbishop replied that the Bishop was disturbing himself unnecessarily, since evolutionary views had won wide acceptance amongst religious people, and were now no novelty.

"I believe that you overrate the adherence of thoughtful people to creation theories of fifty to a hundred years ago, and I scarcely think that among those who listen to you there are a great number who hold the opinions which you satirise. For myself, at least, I can say that your position on the biological question, in outline and so far as I understand it, is one with which I personally have been familiar for more than fifty years. Believe me, this teaching, however admirable, is to most of us not novel."

Although these remarks may be said to have evaded the issue raised by Dr. Barnes, yet they constitute a valuable pronouncement, admitting as they do the theological legitimacy of evolutionary opinions; and they were immediately welcomed as such by Dr. Barnes in his reply.

"I would publicly thank your Grace for your letter in answer to my own. By tacit acknow-

ledgment of the truth of the biological doctrine of evolution your Grace removes from Christian ministers of our Church any qualms in proclaiming it."

Dr. Barnes then returned to the point alluded to in his former letter, a point which the Archbishop had allowed to escape him.

"Of course in my sermons I have sought to emphasise not so much the doctrine itself as the readjustments of Christian dogma consequent upon its acceptance."

Since no official reply has been published to this further letter of the Bishop of Birmingham, the Council of the Churchmen's Union, a body of theological liberals under the presidentship of the Very Rev. Dr. Inge, Dean of St. Paul's, dispatched a letter to Dr. Barnes, which contained the following remarks:

"You are blamed for preaching evolution to general congregations. Now it is true that the accepted teaching of science on this subject has long been familiar to educated people who find no difficulty in reconciling it with the Christian faith. But the acceptance of evolution as a biological theory is often unaccompanied by any attempt to follow up the consequences of the theory in their bearing on traditional theological statements, and we believe that in making the attempt you are doing good service which is greatly needed at the present time."

The correspondence from which the foregoing extracts have been given seems to indicate a somewhat anomalous state of affairs. While biological theories of the evolutionary origin of man, and indeed of creation generally, appear to prevail among educated members of the Church of England, clerical as well as lay, no systematic attempt is being visibly made to modify the traditional dogmatic system in view of the new knowledge which radically affects it.

The pressing nature of the need for such theological restatement in view of knowledge which, as the Archbishop reminds us, is fifty years old, can escape no reflective person. We have only to consider how integral to the traditional dogmatic system is the doctrine of a historical fall of man. The Christian theory of human nature (that is, its need of supernatural grace, and so on) hangs upon it; while the scheme of redemption, involving a historical incarnation, is its dogmatic correlative. It is not merely a question of the earth having been created in six days or during incalculable periods of time—that issue, though it has been considered serious, is trifling compared with the others raised by the theory of evolution.

There has, of course, been much literature published dealing with different aspects of the subject. Dr. N. P. Williams, the Regius professor of divinity at Oxford, devoted his recent "Bampton Lectures" to a historical and philosophical treatment of the doctrine of original sin; a book characterised, as Prof. W. R. Matthews has observed, by "its frank acceptance of modern views of the world and its repudiation of ideas which have long been accepted in the Church." Canon Streeter also, in his book "Reality" (1926), includes some remarkably stimulating chapters which deal quite frankly with the problems of man's relation to Nature, and, above all, of the problem of evil—of which the *Genesis* myth is an attempted solution. This problem, which is so radically affected by evolutionary theories, Canon Streeter rightly regards as more important than any other for religion. Thus evolution touches the very heart of religion, and cannot be disregarded by religious teachers who take their task seriously.

If we may be permitted another example, it may be found in Dr. Major's "English Modernism," a work which contains lectures recently delivered at Harvard. Dealing with new ideas of creation, he registers "the acceptance of evolution as the Divine creative method, and the abandonment of instantaneous creation by successive Divine fiats"; and he observes that this "entails the acceptance of the fact that the creative process is still proceeding." This view, "although it seems modern, appears to underlie the theology of the Fourth Gospel," and is also in harmony with the remarkable passage in the eighth chapter of *Romans*, where creation is spoken of as still travailing in birth-pangs.

Yet in spite of these and other sincere and able efforts to find a new expression of Christian truth in terms of evolutionary science and philosophy, it seems to be widely held in authoritative circles (1) that the new doctrinal view should be disseminated only with extreme caution and reserve, and (2) that restatements of dogma would at present be highly dangerous. It would seem to be against this overcautious policy that Dr. Barnes is in revolt. In advocating the bolder course, he will certainly have the sympathy of men of science, who are quite accustomed to frank restatements of doctrine; indeed, science has progressed by means of them. As for the fears expressed for the faith of the weaker brethren, a remark made many years ago by Prof. Harald Höffding seems apposite:

"No one wants to rob the poor man of his ewe lamb—only let him remember that he must not drive it along the high road unnecessarily and then demand that the traffic should be stopped on its account."

J. C. H.

History of Medicine.

An Introduction to the History of Medicine: from the Time of the Pharaohs to the end of the XVIIIth Century. By Dr. C. G. Cumston. With an Essay on the Relation of History and Philosophy to Medicine, by Dr. F. G. Crookshank. (The History of Civilization Series.) Pp. xxxii + 390 + 24 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1926.) 16*s.* net.

WE welcome the appearance of a work on the history of medicine by Dr. C. G. Cumston, who, in addition to other qualifications for the task, was president of the fifth International Congress of the History of Medicine held at Geneva in July 1925 (see NATURE, Nov. 14, 1925, p. 729).

The book is divided into twenty-one chapters, in which the writer successively discusses Egyptian medicine, Hindu medicine, Greek and Roman medicine, Islamic medicine, medicine including physiology, anatomy, pathology, nosology, therapeutics, and surgery in the sixteenth and seventeenth centuries, and the principal medical doctrines of the seventeenth and eighteenth centuries. A special chapter is devoted to the doctrine of irritability, the Brunonian theory, and naturalism, and another to organicism and vitalism. The concluding chapter consists of a brief survey of the evolution of therapeutics.

After an introductory chapter on the evolution of medicine, showing how it gradually advanced through the theological and metaphysical stages before reaching the positive stage described by Comte, Dr. Cumston devotes a chapter to Egyptian medicine, in which he shows how the history of the healing art is to be found in the various papyri. The following chapter on Hindu medicine contains numerous quotations from the Vedas relating to medicine, such as the account of the birth of the Hindu Æsculapius, the duties of the physician and nurse, plastic operations, and the legend of Jivaka, which shows that the operations of major surgery were at least known if not actually carried out by the ancient Hindus. The next chapters deal with Greek medicine, commencing with the philosophers, such as Theophrastus, Pythagoras, Heraclitus, Parmenides, Alcmæon, Empedocles, and Diogenes of Apollonia. A special chapter is devoted to the Hippocratic oath, which has always been the guide of the medical profession. In the following chapter, which is concerned with Hippocrates and the Hippocratic Collection, Dr. Cumston points out that naturalism was created from the time that Hippocrates demonstrated the existence of a formative, conservative, and medicative power inherent in the organism, by which it feels, reacts, and develops, preserves itself, and combats morbid causes and the effects produced by them.

Among the direct successors of Hippocrates, with whom the next chapter deals, may be mentioned Aristotle and his disciple Theophrastus, who contributed indirectly to the progress of medicine by their studies in natural history, Diocles of Carystus, who was one of the first to make a scientific study of anatomy, and Praxagoras of Cos, who was one of the last of the Asclepiadæ whose name has been preserved. More importance, however, attaches to the school of Alexandria, of which Erasistratus and Herophilus were the most illustrious representatives, as it was from this school that the systematic study of anatomy emanated.

An interesting survey is given in the succeeding chapters of medicine in ancient Rome, including the practice of Asclepiades, whose system was based on the teaching of Epicurus, the school of methodism founded by Themison and also represented by Thessalus, Athenæus of Cilicia, Archigenes of Apameia, Soranus, the author of a work on diseases of women, and Cælius Aurelianus, who wrote on acute and chronic diseases. The chapter on Galen contains an instructive comparison between him and Hippocrates. According to Dr. Cumston, Galen would certainly have equalled the father of medicine if he had had less imagination and independence of character, and had not been influenced by the philosophy of Aristotle. Galen explained facts by hypotheses, whereas Hippocrates observed the phenomena of Nature without explaining them. The result has been that the doctrine of Hippocrates has survived, but Galen's system of medicine has been completely destroyed.

In the chapter on Islamic medicine, Dr. Cumston controverts the view that the Arabians were merely servile copyists of the Greeks, and maintains that in addition to their methodical classification of the scattered elements of Greek medicine they created clinical medicine and enriched pathology with a knowledge of new diseases.

The medical schools of Salerno and Montpellier next receive attention, an interesting description being given of Trotula, Constantine the African, the Regimen Sanitatis, Roger of Parma, Guy de Chauliac, Sylvius, and Rabelais.

The chapters on medicine in the sixteenth century contain an account of the work of Jean Fernel, the author of "Universa Medicina"; Fracastor, the first scientific writer on the doctrine

of contagion and author of the celebrated poem on syphilis; Paracelsus, who helped in the advancement of medicine by introducing mineral substances into therapeutics; and the great Italian anatomists. In discussing the medical doctrines of the seventeenth century, Dr. Cumston maintains that the three great contemporary schools of medicine, namely, the iatro-chemical, iatro-mechanical and vitalistic, and animistic schools, owed their existence to the three great philosophers Van Helmont, Descartes, and Leibnitz.

Dr. Cumston distinguishes three periods in the eighteenth century to illustrate the progress made in anatomy and physiology. The first period was that of direct continuation of the researches carried out during the seventeenth century, and was represented by Littré, Duverney, Verheyen, and especially Winslow and Sénac, who discovered the muscular fibres and valves of the heart. The second period was represented by Albrecht von Haller, who published his work on sensibility and irritability in 1752; while the third period, which covered the last twenty-five years of the eighteenth century, was remarkable for the discoveries of Lavoisier, Fontana, Priestley, Fischer, Vauquelin, and Abernethy.

Dr. Cumston may be congratulated on having succeeded in presenting the general reader and student of medicine, for whom the work is intended, with an admirably clear and thoughtful introduction to the study of medical history. The text is accompanied by excellent portraits and other illustrations, most of which are from the author's private collection.

Australian and New Zealand Insects.

The Insects of Australia and New Zealand. By Dr. R. J. Tillyard. Pp. xiii + 560 + 44 plates. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Co., 1926.) 42*s*.

THE curious and beautiful insect fauna of Australia is perhaps the most attractive in the world. That of New Zealand, notwithstanding certain features of special interest, is on the whole rather disappointing and very defective, but its treatment in conjunction with the Australian relieves this difficulty. Both faunas are now so far known as to admit of their general features being set forth in a text-book, and also so far unknown as to offer a marvellous field for exploration to those possessed of such a guide. The appearance of this volume, which is intended both for university students and for amateur naturalists, is well timed, and it should cause a large expansion of local study.

A full and lucid account is given of the general structure of insects, and the modifications characterising the twenty-four orders in which they are classed, illustrated by numerous clear and excellent drawings. This, the most important part of the work, is also the best, and can be recommended to entomological students of any country; the fundamental details of the wing-neuration in particular are thoroughly explained. The broad lines of the scheme of classification employed are reasonable and intelligible. The characters of the orders are tabulated in the form of a general conspectus, and in each order the analysis is carried down to families by dichotomous keys; hence an unassisted student should find himself able to refer any insect to its proper family. This method of procedure so much assists comprehension and saves so much time that it is unavoidable; but all who use such keys should be made aware that they can only be generally and not absolutely correct; exceptions are continually being discovered, and nothing in Nature is constant. Undoubtedly learners, especially when dull, like to have cut-and-dried formulæ, but they had better face the truth. They will also find that reliance on any single character is always risky, and that affinities must be judged by the sum of all characters, if they are to be natural.

When we examine the internal arrangement of the orders, some errors are perceptible. Taking the Lepidoptera as an example, the butterflies are still classed as a separate division, Rhopalocera, equivalent in value to all the rest of the order except the primitive Jugata (Comstock's group, quite unnecessarily renamed by Dr. Tillyard Homoneura), though the case is really given away on p. 455, where the probable relationship to the Pyraloid groups is admitted. The definitely conclusive argument is, however, that when all other groups are considered separately, all are found alike impossible as ancestors of the butterflies, except the Pyraloids alone. Most authorities would also probably now admit that the skippers (Hesperiadæ) are not really from the same stock as the other butterflies, but from a related and more primitive one, the antennal club and loss of frenulum being adaptive characters and developed independently in each case. Again, the small jugal lobe quite correctly mentioned as present in early forms of Nepticulidæ (discovered by Miss Braun) might have warned the author that these highly interesting little insects (with quite unique

neuration) cannot possibly be degraded Tineoids; they are an original development from Micropterygidæ, and must form a separate primary division; their universal distribution is part of their antiquity. The singular little Epipyropidæ, confined to Australia, the larvæ of which are parasitic on Hemiptera, cannot be included among the Tineoidea; the neuration, absence of palpi and tibial spurs, and all other characters refer them to the Psychoidea, certain forms of which they closely resemble. Nor does the inclusion of the Drepanidæ in the Noctuoidea seem to have any other merit than that of novelty; the type of neuration approximates to the Pyraloid.

Under each family are given some few details of striking or interesting species, and there are coloured and plain plates acquainting the student with the general aspect of many of these, which are probably intended to stimulate popular interest. These items of general information appear sometimes untrustworthy. Corrections under the Lepidoptera should be made as follows: *Tinea fuscipunctella* is not a clothes-moth, but a refuse-feeder; the similar clothes-moth is *T. pellionella*. *Ephestia cautella* is certainly not identical with *E. kuehniella*, the so-called 'Mediterranean Flour-moth'; it is the species formerly known as *cahiritella* Guen. The attribution of Lysiphragma to the Elachistidæ, even in the wide sense (out-of-date) in which this term is used, is quite unintelligible and cannot be intended; it is a true Tineid. The decaying family Copromorphidæ are twice stated to be confined to Australia and New Zealand; but even the first species ever described was from Fiji, and others have been recorded from the Papuan and Malayan regions, India, S. Africa, and S. America. The character by which this family is separated from several others in the key (presence of cubital pecten in hindwings) fails to operate, as the same structure occurs fairly frequently in one of them, the Gelechiadæ, for example in Dichomeris. It may also be noted that the characteristic compression of the third segment (terminal joint) of palpi in Glyphipterygidæ is not lateral but transverse.

It is gratifying that Dr. Tillyard has attempted to preserve orthography in nomenclature. Such forms, however, as Sericostomatidæ, Selidosematidæ (formed from Sericostoma, Selidosema), are really new errors, based upon the old error (corrected in NATURE, vol. 41, p. 342; 1890) that such generic names are neuter substantives, whereas they are feminine adjectives; the stem of the Greek stoma is stomat-, but of Sericostoma it is Sericostom-. Another barbarism adopted from Hampson is that of the use of the terms Trifinæ and Quadrifinæ for the divisions of the Noctuoids called by Guenée quite correctly Trifidæ and Quadrifidæ; presumably on the supposition that *-idæ* is a family termination and therefore inappropriate, whereas -id- is of course part of the stem (fid-, denoting fission), and if the termination *-inæ* is desired, the correct terms would be Trifidinæ and Quadrifidinæ.

Finally, in an interesting chapter on the geological history, Dr. Tillyard states his views on the origin of these two faunas. It is impossible to discuss them here; a long article would be required even to recite the difficulties that arise on their consideration. Why, for example, if both New Zealand and Tasmania were successively connected with Antarctica, should there be fifty species of Crambus (the origin of which must certainly have been thence) in New Zealand and none in Tasmania? More probably Tasmania was never so connected. We must leave such problems to be investigated by some of the philosophers who are to be called forth by this useful volume. EDWARD MEYRICK.

Science and Art of the Dyer and Colourist.

(1) *The Dyeing of Textile Fibres.* By R. S. Horsfall and L. G. Lawrie. Pp. x+415. (London: Ernest Benn, Ltd., 1927.) 28*s.* net.

(2) *The Dyeing of Cotton Fabrics.* By Franklin Beech. Third edition, revised and enlarged by A. J. Hall. Pp. xii+296. (London: Ernest Benn, Ltd., 1927.) 18*s.* net.

(3) *Textile Colour Mixing: a Manual intended for the Use of Dyers, Calico Printers and Colour Chemists.* By David Paterson. Third revised edition. Pp. xiv+130+7 plates. (London: Ernest Benn, Ltd., 1927.) 12*s.* 6*d.* net.

(1) MR. R. S. HORSFALL and Mr. L. G. Lawrie, who are members of the staff of the British Dyestuffs Corporation, Ltd., the former being head of the dyehouse department of that firm, are peculiarly well-fitted for the compilation of a book dealing with the dyeing of textile fibres in general. The outlook of the average dyer must be limited largely to the activities within his own dyehouse, so that the types of dyeing upon which he is engaged and in which he is expert eventually become in his eyes the most important. As a result, although fitted to produce a specialised monograph dealing with the sections of the trade upon which he is engaged, he would be liable to produce an unevenly balanced general book on

dyeing. On the other hand, nowhere can such a varied experience of dyeing be gained as in the dyehouse section of a works where colouring matters are manufactured. It is here that colouring matters are submitted to the most rigorous examination in order to discover their good qualities or defects, and to elaborate the most suitable methods of application in the case of products of commercial value. Further, the success of a colour works depends to a great extent upon close touch being maintained between the expert staff of its dyehouse section and all types of the colour consuming industries. Consequently, a most varied and evenly balanced experience of dyeing is gained, as is apparent in the book under review.

The authors consider that most text-books attach more importance to dyestuffs than to the material to be dyed, with the result that the subject of dyeing the various fibres, cotton, bast fibres, artificial silk, wool, and natural silks, is approached through descriptions of the various classes of colouring matters. They have decided, therefore, to approach the subject from the angle of the material to be dyed, keeping in mind the manufacturing processes which the dyed material still has to undergo or the final uses to which it is to be put, with the view of simplifying the matter. Whether it is really a simplification to give excellent descriptions of machines without a single illustration, and to restrict the use of the formulæ of dyestuffs to the solitary example of aniline black, is open to debate, but that the authors have produced an outstanding book on dyeing cannot be questioned. It is written most attractively, and once its pages are opened it is difficult to lay it down unread. This thoroughly up-to-date book invites perusal and will be heartily welcomed by students of dyeing, whilst the general science reader who desires to know something of the science and art of dyeing as practised at present, can turn to no better source of information.

(2) Mr. A. J. Hall, on the other hand, has laid himself open to criticism in attempting to revise Mr. Franklin Beech's book. The first edition, published in 1901, described various processes and operations involved in dyeing cotton fabrics, from a practical and empirical point of view, rather than a scientific one, and may have been of service to evening students in technical schools at that date. Actually, the limited and unsatisfactory revision which has been carried out has altered the original character but little, whereas such drastic treatment as to render the original text unrecognisable would have been necessary to convert this into a modern text-book. The publishers would be well advised to discard this book and arrange with Mr. Hall to write a new one.

(3) Mr. David Paterson's well-known little book on colour mixing, in which he deals with his subject in a simple and practical manner, has proved a useful manual for elementary students since it first appeared in 1900. Although the original style has been preserved, the opportunity has been taken to revise the text somewhat without materially affecting its length. The dyed patterns used as illustrations of the text were dyed with German dyes in the first two editions, but are now dyed with colours of British manufacture, whilst further signs of the times are the increase in the price from 7*s.* 6*d* to 12*s.* 6*d.* since the second edition appeared in 1915, and the use of fewer coloured plates. Those engaged in the application of colouring matters cannot afford to neglect the subject of colour from a purely physical point of view. The first few chapters give an elementary account of colour, absorption spectra, and the spectroscope, and with this as a basis the remainder of the book deals practically with the mixing of lights, dyes, and pigments.

Although it is true that skill in dyeing and colour mixing cannot be acquired from books alone, knowledge such as can be acquired from the first and third of the books on this list is indispensable if young men are to cope with present-day conditions in the colour-using industries. F. M. ROWE.

Cultivation of Sugar-Beet.

Handbuch der Zuckerrübenbaues. Unter Mitwirkung von Dr. A. Schaumburg. Bearbeitet von Prof. Dr. Theodor Roemer. Pp. v + 366 + 8 Tafeln. (Berlin: Paul Parey, 1927.) 19 gold marks.

ANY considerable work dealing with the selection, culture, and manuring of sugar-beet is certain to arouse interest in England, now that our own sugar-growing industry is developing with such great speed. In some six years our area under the crop has increased from about 8000 to 126,000 acres, and even those farmers who have been growing it since the starting of the Cantly factory in 1910 must confess to a considerable ignorance of the principles underlying the cultivation and manuring of it. Recently, many inquiries on the subject have been addressed to the various centres of agricultural teaching and research, and there has been some difficulty in obtaining trustworthy information.

Dr. Roemer, with a full century of continental experience behind him, attacks the whole subject in a patient and thorough manner, and quotes the chapter and verse of laboratory and field experiments in support of most of his statements and recommendations.

In the department of manuring he owes much to Schneidewind, several of whose opinions and experiments he quotes, while in the realm of cultivation he has drawn on the work of Wollny and a host of other continental workers. In the matter of manuring, Dr. Roemer stresses the fact that an excess of nitrogen and its late application leads to poverty of sugar content, delayed maturity and poor keeping quality, points which were well confirmed in an experiment at Rothamsted carried out only last year. In other particulars of manuring he recommends a moderate use of phosphate to ensure good texture in the root and to help maturity, and he thinks that a shortage of available potash leads certainly to a lowering of the sugar percentage in the root.

In regard to spacing the roots in the field, Dr. Roemer favours a wider setting of the rows than most continental experts. 20 in. × 9 in. is the actual spacing that he names, and this compares curiously with the 14 in. × 8 in. and 16 in. × 8 in. which have been recommended by many of the Dutch and German experts. Many British growers have objected to these very small spacings on the ground that it is practically impossible to use horse labour in the narrow rows, and that additional hand labour is very expensive and slow even when it is available. It is interesting to observe that Dr. Roemer supports his practical recommendation with a similar statement of labour difficulties in Germany. Throughout the book he makes great play with the necessity that exists for improved mechanisation in the handling of the crop in the interests of speed and labour saving, and he has a number of interesting things to say about spacing drills, singling machines, and mechanical harvesters. In this last and very important particular he considers that the problem of mechanical harvesting of beet is now solved, and that we only wait for improvements of the existing machines.

Taking the book on the whole, it appears as a very valuable addition to a section of agricultural literature which is not well represented in Great Britain, and it seems reasonable to expect that many of Dr. Roemer's conclusions will apply quite closely to sugar-beet growing in British conditions.

C. H.

Our Bookshelf.

Spectroscopy. By Prof. E. C. C. Baly. (Textbooks of Physical Chemistry.) Third edition. In 4 volumes. Vol. 3. Pp. viii + 532 + 6 plates. (London: Longmans, Green and Co., Ltd., 1927.) 22*s.* 6*d.* net.

THE third volume of Prof. Baly's "Spectroscopy" has followed very quickly upon vol. 2, a review of which appeared in our issue of Aug. 6, p. 185. It includes only four chapters, on series of lines in spectra, on the Zeeman and Stark effects, and on emission band spectra; but, since the first of these chapters covers more than 300 pages, the volume is rather larger than its immediate predecessor. The volume starts inevitably with Balmer's discovery of the first spectral series in 1885, but records an ever-growing acceleration which must have made it very difficult for the author to leave off writing and let his work go to press. In order to do justice to the work of the pioneer investigators, he has rejected the tempting option of beginning with Bohr's first application of the quantum theory to spectroscopy in 1913, and has told the complete story of the work done by Rydberg, Kayser, Runge, Paschen, Fowler, and Millikan in the period when experiment rather than theory was the order of the day.

The main portion of the volume, however, is necessarily based upon the Bohr theory and its developments; and those who have tried with only moderate success to grapple with these developments will appreciate the 'humbleness of mind' which the author admits in his preface. He has, nevertheless, been able to complete this portion of his task within a reasonable time, and may be congratulated on his success in dealing with a situation which he could not possibly have foreseen when in 1905 he wrote a single volume on spectroscopy for this important series of monographs. It is, indeed, a noteworthy fact that the task of keeping abreast with the most active section in pure physics should have fallen to the lot of a chemist, writing (under the editorship of a chemist) a text-book of physical chemistry, and that his courage and skill should have proved adequate to this formidable task.

Hydro-Electric Handbook. By William P. Creager and Joel D. Justin, with the Assistance of nine Contributors. Pp. xxiv + 897. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 40*s.* net.

A BOOK verging on 900 pages provides scope for much matter, and the designation "Handbook" rather inadequately describes the wealth of information which is to be found in the volume before us. Although bearing the names of two authors, it is really a compendium by them and nine other contributors, covering in its thirty-five chapters almost every subject and topic connected with hydro-electric development works. It is essentially an engineering manual, based on the wide field of experience obtainable in North America, where water power is an important natural endowment and is being exploited for

industrial purposes on a scale of magnitude greatly exceeding anything that is feasible in Great Britain.

The mere enumeration of chapter headings would occupy almost the whole of the space available for a short notice, and it is only possible to indicate a few of the more important items which are treated by the various writers. There is an introductory section on rainfall, evaporation, and run-off, illustrated from United States records, together with a description of methods of estimating stream and flood flow, with the resultant yield of data respecting storage and power available for development. A short résumé of principles of hydraulics is then followed by four chapters dealing with different types of dams, and thereafter come descriptions of various other constructional features and power-developing equipment, including turbines and generators, extending to power transmission lines.

In brief, the book is a very complete and concise summary, from the American viewpoint, of the theory and practice of water-power supply at the present day. It is excellently printed and produced. The diagrams also are clear, and in some instances are duplicated, so that one copy may be detached for pocket use.

BRYSSON CUNNINGHAM.

In Search of our Ancestors: an Attempt to retrace Man's Origin and Development from Later Ages back to their Beginnings. By Mary E. Boyle. Pp. 287 + 4 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1927.) 10*s*. 6*d* net.

MISS BOYLE has reverted to the practice of a former day in archæological exposition by working backwards. Her search for our ancestors begins with the Iron Age and traces them back through the various stages of culture of metal and stone to Quaternary and Tertiary man with their eoliths, and then to the earliest forms of life in the tertiary, secondary, and primary periods. The Abbé Breuil, in a foreword, commends the author's method of attack on the ground that it leads the student back ultimately to the principle of unity and the first cause. With all deference to so great an authority, we would dissent. In dealing with prehistoric culture, the sense of development, the evolutionary process, even as a 'way of knowledge' as the Abbé defines it, to a great extent is lost when we work back from the complex to the more simple.

Apart from this point of method, Miss Boyle's treatment of her subject is eminently skilful, and she has handled the mass of detail now available in a masterly fashion. She deals, however, in the main, with Europe only, and that from the cultural side. Ethnological questions are not taken into account. This no doubt must be held to account for some omissions and for the fact that references to Egypt and Africa are incidental only. Yet it is difficult to see why recent discoveries at Ur and Kish, important as they are for the early use of copper and bronze and their relation to the use of stone, are not mentioned, although there is an adequate summary of the evidence from Hissarlik.

Navigational Wireless. By Dr. S. H. Long. Pp. xi + 164 + 12 plates. (London: Chapman and Hall, Ltd., 1927.) 12*s*. 6*d*. net.

THE scope of this book is not so comprehensive as the title suggests, since the book deals almost entirely with the application of wireless direction-finding to marine navigation; and the book is intended to provide mutual instruction to the wireless operator and to the navigating officer. After two introductory chapters on general electricity and the application of valves and methods of screening to wireless receivers, the principles of direction-finding and the various available systems are described. The next two chapters deal with the installation of the Siemens direction-finder on board ship and the calibration of the instrument to determine the quadrantal error curve due to the metalwork of the ship.

The navigational side of the subject is treated in chapters vii., viii., and ix., which describe the various charts necessary in plotting off bearings at sea, and the method of applying corrections to the charted bearings. In the following chapter a description is given of the various effects on wireless bearings encountered in practice, but here many of the results of recent research on the subject have been omitted. The necessity for the provision of beacon transmitting stations for the use of ship's direction-finders is mentioned in the concluding chapter, which also contains a brief description of some sound-signalling devices.

The book has been well produced with a large number of excellent photographs and diagrams, and only one or two misprints have been noticed.

R. L. S.-R.

Der Erde Eiszeit und Sintflut: ihre Menschen, Tiere und Pflanzen. Von Dr. O. Hauser. Pp. viii + 370 + 22 Tafeln + 2 Karten. (Berlin: George Stilke, 1927.) 16 gold marks.

FOR the layman who can read German, and is not deterred by Germanic characters, Dr. Hauser has provided an extremely interesting survey of early human types and history. The introductory chapters include a brief summary of historical geology and of the evolution of life forms. Considerable attention is given to the Wegener hypothesis of continental drift, the treatment leading up to a discussion of the 'new world' of the Tertiary period and the acceleration of progress in the world of life that accompanied the far-reaching geographical changes of the time. The next revolutionary event was the onset of widespread glaciation that began a new period and saw the effective beginnings of mankind.

In dealing with Palæolithic man, Dr. Hauser is thoroughly up-to-date, for he appears to have made use of all the evidence available up to the middle of 1926. He is particularly interested in the art and culture of early man, and by plotting the localities of significant discoveries he attempts to follow up the migrations of some of the recognised races. The book is beautifully printed and illustrated, and is a thoughtful contribution to the literature of its subject.

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.*]

Variation of Intensity Ratios of Optically Excited Spectrum Lines with the Intensity of the Exciting Light.

IN a recent paper on the optical excitation of mercury vapour (*Phil. Mag.*, Sept. 1927) I directed attention to the fact that lines excited by two successive processes of absorption should increase with the square of the intensity of the exciting light, while lines resulting from a three-stage absorption should increase with the cube of this intensity.

As an example of the last case, we may take the emission of the line λ3650 of mercury. The vapour of mercury at room temperature in a quartz tube, highly exhausted, is illuminated by the total radiation of a water-cooled quartz mercury arc. The absorption of the line λ2537 raises the electrons from $1S$ to $2p_2$, from which level they are raised to $1s$ by the absorption of λ4358. From $1s$ some fall to $2p_1$, a metastable level, with emission of λ5461, and from here some are raised to the d level by the absorption of λ3650, from which level they return to $2p_1$ with emission of λ3650. If we move the arc away until the illumination of the vapour is reduced to one-half of its initial value, one would expect that the intensity of λ2537 would be reduced to one-half, of λ4358 and λ5461 to one-quarter, and of λ3650 to one-eighth of their initial values, for by reducing the illumination by one-half we have only half as many electrons raised from $1S$ to $2p_2$, owing to the reduced intensity of λ2537. But λ4358 has been reduced by one-half as well, consequently there is but half as much light available for absorption by the reduced number of electrons in $2p_2$. Lines resulting from a two-stage absorption process are thus reduced to one-quarter, and from a three-stage absorption to one-eighth of their initial values. Several observations bearing out this view were given, though a special investigation of the matter had not been made at the time.

Practically all of the light emitted by the tube results from two-stage or three-stage absorption. This accounts for something that has always surprised me, namely, the impossibility of obtaining a satisfactory amount of emission by forming an image of the lamp on the resonance tube by means of quartz lenses. I had attributed it the absorption of λ2537 by mercury vapour in the air, but the relations above described amply account for it.

The phenomenon can be shown in a very spectacular manner by the very simple expedient of inserting a sheet of fine wire gauze, which is non-selective in reducing the intensities of the lines, first between the resonance tube and the eye, and then between the lamp and the resonance tube. We find that in the latter case the intensity of the emitted light is very much fainter than when the gauze is held between the eye and the tube. The gauze employed was of very fine copper wire, and transmitted about one-fifth of the light. When held between the eye and tube, the light was reduced to one-fifth, but when held between the lamp and the tube, the reduction was to one twenty-fifth; *i.e.* the light was almost invisible. A quantitative investigation of these relations is now in progress in collaboration with E. Gaviola.

R. W. WOOD.

Johns Hopkins University, Oct. 16.

Biological Work in Russia, Siberia, and Turkestan.

MY wife and I reached Leningrad early in July, and left for England about the middle of September. In the interval we journeyed in Siberia so far as Lake Baikal, to Archan in the Buriat Republic, and to Tashkent in Usbekistan (Russian Turkestan). We visited the old town of Tashkent, where the women are veiled and the general aspect of things recalls the times of the Arabian Nights, until we notice the street cars, and entering a large mosque, find it converted into a cinema theatre, just then producing the American film 'Speed.' We travelled far on the railways, more often in the 'hard' than the 'soft' cars, in one case for ten days, and talked with all sorts of fellow passengers, getting a good idea of the state of public opinion. We took long journeys in the springless country carts, seated on a small quantity of hay; and we slept in the houses of the peasants. Thus, although the time was short, we got a fairly good idea of the condition of affairs in U.S.S.R. We were, however, on a strictly scientific mission, and what I have to say relates only to scientific work. The extent and variety of the biological investigations and institutions was greater than we could have supposed, and it seems worth while to give some account of what we saw.

I had heard of the University at Irkutsk, founded during the civil war, but was quite unprepared to see a great organisation, with numerous buildings and strong faculties. All this has come into being in less than ten years. At the head of the Biological Institute of the University is Prof. W. Schewiakoff, a zoologist of the first rank, well known for his magnificent studies of the Radiolaria, published in the series of Naples monographs. His wife is a daughter of the famous zoologist Kovalevsky, remembered especially in connexion with Amphioxus. Prof. Schewiakoff has devoted himself to improving the facilities for teaching, and has developed a most beautiful series of anatomical preparations, with accompanying explanatory drawings. I have never seen anything more perfect of the kind, and all has been done with small funds and what we should consider extremely poor facilities. Thus one preparation, apparently in a museum jar, was really placed in a perfume bottle, with the top neatly cut off. Prof. V. Dorogostaisky, whom I met later on the shore of Lake Baikal, is a very keen zoologist, concerning himself with the domestication of fur-bearing animals, with the Baikal fishes, with the remarkable Amphipod Crustacea of Lake Baikal, and other matters. He showed me his exquisite series of water-colour drawings of Baikal Amphipods, many of them new. The paper will be published later by the Academy of Sciences at Leningrad. Prof. B. Swartschewsky, whom I met in Irkutsk, is also a zoologist concerning himself with the fauna of Baikal, and the author of important papers. I also met the botanist V. Jasnitsky, who is specially interested in algæ, and has published on the plankton of Baikal and other matters. He has also a good knowledge of the local flowering plants, as I found when accompanying him in the field.

My wife and I were for some days guests at the biological station of the University of Irkutsk, situated on the shore of Lake Baikal. There we found a group of young people living happily together, investigating the fauna and flora, and doing excellent work. The beauty of the surroundings, and the endless fascination of Baikal, together with the good fellowship and enthusiasm in the station, produced an impression long to be remembered with pleasure. At Maritue, nearer the southern end of the lake, I visited the headquarters of the Baikal expeditions of

the Academy of Sciences, and was fortunate in finding there Prof. Nassonov, one of Russia's most distinguished zoologists. I used to correspond with him about Coccidæ in the days before the War.

Later on we spent a week at Tashkent, in Usbekistan (Russian Turkestan). Here also I found a great University, developed since the War. There is also a very good laboratory of economic entomology, phytopathology, etc., which publishes excellent bulletins. One of its publications is an important illustrated work on the grasshoppers of Turkestan, by Uvarov, of the British Museum. The Tashkent Museum has been greatly developed in the last few years, and now contains very good collections illustrating the local fauna and flora, palæontology, works of art, etc. The director, Mr. Yankowsky, is a competent scientific man, specially interested in entomology. The Museum is called the Middle Asian Museum, and is officially connected with a society for the protection of ancient monuments and natural objects (in the language of the locality, Sred az com star-is). In this museum I was shown and allowed to study a series of the wonderful Jurassic fossil insects found near Galkino, in the neighbouring Cossack Republic. They have been largely collected and partly studied by Mrs. Besobrasoff, of the Faculty of Physics and Mathematics in the Central Asian University at Tashkent. She has described a new species of the extraordinary genus Kalligramma, while her sister has written a paper, shortly to appear, on the fossil fishes of the same deposit.

The entomologist at the University, Prof. N. N. Kuznetzov-Ugamsky, is especially interested in ants and sawflies, but has studied many other insects, and has written a paper describing a number of new bees of the genus Anthophora, a genus remarkably developed in Turkestan. Prof. Kuznetzov took me on a collecting trip, and when I left, placed in my hands a large collection of Turkestan bees for study. Prof. N. A. Keiser, zoologist at the University, is especially interested in hydrobiology, more particularly the Cladocera, but he and his students have collected in many groups. A party of 14 students, the majority women, went with him on an expedition to Lake Issik-Kul. He kindly handed me for study and report a series of land shells obtained on this expedition. Prof. Keiser gave me some account of the growth of his department. In 1918 they had only two rooms and 10 microscopes; now they have several rooms and 40 microscopes. About 500 students work in the department. The financial support is better each year. I was shown a collection of 500 large and excellent charts made in the department.

In the Botanical Department I met Mr. Alexey Vvedensky, in charge of the herbarium. Within five years or so there has been built up a herbarium of about 20,000 sheets of Turkestan plants and 15,000 sheets of the flora of other regions or countries. Original work is being done and many new plants described. Numerous fascicles of "Herbarium Floræ Asiæ Mediæ" have been issued, together with pamphlets describing the plants when new, and giving full citations of literature when old. In the British Islands these are sent to Kew and Edinburgh; in the United States to the California Academy and the New York Botanical Garden.

During our stay both at Irkutsk and Tashkent, we were guests in the rooms of the respective branches of the Geological Committee. This organisation, centring in a very large building in Leningrad, is the Geological Survey of the U.S.S.R. It is purely scientific and non-political, doing work of the highest practical and theoretical importance. This year it has had about 200 geologists in the field. Our work in U.S.S.R. was made possible by the hospitality and co-operation of the Geological Committee, and without this it is probable that we could have accomplished nothing. We were especially indebted to Mr. Theodore F. Schwab, director of the branch at Irkutsk, who prepared matters for us before we arrived, so that we were given every advantage, and spared all friction and difficulty.

In Leningrad we of course visited the Academy of Sciences, and saw the famous zoological and geological museums—the mammoth taken from the ice of Siberia, the Baluchitherium skeleton of almost unbelievable size, the extraordinary great reptiles extracted from concretions of Permian age. The entomological collections are very fine and most excellently arranged; I spent some time examining the bees of the genus Andrena. I met several of the entomologists, but greatly to my regret missed Skorikov, the authority on Bombus, because the day he expected me was consumed in getting permission to leave the country. I was especially pleased to meet A. B. Martynov, the great authority on fossil insects and living Trichoptera. He showed me the amazing collections from the Jurassic of Turkestan, which open up a great new chapter on the history of insect development; and also the wonderful series of insects he found in the Permian concretions, a single block often containing numerous species, exquisitely preserved. I regard Martynov as one of the greatest masters of insect morphology of our times, and were I a young man I could think of nothing better than to study under his guidance.

We received great kindness at the hands of the veteran Dr. Karpinsky, the head of the Academy, and his daughter, Mme. Karpinsky. The latter is a sort of guardian angel to foreign scientific people visiting Leningrad, much as Mrs. Britton is to botanists visiting New York.

The Leningrad Botanical Garden, occupying 15 acres, is a great centre of botanical work, and its library is said to be second only to that of Kew. The grounds are now being reorganised by a force of 300 men, but we saw very good exhibits of the flowering plants of different parts of U.S.S.R. The hothouses are full of interesting things. We were taken over the gardens by Prof. Komaroff, well known for his important studies of the flora of Eastern Siberia and the Mongolian Region.

There is a small botanic garden at Tashkent, the principal exhibit being a fine *Victoria regia* water-lily in a tank in the open. Many of the trees (as honey-locust, box-elder, and Robinia) planted along the walks are of American origin. Near the gate is a fine specimen of the Asiatic *Juglans fallax* Dode.

T. D. A. COCKERELL.

On s.s. *Yamel*, Thames Estuary,
Sept. 23.

The Maxwell Effect in Liquids.

CLERK MAXWELL many years ago surmised that viscous liquids in a state of flow should exhibit birefringence, and devised methods of observing the phenomenon. Vorländer and Walter (*Zeits. Phys. Chem.*, **118**, 1; 1925) have recently investigated no fewer than 172 liquids of known chemical composition by Maxwell's method, and their work has demonstrated conclusively that a great many pure liquids which cannot by any stretch of language be classed as colloids, exhibit birefringence when subjected to viscous flow. The Maxwell effect, as it may be called, is thus a characteristic property of pure liquids just as much as the power of exhibiting birefringence in strong electrostatic or magnetic fields. We wish

briefly in this note to indicate a molecular theory of the Maxwell effect we have worked out which has proved itself very successful in explaining the observed phenomena.

It is easily seen that the stresses in flowing liquid can be considered as equivalent to a set of tensions and a set of pressures acting perpendicularly to each other, and at angles of 45° to the plane of sliding. When the liquid consists of molecules which are highly asymmetric in shape, there would be a tendency for the molecules to orientate under the influence of this system of stresses in such manner that the longest dimension of a molecule tends to lie along the axis of tensions and the shortest one along that of pressures; because such orientation would evidently result in the fluid, regarded as a densely packed assemblage of molecules, expanding along the direction of tensions and contracting along the direction of pressures, thus allowing the system of stresses to do work. By considering the work done during such deformation by the acting stresses as equivalent to the change of energy of the molecules resulting from orientation under a system of couples acting upon them, we can determine the latter in terms of the viscous forces and the asymmetry of shape of the molecules; it being remembered that the orientation is opposed by the thermal agitation of the fluid and that the resulting equilibrium is to be determined statistically in accordance with the Boltzmann principle.

The birefringence of the fluid resulting from the orientation of the molecules under the viscous stresses and their known optical anisotropy, is then readily worked out on lines analogous to those used by Langevin in his theory of electric and magnetic double refraction. The final expression obtained in this way for the difference between the refractive indices n_t and n_p for the vibrations along the axes of tensions and pressures respectively, is:

$$n_t - n_p = \frac{(n^2-1)(n^2+2)}{5n\nu kT} \cdot \frac{(a_1-a_2)(b_1-b_2)+(a_2-a_3)(b_2-b_3)+(a_3-a_1)(b_3-b_1)}{(a_1+a_2+a_3)(b_1+b_2+b_3)} \cdot \eta \frac{v}{c},$$

where n is the mean refractive index of the fluid, ν is the number of molecules per unit volume, k is the Boltzmann constant, T is the absolute temperature, a_1, a_2, a_3 are the linear dimensions of the molecule along the three principal axes, b_1, b_2, b_3 are the optical moments induced in the molecule along these axes by unit field acting on it successively along the same three directions, η is the coefficient of viscosity and v/c is the velocity gradient.

The birefringence calculated from our formula, utilising the optical anisotropy ascertained from observations on light scattering and the geometrical dimensions derived from X-ray data, comes out in excellent agreement with the determinations of Vorländer and Walter.

The extension of the theory to the case of colloidal solutions and gels is at present engaging our attention.

C. V. RAMAN.
K. S. KRISHNAN.

210 Bowbazar Street,
Calcutta, India, Sept. 17.

The Excitation of Spectra by High Frequency Oscillations.

THE letter in NATURE of Oct. 8, p. 510, from Prof. R. W. Wood and Mr. Loomis directs attention to the possibility of developing spectra by means of high frequency oscillations. Work on these lines has been proceeding in this department for some time, and the results obtained with mercury as a 'trial horse' are encouraging.

A short coil of copper tubing was wound round a horizontal hard glass tube through which a stream of mercury vapour was caused to flow. The coil was connected in parallel with a condenser, and oscillations were maintained in this circuit by means of a high-power three-electrode valve. The frequency of these oscillations was of the order of 10^6 cycles per second, the voltage applied to the circuit could be varied from 2000 to 10,000 volts, and the power input increased up to 3·5 kilowatts. The pressure inside the glass tube was adjustable by the admission of air, and the spectrum produced when the coil was activated was examined end-on by means of a quartz spectrograph.

Before a glow was visible, the resonance line λ2536·7 was photographed with a long exposure. An increase of the voltage applied to the circuit caused the appearance of a greenish glow, which was found to be due to the lines of the *s* and *d* triplet series in addition to this line; prolonging the exposure only resulted in more members of these series being recorded. A further increase in the voltage caused the colour of the glow to change to that of the ordinary mercury arc, the photographs now showing the resonance line, the *s* and *d* triplets, the lines of the *S* and *D* singlet series, and some combination lines. Only those combination lines were present, however, which involved the arrival and departure levels of the series lines present. When the voltage was still further increased, more members of the triplet and singlet series were developed, together with additional combination lines connected with these new members.

Simultaneously excited, however, were also thirteen lines, which have not yet been allocated to any series or combination, though these have all been identified as being present in the ordinary mercury arc. Their wave-lengths were 3984·1, 3860·4, 3820·6, 3790·4, 3751·8, 3561·5, 3543·7, 3390·5, 3351·5, 2820·0, 2686·7, 2660·1, and 2540·4. They were all of very feeble intensity except the first, which was as strong as an early member of the triplet series. A step by step reduction of the pressure from 1 cm. to that of the vapour alone, keeping the voltage constant, produced the same effects as increasing the voltage when the pressure was constant. An increase in the temperature of the vapour also facilitated the development of the lines. The line λ3984·1 was abnormally affected by pressure; increasing the pressure caused it to fade much more rapidly than the other lines.

It had been anticipated that enhanced lines due to atoms in various stages of ionisation might have been obtained, especially near the circumference of the tube, but these have not yet been observed; further endeavours to obtain them will be made. It is remarkable that although several of the lines of the *p* series are present in the ordinary arc with an intensity as great as that of some of the higher members of the *s* and *d* series, yet they have not been observed as being excited by this method, even when the exposure has been prolonged up to five hours. It is possible that they require higher voltages for their excitation than have been available so far.

It is apparent that this method of developing spectra is full of promise, and its extension to other elements than mercury, the spectra of which have not yet been analysed so completely, is proceeding.

J. R. CLARKE.

Physics Department,
University of Sheffield,
Oct. 11.

The Mechanism of Formation of the Latent Photographic Image.

IT is with great interest that I see in NATURE of Sept. 24, p. 441, Dr. Toy's letter with regard to the part played by the photo-electric conduction effect in the formation of the latent image on silver halide.

At the Detroit meeting of the American Chemical Society on Sept. 10 last I read a paper in which I presented a tentative picture of a mechanism for the formation of the latent image based on the known facts of silver halide and silver sulphide. An earlier paper on the same subject will appear in the November number of the *Journal of the Franklin Institute*.

E. P. Wightman and R. F. Quirk, at the American Chemical Society meeting in Sept. 1926, stated in their second paper on "Intensification of the Latent Image on Photographic Plates and Films," that they believed that the sensitivity spots on silver halide grains contain some silver in addition to the silver sulphide. W. Clark independently, in his experiments on the action of oxidisers on the sensitivity and latent image, supports this view of Wightman and Quirk. He concludes: "It appears, then, that the results obtained could be explained on the view that silver sulfide is present in the sensitivity substance provided it is postulated that there is also present something—say, silver—which is attackable by oxidisers of potentials too low to attack silver sulfide."

Assuming that the explanations of Wightman, Quirk, and Clark are correct, we have in our high sensitivity photographic materials to deal with the system:

silver | silver halide | silver sulphide

in which silver and silver sulphide are in contact with each other. This system represents a photo-electric cell of the Becquerel type, in which silver is the cathode, silver sulphide is the anode, and silver halide is the solid electrolyte.

In light, the potential difference between the electrodes increases, the conductivity of the silver halide increases (*i.e.* photo-conductivity), and an electric current flows around in this closed system. The result will be an electrolysis of the silver halide, the cations moving towards the cathode (concentration speck theory; coagulation theory of the latent image), the anions losing their charge and staying in the crystal substance (Tubandt).

The photo-electric action according to the old theory (Fajans) was

$$[Ag^+, \text{halogen}^-] \xleftarrow{} Ag + \text{halogen}.$$

The halogen ion loses an electron, which moves towards the silver ion, thus discharging the silver cation. According to the above proposed theory, the electron from the halogen anion liberated by the light absorption moves towards the silver sulphide anode, then goes to the cathode; at the same time, the

$$\frac{Ag^- \mid Ag_2S^+}{[Ag^+\ \text{Halogen}^-]}$$

silver cation moves towards the cathode and is there discharged by the electron from the halogen anion. If the silver speck has grown to a certain size, developability is introduced.

This picture of the formation of the latent image also takes into account the failure of the reciprocity law and the intermittency effect.

One of the difficulties in the photo-electric conduction theory of the latent image has been the wavelength effect, which has now been removed by the valuable work of Dr. Toy.

A. P. F. TRIVELLI.
Research Laboratory,
Eastman Kodak Company,
Rochester, N.Y., Oct. 13.

Some Further Spectral Lines of Trebly-ionised Germanium.

CARROLL (*Phil. Trans. Roy. Soc.*, vol. 225, p. 357) has identified the first members of each of the first principal, sharp, diffuse, and fundamental series of trebly-ionised germanium (Ge IV), which in Hund's notation may be represented by $4S_1 - 4P_{1,2}$, $4P_{1,2} - 5S_1$, $4P_{1,2} - 4D_{2,3}$ and $4D_{2,3} - 4F_{3,4}$ respectively. All these lines lie in the Schumann region. Using a condensed spark between metallic electrodes *in vacuo*, the near ultra-violet region has been examined for further spectral lines of Ge IV by means of a concave grating of radius 2 metres arranged on a Rowland mounting.

The first members of the second principal series $5S_1 - 5P_{1,2}$ were easily found at λλ3554 and 3676. A triplet resulting from combinations between $4D_{2,3}$ and $5P_{1,2}$ has also been identified. Taking Carroll's value 178094 for the wave-number of $4D_2$, the $4D_{2,3} - 5P_{1,2}$ triplet yields for $5P_1$ and $5P_2$ the wave-numbers 142242 and 141305 respectively. These terms combining with $4S_1$ would give a doublet, namely, the second member of the first principal series, of wave-number 227396 and 226459. This doublet has been found by Dr. R. J. Lang, to whom I am indebted for the measures of these lines and permission to include them in the table below. The discrepancy between the estimated and measured wave-numbers of these lines is due to a lack of adequately accurate standards in the λ400 region.

The measures are given in the following table:

Intensity.	λI.A. air.	ν.	dν.	Term Combination.
8	3676·61	27191·3	936·9	$5S_1 - 5P_1$
9	3554·14	28128·2	936·9	$5S_1 - 5P_2$
5	2788·41	25852·2		
5	2736·09	36537·7	936·7	$4D_2 - 5P_1$
1	2717·41	36788·9	251·2	$4D_3 - 5P_2$
				$4D_2 - 5P_2$
1	441·95	226270	946	$4S_1 - 5P_1$
1	440·11	227216	946	$4S_1 - 5P_2$

STANLEY SMITH.
University of Alberta,
Edmonton, Canada,
Sept. 30.

The 'Green Flash' at Sunrise.

WATCHING the sunrise this morning across the Nile valley, under conditions of very good visibility and no local wind, using Goerz ×8 binoculars, I saw what is, to the best of my knowledge, a novel form of the 'green flash.'

From the top floor of Mena House Hotel the sunrise was behind Gebel Tura, with its skyline at about 300 metres elevation, and some 25 kilometres away. The dawn was clear, a light white mist lying low on the valley floor; the sky was cinnamon colour, changing to amber as the sun rose; the desert hills appeared deep blue to the naked eye, and brownish purple through the field-glasses.

The form of the actual flash was totally unexpected; it preceded the emergence of the limb of the sun itself by perhaps as much as two seconds, and I can only describe it as resembling a shallow and turbulent river of apple-green water hanging ready to break over the hill crest. But this river flowed with a surface which seemed to follow the minor prominences of the skyline, instead of first appearing between them; it appeared suddenly, not seeming to widen

much after its first apparition, the greatest width attained being perhaps one-third of the diameter of the sun's disc. At the emergence of the orange-gold disc in the centre of this pale-green band, the two colours seemed momentarily to co-exist; this was probably persistence of vision, but indicates that there was no eye-fatigue.

The intensity of the green was never the vivid emerald of sunset which I have twice seen, once in the Mediterranean and once in Upper Egypt; it was the paler colour, which is less uncommon. Probably the actual intensity of the colour is a matter of luck. The fact of the flash appearing at sunrise seems finally to exclude any physiological cause, and agrees with the explanation of refraction through air layers of different temperatures. The apparent turbulence might well be real turbulence of the air, induced as the desert starts to be warmed by the sun's first rays.

W. LAWRENCE BALLS.

Cairo, Oct. 26.

Influence of X-rays upon Time-lags of the Faraday Effect and upon Optical Rotation in Liquids.

DIFFERENCES in the time-lags of the Faraday effect behind the magnetic field in various liquids have been measured by Beams and Allison (*Phys. Rev.*, **29**, 161; 1927). Certain considerations have led me to suspect that these time-lag differences might be affected, and even reduced to zero, by the action of X-rays on the liquid. A number of experimental tests very recently carried out demonstrate that the X-rays have such a property. It was found in every case that the time-lag differences of the Faraday effect between any pair of the liquids vanished so long as the liquids were exposed to the X-rays, and that the lags were restored with the screening off of the X-rays. The liquids thus far used are carbon disulphide, carbon tetrachloride, ethyl alcohol, xylene, and chloroform.

The method also affords a means of measuring the absolute time-lags of the Faraday effect, giving values for the various liquids which are consistent with the previously measured time-lag differences.

This work having shown an influence of X-rays upon the lag of the Faraday effect, it was decided to find out whether these rays could produce an effect in rotating the plane of polarisation of light in these same liquids. A preliminary series of tests shows that a beam of X-rays traversing the liquids does impart to them the power of rotating the plane of polarisation, though it is small.

These investigations are being continued, and it is hoped that a detailed report of them will be published in the near future.

FRED ALLISON.

Alabama Polytechnic Institute,
Auburn, Alabama,
Oct. 11.

Synthesis of Rubiadin.

MY attention has been directed to a paper in the August (1927) issue of the *Journal of the American Chemical Society* (p. 2043), in which Stauder and Adams have shown that rubiadin is not 1,3-dihydroxy-4-methylanthraquinone. It is of interest to record that we came to the same conclusion by condensing cresorsellinic acid with benzoic acid in presence of sulphuric acid.

1,3-Dihydroxy-4-methylanthraquinone melts at 265°-266° (not 251°, as found by Stauder and Adams) and the diacetyl derivative melts at 181°-182°. The deacetylation product melts at 265°-266°. We have also succeeded in synthesising rubiadin itself by condensing dihydroxyparatoluic acid with benzoic acid (Schunck and Marchlewski's original method). Papers dealing with this work have already been communicated to the *Journal of the Indian Chemical Society*.

It is interesting to note that with the elimination of rubiadin from the list of α-methylanthraquinone derivatives there is not a *single* natural product (of proved constitution) left in that list. Substances like emodin, chrysarobin, chrysophanic acid, etc., which have at one time or another been regarded as α-methylanthraquinone derivatives, have all been since proved to be β-methylanthraquinone derivatives. It is curious to note in this connexion that while β-methylanthracene occurs in coal tar, α-methylanthracene is a purely artificial product.

P. C. MITTER.

University College of Science,
Calcutta, Sept. 29.

Orientation of the 'Devil's Arrows,' Boroughbridge, Yorks.

AT the recent meeting of the British Association at Leeds, Excursions Handbook Q was issued for members taking part in excursion No. 18 to Aldborough and the 'Devil's Arrows.' On pages 16 and 17 of this handbook there are remarks on this monument, and a plan of the positions of the three megaliths of which it is formed, for which we are responsible.

It is now found that the measurements and azimuths on which the plan was plotted are inaccurate, and that the positions of the three stones do not, as there shown, fall on the arc of a circle. The theory derived from this supposition, namely, that the three stones originally formed part either of a great stone circle or were the remains of the peristalith of a tumulus, must therefore be abandoned.

The 25-inch Ordnance Survey map of the site shows that the three stones are actually almost in alinement. From the northern monolith the azimuths of the other two lie between 151° 00′ and 152° 30′, approximately, while the distance from the northern stone to the middle one is 200 feet, and from the northern to the southernmost is 570 feet (also approximately).

BOYLE T. SOMERVILLE.
HERBERT E. WROOT.

An Active Form of Oxygen.

AN active form of oxygen, presumably monatomic, has been produced by passing oxygen gas saturated with water vapour through a discharge tube. The oxygen was generated electrolytically and subjected to a discharge of about 1000 volts at a gas pressure of 0·4 mm. of mercury. The gas was removed from the discharge tube through a side arm, and its density measured by passing it through a small hole which was located at a distance of 25 cm. from the discharge tube. Pressure measurements at the small hole indicated a decrease in the density of the gas corresponding to about 8 per cent. monatomic oxygen. A platinum calorimeter mounted over the hole showed a decided rise in temperature during the passage of the discharge. These effects were continuous throughout one 3-hour experiment. This work is being continued with the object of determining the most favourable conditions of studying the chemical properties of this gas. It is also hoped that a measurement of the heat of association may soon be completed.

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Research in the Textile Industry.[1]

THE eleventh annual report of the Committee of the Privy Council for Scientific and Industrial Research gives a comprehensive survey of the state of research in the various branches of industry, and of developments in industrial research since that Committee was established. The record is both impressive and instructive. In its survey of the great productive industries it points out that "the textile industries, though the largest manufacturing industries of the country, are by contrast with other industries . . . far more dependent on their own efforts for the prosecution of research and for the specialised training of their technical staff. While engineering, metallurgy, and industrial chemistry are considered suitable subjects for university research, there are no university organisations for research into textile problems except at Leeds and Manchester. There is no obvious reason for this, except that the subject *from a scientific point of view is more difficult.*"

At the recent meeting of the British Association, considerable attention was for the first time given to this subject of research in the textile industries. Several papers were contributed upon textile problems and the difficulties of research workers in the textile industry were emphasised. Attention was directed to the considerable volume of work which is being conducted by the Textile Institute and by similar professional bodies which are concerned with allied branches of the industry, and to the fact that although, as the Report of the Committee of the Privy Council states, the only university organisations for textile research are at Leeds and Manchester, a large volume of first-rate work is being and has already been done by the Cotton, Silk, Linen, and Woollen and Worsted Research Associations, as well as by academic and quasi-academic bodies such as the College of Technology at Belfast, the University College at Nottingham, the Imperial Institute, the Manchester Chamber of Commerce's Testing House, and the Conditioning House and Technical College at Bradford.

The British Association would have done a useful work if it had merely succeeded in focussing the attention of the academic and scientific world upon this matter. In directing attention to the fact that the fundamentals upon which the researcher in textiles has to work are just as indefinite, and at least as variable, as the fundamentals in any branch of science and technology with which the universities have been in the habit of intimately concerning themselves, it has, however, done much more. If, therefore, the meeting has succeeded in ensuring that textile teaching and research shall and ought properly to form an integral part of university and higher technological training, and no longer remain an almost despised Cinderella of subjects, it will have rendered a signal service to the industry and probably no less a service to the academic world.

[1] The British Research Association for the Woollen and Worsted Industries: An Outline of its Activities. Leeds: Torringdon, Headingley. 1927.

Naturally the British Research Association for the Woollen and Worsted Industries, and its work, received considerable attention from the members of the British Association. This Research Association owes its inception and development partly to the Department of Scientific and Industrial Research, from which body it has received, in common with other research associations, very considerable monetary grants, and partly to the initiative and enterprise of certain West Riding industrialists. It has been guided in its development by a distinguished Council, over which Sir James Hinchliffe, a noted leader of advanced thought in the West Riding, has presided since its formation.

The Research Association has, in common with the other bodies which have concerned themselves with textile research, had to consider problems in the two categories into which all research in connexion with the industry may be conveniently divided. It has considered the industrial or practical problems of the industry, and also the scientific principles underlying all the industrial operations. In order that the necessary experimental work might be carried out, it has established physical, chemical, and biological laboratories as well as machinery rooms in which manufacturing processes may be studied from an experimental point of view. The progress which has been made has necessarily been slow, though probably no less rapid than is usual with the development of theory in any other branch of science and technology. Its work, however, seems very clearly to have demonstrated two points; it has shown, first of all, that although the textile industry has been developed by what are sometimes described as unscientific men, yet their achievements have reached a remarkable standard of accuracy, and secondly, that spectacular development and invention is, very possibly, unlikely to take place in the future. Moreover, it has emphasised the vital fact that the gradual introduction of a special technologist capable of interpreting the thought and work of the investigators in pure and applied science is indispensable if the gulf which has so far existed between the industry and the field of genuine research is to be successfully bridged.

The nature of the fundamental problem which presents itself to the textile researcher may be appreciated by the consideration of the raw material of the industry, namely, the wool fibre. Examples of fibres (under the same magnification) of (*a*) Lincoln, (*b*) Merino, and (*c*) Crossbred wools are given in Fig. 1. These photomicrographs illustrate very clearly the variation in diameter and physical structure of three typical wools. It is evident that a complete knowledge of the wool fibre is essential and must ultimately become available, and that this knowledge will involve full information of the structure and physical and chemical properties of the fibre. Such information does not at present exist. In the industry the value of raw wool is, from a monetary as well as from a manufacturing

point of view, at present judged by what is called its 'quality.' Quality is a term or number used to connote the probable spinning value of the wools (termed combing wools) employed in the worsted industry. Whilst it is true that experienced members of the worsted industry are able to gauge with remarkable accuracy the quality number or the counts to which a particular wool will spin, yet for this fundamental characteristic the industry has at present no definite measure. The quality of a fibre may, for example, depend on diameter, length, and elasticity, and each of these provides, in itself, a subject for research. Important biological and physical problems must be considered in connexion with the length of the staple, while the elasticity involves a knowledge of the physical, and probably of the chemical, structure of the fibre.

These matters are fundamental subjects of importance upon which the Woollen and Worsted

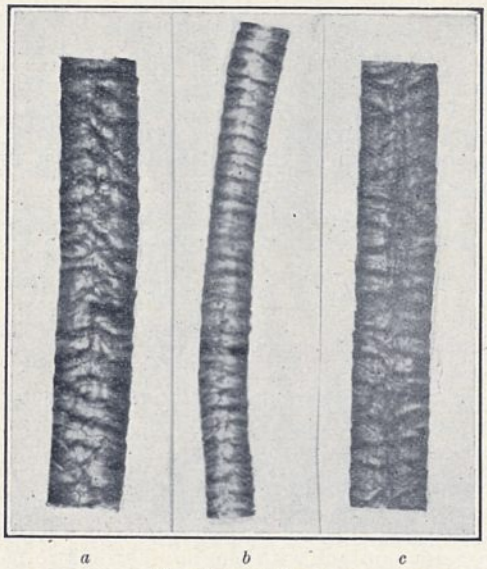

FIG. 1.—Wool fibres.
a, Lincoln wool fibre; *b*, merino wool fibre; *c*, crossbred wool fibre.

Research Association, as well as several other workers in textile technology, are now engaged. In "An Outline of its Activities," a recent publication of the Woollen and Worsted Research Association, the present position has been summarised. This report states, *inter alia*, that "at present there is an entire lack of definite knowledge on both points [the determination of the precise characteristics of and the best means of production of the raw material] regarding this raw material. The primary factor is to investigate those points regarding quality which may be expected to have a direct bearing on the economic value of the fleece."

Some of the chemical problems which have engaged the attention of the textile researcher are of special interest, indicating as they do the extent of the field for systematic research. The method of elimination of grease from raw wool by scouring with soap and alkali is being investigated. The soaps used may not, after scouring, be completely eliminated from the wool, and it appears that unless the soaps are made from suitable fatty acids, other products are produced after scouring takes place, and these products materially affect subsequent processes, such as dyeing and finishing, to which the wool, in one form or another, is subjected. A preliminary examination appears to show that the absorption of alkali by wool may increase the susceptibility of the resulting cloth to bacterial action and may cause the dyeing affinity to vary from point to point of the cloth. The cause of this variation in distribution of the alkali after scouring is not merely mechanical but is undoubtedly related to alkali migration and to chemical action.

Probably one of the most important aspects of the chemical work of the Research Association, a reference to which is made in the recent publication of the Association, is an investigation which it is conducting jointly with the Society of Dyers and Colourists. This investigation, which is being directed by a joint committee, will, it is understood, include initially fastness tests for sunlight, washing, and perspiration. The fastness tables which are already in existence do not give a definite fastness test to dyed materials, because the tests have so far been applied to single dyestuffs only. In practice, dyeing by single dyestuffs is not usual. The work which is now in process should thus enable the preparation of a complete standard for dyed or coloured materials.

One of the most interesting, though at the same time incomplete, investigations which has been made is the physical examination of the wool fibre. The report of the Research Association states that "wool is an amphoteric colloid which in regard to physical and chemical relations presents the well-known colloidal characteristics." Dr. Shorter, in the *Transactions of the Faraday Society*, describes his attempts to develop a complete colloidal theory of the elasticity of the wool fibre. In his theory he attributes "to the fibre the characteristics of a two-phase system consisting of an elastic frame-work (the elastic phase), the interstices of which contain a viscous medium (the viscous phase)." The elaboration and extension of such physical work must ultimately yield results of fundamental importance in so far as the primary formation of the fibre is concerned.

Other investigations, though probably of no less fundamental significance but of immediate practical importance, are being made into the thermal conductivity of wool, its electrification and electrical conductivity, its elasticity, and especially into the effect of moisture upon it. The action of water upon wool is of immense practical importance, as it has a well-defined effect upon the combing, spinning, and manufacturing properties of the fibre, and depends to a very large extent upon the degree of moisture and the conditions under which the moisture reacts with the wool. It is, of course, well known that one of the reasons for the prosperity of the textile industry in Yorkshire and Lancashire is the dampness of the climate in those areas. This condition formerly made possible operations in those areas which could not be carried out as

efficiently elsewhere. The advent of systems of artificial humidification have, however, neutralised to some extent the natural advantages of the climates of those localities, and the work to which reference has already been made indicates that a complete knowledge of the mechanism of these actions is now within measurable distance.

The development of textile research would appear to deserve not only the attention which the British Association has properly given to it, but also the best which can be afforded by our academic and industrial bodies. Research is not, and should not be, the responsibility of one particular body. The research associations can do a great deal. The industries and the large academic bodies have also an equally important duty to perform. The co-operation and sympathetic efforts of all these bodies should, however, ensure that textile research shall, under the favourable conditions which now exist, enter upon one of the most important stages in its development. Whitehead, in the preface to his "Principles of Natural Knowledge," points out that his inquiry "raises more difficulties than those which it professes to settle. This is inevitable in any philosophical work. . . . All that any one can hope to do is to settle the right sort of difficulties and to raise the right sort of ulterior questions, and thus accomplish one short step further into the unfathomable mystery." So it is with our textile researches.

The Germplasm and its Architecture.[1]

By Dr. F. A. E. CREW.

THE neo-Mendelian theory is like its parents a particulate theory, implying that the germplasm of organisms is not an indivisible whole but an organisation of units or factors which can be dissociated and recombined in various ways, just in the same manner as on the atomic theory a chemical compound is not a thing indivisible but an organisation of units which can be dissociated and recombined in other ways. But it differs from the theories that have gone before in that it is not purest speculation, incapable of confirmatory test; it is not merely an *ad hoc* explanation. It is not a preformatist doctrine, for no one ever seriously held that a factor was in any way a miniature replica or even was representative of a single character. The term unit character itself has been dropped, for it was misleading in view of the manifest fact that characters can never be units. The attitude of the geneticist in regard to the architecture of the germplasm is similar to that of the chemist in regard to the atomic constitution of matter. It is held that the hereditary constitution of an individual is not only composed of units in particular proportions and arrangement, but that its effects are determined by these proportions and by this arrangement just as much as by the particular nature of the units themselves. A character is the resultant of a large number of agencies of the internal environment of the zygote interacting with a large number of agencies of the external environment.

Weismann, in constructing his edifice of theory, with its purely hypothetical determinants, biophors, and ids, at least did one thing that must make his name immortal; he attached his speculations to something tangible by locating his units in the then newly investigated chromosomes. In this guess he enshrined the truth, for *Drosophila melanogaster*, in the hands of Morgan, Bridges, Sturtevant, Muller, and their colleagues, has provided definite and final proof that the chromosomes are indeed the germplasm, that upon each chromosome is borne a certain definite association of the hereditary factors or genes, and that each gene has its own particular place upon a particular chromosome. It has been possible in the case of Drosophila to construct a map of the chromosomes showing the relative position of all the genes so far discovered, and this map, like a railway time-table, giving the sequence of the places and the distance between them, in the hands of the breeder of this animal endows him with the powers of the synthetic chemist in the manipulation of his own material.

As yet, there exists but little exact knowledge of the chemical nature of chromatin: it is known, however, that it is intimately related to the activities of the cell as a whole; that it has a definite architecture and disposition within the nucleus; that during cell division it becomes condensed and homogeneous and then displays most clearly its organisation into units, the chromosomes. It is established that the number, size, form, and behaviour of the chromosomes are constant in a species and are characteristic of that species. It is known that even when the chromatin is thus condensed in the form of chromosomes, it still retains its organic contact with the non-chromatic part of the cell of which it is but a part, though an essential part: it is established that no development is possible at all in the absence of at least one haploid set of chromosomes. It has been amply demonstrated that the only identifiable cell organ which can satisfy the demands made upon the germplasm by the results of countless experiments are the chromosomes, and that in the behaviour of these are realised the precise conditions of hereditary transmission as recorded by observation.

The exact parallelism between the distribution of the chromosomes and the distribution of the hereditary characters affords an explanation of the ratios obtained in experiments involving freely assorting characters, if it is assumed that within the chromosomes are resident the genes, for the gene within the chromosome must necessarily go whither the chromosome passes. It is established that the chromosomes in the immature gamete and in the body cells generally are present in pairs, and that of each pair one member has been received from each parental organism. It has been demonstrated that in the ripe gamete only one member of each pair of

[1] Continued from p. 698.

homologous chromosomes is present, and moreover, that the sorting of the chromosomes during the maturation of the gamete is at random, the distribution of one member of one pair being in no way influenced by that of either member of any other pair. It is not difficult, therefore, to explain the results of an experiment involving more than one pair of factors and giving free assortment and recombination, for all that must be postulated is that the different factor pairs are resident in different chromosome pairs.

The facts of linkage can be interpreted by postulating that the factors for linked characters are resident in one and the same chromosome, and that for this reason they must remain together in inheritance so long as the chromosome concerned retains its integrity. The facts of crossing-over can be explained by postulating that the cause of this is an interchange of material between the members of a pair of homologous chromosomes, these chromosomes being dissimilar in their genetic constitution. It is frankly admitted that in this matter of crossing-over genetics has outrun cytology, just as at one time cytology had outpaced genetics in regard to the mechanism of sex-determination, but the fact of crossing-over must not be confused with the validity or otherwise of the suggestion put forward to explain it. It is the case that during the maturation division in gametogenesis the segregation of homologous chromosomes is complicated by the fact that the members of each pair, prior to their separation, become most intimately intertwined. This apparently single, but really double, chromosome then splits longitudinally. This conjugation of homologous chromosomes provides the opportunity for crossing-over. It cannot be shown to have occurred, but if during this conjugation the two chromosomes stick, fracture, and rejoin before separation, then interchange of chromatin will have occurred. It is not without significance that conjugation occurs when the chromosomes are drawn out to their greatest attenuation, so that the homologous chromomeres derived from the two parents achieve the maximum degree of association in a linear series.

It is seen that the equivalent chromosome contributions of the two parents and their random assortment in maturation and chance recombination in fertilisation, together with the possibility of an inner reorganisation of each chromosome through its most intimate association with another of identical structure but different content, provide an infinite range of new combinations of character which can be tested out by environmental agencies. The chromosome mechanism can supply the variations upon which the forces of selection can operate. It becomes apparent also that this conjugation of chromosomes in synapsis excludes the possibility of fruitful crosses between species widely different in chromosome constitution.

If the conjugation of homologous chromosomes is accepted as evidence in support of the conception of crossing-over, and if the genes are strung like beads upon a string, each particular gene having its own particular locus upon a particular chromosome, then it follows that the percentage of crossing-over between any two loci can be regarded as an indication of the distance between them. If the members of a pair of homologous chromosomes during their conjugation are as likely to fracture and reunite at one point as at any other point along their length, it follows that the farther apart any two genes lie in the chromosome, the greater is the chance of crossing-over occurring; and, conversely, the nearer together the genes lie, the smaller is the chance of crossing-over occurring. If this is so, then it is possible to construct a map of the chromosomes, showing the relative positions of the different genes resident in each. If A, B, and C form a linear series, and if B lies between A and C, then the crossing-over percentage occurring between A and C should equal the sum of the crossing-over between A and B, B and C.

The conception of the localisation of the genes in linear alinement is due to the peculiar differences between the crossing-over between genes of the same character linkage group. The relation of three or more points to each other is a relation of linear order and cannot be represented in space in any other manner than by a series of points arranged in a line. Linearity is the expression of a system in which there is a fixed succession of elements. The distance between any two elements is constant but is variable throughout the series. In the case of the more simply organised forms of life it is possible to conceive the germplasm having the form of a congeries of chromatin units, the members of which can exist separately within the nucleus and become associated by chance. In the more complex forms, however, the precision exhibited in the inheritance of a most complicated characterisation demands a very precise and more complex hereditary mechanism, such as is supplied by the chromosomes in their constitution and behaviour.

The Columbia school has practically completed the essentials of the static theory of heredity concerning the existence and distribution of genetic units initiated by Mendel. The germplasm has been identified and its architecture defined. The chromatin material of the nucleus of the cell is the germplasm and the hereditary units are the genes. A gene is a particular state of organisation of the chromatin at a particular point along the length of a particular chromosome. It is a particular area or locus of the chromosome in a particular state. One particular condition of this chromatin can be replaced by others and with each change another gene appears.

The Columbia school has, however, done more: it has initiated a dynamic theory concerning the relation of these genetic units to development. Bridges, out of his magnificent work on balanced intersexuality in Drosophila, was able to lay the foundations of the fundamental theory of genic balance, according to which the effect of a gene depends not only upon environmental conditions but also and particularly upon the other genes with which it is associated in the hereditary constitution of the individual. Bridges has proven up to the hilt that the sex-chromosomes exert their effects

not *per se* but only when in a certain relation with other chromosomes. Further, it has been shown that the subtraction or addition of whole chromosomes or of whole sets of chromosomes, as in haploid or polyploid individuals, is associated with constant and definite variations in characterisation. This observation, first made by Gates, has been extended, for example, by Bridges to Drosophila, by Wettstein to mosses, and by Blakeslee to Datura.

It is an obvious fact that the extent of our knowledge of the genetics of a particular form is determined by the frequency of mutation in that form. So much is known of Drosophila, because, amongst other things, observed mutation in this form is relatively common. The gene is stable and so far has resisted most attempts to modify it experimentally. It will be recognised that if the usual genetical methods of investigation are to be used, then in the case of an animal or plant of economic importance in which mutation is rare, there can be no rapid increase in our knowledge of the genetics of this form until it has become possible to provoke mutation at will. It has been reported repeatedly that germinal changes, presumably mutational, had been induced by X-rays, radium, alcohol, lead, antibodies, and so forth, but the interpretation of the data thus secured has been highly disputatious. It is known that X-rays can and do affect the distributive mechanism of the chromosomes and the phenomenon of linkage, and it is now reported by Muller that radiations of short wave-length can produce gene mutations in a high proportion of germ cells so treated. Mutations thus produced are stable in their inheritance and behave in a manner typical of Mendelian chromosomal mutant genes found in organisms generally. Such treatment produces an increase of about 15,000 per cent. in the mutation rate of the stock. Many of the mutations invoked are those which have previously appeared in Drosophila; many, on the other hand, are mutations in loci, in which mutation apparently has never been observed before.

Through the use of appropriate doses of X-rays also it has been found to be possible to provoke a high proportion of rearrangements in the linear order of the genes associated with fragmentations and translocation of portions of a chromosome. Here, lying now in our hands, is the very tool wherewith to explore the hereditary constitution of animals and plants of interest and of economic importance. No longer must we wait for mutations to occur: no longer need we squabble amongst ourselves concerning the rôle of external agencies in the provocation of mutation, for it is demonstrated that it is possible in our chosen experimental stocks to manufacture series of artificial strains for use in the study of genetic and phænogenetic phenomena. It may soon be possible to produce to order sufficient mutations to furnish adequate chromosome maps, and thereby to give to the breeder of domesticated stock the powers of control that he must have to be ultimately successful. There is no reason to assume that X-rays alone will do this thing: doubtless there are plentiful agencies, chemical and physical, which appropriately exhibited will do the same.

Advances in genetics in the more immediate future will be in the borderland of formal genetics and of developmental physiology. They will result from the deliberate and artificial induction of mutation and from the study of the gene in action. In this latter field the trail has been blazed by Goldschmidt and by Haecker. Drosophila has served its purpose magnificently, but the time now approaches when other animals will usurp the centre of the genetic stage; experimentation will become more laborious, since each gene will have to be examined for the kind and rate of change which it produces. Geneticists, hearing of the vein discovered by Mendel, rushed headlong to this new Klondyke, avid for the gold of truth. They are now returning, some empty-handed, but many with nuggets of great worth. It will be well for biological science if those who resisted the call and stayed dutifully behind deny themselves the simple amusement of taunting the wanderer until at least they have assured themselves that nomadism of this kind must necessarily be profitless.

Rationalisation in Industry.

FOR many reasons the introduction of scientific research into the old-established industries of Great Britain as an aid to production is a lengthy and difficult process. Much progress, however, has been made in recent years, notably with the aid of co-operative research associations, but much more remains to be done. The degree of interest in research shown by industries is a matter of concern to every scientific man, for an increasing appreciation of the potential industrial value of research spells more practical interest in the work of universities and similar institutions where pioneering investigations are carried out, and increased outlet for scientific employment.

How confidence can best be fostered is a matter of concern to many, and various ways have been tested or considered. Research is slow to fructify, and industrial research may be especially so when the objective is restricted and definite. While broad researches are maturing the interest of the manufacturer may wane unless he have the stimulus of some accessory assistance. The successful solution by scientific research of a simple technical problem may be as convincing to a manufacturer as a far-reaching investigation of, say, the properties of his raw materials, necessary though that investigation may be. The simple problems cannot be ignored. Similarly, the demonstration of the utility of existing information is a valuable aid. There is much scope in industry for the increased utilisation of current information, scientific or otherwise, and valuable propaganda work can be accomplished by the organised collection and distribution of such information. In

this connexion a group of papers relating to information, organisation, and statistics in commerce and industry, discussed at the recent conference in Cambridge of the Association of Special Libraries and Information Bureaux, is of direct interest.

The first paper in the group, dealing with rationalisation in industry, was communicated by Major L. Urwick, honorary secretary of the Management Research Groups. The basic idea of the rationalisation movement is 'control' in the sense of "the detailed analysis and measured presentation of the facts in each and every set of circumstances—and the planning and organisation of future common action in the light of those facts." The movement is, in reality, an endeavour to develop the scientific habit of thought within industry and commerce. It insists that the phenomena influencing the course of business have each their cause, that the causes are capable of investigation and definition in the light of modern knowledge, and that the facts so gathered can advantageously be applied to the effective solution of fresh problems. Such an outlook must, as Major Urwick points out, be rationally applied to a manufacturing concern as a whole. It is useless, for example, to attempt to improve output by motion study among the operatives until the management, organisation, and planning of the concern as a whole have been put upon a sound basis; in the smaller industries, labour is often more conscious of inefficiencies than is management. The objective should be a well-planned structure, strong, efficient, and co-ordinated in all its activities, and ever alert for improvement.

In Great Britain the movement has recently found an outlet in the formation of the Management Research Groups. Co-operation is essential to the success of the movement, which calls for the free exchange of experience and facts bearing upon every aspect of industry. Each of the groups is a small band of representatives of manufacturing concerns in different industries. No two competing firms are represented in the same group, a compromise which meets the still existent feeling in favour of secrecy in industry. The firms in any group can investigate and discuss the best practice in each individual concern without fear of giving advantage to a trade rival. Major Urwick's survey of the need and scope for rationalisation in industry was of such great interest that it was to be regretted that time did not permit him to give a more detailed account of the progress of the Management Research Groups with which he is associated.

In the course of his paper, Major Urwick directed attention to the need for more and better co-ordinated statistics; in a later paper, Mr. A. E. Overton, of the Board of Trade, described the trade information and statistics in Great Britain as compared with those in other countries. Many manufacturers and traders are probably not fully aware of the sources of statistical information that are available, and to these Mr. Overton's paper will be of value; reference is made to the time-lag in the issue of the statistical information from the various sources and the degree of classification adopted. Statistics of external trade and of internal production are of course of prime necessity in business forecasting, a subject discussed in the paper by Mr. W. Wallace. This paper outlines and illustrates the conclusions of the Harvard Committee on Economic Research; incidentally, it gives due weight to the limitations of business forecasting in its present pioneer stage. The paper by Mr. S. J. Nightingale and Miss A. L. Bennie dealing with statistical analyses in the engineering industry gives illustrative examples of the analysis of the available information in the formation of a sales policy. A further example of the use of statistics in an industry was given by Mr. F. W. Tattersall, who discussed the relation of cotton statistics to marketing and market estimation, and the group of related papers was completed by Mr. F. Hall's account of the more general aspects of the trade survey.

At first sight the interest of such papers for a conference of the Association of Special Libraries and Information Bureaux is not obvious. The collation of sources of information, which is the chief function of the Association, should, however, render the latter almost essential to the rationalisation movement. The Directory of Sources of Specialised Information which the Association is shortly to publish will be of the greatest assistance to those who have to collect and collate the facts that industry needs. As an organisation for ascertaining and indicating where information is to be found, the Association should play a not insignificant part in the movement.

The movement deserves at least the benevolent interest of the scientific worker. It awakens in industry the scientific habit of thought; it encourages the wider dissemination of knowledge, including scientific fact; it fosters an increasing interest in, and appreciation of, science; if successful, it cannot fail to stimulate the utilisation of scientific research in industry.

Obituary

DR. D. G. HOGARTH, C.M.G.

BY the unexpected death of Dr. David George Hogarth on Nov. 6, geography and archæology lose one of their most distinguished representatives in Great Britain, and the University of Oxford one who combined in an unusual way the qualities of a student and a man of action and affairs. Born on May 23, 1862, at Barton-on-Humber, he was admitted commoner of Winchester in 1876, and elected to a classical demyship at Magdalen College, Oxford, in 1881, where he was placed in the first class in Honour Moderations and Literæ Humaniores, appointed to a classical lectureship, and then in 1886 elected to a fellowship. Both at school and at college he distinguished himself as a runner, and made himself felt in the social life of the place, presiding over the Junior Common Room, acting with the O.U. Dramatic Society, and

editing the *Oxford Magazine*. Of these early days he has left his own frank account in one of his most characteristic books, "Accidents of an Antiquary's Life."

It was, indeed, a group of accidents that determined Hogarth's career. The Craven Travelling Fellowship, of which he was the first holder in 1886, was itself an experiment in classical endowment, though the benefaction was an old one. The new Lincoln and Merton professorship in classical archæology and art was inaugurated in 1885 by Dr. (now Sir) W. M. Ramsay, who had begun in 1880 those journeys which revolutionised our knowledge of ancient Asia Minor. Hogarth had already been attracted by the historical and geographical achievements of Alexander the Great, and was collecting materials for his "Philip and Alexander," though this was not published until 1897. He seized the opportunity of apprenticeship to field work with Ramsay; and so began a partnership in research, all the more fruitful because the qualities of the two men supplemented each other. As one of the first students at the newly founded British School of Archæology at Athens, he took a leading part in excavating the famous Temple of the Paphian goddess in Cyprus. First fruits of this adventure and of an extensive tour in unfrequented parts of the island were published in 1890 under the title of "Devia Cypria." In Cyprus, then, and Asia Minor, he began that intimate acquaintance with the peoples and problems of the Near East which led him afterwards to Deir-el-Bahari, Naukratis, and Carchemish, to North Arabia, and the 'Arab Bureau' in Cairo.

To combine these vacation pursuits with the routine of a college dean and vice-president was not easy. "Philip and Alexander" had to await the convenience of Turks and undergraduates; but with wise economy of resources Magdalen created a research fellowship, and made Hogarth master of his time and movements, with an Oxford home in which to store and work up his materials. Fortunate again in his opportunities, he was Director of the British School at Athens, and in charge of excavation on the prehistoric site at Phylakopi in Melos, during the years when Crete fell free of Turkish rule and excavation became possible there; and in the early years of Sir Arthur Evans's great enterprise at Cnossus, Hogarth was engaged in opening tombs hard by, and in exploring the important and difficult 'Cave of Zeus' on Mt. Dicta, and the remote but significant site at Zakro, looking out over the ancient sea route to Egypt. Emergency work at Naukratis, rendered necessary by the extension of irrigated land in the Delta, took him in 1899 and 1903 to Egypt, where he had already excavated at Deir-el-Bahari in 1894, at Alexandria in 1895, and in the Fayum in 1896. Then came the British Museum's excavation of the Temple of Artemis at Ephesus in 1904–5, with unforeseen difficulties from flood and fever, and no less unforeseen results in the splendid foundation-deposit of early goldwork and ivories, throwing quite new light on early Ionian art and culture. These were published in a stately memoir in 1908, and interpreted in larger historical perspective in "Ionia and the East" in 1909. After another season in Egypt, at Assiut, came another chance to break fresh ground, at Carchemish on the Euphrates, again for the British Museum, with assistants of his own training, T. E. Lawrence and C. L. Woolley, both destined to notable achievements later.

Meanwhile a fresh line of work opened in 1909, when Sir Arthur Evans resigned the keepership of the Ashmolean Museum, which he had re-created as a centre of prehistoric and oriental studies. Hogarth was the obvious man to succeed him, and the peculiar combination of facilities for home study and field work which the keepership offers, happily provided for him the post which he held until his untimely death. He retained his Magdalen fellowship, and took an ever-increasing part in University affairs, on the Hebdomadal Council, the Clarendon Press, and (later) the Statutory Commission; and it was at one time hoped that he might represent the University in Parliament.

Across these many activities, and still more across his archæological work, broke the Great War. Hogarth had intimate knowledge of Turkish and Arab ways, and was able to render most valuable services in organising and directing that 'Arab Bureau' in Cairo which prepared the way for attacking the Ottoman Empire at its weakest point, through that 'Revolt in the Desert,' in which T. E. Lawrence was his own discovery. At the Peace Conference he represented Great Britain in the Middle East Commission, and maintained the keenest personal interest in the new regime and its problems. For these public services he was honoured with the C.M.G., and Egyptian and Arab decorations. His wide and detailed knowledge of Arabia and the neighbouring lands was recognised already by the award of the Founder's Medal of the Royal Geographical Society, and assured his election as president of that Society in 1925.

With these numerous calls upon his time and great abilities, Hogarth's output of scientific work was less abundant and consecutive than those who best knew his fine scholarship, wide learning, and literary facility, had reason to expect. Not that he neglected the prompt and detailed publication of his numerous pieces of field work and excavation—though this was not the side of the business that best pleased him. But, naturally laconic, and clear-headed, he wrote concisely, and without parade of information, beyond what was essential to his point. He had, moreover, a journalistic—or was it rather Herodotean—appreciation of episodes and situations, vividly revealing "all the kingdoms of the world in a moment of time," and some of his best remembered writing deals with incidents of this kind. But for a man of these wide interests "the world is so full of a number of things," that a lifetime passes all too soon, in 'Forschungen' and 'Prolegomena,' not to mention the "History of the Air Force," which he inherited from his friend Sir Walter Raleigh, and a projected life of 'Arabian' Doughty, another of his heroes. "Alexander" seemed always to have to wait.

What will be remembered, however, besides

Hogarth's brilliant summaries of geographical and historical knowledge, "The Nearer East," "The Penetration of Arabia," "The Ancient East," and "The Balkans," is his monumental catalogue of the "Hittite Seals" of the Ashmolean Museum (1922), and the numerous short articles which announced, interpreted, and thereby in a very real sense guided the progress of discovery in the difficult history and ethnography of Asia Minor and North Syria. Though he never brought his materials together into a general survey—for which, indeed, the time is scarcely yet come—this group of problems was that to which his mind seemed most spontaneously to recur; to which he gave all time spared from the more urgent 'accidents' which beset a 'wandering scholar'; on which his judgment was most in demand among colleagues who had not his distractions and occasions. Had he entered the army (as at one time he desired), Hogarth might have been a great commander, for he could handle men, and his decisions were those of a 'cavalry-mind.' In his actual career he was a superb scout, with a general's outlook over the prospects and trend of exploration. J. L. M.

News and Views.

THE appearance of Prof. C. T. R. Wilson's name in the list of Nobel prize winners for 1927 will be received with acclamation by physicists throughout the world. The polished perfection of his experimental work and the subtle ingenuity of his methods have long been the admiration and the despair of workers in the same or in cognate fields. Prof. Wilson is, perhaps, best known for his experiments on the tracks of ionising particles in gases, work which has occupied him, at intervals, from the time when he joined the first group of research students under Sir J. J. Thomson, some thirty years ago. His discovery that gaseous ions would serve as nuclei for the deposition of water drops was the basis of the first methods of measuring the charge on an electron. With definite patience and resource, the technique of these early experiments has been gradually perfected, until now it is possible to make visible, and to photograph, the actual tracks of ionising particles, to count their number, and to watch every twist and turn in their paths. The power of rendering visible, at will, the actual paths of particles which, themselves, must remain for ever invisible is a weapon of no small value in investigating the behaviour of these particles, and Prof. Wilson's apparatus is being employed more and more in our great research laboratories, almost always with striking and important success. Prof. Wilson, however, is not known only by his work on 'tracks.' He is one of our foremost experts on atmospheric electricity; and it would be both unfair and ungrateful not to recall in conclusion his 'tilted' electroscope, a measuring device which made possible much of the early work on ionisation in gases.

PROF. ARTHUR COMPTON, of Chicago, who divides with Prof. Wilson the Nobel prize for physics for 1927, belongs to the younger school of American physicists, and has distinguished himself by the daring originality of his speculations, as well as by the variety and ingenuity of his experiments. Adopting the new 'quantum' theory in its most extreme form, he was able to calculate the change in wave length which should occur when X-rays are scattered, and by very able experimental work to obtain confirmation of his calculations. The technique of these experiments was so difficult that it was some time before the results were confirmed by other workers, and some controversy arose as to the genuineness of the effect. In the end, however, the Compton effect was finally established, and it stands to-day as the firmest individual piece of evidence in favour of the hypothesis of localised light quanta.

THE recent judgment of the Court of Appeal in Inland Revenue Commissioners *v.* Yorkshire Agricultural Society, before the Master of the Rolls, Lord Justice Atkin, and Lord Justice Lawrence, is significant as indicating the confusion and difficulty prevailing in interpreting what is or what is not a 'charity' within the meaning of the Income Tax Acts. The Commissioners had refused the claim of the Society to exemption, whilst on appeal to the Special Commissioners the claim was allowed. Mr. Justice Rowlatt in the High Court afterwards reversed the decision of the Special Commissioners; and now the Court of Appeal unanimously affirms the Special Commissioners' decision. In giving judgment for the Society the Master of the Rolls referred at length to the objects for which the Society was established, pointing out that it was formed at York in 1837 for the purpose of holding an annual meeting for the exhibition of farming stock and implements, etc., and for the general promotion of agriculture. Prizes were awarded, and the members enjoyed certain privileges and benefits. The privileges and benefits which the members derived did not, in his lordship's opinion, in any way detract from the fact that the purpose of the Society was charitable within the meaning of the Act, any more than the privileges and benefits which subscribers to other charities, such as hospitals, derived, altered the fact that they were charities. He held that this Society, which by its constitution in 1837 and since had continued for the purpose of the general improvement of agriculture and not merely for the special benefit of its members, was in fact a society for the general benefit of the community, and therefore came within the accepted definition of a charity as laid down by Lord Macnaghten (Income Tax Commissioners *v.* Pemsel, 1891). This decision should help to define the position of scientific societies in regard to exemption from income tax; for they should be able to establish, by their constitution and the aims and objects of their work, those elements of permanency and benefit to the community that the Yorkshire Society has claimed and won for agriculture.

PROF. W. A. BONE'S researches on high-pressure gaseous combustion which, with the collaboration of assistants, have been carried on since 1920 at the Imperial College of Science and Technology, London, have become so well known, and have so direct a bearing on new developments in chemical industry, that the extension of the work and the occurrence of greater opportunities for training in its special technique will arouse more than local interest. A generous donation and annual grant by Imperial Chemical Industries, Ltd., together with increased assistance from the Department of Scientific and Industrial Research, have supplemented the funds already supporting the investigations, making possible the equipment of two new high-pressure gas research laboratories, including an experimental gas-generator plant, gas-holders ranging in capacity from 10 to 3000 cubic feet, and compressors. The explosion bombs will be capable of withstanding pressures ranging from 100 to 20,000 atmospheres, respectively, and the catalytic-tube units will withstand 500 atmospheres at 500° C. By the end of March 1928, most of the new equipment will, it is expected, be ready for operation, and a limited number of selected post-graduate research students (early application regarding the vacancies being advised) will be accepted for systematic training over a period which will usually be not less than two years. The staff will consist of four research assistants, an instructional assistant, and a mechanical assistant; the work will be directed by Prof. Bone, assisted by Dr. D. M. Newitt and Dr. D. T. A. Townend, and by Mr. W. E. Stockings.

A DISPATCH from the Cairo correspondent of the *Times* which appeared in the issue of Nov. 9 describes some of the results obtained by the excavations at Sakkarah, where work has now been resumed for the season. The excavations, which began in 1923, are being carried out under the direction of Mr. Cecil Firth for the Egyptian Department of Antiquities. They have opened up an entirely new chapter in the history of Egyptian art and architecture, and may be expected to lead to even more important results in the near future. In carrying on the clearing of the Temenos surrounding the Step Pyramid, which was begun in 1926, it was discovered that at one point where the Temenos wall was higher it formed the superstructure of a tomb which proved to be of the III. Dynasty, and must have belonged to a member of the Royal family or an important personage of the court. Access was obtained to the tomb after immense labour by means of a plunderer's shaft in the rubble and giving access to a rectangular space cut in the rock, and a stairway leading at a distance of twenty yards to a doorway beyond which the stairway continued. This passage, after passing two sets of chambers, eventually reached one of the most extraordinary funeral apartments ever found. So far as explored it has two rooms which were entirely lined with blue tiles. In one room, three doors each had exquisite reliefs of King Zoser wearing the red or white crown. The tiles were arranged to give the impression that the rooms were lined with reed mats, placed vertically, except over the panels of the doors and the drums over the doorways where they are horizontal, and give the appearance that the mats are rolled up to reveal the reliefs. A series of passages behind leads to a pit filled with debris, upon which work is now being concentrated.

COD-LIVER oil has for long been considered the most potent source of the two fat soluble vitamins A and D: but, though palatable to some, to others it possesses an unpleasant flavour which is only imperfectly disguised even when the oil is mixed with extract of malt. The discovery by Rosenheim, Webster, and Windaus (*Lancet*, 1927, vol. i. p. 306, and NATURE, Sept. 24, p. 440) that the parent substance of vitamin D (the antirachitic vitamin), from which it is formed by the action of ultra-violet light, is ergosterol or a highly unsaturated sterol of similar constitution, opened the way to the production of this vitamin on a large scale, under controlled conditions, and without the necessity of using cod-liver oil at any stage, since the ergosterol can be obtained either from ergot or yeast as a pure chemical compound. Although vitamin D is specific in its effect in ensuring proper calcification, its absence from the diet leading to the development of rickets, yet in its influence on growth it is associated with vitamin A: the latter is probably of the greater importance in this connexion, but its full effect in producing growth in the young animal is not observed unless vitamin D is also present. For this reason vitamin D alone would be of less general use than if accompanied by vitamin A.

THE British Drug Houses, Ltd., London, N.1, have taken advantage of the recent advances in our knowledge of the vitamins to put up preparations containing vitamins A and D obtained from sources not previously utilised. Vitamin D is made by the irradiation of ergosterol, and is issued under the name 'Radiostol' in solution as a sweetmeat pellet. Vitamin A is contained in an oil not previously used as an accessory food: it is issued, combined with vitamin D, as an oil called 'Radiostoleum.' The latter is also issued as an emulsion, 'Radiomulsin,' and as an emulsion with malt, 'Radio-Malt,' in which the malt extract provides also a supply of vitamin B. The vitamin content in these different preparations is controlled by physiological feeding tests on animals, and is higher than in cod-liver oil and its various preparations.

THE Slutzk, better known under its original title, Pavlovsk, Observatory for meteorology and geophysics, will celebrate on Dec. 4 the fiftieth anniversary of its foundation. Well equipped with magnetic instruments designed by its eminent first director, H. Wild, and for many years the most northern magnetic observatory in the world, Pavlovsk has supplied a long series of valuable magnetic results, which have been utilised in many researches by foreigners as well as Russians. Observations in atmospheric electricity, begun in 1913, have supplied data of much interest in connexion with the vexed question of the true nature

of the diurnal variation of the potential gradient. Actinometry has also had a special place in the programme of the observatory during the present century. Aerological work in Russia had its origin at Pavlovsk some thirty years ago, but it is now provided for in a separate institution. Foreign participation is invited in the approaching ceremony.

AN interesting biographical sketch, by Mr. Rollo Appleyard, of Heinrich Hertz, one of the greatest pioneers on the transmission of electrical waves, appears in the October number of *Electrical Communication*. At the age of twenty-three years, Hertz was elected a demonstrator in physics by Helmholtz. Three years later he became a lecturer in theoretical physics in the University of Kiel. After two years at Kiel he became professor of experimental physics at Karlsruhe, and finally he was appointed to succeed Clausius as professor of physics in the University of Bonn. His wonderful experiments on the reflection, refraction, and polarisation of electric waves created intense interest at the time and opened a new field of research. They form the foundation on which most of present-day developments on radio communication are based. The author gives photographs of Hertz's original apparatus and of the devices he employed to produce and to detect the electric waves. He points out how nearly Hertz and his colleague Lenard anticipated the discovery of Röntgen rays. Hertz himself thought it unlikely that electric waves through space could be used for communication. He died at the early age of thirty-seven. Those who knew him best remember him as a singularly modest man, one who seldom spoke of his own discoveries and never mentioned himself. When the Royal Society presented him with the Rumford medal, he silently disappeared from Bonn for a few days, giving no reason for his absence. He studied pure science exclusively, and yet the importance of his discoveries in the advancement of the practical applications of electricity is beyond measure.

OPINIONS may differ about the ethics of greyhound race-courses, but it seems likely that this form of sport will become as popular in Great Britain as it has already become in the United States. In the *Metropolitan-Vickers Gazette* for October, a good account is given of the electrical equipment of a greyhound race-course. All around the course, which is 500 yards long, a sunken trackway is constructed in which a narrow-gauge railway is laid. The trackway is covered, but an opening in the woodwork is left on the side nearest the course. Through this opening an arm projects which carries an artificial hare. The arm forms the axle of a rubber-tyred wheel above which is the hare. It is attached to an electrically-propelled truck which collects the electric current from a third rail and returns it by the ordinary rails. Special precautions have to be taken to avoid sparking, which might disturb the dogs. Acceleration and deceleration have to be very rapid and high power is therefore necessary. The running of the truck is controlled by a single operator from a control tower observation room, so situated that a full view of the racing can be had at all times. Speeds up to 50 miles per hour are obtained, and the hare must be capable of being accelerated at a rate of not less than 2·5 miles per hour per second. When a race takes place the hare is run round the track, and immediately it has passed the boxes where the greyhounds are confined, the gate is thrown open and the dogs dash out in pursuit. The attendant keeps the hare ahead of them until the circuit is complete and then switches the truck into a siding. This causes the hare to disappear and the dogs cease to run. The Company mentions ten large towns in Great Britain for which it has supplied or is supplying the electrical equipment for the tracks.

IN order to lower the price of electricity it is necessary to have all the machines in a power station running for as long a period as possible. To enable this to be done it is advisable that engineers should encourage a night load on their stations. One way of doing this is to store up energy in consumer's houses during the night time which can be utilised during the day. One of the best ways of doing this is to heat water slowly during the night by electricity, the warm water being utilised during the day. This is already done on a large scale in several places in Great Britain and abroad. In Basle there is a thriving industry in making electric water heaters and time switches. These heaters work only between 10 P.M. and 6 A.M., the switching being done automatically. The results obtained prove that this domestic storage is a boon to the consumer and is profitable to the electric supply company. The Glasgow Corporation is also encouraging domestic storage. Electricity is supplied for this purpose at the very low rate of $\frac{3}{8}$ths of a penny per unit. The heat losses from a well-designed electric heater are so small that the consumer is scarcely affected by them. In another system, used abroad, each room of the house contains a 'heat-accumulation' stove. Each stove contains steatite blocks of high specific heat which are heated by cheap night energy. When taking energy during the night a damper at the top of the stove is kept closed. In the morning, or whenever necessary, this is opened and convection currents circulating upwards heat the room. Another system of storage heating for large buildings is to have heating elements embedded in concrete floors. A full description of these and other methods is given by L. G. A. Sims in a series of articles in the *Electrical Review*, beginning in the issue for Oct. 21.

IN travelling about the country, especially, but not entirely, in out-of-the-way fishery districts, fishery enthusiasts, both amateur and professional, are frequently met with, demanding information on fishery problems, whether these relate to fish in a zoological sense, or 'shellfish.' The Fisheries Branch of the Ministry of Agriculture and Fisheries is now making efforts to form what is, in effect, a British Fisheries Information Bureau in embryo, by supplying information (free on application to the Fisheries Secretary, 43 Parliament Street, London) in a series of numbered *Fisheries Notices*, which are small pamphlets dealing in a popular manner with fishery

problems on the biology and/or economic aspects of particular freshwater and marine fish and 'shellfish.' There remains, however, a lot of ground to be covered before the Fisheries Branch can be regarded as having supplied inquiring fishery interests, with not only that which is known, but also in many cases that which is not known, and the department concerned may reasonably be urged to speed up its work. So far the subjects dealt with are, respectively: No. 3, Precautions *re* installing motor power in fishing vessels; No. 4, Value of the herring as good; No. 5, Instructions for taking water samples in cases of pollution of fisheries; No. 6, Particulars of publications about all fishery matters; No. 7, Instructions for cooking salted herrings; No. 8, Methods of preparing and cooking freshwater fish; No. 9, On the capture of freshwater eels; No. 10, About the marking of fish; No. 11, On sheep-dips and sheep-dipping; No. 12, The life-history of the plaice; No. 13, Mussel cultivation; and No. 14, Cockle culture.

Fisheries Notices, No. 13 and No. 14, are new, and both contain interesting and informative short chapters on natural history, methods of fishing, cultivation, destructive influences and animal foes and parasites, economic uses, and also—a subject on which the Ministry can speak with authority—on pollution and purification. In both cases the account of the natural history would have been improved if it had been explained that, in spawning, the eggs are shot out of the shell, and not retained as they are in the English oyster (*O. edulis*) and some freshwater pearl mussels (*e.g.* Anodonta). Similarly, in the chapters on cultivation, the practical value of simply transplanting young individuals from situations high up in the tidal zone to lower ones, chosen with circumspection, might have been stressed to greater advantage. The mussel and cockle are, however, of relatively small value compared with the oyster, lobster, crayfish (Palinurus), and the various dog-fishes, about all of which the dissemination of information would be of undoubted economic value to many interested in fisheries. It is to be hoped that the Fisheries Branch has in view the issue of additional pamphlets on these subjects in the near future.

THOUGH the problem of providing adequate indexes to scientific and learned books and journals is ever to the fore and is constantly engaging the attention of the various professional bodies concerned, the old idea that indexing is essentially the work of the unskilled drudge has not been entirely eradicated. It is now proposed to form an Institute of Indexing, the main objects of which will be to encourage the compilation of efficient indexes to books, periodicals, and other literary works and papers, and to promote their intelligent use by the public, to maintain a register of qualified indexers, and generally to give advice and assistance wherever needed. It is not apparently intended that the Institute should follow in the footsteps of the old Index Society and devote itself to the actual compilation of indexes, but that primarily it should act as a trade union to represent qualified indexers in all matters affecting their status and recognition as members of a 'key' profession. The organisers are ambitious enough to hope that there will be a grade of 'fellows' confined to fully qualified indexers, and one of ordinary members for those interested from the users' point of view or who wish to avail themselves of the advisory and other services of the Institute. Particulars may be obtained from Mr. W. R. Douglas Shaw, "Beaufort," Mornington Road, Chingford, London, E.4.

PROF. W. A. BONE will deliver a lecture entitled "Gaseous Combustion at High Pressures," in the rooms of the Chemical Society, Burlington House, on Thursday, Nov. 24, at 8 P.M.

SIR ARTHUR KEITH, president of the British Association, will take the chair at the third annual Norman Lockyer lecture, "Scientific Ethics," to be delivered by the Very Rev. Dean Inge, in the Goldsmiths' Hall on Monday, Nov. 21, at 4 P.M.

PROF. E. T. WHITTAKER will deliver a lecture at the meeting of the London Mathematical Society on Thursday, Dec. 15, at 5 P.M., in the rooms of the Royal Astronomical Society, Burlington House. His subject will be "The Influence of Gravitation on Electromagnetic Phenomena." Members of other scientific societies are invited to attend.

THE inaugural meeting of the British Institute of Radiology, with which the Röntgen Society is now incorporated, is being held on Nov. 17 and 18, and is the first meeting of the reconstituted body. The meeting thus marks the commencement of a new era in the history of radiological organisation in Great Britain.

THREE earthquakes of moderate intensity were recorded at Kew Observatory on Nov. 14. The times of arrival of the first phases were 0 hr. 21 min. 25 sec., 5 hr. 5 min. 49 sec., and 7 hr. 33 min. 21 sec. G.M.T. The second earthquake was a repetition of the first, and the epicentre is estimated to have been 3680 miles away, probably in the Arctic Ocean. The epicentre of the third disturbance was at a distance of about 6300 miles.

THE following officers and new members of council of the London Mathematical Society were elected at annual general meeting held on Nov. 10: *President*: Prof. G. H. Hardy; *Vice-Presidents*: Prof. A. S. Eddington, Mr. R. H. Fowler, Prof. G. B. Jeffery; *Treasurer*: Dr. A. E. Western; *Librarian*: Prof. H. Hilton; *Secretaries*: Prof. G. N. Watson, Mr. F. P. White; *New Members of Council*: Prof. P. J. Daniell, Mr. A. E. Ingham, Dr. E. G. C. Poole.

APPLICATIONS for grants from the Chemical Society Research Fund must be received, on a prescribed form, by the Assistant Secretary of the Society, Burlington House, W.1, not later than Dec. 1. The income arising from the donation of the Goldsmiths' Company is more or less especially devoted to the encouragement of research in inorganic and metallurgical chemistry. The income from the Perkin Memorial Fund is applied to investigations relating to problems connected with the coal-tar and allied industries.

MESSRS. J. and A. Churchill, the well-known firm of medical and scientific publishers, have removed from Great Marlborough Street to 39 and 40 Gloucester Place, Portman Square, London, W.1. The firm was founded in 1825 by the grandfather of the present partners, the late John Churchill, and since 1845 it has published "The Medical Directory." Its list of authors includes leading representatives of many departments of science.

WE have received from Mr. W. H. Harling, 117 Moorgate, London, E.C.2, copies of two recent sectional catalogues of drawing instruments, most of which are manufactured by the firm at the Grosvenor Works, Mount Pleasant Hill, London, E.5. Catalogue No. 5*c* deals with compasses, dividers, and similar instruments, both singly and in sets. The 'British Empire' (B.E.) series of instruments are made of hard-drawn electrum and fitted with stainless steel ink points; the compasses are provided with self-centring head-joints. Catalogue 8*b* is devoted to drawing scales and boards, T-squares, etc.; it includes particulars of slide-rules, planimeters, and integrators of special patterns, as well as instruments made by the firm.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Full-time teachers of carpentry and joinery, carving and modelling, and of pharmacy, in the Leicester Colleges of Art and Technology—The Registrar, Colleges of Art and Technology, Leicester (Nov. 30). A senior lecturer in the department of pure and applied science of Loughborough College—The Principal, Loughborough College, Leicestershire (Dec. 1). A mathematical master at the Royal Naval College, Dartmouth—The Headmaster, Royal Naval College, Dartmouth (Dec. 15). An officer with experience of plantation work to take charge of the Oil Palm Plantation of the Government of Sierra Leone—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1. A head of the Arts department of the Portsmouth Municipal College—The Secretary, Office for Higher Education, Municipal College, Portsmouth.

Our Astronomical Column.

THE TRANSIT OF MERCURY.—Fine weather favoured this phenomenon in most parts of England, and a large number of observers made successful observations. The planet appeared as a well-defined black spot, decidedly darker than any of the umbræ of the large sunspot group that was nearly central on the disc. No trace was seen of any luminous ring round the portion of the disc that had passed off the sun at egress. Definition was not very good owing to the low altitude; consequently there is a range of many seconds in the times of contact given by different observers. It is most convenient to give the times as corrections to the predicted times, which were $8^h\ 28^m\ 23^s{\cdot}9$ for third contact, and $8^h\ 30^m\ 5^s{\cdot}2$ for fourth contact for London and neighbourhood. Mr. L. G. Guest, observing with an 8½-inch refractor at Ferring, Sussex, found the corrections $-25^s{\cdot}9$ and $-30^s{\cdot}2$. Mr. A. F. Bennett, observing with a 6-inch refractor at Leiston, Suffolk, found corrections $-15^s{\cdot}3$ and $-29^s{\cdot}2$. Dr. A. C. D. Crommelin, observing with a 3-inch refractor, power 40, at Blackheath, found -33^s and -48^s. The last are undoubtedly too early, the power being inadequate for accurate observation. The fact that the contacts happened some twenty seconds ahead of calculation is confirmed by other observations; a similar result was obtained in the 1924 transit; this is the direction to be expected if the unexplained lunar irregularities are due to change in the rate of the earth's rotation. It is noteworthy that observations have been obtained in England of all the four transits in the present century.

NAKED-EYE SUNSPOT.—The appearance of a large group of sunspots near the sun's central meridian was noted by observers of the transit of Mercury on the morning of Nov. 10. By the following day the group had increased perceptibly, and it became a naked-eye object for two or three days, after which its approach to the west limb with consequent foreshortening prevented its being seen without slight optical aid. A photograph taken on Nov. 6 shows the group commencing as a small spot in some faculæ which could be identified with an earlier group of spots in the preceding rotation. The increase in the size of the spots and their changes in structure between Nov. 9 and 12 denoted considerable activity. The magnetograph traces at Greenwich show, however, no unusual disturbance of the magnetic elements. Other particulars of this group of spots are given below.

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Area.
10	Nov. 6-16	Nov. 10·4	9° S.	1/800 of hemisphere

THE NUCLEUS OF COMET PONS-WINNECKE.—*L'Astronomie* for October contains an interesting drawing of this comet made by M. F. Baldet with the great Meudon refractor at the time of its near approach to the earth last June. His photographs appeared in the September issue, but they were on an insufficient scale to bring out the extremely small size and sharpness of the stellar nucleus. The drawing is on a scale of 1 inch to 4″; it shows a well-defined central nebulosity 2½″ in diameter, with a very minute stellar point in the centre. The latter was too small to measure, but M. Baldet estimates that its linear diameter did not exceed 400 metres. It presumably consisted of a compact swarm of meteoric masses. It is a matter of surprise that these have retained their compact formation for more than a century (the comet was first seen in 1819), in view of the large perturbations by Jupiter that it has experienced on several occasions.

A few weeks ago comment was made in this column on the compactness of the meteoritic swarm that is supposed to have formed Meteor Crater in Arizona by impact with the earth. The central portion of the present comet, if we accept M. Baldet's estimate of its size, seems to be of comparable dimensions. M. Baldet goes on to comment on the difficulty of supposing that such compact swarms are of great antiquity, and directs attention to the theory (first seriously proposed by R. A. Proctor) that the short-period comets are the products of eruptions from Jupiter. In this connexion it is interesting to note that the astronomers of the Jungfrau observatory report an interesting outburst on Jupiter on Oct. 11. A small bright spot suddenly appeared in the equatorial zone (having somewhat the appearance of a satellite in transit). It seems to have disappeared after a short time; but the details to hand are telegraphic and meagre.

Research Items.

TOTEMISM IN SOUTH AMERICA.—Mr. R. E. Latcham, for many years a resident in Chile and a student of the history and ethnology of the Indian tribes at present inhabiting the Andean area and their predecessors, has made an exhaustive study of a mass of unpublished material stored in Spain and in South America, much of which has never been examined before from the point of view of the anthropologist. Many of these documents, especially the grants of Indians to the early Spanish colonists, recite details relating to the tribes which have provided evidence throwing an entirely new light, Mr. Latcham maintains, on the organisation and beliefs of the early Andean peoples. A study of their totemism based upon this material is published in the *Journal of the Royal Anthropological Institute*, vol. 57, Part 1. From this it appears that not only was descent matrilineal, contrary to what has been believed, patrilineal descent being introduced later under Spanish rule, but also their totemic system differed essentially in certain important respects from the standard system of other continents, though it presents close affinities with the system of North-West America. The tribe was not descended from the totem, although they called themselves children of the sun, the lion, and so on. They had a common ancestor who had a separate cult from the totem, but to whom the original totem was ally and blood brother. Only occasionally was the totem an animal or plant; celestial bodies, natural phenomena, geographical features, and inanimate objects were also chosen. These latter, however, might have a symbol; *e.g.* the falcon, eagle, and bustard were symbols of the sun, taking its place in many rites and ceremonies. The sun, it now appears, was the totem of a special and powerful clan widespread over the country, and not the symbol of the Incas generally. The totem when an animal was sometimes, but not always, taboo. It might, especially in the coastal region, be chosen from among the animals or articles which formed the staple diet of the tribes. Sometimes the totem was an animal having a special mark or defect. During ceremonial dances, the dancers dressed in the fur or feathers or some article symbolic of the totem. As a rule clans were exogamous.

TELEGRAPHISTS' CRAMP.—In 1922 the Industrial Fatigue Research Board was approached by the Union of Post Office Workers with a request to investigate the subject of telegraphists' cramp. The resulting investigation (Medical Research Council, Industrial Fatigue Research Board, Report No. 43: A Study of Telegraphists' Cramp. By May Smith, Millais Culpin, and Eric Farmer: H.M. Stationery Office. 1*s.* 6*d.*) was directed towards finding "whether, and how far, there is a specific susceptibility to it." A comparison was made between two groups, telegraphists certified as suffering from cramp, and others apparently free from it. Certain psychological tests involving speed and accuracy of movement were applied to both groups (test of pressure exerted, the ergograph test, and the McDougall-Schuster dotting test), and it was found that, with certain exceptions, the telegraphists in the non-cramp group showed better records than those in the cramp group. The subjects in both groups were then studied, with special reference to the presence or absence of psycho-neurotic symptoms. Again the two groups were not completely differentiated, but 75·6 per cent. of the cramp cases showed symptoms of psycho-neurosis, while of the non-cramp group 32·5 per cent. had these symptoms. The tests were repeated with a group of a hundred learners at the school of telegraphy, and it was found that amongst these the 'cramp type' could be differentiated. The working efficiency of the learners (based on the opinion of a superior officer) showed some relationship to their ability at the tests. Finally, a study of the psycho-neurotic symptoms of certain control groups was made, which suggested that the incidence of these symptoms among telegraphic workers was approximately normal. It appears, from the results of the research, that some preliminary selection of telegraphists by tests and examination would reduce the incidence of cramp.

PENNATULIDS OF JAPAN.—Prof. J. Arthur Thomson and Miss Nita J. Rennett, in their report on the collection of pennatulids from Japanese waters ("Report on Japanese Pennatulids." *Journal of the Faculty of Science*, Imperial University of Tokyo. Section 4. Zoology, vol. 1, Part 2, 1927), record 24 species, none of which is new, but they show interesting variations among the commoner forms, and valuable notes are given on those which are less well known. Three beautifully coloured plates show complete specimens of six species with details of others. Figures of spicules are given in the text. These spicules, absent in only a few forms, are some of the chief characters used to distinguish the species, genera, and even families. It is a vexed question whether to place the genus Scytalium in the family Virgulariidæ, the Balticinidæ, or the Pennatulidæ. The authors have solved the problem by creating the new family Scytalidæ, which agrees with the Pennatulidæ in having pronounced pinnules but differs in having the spicules small and oval instead of three-flanged, whilst it is removed from the neighbourhood of the Balticinidæ and Virgulariidæ, which are without very pronounced pinnules. *Anthoptilum thomsoni*, which is figured in colour, natural size, is regarded as a species distinct from *A. grandiflorum*, with which it was merged by Hickson and Kükenthal. It is described as a "large, magnificent Pennatulid," measures 94 centimetres, and differs in many respects from *A. grandiflorum*. It has been previously recorded from the Atlantic, south of Buenos Ayres, at 600 fathoms.

REPRODUCTION IN *CALANUS FINMARCHICUS*.—Dr. G. P. Farran has recorded interesting observations on this important copepod (*Jour. Con. Internat. Explor. Mer.*, vol. 2, No. 2, 1927. "The Reproduction of *Calanus finmarchicus* off the South Coast of Ireland"). Investigations were undertaken by the Department of Fisheries of the Irish Free State and its predecessor the Fisheries Branch of the Department of Agriculture and Technical Instruction. A special area was chosen and samples taken at intervals from 1913 to 1924, a Nansen net of standard silk No. 3 with a ring of 50 cm. diameter being used, hauled by a hand winch at an average rate of between 3 and 4 metres per second, and the total number of Calanus present and the proportions of the successive developmental stages estimated. Nauplii as a rule escaped through the meshes, therefore the copepodite stages only were noted (Stages I to VI, the sixth being the adult form). The average catch for each month in a vertical haul from bottom to surface shows that April is the maximum month and March the minimum, although very few specimens were caught from September to February. The number of specimens in each month range from 75 to more than 34,000. There are, however, only few adults compared with the numbers of immature forms. *Calanus finmarchicus* in the area examined passes the

winter mainly in the late copepodite stages, then becoming adult in January, February, and March, but meantime the total stock diminishes rapidly, reaching a minimum in March. In April reproduction, which has already begun in March, is at its height, and is still going on in May, after which the numbers fall off gradually until September. Calanus may reproduce irregularly all through the summer, and a few early stages may still be found in the autumn. The only record for January shows that there was a very large preponderance of males, chiefly in Stage V in 1921, females predominating in all the other months, adults especially in February and March. In April, Stages II and III; June to July, Stage IV; August, IV and V; September and November, VI. The author thinks it is probable that adults of the previous year do not live beyond April and May, their places being taken by specimens hatched earlier in the year which have rapidly gone through their metamorphosis. In the autumn the growth appears to be much slower; months instead of weeks being necessary to complete the development.

USEFUL EXTRACTS FROM JAPANESE FOREST TREES.—In the *Journal of the College of Agriculture*, vol. 9, No. 2, Imperial University of Tokyo, Ihachiro Miura gives some of the results of three years' laborious work on the determination of 'useful matters' contained in the forest trees of Japan. More than 100 species have been examined and analysed, and the results, given in tabular form, will form useful data for industrial chemists engaged on problems connected with plant products. The work is divided into six parts as follows: (1) Fatty oil contents in seeds of various forest trees; (2) contents and properties of tung oils from various species; (3) tannin contents in various forest trees; (4) the content of the methoxyl group in the principal forest trees, and its utilisation by dry distillation; (5) the growth of cinchona in Formosa and its alkaloid content; (6) the needle oils from coniferous trees.

THE CALCIFUGE HABIT IN MOORLAND PLANTS.—The occurrence of moorland plants on 'sour' or lime-deficient soils and their absence from calcareous soils has presented a problem of perennial interest to field botanists. W. H. Pearsall and Marjory Wray have investigated the problem in the case of *Eriophorum angustifolium* in terms of (1) the calcium content of the soil solution, (2) its basic ratio, *i.e.* (K + Na)/Ca, and (3) its hydrogen ion concentration (*Journal of Ecology*, vol. 15, No. 1). These factors were controlled by using variations of Shive's three-salt culture solution as rooting media. The constituent elements of the solutions were varied in concentration within certain definite limits, and the effects on the growth and form of the culture plants were noted. In general, the effect of high calcium content in the culture solutions was a pronounced tendency to lowering of the water content of the plants as expressed in the ratio of fresh weight to dry weight. When the basic ratio was high, however, the effect of calcium was reduced. Change of acidity in the medium altered the calcium absorption, which was high when the hydrogen ion concentration was in the vicinity of *p*H 7, low in the region of *p*H 4·5. In a series of germination experiments it was found that in relatively acid media (*p*H 4·5) the most rapid germination took place in solutions relatively rich in calcium, while in neutral solutions (*p*H 7) germination was most rapid in media containing smaller quantities of calcium. These conditions are explained on the basis of the effect of hydrogen ion concentration on calcium absorption. That climatic conditions may act as factors modifying the effects of calcium is indicated by varying the temperature and atmospheric humidity conditions of the experiments. Calcium effects were accentuated by low temperatures and dry atmospheres, and decreased by the opposites. Under natural conditions similar effects seem to obtain. Analysis of soil waters showed concentrations of calcium and potassium similar to those used in the experiments.

EXTRACTION OF SUGAR FROM BEET.—An illustrated account of the various processes in the sugar beet factory at Poppleton, Yorks, is given in the *Journal of the Ministry of Agriculture* (vol. 34, p. 612). This factory, erected in the summer of 1926 by the Anglo-Scottish Beet Sugar Corporation, sliced its first beet in October of that year, and in the first three months of working extracted more than 7000 tons of white sugar from 53,233 tons of beet. After thorough washing, the beets are weighed, so that the quantity of raw material being dealt with during a given period can be ascertained if desired. The roots are then sliced preparatory to the extraction process, which is carried out by a modern method known as 'continuous diffusion.' The general principle of this method is the extraction of the sugar and other soluble substances by osmosis, the beet slices being made to pass in an opposite direction to a stream of water. The exhausted pulp forms good stock food and is known as 'dried beet pulp.' The extracted juice is then subjected to successive treatments of slaked lime, carbonic acid gas, and sulphur dioxide, by which means impurities are precipitated and the liquor clarified. Evaporation, however, is necessary before crystallisation can be carried out, as the juice still contains a large quantity of water. The size of the crystals desired, which depends on the demands of the market, can be determined by conditions of temperature, vacuum, etc., during the boiling process. When the mass of sugar and syrup has reached the appropriate stage it is centrifuged, whereby the crystals are retained and the syrup run off, the latter being reintroduced to the process as desired. The white sugar is dried by hot, followed by cold air, and after the lumps have been removed for remelting by 'shakers,' the finished granulated product is deposited in the sugar bins. At no time from start to finish is there any interruption in the process, nor is the product at any stage touched by hand. For the year 1927–28 more than 11,000 acres of beet are under cultivation for the Poppleton factory, and there is every prospect in this area that both the tonnage per acre and sugar content will show a marked improvement on the results of the previous year.

MAGNETIC OBSERVATIONS IN FRANCE.—The observations made at the two French magnetic observatories, Val Joyeux and Nantes, are now published under the auspices of the Institute of Physics of the Globe (of the University of Paris). Tome 5 of the *Annales*, recently issued, contains the results for 1925, including complete hourly values for Val Joyeux, and four hourly values per day for Nantes; the Val Joyeux records for nine disturbed days are reproduced graphically. Magnetic survey observations made in various parts of France are included in the volume, and also arctic magnetic and electric observations made on board the vessel *Pourquoi Pas?* in 1926. The Director, Prof. Maurain, contributes three interesting discussions of the now long series of magnetic records at Val Joyeux and Parc St. Maur, relative to their correlations with sunspottedness, and to their annual variations. The seismological, meteorological, and actinometric observations at Parc St. Maur are also given, in summary.

MILD STEEL UNDER PROLONGED STRESS AT 300° C.—W. Rosenhain and D. Hanson, in connexion with a study of intercrystalline cracking in boiler plates, have carried out prolonged tests of mild steel under loads ranging from one-third to two-thirds of the normal tensile strength of the metal at a temperature of 300° C. The results are given in a paper read at the Glasgow meeting of the Iron and Steel Institute. The loads have been maintained almost uninterruptedly for more than five years. The material used contained 0·11 per cent. carbon and 0·4 per cent. manganese, the other elements present being very low. Test-pieces in several different conditions of heat treatment were employed, and at stresses up to two-thirds of the normal maximum stress at that temperature, no case of fracture was observed. In one case only was there any appreciable extension. A sample coated with solder behaved in the same manner as the remainder of the specimens. The Brinell hardness of the steel increased to a marked extent in the stressed portions of the test-pieces, a result which is regarded as being remarkable in view of the small amount of deformation which the steel underwent. In connexion with the failure of boilers, the results are of value in proving that stress alone at the high temperatures does not lead to the type of fracture which is observed, and confirm, therefore, the view that both stress and chemical attack are necessary to produce the cracking. It is pointed out that the results were obtained on specimens free from notches, and for the present can with certainty be applied to such material only.

THE ELEMENT 'MOSANDRUM' OF J. LAWRENCE SMITH.—In the issue of the *Journal of the Washington Academy of Sciences* for Sept. 19, R. C. Wells discusses the discovery of samarium, gadolinium, and europium. In 1877, J. Lawrence Smith, who was working on earths obtained from samarksite, claimed to have found a new element which he called *mosandrum*. About this time various chemists, including Delafontaine, Soret, and Marignac, were claiming to be discoverers of new elements, and Smith's claims received little support. Samarium was definitely isolated nine years later as a result of the spectroscopic work of Lecoq de Boisbaudran. Although it must be admitted that Smith's preparations were impure, he recognised the presence of a new element in samarksite. His element mosandrum later proved to be at least two elements, afterwards called samarium and gadolinium.

ACTIVE NITROGEN AND THE METALS.—The September issue of the *Journal of the Chemical Society* contains an account by E. J. B. Willey of the catalytic effect of certain metals in accelerating the decay of active nitrogen. It is suggested that clean cold metals generally have no effect upon the afterglow owing to the formation of a protective film of nitride. The active gas was passed at measured rates over a metal filament which served both as a resistance thermometer and a heating coil. An increase in temperature was observed with various metals due to the endothermic decay of the active nitrogen, but the greatest effect was obtained when a platinum filament thinly coated with copper was used. In this case 'spattering' of the copper took place, but this disintegration did not occur with other metals. It was found that iron, platinum, and silver become active catalysts for the destruction of the afterglow at the temperature of decomposition of their nitrides. The approximate value 46,600 cal./gm.mol. was obtained for the energy of active nitrogen.

THE ACTION OF LIGHT ON CHLORINE.—An interesting contribution to the photochemistry of chlorine is found in a recent paper by G. B. Kistiakowsky in the *Journal of the American Society* for September. After briefly reviewing the literature on the nature of the primary action of light on chlorine, the author points out that all the existing theories which assume the presence of foreign molecules to be essential for the initial photochemical process also assume that pure chlorine fluoresces on exposure to light. It is shown that there is no appreciable difference in the total absorption of polychromatic light by very dry and by moist chlorine. Moreover, there is no change in the absorption spectrum upon extreme drying of the gas, and only a small fraction of the absorbed light energy can be re-emitted as fluorescence even in very dry chlorine. Hence, since the Budde effect undoubtedly decreases on drying chlorine, the introduction of the same amount of light energy may or may not cause a heating effect according as impurities are present or absent. It is rather difficult to reconcile the new data with those theories that assume that the presence of foreign molecules is necessary for the primary photochemical process in chlorine. It is suggested that the gas is dissociated into atoms on the absorption of light independently of its degree of purity. The recombination of atoms to molecules liberates the absorbed energy as heat, but in the dry state this process must be assumed to be very slow and to take place only on the dry walls of the containing vessel, the large heat capacity and relatively good conductivity of which prevent the Budde effect. A difficulty arises in this explanation in that if moisture has a catalytic effect on the recombination of atoms, it should also accelerate the thermal dissociation of chlorine molecules.

STRUCTURES IN SEA WATER.—The committee of the Institution of Civil Engineers which has been studying the deterioration of structures of timber, metal, and concrete in sea water has recently issued a seventh report of an interim character (London: H.M. Stationery Office. 2*s*.). Specimens of iron and steel have now been kept under observation in several parts of the world, but it is difficult to sum up the results in any simple way, as the relative behaviour of different steels varies in different harbours. Highly alloyed steels seem to have some advantage. A set of 330 mild steel plates, coated with various protective paints and coverings, has been exposed in Southampton Docks, and after a year there are marked differences in the extent of wasting and pitting, but again it is difficult to express a general conclusion. In regard to the protection of timber against the attacks of Teredo, the effect of various arsenical compounds has been examined. The protection depends largely on the extent to which the poison enters the wood, and Prof. Barger reports that a 'mixed oil,' containing 60 per cent. of phenyl arsenious oxide together with chloride, penetrates best. Limnoria is more resistant to poisons than Teredo. The organic arsenical compounds are evidently of great value in this connexion. Creosoting of timber by a low temperature process, the excess of creosote being extracted, has little effect on the mechanical strength, but the high temperature process has a deleterious effect, probably increased by the excess left in the wood. Investigations on the deterioration of marine piling are also being carried out in the United States, and an abstract of the report to the American Railway Engineering Association has been included. It appears that Australian turpentine wood has a high natural resistance to attack by borers.

The Salisbury Meeting of the South African Association for the Advancement of Science.

THE twenty-fifth annual meeting of the South African Association for the Advancement of Science was held at Salisbury, Southern Rhodesia, on June 29–July 4, under the presidency of Prof. H. B. Fantham. The meeting was very well attended and ninety-three papers were read. Joint meetings of several sections were held. The South Africa medal and grant were presented to Dr. Annie Porter at the conclusion of the presidential address. A popular lecture was given by Dr. A. L. du Toit on "The Kalahari and some of its Problems." There was a reception by His Excellency the Governor of Southern Rhodesia at Government House, and visits to various places of scientific interest in the neighbourhood.

The president, Dr. H. B. Fantham, gave as his address, "Some Thoughts on Biology and the Race." Dr. Fantham stated that it is to be regretted that the study of the general applications of science to everyday life are still so little evident in the education of the average citizen of South Africa. He is whole-heartedly in favour of the retention of classical and cultural subjects in the high school curriculum in South Africa, but every pupil should also become acquainted with both physical and biological science during his school career. Education is not a failure, but 'what passes for it' is at fault, such as the undue desire of parents and pupils for the mere passing of examinations; in other words, the informative function has overwhelmed the truly educative function. It tends to be overlooked that all men are not born equal in inherent capacity, that is, that variation exists. Consequently, the ideal of a university as a home for culture and the training of real leaders is being supplanted by mere utilitarianism. In South Africa matriculation has become a fetish and hence a disappointment.

There is much to be said for the correctness of the aphorism that the white race must form an aristocracy of labour in Southern Africa, but it is doubtful if the idea is being fulfilled practically. Vocational training is necessary, but must not be entirely divorced from culture and must not be undertaken too early. Psychology and education must be founded on biology. Even civilisation itself must depend on the principles of biology for its constitution. One of the saddest features of the modern educational system in South Africa is that the best types of students are not desirous of entering the teaching profession. One great value of biological training is the appreciation of cause and effect and the application of these to everyday affairs. Such implies personal effort or striving, personal observation, personal thinking. To-day, however, the mass of the people seem to be merely absorptive, and adopt the views of the press or pulpit or party politician. The ideas of life as seen in the cinema, catchwords, phrases, and slogans are much to the fore. Minorities often represent the variations most fitted to survive. Many parents do not realise that they are delegating most of their parental responsibilities as regards education to the government and to the teachers.

A knowledge of biology would inculcate in the parents the presence of natural variation among children and would indicate that full opportunities should be afforded to all children for development and progress so far as their inborn or hereditary qualities allowed. If such an elementary knowledge of biology were in possession of the masses, there would be less false pride, fewer occupational misfits, more skilled craftsmen, and a truer appreciation of the dignity of manual labour. At present we are told that we must be up-to-date and not 'old-fashioned'; in education we are told 'to follow the child' in spite of the fact that the young are immature learners. Surely a continuity should be preserved with the past and its heritages. The unfortunate disharmony that so often occurs in thought between succeeding generations is a real danger to civilisation and merely leads to repetition of old blunders. Discipline, which is such an irksome term to some modern people, only means ordered activity as opposed to disorder and chaos. A study and knowledge of biology will inculcate this discipline as perhaps no other subject can do.

Turning to another aspect, it may be remarked that probably the great cost of social services to modern white communities has been accepted by most people as a necessary expense. In South Africa, however, the financial burden is too great for the white race to carry. Over-administration is a soulless, bad master biologically and has led to reaction on the part of the organisms over-administered, producing a state of lethargy and apathy (as shown by individuals not voting at elections) or else a state of violent reaction manifested by Communistic activities. Turning to the eugenic aspect, the subject of differential fertility is most important. At present, many excellent hereditary strains are in danger of being lost or are actually being lost, while the thoughtless and irresponsible are relatively increasing in numbers. As regards the colour problem in South Africa, it should be kept in mind that the real aim should be to make the native African a happier and more capable African, and not a caricature or imitation white man. At present there is not enough incentive to real effort on the part of the whites.

Biological training should be begun in early life and should receive special attention in the high schools. Biology has done much for the economic life of the people already, and more can be done. By the study of biology, humanity should be brought into harmony with the great world of Nature and carried above the smallnesses of parochial outlook and party politics. In attempting the improvement of the human race, even to a small degree, co-operation and goodwill are necessary, and by calm, dispassionate biological consideration, much can be done to break down barriers of ignorance. By service and sacrifice as a people shall we attain harmony with Nature and the infinite.

An account was given of "Irrigation and Water Supplies in Southern Rhodesia," by Mr. A. C. Jennings in his presidential address to Section A. Southern Rhodesia, having no seaboard, has developed from the inland plateau along the headwaters of the rivers. In regard to irrigation, he advocated the small individual scheme, for successful irrigation requires not only good land and an assured water supply, but also a population capable of using the water to the best advantage. Rhodesia lacks population at present. Practically all irrigation is carried out by Europeans, natives making very little use of water, even when easily available. Most schemes use direct flow of rivers without recourse to conservation, and the land is devoted to mixed farming. As water and land are still comparatively cheap, there has been little inducement to effect the most economical use of the water. Investigations have been begun on irrigable possibilities of many of the larger rivers, using both normal flow and flood discharges. Conservation needs more attention and should be a national concern. Potentialities for development of water power are considerable. No general artesian basin exists, but

ground water is encountered often about 60 feet deep. Irrigation machinery has been designed and built in Rhodesia and has proved superior to imported plant.

Mr. H. B. Maufe discussed "Some Problems in Rhodesian Physical Geology" in his address to Section B. Incompleteness of topographical maps has rendered many lines of research work difficult. The past geological history and present topographical features of Rhodesia were detailed. Southern Rhodesia has its high ground in the form of an elevated plateau running from south-west to north-east, with mountains arising from low ground around, the high level plateau having been uplifted at the end of the Pliocene, when the climate became more humid and rivers gradually carved out the valleys. The old plain, only slightly eroded, was recognisable in the main watershed, running from south of Bulawayo to east of Salisbury. The differences in the two types of Rhodesian scenery are not due to differences in geological structure, great stretches of flat country being found where there has been but little erosion, and hill ranges and isolated kopjes where the rivers have cut into the flanks of higher ground.

Prof. R. S. Adamson chose "Some Problems of Vegetation in South Africa" as the subject of his presidential address to Section C. The problems of a survey of the botanical resources of the Empire were mentioned, these being based on ecology. In South Africa, taxonomic work is a necessity and ecology has received less attention, but vegetation study is essential. The characters of plant succession were discussed and also vegetal changes due to climate, concerning which more accurate information is desirable. Changes due to interference, by destruction particularly of the climax vegetation and reversal of succession were noted. The recognition and definition of communities as units of vegetation study were discussed and illustrated by reference to the plant communities of the Cape region, where the flora is exceedingly rich and varied, and the 'biological spectrum' was set forth. The similarity of the Cape Fynbosch communities to those of the Mediterranean coasts, California and S. W. Australian coasts, with similar climatic conditions, was noted and various hypotheses were given to account for variability of the flora. The practical advantages of the study of plant communities in grazing, farming, afforestation, or fruit culture were indicated.

"The Teaching of Zoology in South African Schools" was the subject of Dr. S. H. Skaife's presidential address to Section D. He showed statistically that in order to give every school child some training in scientific method, the nature study course, including animal life, in the primary school must be employed. In the secondary school he advocated a four years' course in general science and not premature specialisation, as too often occurs. This should include zoology, botany, physics, and chemistry. The aim should not be to train experts in any one branch, but to create and foster a scientific attitude of mind. In schools, the majority of the pupils take the matriculation course, adapted to the needs of the few who proceed to the university, and the regulations for matriculation only exceptionally allow of more than one science subject being taken, and amendment of the regulations was urged. Zoology as a school subject is of great importance and high educational value and needs better development. All teachers-in-training should receive a course in general science as part of their training. More attention to zoology as the science of living things should be given.

Rev. Neville Jones, in his presidential address to Section E, made "Some Remarks on the Present Stage of Prehistoric Research in South Africa." The abundance of archæological relics and the recognition of three Newer Stone Age industries in South Africa were noted. The Stilbaai and Smithfield industries were regarded as specific to the Union of South Africa, but the Wilton occurred throughout the subcontinent and was probably the basal industry. In Rhodesia two industries referable to the Wilton and an older cave industry exist. An extensive Wilton workshop and distributing centre was at Sawmills; the Matopo caves yielded Wilton microlithic implements. All over South Africa evidence of a race or races equivalent to the Upper Palæolithic of Europe existed. The evolution of the Bushman and the question of the origin of the San races were discussed. The probable existence of an earlier race intermediate between the older and newer stone ages, that may have contributed to the evolution of the San people, was indicated by the occurrence in caves of implements showing a technique like that of the Mousterian of the Palæarctic. Evidence of contemporaneity of these stone ages is lacking. The Stellenbosch industry shows much correspondence with the early stone age of Europe, and it is thought that the European makers of Chellean implements made their way to South Africa. There are great opportunities for research in South Africa.

The presidential address to Section F on "Some Observations on the Economic Position of the Native in Rhodesia" was delivered by the Hon. W. M. Leggate, who showed by concise words and figures that the rate of progress in Southern Rhodesia and the present output of that colony in both mining and agriculture are due to the employment of native labour under European direction. The presence of a small proportion of Europeans with capital and organising ability has greatly increased the producing power of the native, who has benefited greatly in agriculture and stockfarming. In mining, the presence of the native has made it possible to work grades of ore that would be impossible if white labour only were used. Without the native, double the present white population would not maintain its present level of production, but, without the European, native production would revert to negligible proportions. The natives object to differentiation in pay whatever their capacity as workers, and differential training of the native will have to be applied gradually in consequence.

A few remarks may be made on the work of the Sections.

In Section A the hydrographic conditions, measures against soil erosion, and the variability of rainfall in Rhodesia were discussed. Engineers were interested in experimental work on water hammer and physicists in electric charges of bacteria.

Rhodesian geological problems were prominent in Section B. The pre-Cambrian atmosphere was discussed. Fossil Widdringtonia occurring in the Knysna forests, where living Widdringtonia abound, were of interest to geologist and botanist. A joint meeting was held with Section D for an important paper on the influence of variation in the ration on the assimilation and retention of minerals in farm animals. When oil is added to the ration, the calcium balance of pigs shows progressive increase, and sodium chloride or citrate added to a cereal ration causes increased assimilation and retention of nitrogen, calcium, and phosphorus.

In Section C there were valuable papers dealing with forestry, ecology and bacteriology. The behaviour of South African tree seedlings and seeds in artificial habitats were discussed, dendrographic experiments in the Knysna forests described and accounts given of *Ekebergia capensis* and Oxytenanthera. Discussions of *Clostridium botulinum*, contagious abortion and undulant fever were of interest to

bacteriologists, and descriptions of native cattle in Rhodesia and of new fungi appealed to agriculturists.

Many subjects of wide range were discussed in Section D. An important contribution was made on the breast-shoulder apparatus of Xenopus, Pipa, and Hymenochirus. Protozoology included papers on soil Protozoa, Herpetomonads and Bodo found in the hind gut of the snake, *Homalosoma lutrix*, and the biological reactions of a Herpetomonas from *Lucilia sericata*. The distribution of Anophelini and Glossinæ in Rhodesia was described. A series of papers dealt with the structure and evolution of the fleece of various breeds of sheep. A skin of the new Cooper's cheetah, *Acinonyx rex*, was exhibited by its discoverer. A joint meeting was held for a paper on South African cases of racial admixture, the colour variations, poor physique, instability of character and social inheritance of such cases being discussed. A tribute was paid to the memory of Francesco Redi at his tercentenary.

A series of papers in Section E on the social anthropology of the Bomvana, Bavenda, Mashona, and Zulu peoples was of much interest, as were discussions on the religious ideas of Rhodesian natives. Stone implements of various types from several sites were discussed, and enthusiasm was aroused by the announcement of the discovery of true burins near Grahamstown. Some large and interesting collections of copies of Bushman paintings were exhibited.

In Section F the nature of attention, the distinctions between tendency, ability, and capacity, and Descartes' second meditation interested philosophers. Papers of interest to economists dealt with the industrial revolution, Indian indentured immigration into Natal and the need for the teaching of economics in South African schools.

The next annual meeting of the Association, under the presidency of Sir J. Carruthers Beattie, will be held at Kimberley in July 1928.

World Weather Records.[1]

THE publication by the Smithsonian Institution of a collection of long-period records of pressure, temperature, and precipitation marks an important step forward in the investigation of the relationships between weather conditions in different parts of the world. The work of Prof. Exner, Sir Gilbert Walker, and others, has shown that there is some general system underlying the at first sight irregular fluctuations of weather, and that, for example, the variations of rainfall in India can be forecast from variations of meteorological elements so far afield as South America. These relationships are being sought for by the calculation of correlation coefficients between variations of meteorological elements at many different stations, a process which requires long and trustworthy records. Hitherto it has been necessary for each worker in this field to compile his own tables from the annual and monthly meteorological reports of the various countries, but at the International Meteorological Conference in 1923, Prof. Exner proposed that all meteorological services should be asked to publish series of observations covering as long a period as possible provided homogeneity was maintained, for selected stations in their areas, at distances of 500 or 1000 kilometres. This suggestion was approved by the Conference, which passed a resolution inviting the following meteorologists to give it practical effect: Dr. (Sir Gilbert) Walker for Asia, Prof. Exner for Europe, Mr. Clayton for America, and Dr. Simpson for Africa, Australasia, and the Oceanic Islands. Mr. Clayton afterwards delegated the collection of data for South America to Mr. R. C. Mossman.

The four collectors commenced the work immediately by writing to the directors of meteorological services all over the world requesting copies of their long records, with details as to corrections, etc., and emphasising the importance of homogeneity. The requests met with a gratifying response, and by September 1926, when the International Meteorological Committee met in Vienna, the collection of the data was approaching completion. At that meeting Mr. Clayton was able to announce that the Smithsonian Institution would undertake the publication of the data, and that an American donor, Mr. John A. Roebling, had offered to defray the cost. This generous offer was accepted, and Mr. Clayton agreed to see the tables through the press.

[1] Smithsonian Miscellaneous Collections, vol. 79. World Weather Records, collected from official sources by Dr. Felix Exner, Sir Gilbert Walker, Dr. G. C. Simpson, H. Helm Clayton, Robert C. Mossmann; assembled and arranged for publication by H. Helm Clayton. Published under grant from John A. Roebling. (Publication 2913.) Pp. vi+1199. (Washington, D.C.: Smithsonian Institution, 1927.)

The results of all this team work are now before us in a volume of some 1200 octavo pages, bearing the title "World Weather Records," which forms volume 79 of the well-known Smithsonian Miscellaneous Collections. Data are included from 385 stations, ranging from Upernivik in the north to the South Orkneys in the south. Very nearly all the series cover more than twenty years, commencing before 1900 and ending in 1920, or later in the case of the American and some other stations; shorter series were included only when the situation of the station gave it outstanding importance. At a moderate estimate the tables include some quarter of a million monthly and annual means or totals. The units in which the data are expressed are those in which they were supplied by the Services concerned. The hundred thousand or so of conversions which would have been necessary to secure uniformity would have involved great labour and some risk of the introduction of errors, but quite apart from this the policy adopted was undoubtedly the wisest, and one would say the only practicable one. The tables are preceded by a number of pages devoted to explanatory notes, some of which give the whole history of the station concerned—a mine of reference—and they are followed by a useful list of relative sunspot numbers from 1749 to 1925.

Finally, a word must be said about the arrangement. The three tables—pressure, temperature, and precipitation—for each station are kept together, and the stations for each continent are kept together, in alphabetical order. There is an index of all stations and countries in alphabetical order, and another in which the stations are arranged by ten-degree zones of latitude, the names in each zone running from west to east; this index gives the geographical co-ordinates. Thus whether one requires a station by name, by country, or the nearest station to some particular point, reference is equally easy.

The volume fills a need long felt by meteorologists, and by the assistance which it provides for statistical research it will certainly lead to results of great practical value. It remains only to express our gratitude to all who have had a part in its production, to the directors of the various meteorological services which have supplied data, to the five meteorologists who have organised its collection, to Mr. Clayton who has had the strenuous task of assembling and arranging the matter and seeing it through the press, and last but not least to Mr. Roebling, whose generous financial assistance has placed this invaluable collection of data within our reach.

Forestry in Trinidad and Tobago.

THE Annual Administration Report of the Forest Service of Trinidad and Tobago for 1926 contains several points of interest connected with future forest policy. The writer states that the reasons for maintaining a certain area of the Islands under forest are twofold: first, the conservation of those forests of indirect utility owing to their protective value in maintaining favourable climatic conditions such as the maintenance of rainfall, humidity, prevention of erosion, and to act as windbreaks; secondly, the management of such areas as may be necessary for the purpose of providing the Colony in perpetuity with timber, firewood, and other forest products. The first object has been already accepted as essential by the authorities. As regards the second, the Conservator writes: "Although faint flutterings to this end may be discerned a real live forestry conscience, willing to face facts and, having done so, to act up to them, has yet to be awakened." Yet these facts, as stated in the report, appear to be sufficiently obvious under existing world conditions.

In recent years the annual consumption of wood in Trinidad and Tobago amounts to more than 2,000,000 cubic feet from Crown lands, nearly 1,000,000 cubic feet of sawn timber imported from the United States and Canada, and a considerable quantity (statistics unavailable) from private lands—the annual *per capita* consumption being more than 100 board feet. In tropical regions the timbers are classified into soft woods and hard woods, both being broad-leaved species of trees. Trinidad possesses excellent soft woods, such as *Cedrela mexicana*, *Carapa guianensis*, *Cordia alliodora*, etc., but they occur, as is usual, in mixed forests and not in pure stands. Their utilisation in the past has been affected by unlimited supplies of cheap imported coniferous soft woods from the United States and Canada; consequently, as in other tropical countries, doubt has been cast on the suitability of the local soft woods for general purposes. The experiments undertaken by the Forest Department on seasoning local timbers have shown that this belief is mainly due to the lack of proper seasoning and grading methods, the Conservator pointing out that unseasoned pine timber would be equally unsuitable. Owing to the rise in price of the imported material, large and increasing amounts of local soft woods are used every year. Of the two million cubic feet of local timber used annually, possibly a fourth is soft wood, the Colony's consumption of the latter material being therefore about 1½ million cubic feet annually. After discussing the threatened diminution in the world's supplies of soft wood coniferous timber, the writer points out that the price will certainly rise and that the Colony will be forced to depend upon its own supplies of soft woods to an increasing extent. To replace this drain on the forests, he advocates a large re-afforestation or planting campaign, suggesting that the annual surplus from the forests, which amounted to £7000 in 1926, should be devoted to this purpose.

As regards the hard woods, it appears that the Colony is well supplied and that some of them may be utilised to replace soft woods when the articles to be manufactured can be turned out by machinery. Balata (Mimusops) and poui (Tecoma) are the favourite hard woods, but mora (*Dimor phandra*) has been successfully used for flooring, after seasoning, by the Government engineers. The Colony, it is remarked, has always been self-supporting in hard woods. In connexion with cedar, it is of interest to note that 19,632 cubic feet cedar logs, valued at £3085, were exported, chiefly to Germany and Holland, during the year, for the manufacture of cigar boxes.

The accounts of the work in progress in the Colony, including research, amply prove that the Forest Department is devoting itself to the conservancy and care of the forests. It must, therefore, be all the more disheartening to the Conservator to find his administration crippled by the want of the necessary staff. He has two deputy Conservators in charge of the north and south of the island. He had applied for a third to act as his assistant at headquarters whilst he was on tour. This post has been refused. The report shows that there are only 1000 acres of plantations in the Colony, and recommends, for perfectly sound reasons, the afforestation of 40,000 acres by 1970. As the writer well states: "The Forest Department can only point out facts." He details the facts, and in support of his suggestions quotes from the report of the recent Imperial Conference (on the subject of forest policy): "It points to the need of all countries maintaining and extending, where possible, their existing forest areas under a system of management based on sustained production of timber." The report would appear to have made out a strong case for such action being taken by the authorities of Trinidad and Tobago.

Gaseous Combustion.[1]

G. I. FINCH AND L. G. COWEN.—Gaseous combustion in electric discharges. Part II. Ignition of electrolytic gas has been studied under different conditions of pressure and current. Ignition occurs immediately, *i.e.* without lag, on attainment of the igniting current, and a hyperbolic relationship exists between pressure and igniting current. Excess or deficiency of water vapour raises the value of the igniting current. Flame is propagated at least ten times more rapidly along the path of the discharge than elsewhere. It is concluded that ignition is determined by the concentration of suitable ions, in the building up of which water vapour plays a rôle, and that flame propagation is also essentially an electrical phenomenon.

D. T. A. TOWNEND.—Gaseous combustion at high pressures. Part VIII. The explosion of methane with up to its own volume of oxygen at initial pressures up to 150 atmospheres. A study has been made of the explosion of (Series 1) methane-oxygen mixtures of composition varying from 5 : 1 to 1 : 1, and (Series 2) a 1 : 1 mixture with $3{\cdot}76R$, where R is nitrogen, argon, or helium. In Series 1, increasing the initial pressure (*a*) raises the upper limit of explosibility, and (*b*) in the case of mixtures containing upwards of 60 per cent. of methane, not only increases the violence of the explosion, but also diminishes and in some cases suppresses altogether, carbon deposition.

In Series 2, nitrogen appears to behave normally as a diluent only. The influence of helium as compared with argon is to shorten the time taken for the attainment of maximum pressure as well as to increase the subsequent rate of cooling. The corrected P_m/P_i ratios, however, were always greater in the case of explosions of the argon diluted mixture. The results accord well with the hydroxylation theory of hydrocarbon combustion.

A. EGERTON AND S. F. GATES.—Further experi-

[1] Substance of papers before the Royal Society on Nov. 10.

ments on explosions in gaseous mixtures of acetylene, of hydrogen and of pentane. Measurements are given of velocities and positions of detonation of acetylene, of pentane, and of hydrogen mixtures with oxygen, nitrogen, and argon at initial pressures up to 6 atmos. in a steel tube 1·5 cm. in diameter. Experiments in a bomb of comparatively large diameter give some evidence of auto-ignition during the progress of combustion of a vibratory character in certain acetylene mixtures. Lead tetraethyl delays the rate of combustion of the pentane in mixtures of acetylene and of pentane.

Photosynthesis.[1]

E. C. C. BALY, J. B. DAVIES, M. R. JOHNSON, AND H. SHANASSY.—The photosynthesis of naturally occurring compounds. I. The action of ultra-violet light on carbonic acid. When an aqueous solution of carbonic acid in quartz tubes is exposed to ultra-violet light, a photostationary state is established. Ordinary formaldehyde is not a component of this equilibrium, but there is present an organic compound which is probably a complex aldehyde. Ferrous bicarbonate in aqueous solution is converted by ultra-violet light in the absence of oxygen into ferric hydroxide, organic compounds with reducing properties being simultaneously formed. This reaction appears to take place mainly on the surface of the quartz tubes in which the solution is exposed to the light, and also on the surface of the iron rods used. When an insoluble powder, capable of adsorbing carbonic acid on its surface, such as aluminium powder, barium sulphate, freshly precipitated aluminium hydroxide, or the basic carbonates of aluminium, magnesium, and zinc is suspended in water through which is maintained a stream of carbon dioxide, and the whole is exposed to ultra-violet light, complex organic compounds are photosynthesised. These may be recovered by evaporation of the solution after removal of the insoluble powder. The total quantity of organic compound produced is about 0·02 gm. in two hours when eight quartz test tubes, 9 in. × 1 in., containing in all 720 c.c. of water and the suspended powder, are exposed to the light from a 220-volt U-shaped lamp at an average distance of 6 cm. The organic compounds thus produced would seem to be of the nature of complex carbohydrates. In the presence of ammonium bicarbonate complex organic compounds are produced which contain nitrogen. Photosynthesis of complex organic material containing nitrogen also takes place when nitrite of potassium or barium is present.

E. C. C. BALY, W. E. STEPHEN, AND N. R. HOOD.—The photosynthesis of naturally occurring compounds. II. The photosynthesis of carbohydrates from carbonic acid by means of visible light. When carbonic acid, adsorbed on the surface of nickel or cobalt carbonate suspended in water, is exposed to visible light, photosynthesis of organic compounds takes place. The material contains a carbohydrate which reduces Benedict's solution, gives the Molisch and Rubner reactions, and forms a solid osazone and also contains one or more complex substances which are hydrolysed by acid to give substances which reduce Benedict's solution. For equal areas of the suspension exposed to the light, the yield of organic products is greater than that obtained with white powders in the light of the quartz mercury lamp. The percentage of carbohydrates in the products photosynthesised with a coloured surface in white light is greater than it is when white powders are used in ultra-violet light. If ammonium bicarbonate solution containing nickel or cobalt carbonate in suspension is exposed to visible light complex nitrogen compounds are photosynthesised. The shift in the exciting wave-length from the ultra-violet characteristic of carbonic acid in solution to the visible region characteristic of natural photosynthesis has been achieved in the laboratory. The photosynthesis by means of visible light has the advantage in that the photochemical decomposition of the products is avoided. Further, the special difficulties connected with the use of quartz apparatus with ultra-violet light are removed. The oxygen set free during the photosynthesis tends to poison the surface, which slowly recovers itself under water.

E. C. C. BALY AND J. B. DAVIES.—The photosynthesis of naturally occurring compounds.—III. Photosynthesis *in vivo* and *in vitro*. A marked similarity exists between photosynthesis *in vivo* and that achieved *in vitro*. The following features appear to be common to both. Ordinary formaldehyde does not take part in the reaction in either case. The laboratory process has been realised by the action of light on carbonic acid adsorbed on a surface. A limiting surface seems to exist in the chloroplast. A visibly coloured surface and visible light function in each process. Marked fatigue effects are observed and there is a slow recovery reaction. It appears that in both cases the photosynthesis must not proceed at a more rapid rate than that recovery reaction. It seems possible that the constant ratio of chlorophyll A to chlorophyll B in the living leaf is maintained by the carotin, which becomes oxidised to xanthophyll; the ratio of xanthophyll to carotin tends to increase during photosynthesis, so the slow recovery process may be due to the reduction of xanthophyll to carotin again. The orientation of the chloroplasts with respect to the direction of the light rays seems to be one of the details of this mechanism controlling the rate of photosynthesis.

[1] Substance of papers before the Royal Society on Nov. 10.

Surface Reactions.[1]

M. FRANCIS AND F. P. BURT.—Sorption of ammonia by glass. The quantities of ammonia taken up by a known surface of glass under constant temperature and pressure conditions, and the rates of sorption, have been measured over a temperature range of 0° to 200° C. and a pressure range of 100 mm. to one atmosphere. The experimental attainment of equilibrium proved impossible, but limiting values were assessed by a process of extrapolation. Though complete desiccation of glass is impracticable, it is possible to maintain it indefinitely in such a condition that its behaviour towards ammonia can be closely recovered. The shape of the sorption curve depends on the dryness of the sorbent. The sorption process can be divided into two parts represented by straight lines when log sorption rate is plotted against log time. The slope of both lines is independent of pressure and varies only slightly with temperature, and their point of intersection corresponds, in all cases, to 50 per cent. sorption. By a suitable choice of co-ordinates the complete sorption process can be represented as a single-valued continuous function of temperature, pressure, and time. As regards temperature variation, this is only approximately true. At 50 per cent. sorption, the rate of sorption is nearly

[1] Substance of papers before the Royal Society on Nov. 10.

proportional to the pressure at constant temperature, and is doubled for every 20° C. rise in temperature at constant pressure. At constant temperature, log sorption, in the limit, was found to be a linear function of log pressure between 0·5 and 1 atmosphere. At lower pressures a departure from linearity was observed. At constant pressure, sorption, in the limit, was found to be inversely proportional to the absolute temperature.

G. I. FINCH AND J. C. STIMSON.—The electrical condition of hot surfaces during the adsorption of gases. Part I. Gold and silver surfaces at temperatures up to 850° C. A gold or silver surface becomes charged when heated either in contact with a gas or in a high vacuum. The charge is characteristic of the gas and dependent on the temperature and previous history of heating of the metal, but independent of the gas pressure. Evacuation of a gas removes the corresponding charge slowly in the case of oxygen or air on gold, and oxygen, air, or hydrogen on silver; but rapidly in the case of all other gases examined. The value of the charge due to a mixture of two gases, whether reacting with each other or not, is intermediate between the charges of the component gases and, as a rule, identical with that due to the reaction product. It is concluded that the charging of the surface is due to 'activation' of the gas, whereby the gas molecules are electrically charged. With oxygen, some become positively charged and remains thus charged on the surface, and some becomes either positively charged and quits the surface in this condition, or is negatively charged and remains on the surface. Gases other than compounds of oxygen are, on 'activation,' either positively charged and quit the surface in this condition, or are negatively charged and remain on the surface. Oxygen forms an oxide with gold or silver, and hydrogen a hydride with silver. The 'activating' powers of the surface are greater towards oxygen than towards nitrogen or carbonic oxide, but very approximately the same towards oxygen and hydrogen. The 'activation' of water vapour or carbon dioxide involves at least dissociation of the gas. Vapour of the metal is activated in the process of leaving the surface.

D. R. HUGHES AND R. C. BEVAN.—A study of the catalysis by nickel of the union of hydrogen and oxygen by a new method. When hydrogen and oxygen at a low pressure are caused to combine at the surface of a nickel wire heated electrically, there is no alteration in the appearance of the wire, although the wire is covered completely with a very thin film of nickel oxide while the catalysis of the reaction is in progress. The extent of the surface covered by the film can be measured by estimating the heat lost by the wire when it is maintained at a fixed temperature in hydrogen at a low pressure. Under the same conditions the heat imparted to the hydrogen by a wire covered with a film is much greater than that communicated to the gas by a wire having a metal surface. The thickness of the films varies between 3×10^{-7} cm. and 9×10^{-7} cm. It is therefore incorrect to speak of the catalysis of the interaction of hydrogen and oxygen by the metal nickel.

B. LAMBERT AND A. M. CLARK.—Studies of gas—solid equilibria. Part I. Pressure—temperature equilibria have been measured over a range 30° to 130° C. for (*a*) ten systems containing different amounts of benzene and ferric oxide gel; (*b*) eight similar systems containing different amounts of benzene and silica gel. Pressure—concentration isothermals for benzene—ferric oxide gel systems and for benzene—silica gel systems are strikingly different in shape for these two closely analogous systems. The adsorptive processes of the two gels for condensible vapours are thus profoundly different, and doubt is cast on Zsigmondy's capillary theory as a general explanation for adsorption of condensible vapours by inelastic gels.

The Neanderthal Phase of Man.

ON Tuesday, Nov. 8, the Huxley Memorial Lecture of the Royal Anthropological Institute was delivered in the lecture room of the Royal Society by Dr. Aleš Hrdlička, Curator of the Department of Physical Anthropology, U.S. National Museum, Washington, who took as his subject "The Neanderthal Phase in Man." For science, the subject of human evolution has long since passed from the realm of theory or hypothesis into that of well-substantiated facts. Many important details, however, of this most wonderful and promising of natural phenomena remain to be determined or settled. One of the foremost of these is the question of the Neanderthal stage of humanity, corresponding roughly to about the fourth fifth of the glacial time. From Huxley and Lyell to Sir Arthur Keith, Elliot Smith, Sollas, Marett, Burkitt, and Karl Pearson, all the noted English, besides a host of Continental and even American anthropologists, have given this stage of human prehistory their earnest attention, without being able to reach final conclusions. The chief cause of this has been the dearth of the skeletal remains of Neanderthal man. Even with repeated finds, material in good condition was insufficient for what is needed.

Notwithstanding this, the indications appeared to justify certain views, and these, formulated by men of high authority, were soon generally accepted. The chief of these was the opinion, fathered by the noted German anthropologist Schwalbe, that Neanderthal man was radically different from later man; that during or soon after the last maximum glaciation he was suddenly and completely displaced by a new human species, *Homo sapiens*, who came from somewhere outside, from the south or, more likely, from the east; and that he left no progeny.

As time advances, however, ever more remains of Neanderthal man come to light, and as the subject is studied more thoroughly, it appears that this older view is in need of a substantial revision. It is now known that no marked disturbance in habits (housing, food, etc.) between Neanderthal and later man can be determined. Neanderthal man occupied a great territory, comprising the larger part of Europe with northern Africa (at least) and western Asia, and nowhere is the higher type of man found to precede him or to live contemporaneously. Abruptly or even slowly to annihilate such an extensive population as that of the Neanderthalers would seem impossible. No separate home of *Homo sapiens* has been discovered; he does not appear with a higher culture, but gradually develops the latter. As his Neanderthal predecessor he knows fire, but no agriculture, no domestication of animals, not even a dog or a cat, makes no pottery, nor even the crudest of walls, and remains for a long time yet in the palæolithic stage of the stone industry. Beyond which, the more the remains from the Neanderthal and the succeeding periods grow in number, the more there appear of transitional features; and this applies to both the archæological as well as the skeletal remains. There is a growing series of Neanderthal skulls and jaws that distinctly approach those of later man (*i.e.* Spy No. 2, Weimar, Gibraltar boy, etc.), and, on the other hand, an ever-increasing number of later crania and

jaws that approach the Neanderthal forms. Moreover, it is biologically certain that man in the course of his evolution must, at some time and somewhere, have passed through a more or less Neanderthal-like stage.

In view of all this, it appears progressively less safe to persist in regarding Neanderthal man as a separate *species* of man, and to close the door to the possibility of further human evolution from his midst. The indications are that before long science will be in a position to view the Neanderthal man and his culture as regular and inherent *phases* of human evolution.

At the end of the lecture, the president of the Royal Anthropological Institute, Mr. H. J. E. Peake, presented the Huxley Memorial Medal to Dr. Hrdlička.

University and Educational Intelligence.

CAMBRIDGE.—Dr. P. M. Dirac has been elected to a fellowship at St. John's College. Mr. McLean, master of Christ's College, has been elected a member of the Council of the Senate.

Regulations have been proposed to the University for the newly founded Rouse Ball professorship of mathematics. It is not proposed to assign the new chair permanently to any one branch of mathematics, but if the General Board so decides at any election, it will be specified in the notice to candidates that preference will be given to those whose work is connected with some particular branch or branches of mathematics.

R. O. Redman, St. John's College, has been elected to an Isaac Newton studentship; J. A. Gaunt, Trinity College, and S. Goldstein, St. John's College, have been elected to additional Isaac Newton studentships for one year.

THE President of the Board of Education has appointed a Departmental Committee to inquire into the public system of education in Wales and Monmouthshire, in relation to the needs of rural areas, and to advise how those needs may best be met, having regard to the requirements (1) of a general education; (2) of rural industries, businesses, and professions; and (3) of life in a rural community. Sir John Eldon Bankes is chairman, and Mr. C. P. Clayton, Assistant Inspector, Welsh Department, Board of Education, is secretary to the Committee. All communications should be addressed to the secretary.

THE Institution of Naval Architects is offering the Elgar Scholarship (£130 per annum) and the John Samuel White Scholarship (£100 per annum) in naval architecture for competition in 1928. These scholarships are tenable at the universities of Glasgow (four years), Durham (Armstrong College) and Liverpool (three years), and the Royal Naval College, Greenwich (three years). They are open to British apprentices or students who have not yet entered upon a university course. Full particulars may be obtained from the Secretary, Institution of Naval Architects, 5 Adelphi Terrace, London, W.C.2.

THE calendar for 1927–28 of University College, London, now entering upon its one-hundredth session, is of exceptional interest, containing, as it does, a full record of the proceedings of the centenary celebrations. The College is remarkable alike for the range of its work and for the unusually ample provision for advanced study and research. Of the 800 pages of the calendar a large number relate to post-graduation study, particulars being given of courses of advanced lectures in forty-three departments, including a series arranged by Prof. Wolf, with the co-operation of other professors and teachers of the University, on the history, principles, and methods of the sciences. There is a list of some 450 original papers published during the past twelve months in 37 departments, notably anatomy (52), physiology (53), chemistry (45), and history (45). The number of graduate and research students last year was 534.

'INDUSTRIAL Administration' has been a subject of university study in Great Britain since 1918, when a group of business men promoted and largely financed a department in the Manchester Municipal College of Technology. In the prospectus of the College for 1927–28, particulars are given of a one-year post-graduate course covering the following ground: industrial output, purchasing and stock-control, economic history, history of industrial organisation, factory law, wage systems and factory costing, business statistics, industrial relationships. The Director of the Department, Dr. J. A. Bowie, in a recent address to a managers' association, defined his subject as the technique and problems of industrial management with special reference to the internal organisation of manufacturing concerns. The two great faults of British management to-day, he said, are secretiveness and an unwillingness to learn, and the remedy is to be found in requiring managers to study management before they attempt to practise it. He quoted Mr. Hoover as having said that the enormous industrial progress of the United States is due mainly to the emphasis placed there on business education, and remarked that about a hundred American universities and colleges have schools or departments of business administration.

AT the League of Nations Assembly in September a report was presented on the work of the League's Committee on Intellectual Co-operation. The report directs special attention to the creation at the International Institute of Intellectual Co-operation of a co-ordination service of information offices attached to libraries, to the Committee's proposals for co-ordination between the organs of bibliography for the various sciences, to the need of funds for the maintenance of the Office for Annual Tables of Constants and Mathematical Quantities, and to the steps taken in preparation for the Popular Arts Congress (to be held at Prague in 1928), for an international agreement with regard to casts, and for promoting the extension of the educational work of museums. It is also pointed out that additional funds are needed for the Institute, grants to which are at present made only by the following countries: Austria, Czechoslovakia, France, Hungary, Italy, Monaco, Poland, and Switzerland. The question how to protect and reward men of science and their discoveries by means of an international convention has been investigated during the past five years, and it is now thought that the matter is ripe for definite action. It is intended therefore to convene a committee of experts to prepare a draft convention. A separate report was submitted on the Italian proposal for the creation of an educational kinematographic institute. This proposal looks to the creation at Rome of an institute under the direction of the League of Nations, but to be carried on at the expense of the Italian government.

Calendar of Discovery and Invention.

November 20, 1817.—It was in 1743 that the Government first offered a reward for the discovery of a North-West Passage, and several attempts were made in the eighteenth century to find a passage. The resumption of such expeditions after the Napoleonic wars was largely due to the Royal Society, Sir Joseph Banks writing on Nov. 20, 1817, to Lord Melville "that discoveries may now be made . . . not only interesting to the advancement of science, but also to the future intercourse of mankind and the commerce of distant nations." The outcome of the suggestion was the fitting out of the *Isabella*, *Alexander*, *Dorothea*, and *Trent*, respectively, under the command of Ross, Parry, Buchan, and Franklin.

November 21, 1843.—Of the invention of vulcanised rubber patented by Thomas Hancock on Nov. 21, 1843, the inventor left a most interesting account in his "Personal narrative . . . of the India Rubber manufacture in England" (1857). Some time in 1842 his friend Brockedon gave Hancock some bits of rubber received from America which did not stiffen with cold. In his private laboratory at Stoke Newington, Hancock, groping "a good deal in the dark," ultimately discovered the changes brought about by mixing rubber and sulphur at various temperatures. Setting out to manufacture the new material on a large scale, he sought for a name, and it was Brockedon who suggested the term "Vulcanisation," which "owes its derivation to the Vulcan of mythology, as in some degree representing the employment of sulphur and heat, with which that mythological personage was supposed to be familiar."

November 22, 1675.—The first determination of the velocity of light was made by the Danish astronomer, Roemer, who, while engaged under Picard in Paris, studied the motion of Jupiter's satellites, and by observing their immersions and emersions found that light took about sixteen minutes to travel a distance equal to the diameter of the earth's orbit. This important result was communicated by him to the Paris Academy of Sciences on Nov. 22, 1675, and gained for him a seat in the Academy.

November 23, 1889.—In a letter to her daughter, dated Nov. 23, 1889, Mrs. King, the niece of Lord Kelvin, refers to Lord Kelvin's "meeting with the Admiralty, which was most satisfactory, for it is now ordained that his be the standard compass and be used throughout the Navy." There had, however, been attempts to prevent the adoption of the compass, approving letters having been pigeonholed. "I believe," says Mrs. King, "this had been going on for years, and that Admiral Fisher has been instrumental in exposing the abuse. . . . There is much of the circumlocution office in the whole affair. Uncle William does not want it talked of. . . ."

November 24, 1831.—In the course of ten days' work, spread over the months August to November, 1831, Faraday made his memorable discoveries in induced currents and magneto-electric induction. In his experiments he employed among other apparatus the famous iron ring, and the copper disc revolving between the poles of a permanent magnet now preserved in the Royal Institution. His results, amplified and extended, were presented to the Royal Society on Nov. 24, 1831. "So exhaustive was his treatment of the subject," said Prof. Fleming, "that no one has since added a single new fact or principle which is not implicitly contained in the record of this work thus given to the world."

November 26, 1725.—The discovery of the aberration of light by Bradley resulted from observations begun at Kew, Nov. 26, 1725. E. C. S.

Societies and Academies.

LONDON.

Royal Society, Nov. 10.—Sir Richard **Paget**: The origin of speech. (See NATURE, July 9, p. 47.)

NUCLEAR PHYSICS.

C. D. **Ellis** and W. A. **Wooster**: The average energy of disintegration of radium E. The average energy of disintegration of radium E is found by measuring the heating effect of a known amount of the material. It agrees with the mean energy of the continuous spectrum of electrons emitted from the nucleus, and the conclusion is drawn that the energy of disintegration is not a characteristic constant of a β-ray body but varies from atom to atom. From this result it appears that the γ-rays cannot be emitted by the electronic part of the nucleus but must have their origin in the positive portion.

P. M. S. **Blackett** and E. P. **Hudson**: The elasticity of the collisions of alpha particles with hydrogen nuclei. Inelastic collisions involving the ejection of a proton from the nuclei of certain light elements are known to occur. They may also occur without, however, a proton being ejected; for example, the nuclei might be deformed without being disintegrated, or energy might be radiated by the rapidly accelerated particles. This problem can be investigated directly by precise measurements of photographs of the collisions taken by the Wilson condensation method. The collisions of fast α-particles with hydrogen nuclei provide tracks which are susceptible of great accuracy of measurement and therefore would reveal any small energy loss should such occur. If any loss of kinetic energy occurs it must be less (for the most favourable of the two tracks measured) than 1/200 of the initial energy of the α-particle; less, therefore, than 40,000 electron volts. If a quantum of radiation were emitted during the collision, its wave-length must be greater than 0·3 A.

SPECTRUM ANALYSIS.

E. T. S. **Appleyard** and H. W. B. **Skinner**: On the excitation of polarised light by electron impact. II.—Mercury. It has been shown that when spectrum lines are excited by a directed stream of electrons, they are variously polarised. Measurements of the polarisation by means of photographic photometry are now described. The most important feature of the curves obtained is the maximum value of the percentage polarisation which occurs when the energy of the electron stream exceeds the critical energy for excitation by a few volts. On the low-velocity side of the maximum, the polarisation falls very sharply, apparently to a zero value at the critical point. For high velocities, corresponding to 200 volts, the direction of the plane of polarisation is reversed. The results can be interpreted as a collision process in which an atom is excited by electron impact.

J. C. **McLennan**, H. **Grayson-Smith**, and W. T. **Collins**: Intensities in the secondary spectrum of hydrogen at various temperatures. The intensities of most of the lines measured by Merton and Barratt in the secondary spectrum of hydrogen have been measured by means of a microphotometer at two temperatures. For Richardson's series system the change of intensity with temperature is generally in good agreement with theory. The alteration of intensity between the odd and even members of the series is also clearly shown. Other regularities which have been found in the spectrum have also been examined, and from the change in intensity, many of these appear to be sequences of corresponding

members of different bands, rather than actual band series.

B. Venkatesachar: Density of the vapour in the mercury arc and the relative intensities of the radiated spectral lines with special reference to the forbidden line 2270. The effect of lowering the density of the vapour on the series lines in the arc spectrum (including inter-combination lines) is to increase the absolute intensities of all lines below $m=5$ and diminish those of all lines above $m=6$. This result can be explained on the hypothesis that inelastic collisions between excited atoms in lower energy levels and thermally energetic normal atoms form the chief source of the radiators of the higher members of series lines. To the radiators of the lower members the contribution from this source is negligible. On increasing the vapour density, collisions between the radiators of the lower members and normal atoms resulting in radiationless transitions increase and the intensities of these lines fall. The forbidden line λ2270, like the lower members of other series lines, increases in intensity when the arc passes to the low density stage.

O. W. Richardson: On the intensity distribution among the lines of certain bands in the spectrum of the hydrogen molecule. The intensities of the lines of the Q branches of various bands of the hydrogen spectrum were examined critically, using the measurements of McLennan and his collaborators. The odd numbered lines are nearly three times as strong as the even numbered. The analysis shows that antisymmetric emitters are three times as numerous as symmetric. This holds for various vibration states of the 3-electron state and probably also for the 4 state. The ultra-violet spectrum data seem to require it to hold also for the 2 state, and Dennison's analysis of the specific heat of hydrogen requires it for the 1 state.

J. S. Foster: Application of quantum mechanics to the Stark effect in helium. New measurements of displacements of helium components in fields of 100,000 v./cm. and 83,000 v./cm. are recorded. The first-order displacements have been calculated at several field strengths for components of the line groups $2P-(4Q, 5Q)$, $2S-(4Q, 5Q)$ and for the corresponding orthohelium lines, considered as singlets. These displacements are in good agreement with observations at all field strengths. Approximate positions of the components at extremely high fields are calculated, and the manner in which certain components are expected to cross each other in moderate to high fields is described. In the case of two lines, at least $(2P-4F, 2P-5G)$, there is conclusive experimental evidence of such crossing. In particular, the theory accounts satisfactorily for the observed disappearance of numerous components when the displacement is equal to that of the $2P-nP$ line at zero field.

R. W. Ditchburn: The continuous absorption of light in potassium vapour. The absorption found is believed to be due to a combination of molecular and atomic absorption. The results are discussed in connexion with the theory of atomic and molecular absorption; the amount of atomic absorption appears to be much less than that expected. The heat of dissociation of the potassium molecule is derived from the absorption curves and used to calculate the degree of association in potassium vapour at different temperatures.

J. W. Ryde: The spectrum of carbon-arcs in air at high current densities. The positive carbons were cored with metallic salts. Under suitable conditions, this allows steady arcs at high-current densities to be obtained. As the current through such arcs is increased, a bright central core develops in the arc stream. In this core it was found that spectra of C I, N I, O I, together with the Balmer hydrogen lines and the strongest lines belonging to the red spectrum of argon, are excited. The relative intensities of C I and N I lines, previously only found in special discharge tubes, are compared with those found in the arc stream. More than fifty new lines were observed. These also are probably due to either N I, O I, or C I.

Tensor and Differential Calculus.

J. L. Burchnell and T. W. Chaundy: Commutative ordinary differential operators. Associated with any polynomial $f(p, q)$ of a certain type is a group [P, Q] of pairs of commutative operators which also satisfy the identity $f(P, Q)=0$. The construction of these operators is based on the set of Abelian equations of the first kind associated with the polynomial $f(p, q)$; the function $\eta(p, q)$ which is annihilated by both $P-p$, $Q-q$ is an Abelian function of the second kind. If P′, Q′ denote the operators adjoint to P, Q, then the group of adjoint pairs [P′, Q′] can be derived from the group [P, Q] by change of sign of x, and in particular there is one pair in the group which can be derived from its adjoint in this way. If P, Q is a commutative pair, there are operators T such that we may write

$$TP=P_1T, \qquad TQ=Q_1T,$$

where P_1, Q_1 are other operators also commutative and obeying the same identity as P, Q.

T. M. Cherry: Periodic solutions of Hamiltonian systems of differential equations. The existing theory (Poincaré's) is unsuited to finding the mutual relations of the periodic solutions of a fourth order Hamiltonian system. Periodic solutions occur in general in continuous singly infinite families. With each solution of a family is correlated a number R which may be real or unreal and varies continuously along the family. From any solution S for which R is real and rational there branch two (in general) new families, whose periods near S are approximately integral multiples of the period of S. A family for which R is real thus throws off branches at all its 'rational' members. These families, when real, are susceptible of a geometrical representation in which to each periodic solution corresponds a point, and to each family a line in 3-dimensional space. Taking the whole aggregate of such lines, they apparently join up so as to form a system of closed meshes of complicated character, only partly elucidated.

M. H. A. Newman: A gauge-invariant tensor calculus. A 'projective' differential calculus is developed, capable of dealing with tensors of various 'weights,' as well as tensors of various ranks. The equations preserve their form both under a change of co-ordinates and under a change of measure-system. The theory is applied to find a tensor and gauge-true form for the identities given by the variation of integrals. The general gauge-true equations resulting from the law

$$\delta\int R^2\sqrt{g}=0.$$

are obtained. The part independent of the 'electrical' vector ϕ_1 is found to be

$$G_{ik}-\tfrac{1}{4}Gg_{ik},$$

a tensor which has been considered by Einstein from time to time in connexion with the theory of gravitation.

F. B. Pidduck: Adjoint differential equations: E. Bortolotti showed that adjoint differential equations have a certain analogy with sets of linear algebraical

equations in which rows and columns are interchanged in the matrix of coefficients. G. D. Birkhoff gave a rule for finding a set of adjoint boundary conditions which make the fundamental integral, or bilinear differential form, vanish when taken over the whole range. The present paper traces the appearance of the adjoint equation and boundary conditions when the number of unknowns in the linear equations tends to infinity.

(*To be continued.*)

Mineralogical Society, Nov. 1 (Anniversary Meeting).—L. J. **Spencer**: (1) Specific gravities of minerals: an index of some recent determinations. Specific gravity as determined by heavy liquids affords a convenient first-aid in the determination of minerals. 2277 determined values collected from the recent mineralogical literature are arranged numerically, and an alphabetical index of mineral names gives the minimum and maximum values for each mineral. (2) South African occurrences of willemite. Fluorescence of willemite and some other zinc minerals in ultra-violet rays. Willemite is described from Broken Hill and two other localities in Northern Rhodesia where it appears to be of abundant occurrence, and from Guchab in South-West Africa. Unlike the willemite of Franklin Furnace, New Jersey, some of these not do fluoresce in ultra-violet rays. Fluorescence is not a constant and essential character of a mineral species, and it evidently depends on the presence of admixed impurities.—T. V. M. **Rao**: A study of bauxite. Specimens of laterite from India, Gold Coast, and other countries were described. It was shown that laterite is a rock largely composed of the mineral bauxite, which has a definite composition corresponding to the formula Al_2O_3, $2H_2O$. Details of an experiment to trace the process of laterisation in Nature were also given.—P. K. **Ghosh**: On the biotite-bearing greenstones and on a rhyolitic pumice in the metamorphic aureole of the Falmouth granite. The biotite constituent, which has so far been ascribed to the metamorphic action of the Armorican granite on the pre-existing greenstone, is proved to be the undigested and residual part of the slate fragments stoped by the 'greenstone' magma at the time of its intrusion. Rhyolitic pumice is noted for the first time in this region and its mineralogical characters are described.

Society of Public Analysts, Nov. 2.—Sir William **Willcox**: The biological tests for blood. An outline was given of the evolution of blood tests, from the days when the only differential method available was based on differences in the form and size of the blood corpuscles, down to the refined serum tests of the present time. Caution is necessary in using bought specific sera for these tests, since they were frequently inert.—G. Roche **Lynch**: The technique of the precipitin test and its forensic value. The various methods of preparing anti-sera, the extraction of blood stains, the filtration and sterilisation of the extract by means of special apparatus, the methods of determining the concentration of the extract, and the various ways in which the precipitin test can be applied were described.—F. C. **Martley**: The use of the blood grouping reactions in forensic investigation. By means of the four blood groups into which the blood of different individuals can be classed, it is often possible to distinguish between the blood of different persons. The method has applications in forensic work and in determining paternity.

PARIS.

Academy of Sciences, Oct. 17.—A. **Lacroix**: First observations on the mineralogical and chemical composition of the Mesozoic and Tertiary lavas of eastern China. The lithological types observed include rhyolites, dacitoides, andesites, basalts, and limburgites. All the rocks which are not basaltic are very poor in coloured minerals and they all contain free silica.—F. E. **Fournier**: The horizontal resistance of water to the translation of hulls.—d'**Arsonval**. The heating of tissues by high-frequency currents. A description of experiments with the 'long chair,' in which the patient and a metallic plate form the plates of a large condenser. The body of the patient was replaced by a bottle containing salt solutions of varying concentrations, and the corresponding rises of temperature measured.—Ch. **Riquier**: The numerical resolutions of systems of integral algebraical equations with any number of unknowns.—P. **Vincensini**: Congruences with mean plane surface.—E. **Lainé**: The partial differential equations of the second order of the form $s=p(x, y, z, q)$ which are of the first class.—Stefan **Kempisty**: The integral (A) of M. Denjoy.—Georges **Alexits**: The divergence of Fourier's series of continued functions.—N. **Podtiaguine**: Regular increasing functions.—Antonio **Cabreira**: Algebraical schemes of the dates of the lunar phases and the table of relative tides.—E. M. **Antoniadi**: The rotation of the planet Mercury. The observations described confirm the discovery of Schiaparelli, that the period of rotation of Mercury is equal to its period of revolution.—G. W. **Ritchey**: A type of fixed vertical photographic telescope, with cœlostat, with interchangeable focal ratios.—Léon and Eugène **Bloch**: Spark spectra of higher order of sulphur and selenium. The sulphur (or selenium) was enclosed in an evacuated quartz tube, without electrodes, and excited by an oscillating discharge in a solenoid wound round the tube. Tables of the lines measured are given.—W. **Swietoslawski** and Mlle. A. **Dorabialska**: An adiabatic microcalorimeter for radiological researches. The microcalorimeter described and illustrated has a thermal capacity so low as 0·08 calories. The instrument has been used to determine the heat evolved by 4·3 milligrams of radium, the rise of temperature found being 0°·0808 per hour. It has also been possible to measure the heat given off by the α- and β-rays of one millicurie of radon contained in a capillary tube.—Vasilesco **Karpen**: Batteries with unalterable identical electrodes.—René **Audubert**: The valve effect presented by a silicon anode and its mechanism. A very efficient rectifier is produced by a cell with a silicon anode: it is shown that the effects produced are connected with an oxidation-reduction process.—Mlle. C. **Chamié**: The existence of groupings of atoms of radioactive elements in acid solutions and in surfaces activated by the emanation.—Jean **Cournot** and Jean **Bary**: The use of electrolytic deposits of cadmium for the protection of metals and alloys against corrosion. Cadmium plating is superior to nickel plating in being non-porous and consequently shows high resisting power to corrosion. On the other hand, the deposited cadmium is not so hard as nickel and soon loses its high polish. Good results were obtained by cadmium and nickel together.—Ed. **Chauvenet** and E. **Duchemin**: The combinations of zirconium oxychloride with the alkaline chlorides. No thermal effect, and consequently no compound could be shown by mixing solutions of zirconium oxychloride ($ZrOCl_2$) with lithium, sodium, or potassium chlorides. On the other hand, definite compounds of zirconium oxychloride were proved with ammonium chloride, rubidium chloride, and cæsium chloride.—G. **Denigès**: Stable and unstable molybdenum blues. Analytical applications to the detection of phosphoric and arsenic ions. Details of the preparation of a

reagent for the detection and estimation of minute traces of phosphates.—Amand Valeur and P. Gailliot: Study of the products of high boiling-point contained in oil of Cadet. A new type of arsenic compound has been isolated containing three atoms of arsenic in the molecule; these bodies are chemically very stable.—L. Joleaud: Contribution to the stratigraphical study of the Tertiary soils of the Caribbean regions of South American Colombia.—Léon Moret: The extension of the phosphate deposits in the Haut-Atlas of Marrakech (Western Morocco).—Jacques de Lapparent: The occurrence of dolomitic walls in bauxite deposits.—Ch. Jacob: The structure of the Turbon, Cotiella, and Castillo-Mayor in Haut-Aragon.—A. Maige: Remarks concerning the greening of plant cells.—Mlle. Suzanne Ancel: The action of time and intensity in the effect of irradiation by the X-rays on germinated seeds. Under the conditions of the experiments described, and for an equal dose of X-rays, the increase of time of irradiation with diminution of intensity shows a clear and constant diminution of the effect of the rays.—R. Franquet: The formation of aerial tubercles of the Jerusalem artichoke without grafting.—L. Mercier: The presence of *Chrysomyia albiceps* on the coast of Calvados.—A. Policard: Studies in microdissection on the cartilage of growth of bones.—R. Fosse and A. Hieulle: A mercuric compound of allantoic acid permitting the identification of this ureide in the green legume of *Phaseolus vulgaris*.

Official Publications Received.

BRITISH.

Aeronautical Research Committee: Reports and Memoranda. No. 1086 (Ae. 265): Wind Tunnel Tests with High Tip Speed Airscrews. The Characteristics of the Aerofoil Section R.A.F. 31a at High Speeds. By Dr. G. P. Douglas and W. G. A. Perring. (A.3.d. Airscrews, 97.—T. 2390.) Pp. 33+14 plates. 1s. 6d. net. No. 1099 (E. 25): A Discussion of the Law of Variation of Engine Power with Height. By H. Glauert. (B. 4. Engines, 63.—T. 2437). Pp. 7. 4d. net. (London: H.M. Stationery Office.)

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1927-1928. Pp. 310. (Manchester.)

The Manchester Municipal College of Technology. Prospectus of Courses in Industrial Administration, Session 1927-28. Pp. 18. (Manchester.)

Proceedings of the Cambridge Philosophical Society. Vol. 23, Part 8, October. Pp. 845-1004+xi. (Cambridge: At the University Press.) 7s. 6d. net.

North-East Coast Institution of Engineers and Shipbuilders. Report of the Council, 1926-27. Pp. 16. (Newcastle-upon-Tyne.)

Transactions of the Hull Geological Society. Edited by Thos. Sheppard. Vol. 7, Part 1, 1926-1927. Pp. 40. (Hull: A. Brown and Sons, Ltd.) 5s.

Malayan Forest Records. No. 4: Notes on Damar-Penak. By R. W. Blair and Dr. F. E. Byron. Pp. 12. (Kuala Lumpur: Forest Department.) 50 cents; 1s.

Department of Agriculture, Ceylon. Bulletin No. 80: Experiments in Cacao Fermentation. By T. H. Holland. Pp. 21. (Peradeniya.) 40 cents.

Ceylon Administration Reports for 1926. Part 4: Education, Science and Art (D). Administration Report of the Director of Agriculture for 1926. Pp. D69. (Colombo: Government Record Office.) 1.45 rupees.

London School of Hygiene and Tropical Medicine. Third Annual Report to the Court of Governors, 1926–27. Pp. 12. (London.)

Journal of the Chemical Society: containing Papers communicated to the Society. October. Pp. xii+iv+2389-2660. (London: Gurney and Jackson.)

Aeronautical Research Committee: Reports and Memoranda. No. 1061 (Ae. 244): The Distribution of Normal Pressures on a Prolate Spheroid. By Dr. R. Jones. (A.3.e. Airships-Experiments on Models, 83.—T. 2171.) Pp. 87. 3s. net. No. 1101 (Ae. 279): Full Scale Tests of a Bristol Fighter with Slot and Aileron Control operated by a Differential Link Mechanism. By H. M. Garner. (A.2.b. Stability Full Scale Experiments, 53.) Pp. 2+2 plates. 4d. net. (London: H.M. Stationery Office.)

Scientific and Industrial Research Council of Alberta. Report No. 18: The Bituminous Sands of Alberta. By K. A. Clark and S. M. Blair. Part ii: Separation. Pp. v+36+3 plates. (Edmonton, Alba.: W. D. MacLean.)

University College of North Wales. Calendar for Session 1927-28. Pp. 403. (Bangor.)

Aeronautics. Technical Report of the Aeronautical Research Committee for the year 1925–26 (with Appendices). General Aerodynamics (Aerofoils, Stability and Control, Performance); Air-screws, Engines, Materials, Strength of Structures, Instruments. Pp. viii+1023+382 plates. (London: H.M. Stationery Office.) 35s. net.

Transactions of the Royal Society of Edinburgh. Vol. 55, Part 2, No. 19: Contributions to the Study of the Old Red Sandstone Flora of Scotland. vi. On *Zosterophyllum myretonianum*, Penh., and some other Plant-Remains from the Carmyllie Beds of the Lower Old Red Sandstone; vii. On a Specimen of Pseudosporochnus from the Stromness Beds. By Dr. W. H. Lang. Pp. 443-455+2 plates. 2s. 6d. Vol. 55, Part 2, No. 20: Geology of the Outer Hebrides. Part iv. South Harris. By Dr. T. J. Jehu and R. M. Craig. Pp. 457-488+5 plates. 5s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Development Commission. Seventeenth Report of the Development Commissioners for the Year ended the 31st March 1927. Pp. 178. (London: H.M. Stationery Office.) 3s. net.

Colony and Protectorate of Kenya: Forest Department. Annual Report for the Year ended 31st December 1926. Pp. 33. (Nairobi: Government Press.) 1s. net.

Ceylon Administration Reports for 1926. Part 4: Education, Science and Art (F). Administration Report of the Government Marine Biologist for 1926. Pp. F29. (Colombo: Government Record Office.) 65 cents.

FOREIGN.

United States Department of Agriculture. Department Bulletin No. 1490: Defects in Timber caused by Insects. By Thomas E. Snyder. Pp. 47. 15 cents. Department Circular 411: The Relation of Insects to Slash Disposal. Pp. 12. 5 cents. (Washington, D.C.: Government Printing Office.)

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 334: First-Order Leveling in Oregon. By Henry G. Avers. (Special Publication No. 122.) Pp. 78+2 plates. (Washington, D.C.: Government Printing Office.) 15 cents.

Technical Books of 1925: a Selection. Pp. 28. (Brooklyn, N.Y.: Pratt Institute Free Library.)

Bulletin of the American Museum of Natural History. Vol. 54, Art. 5: Notes on Chinese Amphibians. By Karl Patterson Schmidt. Pp. 553-575+plates 31-32. (New York.)

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 560: Density and Electrical Properties of the System, Rubber-Sulphur. Part 1: Density of Rubber-Sulphur Compounds, by A. T. McPherson; Part 2: Electrical Properties of Rubber-Sulphur Compounds, by H. L. Curtis, A. T. McPherson and A. H. Scott. Pp. 383-418. (Washington, D.C.: Government Printing Office.) 15 cents.

Journal of the Faculty of Science, Imperial University of Tokyo. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 2, Part 3: Stratigraphical Studies of the Fusulina Limestone of Akasaka, Province of Mino. By Prof. Yoshiaki Ozawa. Pp. ii+12-1164+plates 34-46. 2.00 yen. Vol. 2, Part 4: Fossil Mollusca from Kaga, by Matajiro Yokoyama; Tertiary Fossils from Western Hizen, by Matajiro Yokoyama; Tertiary Shells from the Coal-Field of Haboro, Teshio, by Matajiro Yokoyama. Pp. 165-204+plates 47-52. 1.20 yen. Vol. 2, Part 5: On the Occurrence of Pulsatory Motions in the Earth's Crust. By Takeo Matuzawa. Pp. 205-263. 1.40 yen. Section 3: Botany. Vol. 1, Part 3: On the Structure and Affinities of some Fossil Tree-Ferns from Japan. By Yudzuru Ogura. Pp. 351-380+plates 2-8. 1.30 yen. Vol. 2, Part 2: Experimentelle zytologische Beiträge. Mitteilung 2: Über die Wirkung des destillierten Wassers auf die Wurzelspitzenzellen von *Vicia Faba* bei verscheidenen Temperaturen. Von G. Yamaha. Pp. 215-296+plates 14-15. 1.60 yen. (Tokyo: Maruzen Co., Ltd.; Berlin: R. Friedländer und Sohn.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 8, 1926. 5: Hydrografiska mätningar i Sverige. Pp. 40+5 planscherna. (Stockholm.) 5.00 kr.

Department of Commerce: U.S. Coast and Geodetic Survey. Special Publication No. 133: Progress of Work in Terrestrial Magnetism of the U.S. Coast and Geodetic Survey, January 1, 1925, to June 30, 1927. By N. H. Heck and D. L. Hazard. Pp. 8. (Washington, D.C.: Government Printing Office.) 5 cents.

Meddelande från Lunds Astronomiska Observatorium. Ser. 2, Nr. 37: Investigations on the Stars in High Galactic Latitudes. 1: Colours and Magnitudes of 3700 Stars within 10° of the North Galactic Pole. By K. G. Malmquist. Pp. 104. (Lund: C. W. K. Gleerup; Leipzig: Otto Harrassowitz.)

Proceedings of the United States National Museum. Vol. 71, Art. 18: The Geology, Petrography and Mineralogy of the Vicinity of Italian Mountain, Gunnison County, Colorado. By Whitman Cross and Earl V. Shannon. (No. 2690.) Pp. 42+2 plates. Vol. 71, Art. 21: A recently found Iron Meteorite from Oakley, Idaho. By George P. Merrill. (No. 2693.) Pp. 3+2 plates. Vol. 72, Art. 3: New Species of Mollusks of the Genus Corbicula from Uruguay and Brazil. By William B. Marshall. (No. 2699.) Pp. 7+1 plate. Vol. 72, Art. 4: Heretofore undescribed Meteoric Irons from (1) Bolivia, South America, (2) Western Arkansas, and (3) Seneca Township, Michigan. By George P. Merrill. (No. 2700.) Pp. 4+2 plates. Vol. 72, Art. 16: The Rodents of the Genus Plagiodontia. By Gerrit S. Miller, Jr. (No. 2712.) Pp. 8+1 plate. (Washington, D.C.: Government Printing Office.)

Bulletin of the Bingham Oceanographic Collection. Vol. 1, Art. 1: Scientific Results of the First Oceanographic Expedition of the *Pawnee*, 1925. Fishes. By C. M. Breder, Jr. Pp. 90. Vol. 3, Art. 1: Scientific Results of the Third Oceanographic Expedition of the *Pawnee*, 1927. Ceratioidea. By Albert Eide Parr. Pp. 34. (New York.)

Bulletin of the American Museum of Natural History. Vol. 57, Art. 1: On the Anatomy and Classification of the Weaver-Birds. By Peter P. Sushkin. Pp. 32. (New York.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1548: The European Corn Borer; its Present Status and Methods of Control. By D. J. Caffrey and L. H. Worthley. Pp. ii+48. (Washington, D.C.: Government Printing Office.) 20 cents.

CATALOGUES.

Catalogue of Books on the Subject of Entomology. (No. 155.) Pp. 16. (London: Dulau and Co., Ltd.)

Catalogue of Interesting Works on Flowers, Shells, Insects and General Literature. Pp. 8. (London: John H. Knowles, Balham.)

Diary of Societies.

FRIDAY, NOVEMBER 18.

ASSOCIATION OF ECONOMIC BIOLOGISTS (at Imperial College of Science) (Botany Department), at 2.15.—Foot and Mouth Disease:—F. C. Minett: History; Foot and Mouth Disease in Farm Animals; Disinfection.—Dr. A. Arkwright: Experimental Foot and Mouth Disease in Small Animals; General Characters of the Virus; Immunity.—Dr. S. P. Bedson: Physical Properties of the Virus, Filtration, etc.; Prophylactic Vaccines.—Mrs. Y. M. Burbury: Survival of the Virus Outside the Body.—I. A. Galloway: Demonstration of the Lesions of Foot and Mouth Disease in Guinea-Pigs.

SATURDAY, NOVEMBER 19.

BRITISH MYCOLOGICAL SOCIETY (at University College), at 11.—S. F. Ashby: The Oospores of *Phytophthora nicotianæ*, with Notes on the Taxonomy of *P. parasitica*.—B. F. Barnes: On the Production of Variations in Eurotium.—S. Garside: Method of Reproduction in *Siphula tabularis*.—R. M. Nattrass: The Physalospora Disease of Basket Willow.—J. Ramsbottom: Mycological Nomenclature. Editorial Comments.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch—Junior Section (in Manchester University), at 3.—Prof. F. C. Thompson: Address.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—G. Holst: Samuel Wesley and Robert Pearsall (I.).

HULL ASSOCIATION OF ENGINEERS (at Municipal Technical College, Hull) at 7.15.—Prof. G. Stoney: Modern Practice in Steam Turbines.

MONDAY, NOVEMBER 21.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 6.30.—G. K. Wood: The Locomotive Boiler in Service.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—W. Day and others: Discussion on Automatic Telephony.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Sir Herbert Baker: The Government Offices of Pretoria and the New Delhi.

ROYAL SOCIETY OF ARTS, at 8.—Prof. H. C. H. Carpenter: Alloy Steels, their Manufacture, Properties, and Uses (Cantor Lectures) (II.).

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Major R. E. Cheesman: The Blue Nile.

CHEMICAL INDUSTRY CLUB.

TUESDAY, NOVEMBER 22.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: A Year's Work in X-Ray-Crystal Analysis (I.).

ILLUMINATING ENGINEERING SOCIETY (at E.L.M.A. Lighting Service Bureau, 15 Savoy Street, W.C.2), at 7.—L. Gaster: Report of Progress during the Vacation.—Report of Committee on Progress in Electric Lamps and Lighting Appliances.—H. Talbot: Progress in Gas Lighting.—At 8.15.—Exhibition of Recent Lighting Appliances.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group), at 7.—F. G. Newmarch: Some of my Experiences in Colour Work.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—C. H. Faris: The Uses of Nickel Deposits for Engineering Purposes.

SOCIETY OF GLASS TECHNOLOGY (at Congregational Schoolroom, Stourbridge), at 7.30.—Prof. W. E. S. Turner: Modern Artistic Glass (Lecture).

INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Institute of Transport) (at Institution of Electrical Engineers), at 8.—Capt. C. H. Kuhne: Military Transport Vehicles: Recent Development and their Commercial Significance.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—The Misses French: Where the Great Wall Ends.

WEDNESDAY, NOVEMBER 23.

INSTITUTE OF FUEL (Annual Meeting) (at Institution of Electrical Engineers), at 10.30 A.M.

FARADAY SOCIETY (at Chemical Society), at 2.30.—General Discussion on Cohesion and Related Problems.—Introductory Survey by Prof. C. H. Desch, and Papers by the following:—N. K. Adam, H. J. Gough, A. A. Griffith, Prof. B. P. Haigh, Sir W. B. Hardy, Prof. A. Joffé, Prof. J. E. Lennard Jones, Prof. M. Polanyi, Prof. A. W. Porter, F. I. G. Rawlins, Prof. G. Sachs, A. M. Taylor, Prof. G. I. Taylor.

SOCIETY OF GLASS TECHNOLOGY (at Talbot Hotel, Stourbridge), at 2.30.—M. H. Edwards: Fire Clays as applied to the Glass Industry.—Prof. W. E. S. Turner: Glass-Pot Manufacture in Great Britain.—Mrs. G. A. Green (Edith M. Firth) and Prof. W. E. S. Turner: The Homogeneity of Glass Melted in Pots.—Dr. S. English, H. W. Howes, and Prof. W. E. S. Turner: The Effect of Iron Oxide on the Properties of Glass.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. D. Fordyce: The Prevention of Heart Disease.

ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5.—Dr. E. Obermer: The Endocrinology of Tuberculosis.

ROYAL SOCIETY OF MEDICINE (Balneology Section), at 5.30.—Dr. L. C. E. Calthrop: The Scientific Basis of the Practice of Medical Hydrology (Presidential Address).

INSTITUTION OF AUTOMOBILE ENGINEERS (North of England Centre) (at Engineers' Club, Manchester), at 7.—H. B. Taylor: High-Speed Compression-Ignition Engine Research.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Institution of Mechanical Engineers), at 7.45.—H. L. Hornung: The Trend of Design in Motor Trucks and Motor Coaches for Fleet Operation.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—M. S. Briggs: The Architect (Lecture).

ROYAL SOCIETY OF ARTS, at 8.—T. H. Barry: Malayan Varnish Resins.

ROYAL AERONAUTICAL SOCIETY (Manchester Branch) (jointly with Manchester Branch of Institution of Aeronautical Engineers).—H. B. Taylor: The Design and Development of the Compression-Ignition Engine.

THURSDAY, NOVEMBER 24.

INSTITUTE OF FUEL (Annual Meeting) (at Institution of Electrical Engineers), at 10.30 A.M.

ELECTRICAL ASSOCIATION FOR WOMEN (at 155 Regent Street, W.), at 3.—The Value of a Refrigerator in Winter (Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. R. E. M. Wheeler: London before the Norman Conquest (II.).

ROYAL AERONAUTICAL SOCIETY, at 6.30.—Major C. J. Stewart: Modern Developments in Aircraft Instruments.

CHEMICAL SOCIETY, at 8.—Prof W. A. Bone: Gaseous Combustion at High Pressures (Lecture).

ROYAL SOCIETY OF MEDICINE (Disease in Children, Therapeutics, and Urology Sections), at 8.30.—Special Discussion on The Treatment of Pyuria in Children.

MEDICO-LEGAL SOCIETY (at 11 Chandos Street, W.), at 8.30.—Capt. N. Parkes: A Case of Pathological Drunkenness as a Defence of Insanity at a Murder Trial.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce Buildings, Birmingham).—A. R. Warnes: Notes on the Chemistry and Physics of Stone Decay.

INSTITUTION OF THE RUBBER INDUSTRY (Manchester Section) (at Assembly Rooms, Blackfriars House, Manchester).—Major A. B. Shearer: Artificial Silk and its Use in the Rubber Trade and Possible Lines of Development.

FRIDAY, NOVEMBER 25.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—A. E. Knowler: The Electrical Resistance of Porous Materials.—K. Kichlu: Regularities in the Spectrum of Ionised Neon.—Dr. Ezer Griffiths: A Calorimeter for the Measurement of the Heat Developed by Fruit.—Demonstration of Lantern Slides Connected with the Storage of Fruit.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—G. H. Wilson: Sources of Illumination.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section) (at Manchester), at 7.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 7.30.—L. Andrews: Elutriation as an Aid to Engineering Inspection.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—L. P. Perkins: A Talk about Pioneers in High Pressure Steam.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. E. H. R. Harries: Immunity in the Making.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall).—J. E. Hurst: Centrifugal Castings for Diesel Engines.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—Dr. A. J. Gardner: Lecture.

SATURDAY, NOVEMBER 26.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—G. Holst: Samuel Wesley and Robert Pearsall (II.).

PUBLIC LECTURES.

SATURDAY, NOVEMBER 19.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: Common Mistakes about Evolution.

MONDAY, NOVEMBER 21.

GOLDSMITHS' HALL (Foster Lane, E.C.2), at 4.—Very Rev. Dean Inge: Scientific Ethics (Norman Lockyer Lecture).

UNIVERSITY OF LEEDS, at 5.15.—Dr. R. A. Fisher: Mathematics and Theories of Evolution.

KING'S COLLEGE, at 5.30.—Prof. Doris Livingston Mackinnon: Through a Glass Darkly.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—Prof. R. G. Stapledon: The Growing of Pedigree Strains of Grasses and Clovers for Seed.

TUESDAY, NOVEMBER 22.

ROYAL SOCIETY OF ARTS, at 8.15.—Major H. Barnes: The History of Housing: Housing 1885 to 1927 (Chadwick Lecture).

WEDNESDAY, NOVEMBER 23.

KING'S COLLEGE, at 5.30.—E. Salter Davies: Secondary Education: Technical Institutes, Evening Schools, and Day Continuation Schools.

UNIVERSITY COLLEGE, at 5.30.—C. O. G. Douie: The Report of the Departmental Committee on Libraries.

LONDON SCHOOL OF ECONOMICS, at 6.—H. Coleman: Office Machinery: The Numeralpha Filing System and the Roneodex Visible Index System.

THURSDAY, NOVEMBER 24.

CHARING CROSS HOSPITAL, at 3.—Sir Archibald Garrod: Recent Advances in Science in relation to Medicine and Surgery (Huxley Lecture).

FRIDAY, NOVEMBER 25.

KING'S COLLEGE at 5.30.—C. J. Gadd: The Beginnings of the City of Ur.

SATURDAY, NOVEMBER 26.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. E. S. Dallas: Nature in the Alps.

CONGRESS.

DECEMBER 15 TO 24.

JOURNÉES MÉDICALES D'EGYPTE (at Cairo).